SARAWAK ENERGY TRANSITION POLICY (SET-P)

MINISTRY OF ENERGY AND ENVIRONMENTAL SUSTAINABILITY SARAWAK

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CONTENTS

FOREWORD

FOREWORD BY
THE RIGHT HONOURABLE DATUK PATINGGI TAN SRI (DR) ABANG HAJI ABDUL RAHMAN ZOHARI BIN TUN DATUK ABANG HAJI OPENG
PREMIER OF SARAWAK AND MINISTER OF ENERGY AND ENVIRONMENTAL SUSTAINABILITY SARAWAK

Sarawak is at the forefront of a transformative energy transition, embracing sustainable development to drive economic prosperity, promote social inclusivity, and uphold environmental stewardship. Guided by the Post COVID-19 Development Strategy 2030 (PCDS 2030), we are committed to transitioning Sarawak towards a low-carbon economy. This aspiration aligns with the United Nations Sustainable Development Goals (SDGs) and supports the national ambition to achieve net-zero greenhouse gas (GHG) emissions by 2050.

The development of the low-carbon economy is a critical growth driver for Sarawak. Our abundant renewable energy resources, particularly hydroelectric power, have been harnessed through initiatives such as the Sarawak Corridor of Renewable Energy (SCORE), positioning us as a regional leader in energy transition.

Sarawak has embarked on innovative energy solutions, including clean hydrogen and carbon capture, utilisation, and storage (CCUS) technologies. The establishment of Southeast Asia's first integrated hydrogen production and refuelling plant in Kuching, and the ongoing development of several CCUS sites across Sarawak, underscores our commitment to pioneering low-carbon energy technologies.

Recognising the urgency of the energy transition and climate action, the Sarawak Energy Transition Policy (SET-P) has been formulated to capitalise on these global trends and ensure the state's economic competitiveness in the long-term.

The SET-P outlines clear goals across seven pillars, supported by key cross-sectoral enablers to drive Sarawak's energy transition through the next ten years and beyond. By addressing the energy trilemma, this policy ensures sustainable economic growth while delivering long-term benefits for businesses, the state, and the people of Sarawak.

By 2050 we envision a thriving economy for Sarawak with a secure, equitable, and low-carbon energy future, setting a strong benchmark for sustainable progress. The SET-P is projected to unlock investment opportunities worth RM580 to RM700 billion, boosting Sarawak's cumulative gross domestic product (GDP) impact by RM550 billion until 2050. It is also projected to create 80,000 new high-value energy sector jobs, driving a sustainable and prosperous future for the state. These jobs will be generated by new industries, which can boost opportunities for local small and medium-sized enterprises (SMEs), attract foreign direct investments (FDI), and strengthen our regional and global competitiveness.

As we move forward, Sarawak remains committed to promoting low-carbon energy solutions as part of our aspiration to be a regional energy transition leader. A whole-of-government approach is essential as we aim to build a prosperous, inclusive, and sustainable future for Sarawak.

THE RIGHT HONOURABLE DATUK PATINGGI TAN SRI (DR) ABANG HAJI ABDUL RAHMAN ZOHARI BIN TUN DATUK ABANG HAJI OPENG

"By embracing the principles of innovation, inclusivity and global best practices, the SET-P envisions a multi-dimensional approach that integrates policy, regulation, technology, infrastructure and community engagement."

THE RIGHT HONOURABLE DATUK PATINGGI TAN SRI (DR) ABANG HAJI ABDUL RAHMAN ZOHARI BIN TUN DATUK ABANG HAJI OPENG

PREFACE

PREFACE BY
THE HONOURABLE DATUK DR HAJI HAZLAND BIN ABANG HAJI HIPNI
THE DEPUTY MINISTER OF ENERGY AND ENVIRONMENTAL SUSTAINABILITY SARAWAK

The Sarawak Energy Transition Policy (SET-P) is the state's plan to provide clear policy direction for Sarawak to pursue its vision of a secure, equitable, and low-carbon energy future for the state.

Significant efforts were undertaken to develop the SET-P, with the Ministry conducting over 50 stakeholder engagements and discussions to gather valuable inputs, ensuring the policy's accuracy and effectiveness. A whole-of-Sarawak approach has been instrumental in crafting the policy's vision and objectives, as well as refining the critical policy initiatives and key enablers to drive the policy forward.

The SET-P stands out for its comprehensive and actionable approach, shaped by important contributions from ministries, government agencies, and industry stakeholders. With strong commitment and execution, I am confident this policy will achieve its ambitious vision and targets.

With this forward-looking strategy for Sarawak's energy sector, the state is set for transformative growth, empowering its people with greater economic opportunities and uplifting their wellbeing while ensuring energy security and affordability.

A heartfelt thanks to The Right Honourable Premier, members of the SET-P Working Committee, and the various public and private sector stakeholders for their unwavering commitment and invaluable contributions in shaping Sarawak's bright future in the energy transition.

THE HONOURABLE DATUK DR HAJI HAZLAND BIN ABANG HAJI HIPNI

EXECUTIVE SUMMARY

From a traditional, resource-based economy in the 1980s, Sarawak has transitioned to a diversified economy of services, mining, manufacturing, and agriculture sectors, with the energy sector standing as a central economic pillar.

In 2021, Sarawak launched the Post COVID-19 Development Strategy 2030 (PCDS 2030), underscoring an ambition to elevate and grow Sarawak's economy and bring economic prosperity, social inclusivity, and environmental sustainability.

These efforts reflect the intensifying global push for decarbonisation to meet the Paris Agreement targets, and highlights the urgent need for the energy sector to transition towards a low-carbon future. As Sarawak embarks on the pathway towards a revitalised, inclusive, and sustainable economy, the state's energy sector presents an opportunity to utilise its inherent advantages and embark on an energy transition journey that aligns with global trends and the ambitions of PCDS 2030.

Sarawak has abundant low-carbon power generation potential and holds more than 60% of the nation's natural gas reserves. The state also boasts the highest carbon capture and storage (CCS) potential in Malaysia, accounting for over 65% of the country's storage capacity. The state is therefore well positioned to establish itself as a leader in low-carbon energy within Malaysia and across the region and bring significant socioeconomic benefits from new low-carbon industries.

The Sarawak Energy Transition Policy (SET-P) outlines a unified framework for energy sector transformation that considers the state's specific context and consolidates existing energy sector strategies. The SET-P envisions fostering a secure, equitable, and low-carbon energy future for the state by addressing the energy trilemma and ensuring sustained economic growth for the state, its businesses, and the rakyat.

The SET-P will unlock new low-carbon growth opportunities for Sarawak, is projected to generate RM550 billion in cumulative GDP impact, create 80,000 new jobs in emerging energy sectors and industries, and unlock RM580-700 billion of investments by 2050. More than 90% of the GDP impact will be driven by natural gas, renewable energy, CCUS, and clean hydrogen, and more than 75% of the income flow is expected go towards low- and medium-income groups, ensuring an inclusive and equitable energy transition. The table below provides a summary view of the expected socioeconomic outcomes of SET-P in a decadal view.

ES Exhibit 1

KEY SOCIOECONOMIC METRIC	UP TO 2030	UP TO 2035	UP TO 2050
Cumulative GDP impact vs. 2023 baseline (RM Bn)	110-140	250-300	500-600
Direct jobs created vs. 2023 baseline (FTE)	20,000–55,000	25,000–65,000	70,000–80,000

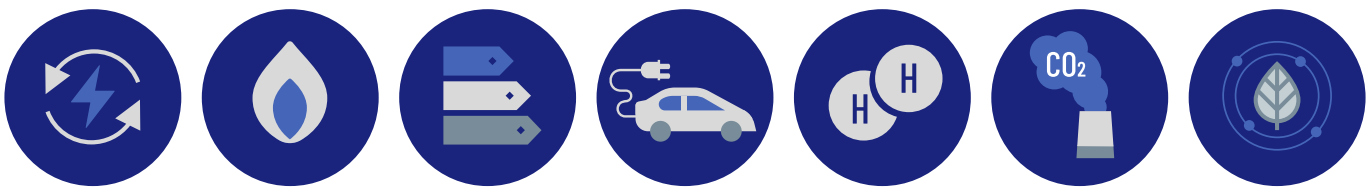
The SET-P seeks to strengthen Sarawak's energy security while ensuring that the power mix becomes cleaner and more diversified. The state's total primary energy supply (TPES) is projected to grow as much as four times from 2023 levels, to reach up to 30.9 million tonnes of oil equivalent (Mtoe) in 2050. Natural gas will serve as a key energy source contributing 63% of TPES, with renewable energy having the potential to achieve greater than 60% share of installed electricity capacity beyond 2035.

The SET-P outlines priorities across seven pillars: Renewable Energy, Natural Gas, Energy Efficiency, Low-Carbon Mobility, Clean Hydrogen, Carbon Capture, Utilisation and Storage, and Alternative Energy. These pillars will drive Sarawak's energy transition to achieve its vision of becoming a regional leader in low-carbon energy, while supporting energy sector decarbonisation.

Five key enablers will facilitate and support the initiatives outlined across these seven pillars: Governance and Regulations, Financing and Investment, Infrastructure, Technology and Innovation, and Workforce and Skilling. Across the initiatives outlined for each pillar and enabler, 22 pathfinder initiatives have been identified as key, high-impact initiatives that will drive significant investment opportunities, lead to high-value job creation, and reduce emissions in the energy sector.

Sarawak's energy sector has the potential to become a key driver of the state's long-term economic ambitions. A whole-of-Sarawak approach will be essential to ensure the strong and focused implementation of the SET-P and to position the state to become a regional low-carbon energy powerhouse, to drive economic progress for the state, and ensure a fair and just energy transition for the Sarawakian people.

SET-P outlines short, medium and long-term priorities across seven pillars:



Renewable Energy | Natural Gas | Energy Efficiency | Low-carbon Mobility | Clean Hydrogen | Carbon Capture, Utilisation and Storage | Alternative Energy

SECTION 01

BACKGROUND AND CONTEXT

THE GLOBAL ENERGY TRANSITION IMPERATIVE

The world is at a critical juncture in its energy journey. Rapid industrialisation, population growth, and increasing energy demand over the last century have led to a heavy reliance on fossil fuels, driving significant environmental consequences—including rising greenhouse gas (GHG) emissions, climate change, and ecosystem degradation. These challenges underscore the urgent need for a transition to a more sustainable, low-carbon energy system.

Despite the recent policy shifts by US government, most countries continue to align their energy strategies with global agreements, such as the Paris Agreement, which seeks to limit global warming to well below 2°C above pre-industrial levels while pursuing efforts to cap it at 1.5°C. Accomplishing this requires achieving net-zero emissions by the mid-century, a goal that has driven unprecedented momentum toward low-carbon energy technologies and sustainable solutions.

This global shift is also driven by rising awareness of the energy trilemma—the need to balance energy security (reliable supply), affordability (cost competitiveness), and sustainability (environmental impact). Governments, businesses, and international organisations are increasingly prioritising renewable energy, energy efficiency, and technological innovation to address these challenges while ensuring a resilient energy future.

Key regions and countries are already leading this charge. Investments in solar, wind, hydropower, clean hydrogen, and carbon capture technologies are accelerating and reshaping the global energy landscape. Policies promoting decarbonisation, coupled with financial mechanisms like green financing and carbon markets, are further supporting this transition.

In Southeast Asia, the energy transition is not just a climate necessity but also an economic opportunity. With its abundant natural resources and rapidly growing energy demand, the region is uniquely positioned to embrace sustainable energy development. Countries that take bold steps toward low-carbon energy adoption will benefit from economic diversification, job creation, and enhanced energy independence.

For Sarawak specifically, the energy transition will develop new low-carbon industries and boost opportunities for SMEs, attract FDI, expand employment prospects in high-demand growth areas, and strengthen the state's regional and global competitiveness. ***(S1 Exhibit 1)***

S1 Exhibit 1

Economic Hubs Development

Foster sectoral growth in new green industries by establishing economic hubs (e.g., CCUS hubs, clean hydrogen hubs, and RE zones)

In-State Value Creation

Boosting opportunities for SMEs along the value chain, while attracting more FDI for new energy transition opportunities

High-Value Job Creation

Expanding employment prospects in new and high-demand growth areas

Enhanced Regional and Global Competitiveness

Strengthen Sarawak's cost advantages by advancing in-house technological development to enhance competitiveness

SARAWAK'S UNIQUE POSITION AND OPPORTUNITIES

Sarawak, Malaysia's largest state, spans 12.4 million hectares of Borneo and is rich in natural resources such as oil, gas, timber, and palm oil. The region's vast geographical diversity includes a large network of rivers, mountains, and a long coastline with a tropical, rainy climate.

Sarawak is uniquely positioned with abundant natural resources, a strategic geographic location, and a well-established foundation in renewable energy. These factors collectively present the state with unparalleled opportunities to lead in the global energy transition and drive sustainable economic growth.

The energy landscape is dominated by its vast hydropower potential, which has been a cornerstone of the state's energy development. With an extensive network of rivers and favourable topography, Sarawak has successfully harnessed hydroelectric power, providing clean, reliable, and affordable energy to the region. Initiatives like the SCORE have capitalised on this natural advantage, transforming Sarawak into a major producer of renewable energy while supporting industrial growth.

Southeast Asia is experiencing rapid economic growth and increasing energy demand. The state has the potential to export renewable energy, particularly hydroelectric power and emerging solutions like clean hydrogen, to neighbouring countries, strengthening its role as a low-carbon energy hub.

Sarawak's rich natural environment, including its forests and biodiversity, reinforces its responsibility to balance economic growth with environmental preservation. By prioritising renewable energy and low-carbon technologies, Sarawak can play a key role in reducing GHG emissions while safeguarding its natural ecosystems. This commitment enhances the state's global reputation as a sustainable and responsible energy leader.

The state is at the forefront of developing and deploying innovative low-carbon technologies. Significant progress has been made in areas such as clean hydrogen production

Sarawak stands at a pivotal position in Southeast Asia, uniquely endowed with abundant natural resources, a strategic geographical location, and an established foundation in renewable energy.

and CCUS. The establishment of Southeast Asia's first integrated hydrogen production and refuelling plant in Kuching is a testament to Sarawak's commitment to innovation and low-carbon energy leadership. Additionally, ongoing exploration of CCUS technology highlights the state's forward-thinking approach to reducing carbon emissions and supporting global decarbonisation goals.

The energy transition provides Sarawak with an opportunity to diversify its economy and reduce dependence on traditional fossil fuel-based industries. By leveraging its renewable energy capacity, Sarawak can attract energy-intensive industries seeking access to clean and affordable power, such as low-carbon manufacturing, data centres, and sustainable industrial processes. This not only strengthens economic resilience but also creates high-value jobs and stimulates investment in emerging low-carbon energy sectors.

The energy transition efforts align with Malaysia's national targets, such as achieving net-zero emissions by 2050, and global frameworks like the United Nations SDGs. This alignment positions Sarawak as a key contributor to Malaysia's climate ambitions and as a model for other regions pursuing similar pathways.

The economy has undergone significant changes over the past few decades, moving from a resource-based state economy in the 1980s to a more diverse economy with a mix of services, mining, manufacturing, and agriculture sectors today. *(S1 Exhibit 2)*

S1 Exhibit 2

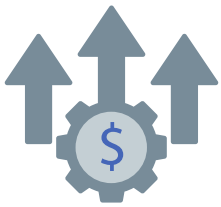
Sarawak Economic Evolution Over the Decades

ASPIRATION

1980s	1990s	2000s	2010s	2020s	2030s
Economic policy in the 1980s focused on value-added sectors	Establishment of Free Industrial Zones spearheaded Sarawak's economic diversification	Launch of Sarawak Corridor of Renewable Energy (SCORE)	Continued advancement into value-added industries leading GDP growth	PCDS 2030 prioritising digital adoption, environmental sustainability, and shift to a resilient economy	Thriving, high-income state-advanced high-value services, downstream industries, and workforce excellence

S1 Exhibit 3

Sarawak' socioeconomic targets under PCDS 2030



Elevate Sarawak's economy
from RM136b in 2019 to RM 282b in 2030

Grow Sarawak's economy
by 8% p.a. between 2021 to 2030

Create 195,000
new job opportunities

Reduce urban and rural
developmental gaps

Raise household income
to >RM15,000

9%
of national GDP

One of Malaysia's most economically significant states, contributing substantially to national output.

In 2024, the economy of Sarawak was the fourth largest of the states in Malaysia, accounting for 9% of national GDP. Sarawak's GDP has grown at an average annual rate of 2.1% (notwithstanding the economic contraction of COVID-19) between 2016–2024 to reach RM148 billion in 2024.

After the economic contraction due to the COVID-19 pandemic, Sarawak's economy has recovered and rebounded strongly, with an average GDP growth rate of 3.9% between 2021–2024. Further, through PCDS 2030, Sarawak has set a strong aspiration to grow the size of the economy by 8% annually to reach RM282 billion by 2030. *(S1 Exhibit 3)*

S1 Exhibit 4

PCDS 2030 anchored on 3 key pillars that highlight imperative for an equitable Energy Transition:

Economic Prosperity
via strategic infrastructure, robust investment policy and emerging industries

Social Inclusivity
via uplifting livelihoods and inclusive development

Environmental Sustainability
via driving green and blue economic initiatives, RE and low-carbon innovations

S1 Exhibit 5

Sarawak is uniquely positioned to drive Energy Transition with significant opportunities:

No.1 in Low-carbon energy potential in Malaysia

No. 1 in Natural Gas production and reserves in Malaysia (>60% reserves)

No. 1 in theoretical CCS potential in Malaysia (>65% of Malaysia's total CCS potential[1])

Abundant land and water resources for industrial development and utilities

Strategic location well positioned at the center of South China Sea covering 1/3 of global maritime traffic

An equitable energy transition will be pivotal for Sarawak's PCDS 2030 goals, which is anchored on three pillars, as seen in *S1 Exhibit 4*: Economic Prosperity, Social Inclusivity and Environmental Sustainability, with Renewable Energy as a key driver. These can only be achieved with a well-planned transition to a low-carbon energy sector.

Sarawak is uniquely positioned to create a high-impact energy transition policy with significant opportunities—the state has the largest low-carbon energy and technical CCS potential in Malaysia. Moreover, the state also has >60% of total national gas reserves. The state is blessed with abundant land and water resources, and strategic location for exporting renewable energy and clean hydrogen to neighbouring countries. *(S1 Exhibit 5)*

Sarawak is well positioned to establish itself as a leader in low-carbon energy within Malaysia and across the region, and play a key role in regional initiatives, such as cross-border CCUS, clean hydrogen exports, and renewable energy exports.

THE NEED FOR AN ENERGY TRANSITION POLICY FRAMEWORK

As the world accelerates toward a low-carbon future, Sarawak finds itself at a critical point where clear direction and strategic action are required to address emerging challenges and seize transformative opportunities. A well-structured energy transition policy framework is essential to guide the state's shift toward a sustainable, low-carbon economy while safeguarding energy security, economic growth, and societal wellbeing.

Energy systems worldwide are grappling with the energy trilemma—the need to balance energy security, affordability, and sustainability. Sarawak, with its growing energy demands and reliance on natural resources, requires a policy that ensures:

- Reliable energy supply for economic growth and industrial development.
- Cost-effective solutions that support businesses and households.
- A sustainable energy mix that reduces carbon emissions and protects the environment.

An energy policy framework provides a blueprint for addressing this energy trilemma through diversification, innovation, and forward-looking planning.

The energy transition represents a significant economic opportunity for Sarawak. By leveraging its abundant renewable energy resources, such as solar and hydroelectric power, and exploring emerging technologies like clean hydrogen and CCUS, Sarawak can attract new investments, create high-value jobs, and position itself as a regional leader in low-carbon energy. A policy framework ensures that these opportunities are strategically identified, prioritised, and implemented in a way that maximises economic benefits for the state and its people.

An effective energy transition must be inclusive, ensuring that all sectors of society benefit from the shift to low-carbon energy. A policy framework ensures that efforts to modernise Sarawak's energy sector uplift local communities through:

- Job creation in emerging energy sectors.
- Capacity building and skills development to prepare the workforce for new opportunities.
- Environmental protection through sustainable practices and reduced GHG emissions.

By addressing social and environmental dimensions, the framework ensures a just transition where no one is left behind.

SECTION 02

INTRODUCTION TO THE SARAWAK ENERGY TRANSITION POLICY (SET-P)

The Sarawak Energy Transition Policy (SET-P) marks a pivotal step in Sarawak's journey toward a sustainable, low-carbon economy.

INTRODUCTION

As the world faces unprecedented challenges driven by climate change, rising energy demands, and the need for energy security, the global energy landscape is undergoing a transformative shift. In response, Sarawak has embraced this energy transition as both a responsibility and an opportunity to drive sustainable economic growth, social inclusivity, and environmental stewardship.

Sarawak has already initiated numerous initiatives related to energy transition to contribute to Malaysia's national goal of achieving net-zero emissions by 2050. Sarawak's low-carbon energy journey is further reinforced by various ongoing policy efforts and initiatives, such as the Sarawak Gas Roadmap, the Sarawak Hydrogen Roadmap, and the Sarawak Sustainability Blueprint. Key projects including the hydrogen hub development in Bintulu along with the hydrogen-powered autonomous rapid transit (ART) and buses under the Kuching Urban Transportation System (KUTS), align with these goals. *(S2 Exhibit 1)*

The SET-P serves to consolidate these efforts and outline the overall framework for Sarawak's energy transition objectives and initiatives. It serves as the guiding policy document intended to drive energy transition efforts in Sarawak across relevant sectors, to accelerate the state's progress towards a sustainable future, and support the achievement of the PCDS 2030 Goals.

S2 Exhibit 1

Energy Transition-Related State Policies and Masterplans

IMPLEMENTED

- Sarawak Gas Roadmap
- Land (Carbon Storage) Rules, 2022
- Environment (Reduction of Greenhouse Gases Emission) Ordinance, 2023

IN PROGRESS

- Net Zero Strategy and Carbon Plan
- Sarawak Climate Change Policy and Low Carbon Society Blueprints in Cities and Towns
- Sarawak Sustainability Blueprint
- Sarawak Hydrogen Economy Roadmap
- Sarawak Integrated Transport Masterplan

Energy Transition-Related Projects

IMPLEMENTED

- Sarawak Corridor of Renewable Energy (SCORE)
- Batang Ai 50 MW floating solar pilot
- Issue of 1st CCUS license (PETROS)
- SaraCarbon awarded 1st carbon license in Sarawak

IN PROGRESS

- Green hydrogen production projects by 2030 (H2biscus, H2ornbill)
- Hydrogen powered buses and ART system by 2026

As part of efforts to formulate the SET-P, the Ministry of Energy and Environmental Sustainability (MEESty) engaged with numerous stakeholders across public and private sector to obtain inputs and feedback. These inputs were critical in ensuring a whole-of-Sarawak approach in shaping and developing the policy that will be critical for the future of Sarawak.

The collaborative nature of this process underscores the government's commitment to transparency, shared ownership, and strategic alignment across all sectors as it positions Sarawak for a sustainable and competitive energy future.

THE SET-P FRAMEWORK

The SET-P is designed to guide Sarawak through its energy transition over the next ten years and beyond. It seeks to transform the energy sector to ensure a secure, equitable, and low-carbon energy future for Sarawak. The policy is developed to achieve four key objectives covering four focus areas supported by seven energy transition pillars and five key enablers.

Each pillar has specific priorities, along with supporting policy initiatives, which are detailed in subsequent sections. The exhibit below summarises the key elements of the SET-P. *(S2 Exhibit 2)*

S2 Exhibit 2

VISION

Secure, Equitable, and Low-carbon Energy Future for Sarawak

4 OBJECTIVES

Energy Security
Maintain adequacy and reliability of energy supply

Equitable & Just Transition
Achieve affordable and accessible energy for all at the right pace

Sustainable
Energy from renewable/ sustainable sources

Economic Growth
Continuous economic growth as Sarawak transitions to low-carbon energy future

4 FOCUS AREAS

- Power
- Transportation
- Industry
- Buildings (Residential & Commercial)

7 PILLARS

- Renewable Energy
- Natural Gas
- Energy Efficiency
- Low-carbon Mobility
- Clean Hydrogen
- CCUS
- Alternative Energy

5 KEY ENABLERS

Governance & Regulations
to ensure effective roll out, monitoring and implementation of SET-P

Financing & Investment
to mobilise public and private resources to fund Sarawak's transition

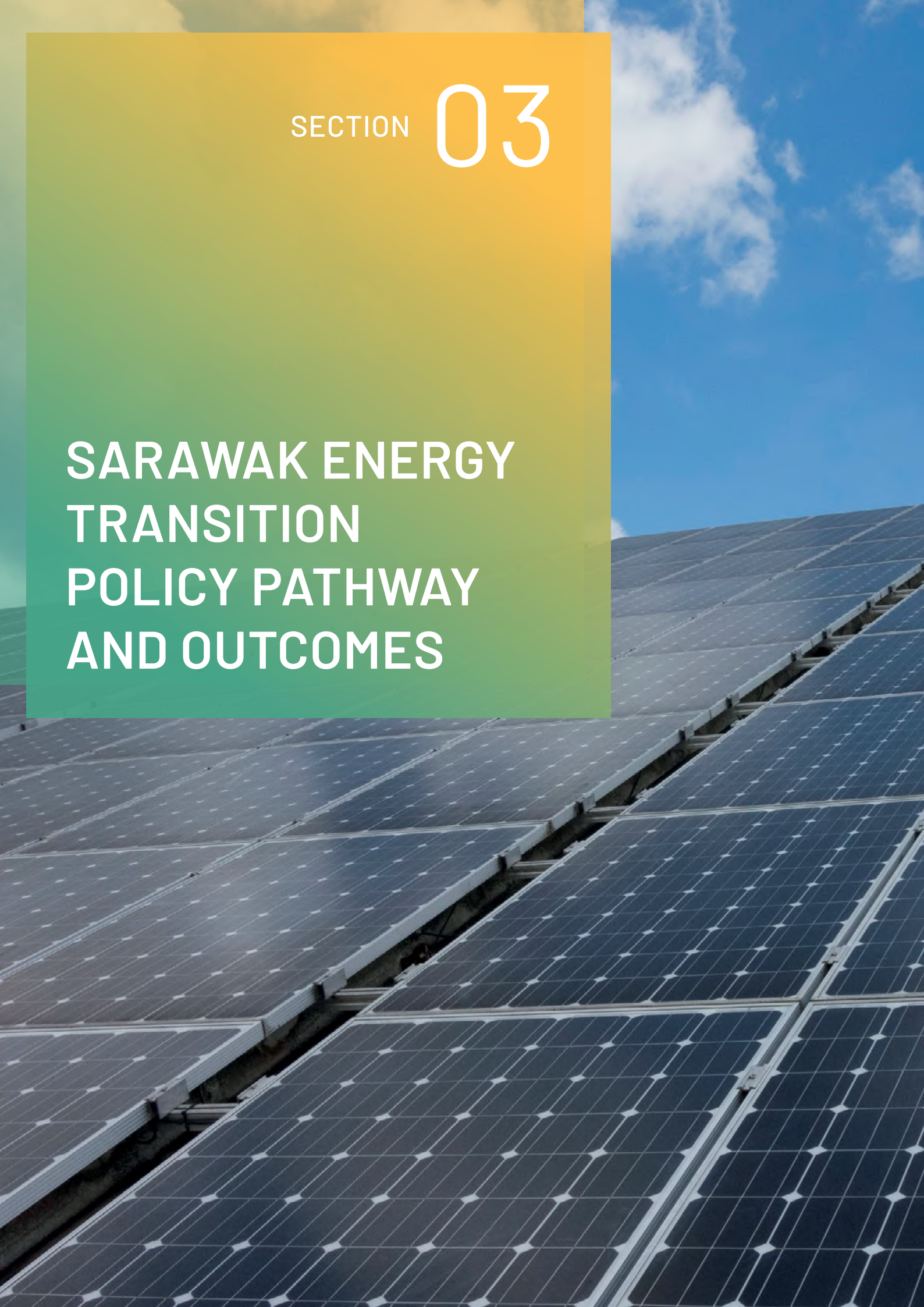
Infrastructure
to support the development and scale up of energy transition projects

Technology & Innovation
to ensure continuous tech development and evolution for energy transition

Workforce & Skilling
to develop the necessary workforce and expertise required for the energy transition

SECTION 03

SARAWAK ENERGY TRANSITION POLICY PATHWAY AND OUTCOMES



3.1 KEY PRIORITIES

The SET-P enables several key priorities across the seven energy transition pillars to drive energy transition in Sarawak. SET-P is designed to support Sarawak' priorities *(S3 Exhibit 1)* and strike the balance of catalysing socio-economic progress in new growth areas and ensuring the environmental sustainability and reliability of the state's energy system.

As the energy sector is constantly evolving, the priorities will be reviewed periodically and updated as necessary to keep pace with technological advancements and shifts in global energy transition trends.

S3 Exhibit 1

SECTOR AND KEY PRIORITIES			2030	2035	2040 and Beyond
Renewable Energy (RE)	Total power generation installed capacity (GW)		At least 10GW	At least 15GW	
	RE installed capacity (%)		60%	65–70%	
	Coal share of capacity mix (%)				0% (2045)
Natural Gas	Domestic gas utilisation share (%)		30%		
	Natural gas hubs (#)		4 (set up)	Continued expansion of the 4 gas hubs	
Energy Efficiency	Reduction of electricity intensity per capita in Residential & Commercial sectors vs. 2023 baseline (%)		2.5%	5–7.5%	7.5–10% (2040)
	Reduction of Industry sector energy intensity vs. 2023 baseline (%)		2–5%	7.5–10%	10–12.5% (2040)
Clean Hydrogen	Clean H_2 production[1] (MTPA)		0.1–0.2	1.0–1.3	2.0–2.5 (2050)
Low-carbon Mobility	Land	Public transport modal share (%)	20% (Kuching)	20% (Kuching) 20% (Bintulu)	
		Low carbon vehicle share of fleet for light transport (%)		35%	80% (2050)
		Low carbon fuel penetration for heavy transport (%)		20%	35% (2050)
	Marine	Low carbon fuel penetration in marine transport (%)		20%	40% (2050)
	Aviation	SAF blending mandate (%), based on international targets	1%	20%	47% (2050)
CCUS	CO_2 storage sites operationalised (#)		2–3	3-4	>4
	Annual CO_2 captured and stored/utilised ($MMTCO_2e$ pa)		5–10	10–20	>20
Alternative Energy	Bioenergy production, in natural gas equivalent (mmscfd)			10	30 (2040)

1. Includes blue and green hydrogen. Development of low-carbon hydrogen is subject to development of CCS (for blue), opportunity economics, off-taker agreements, and implementation of supporting policies.

3.2 PATHFINDER INITIATIVES AND PROJECTS

There are 22 pathfinder initiatives highlighted in the SET-P across the energy transition pillars and key enablers. These initiatives are prioritised as high-impact initiatives with the potential to address current challenges, generate significant investment opportunities, create high-value jobs, and contribute to social inclusivity. *(S3 Exhibit 2)* These initiatives are of high priority and are scheduled to be implemented progressively over the next few years, ensuring a structured and impactful rollout that aligns with the strategic goals of the SET-P.

S3 Exhibit 2

Pathfinder Initiatives and Projects

RENEWABLE ENERGY

- Develop and promote market options to enable customers to have greater access to purchase/subscribe to RE
- Pursue a transition towards market-oriented electricity structure that promotes transparency, operational efficiency, and system resilience, thereby fostering greater private sector participation and investment
- Develop the Sarawak Investment Policy, which includes establishing a single-window system for RE project approval streamlining administrative processes
- Establish solar parks and explore large-scale solar auctions to drive utility-scale solar deployment
- Support the development in grid modernisation and smart grid tech to improve grid stability and accommodate higher VRE

NATURAL GAS

- Implement and enforce the Distribution of Gas Ordinance, 2016 (Cap. 72) to develop and regulate downstream gas utilisation
- Establish strategic hubs in Kuching, Bintulu, Samalaju, and Miri to facilitate effective gas distribution

ENERGY EFFICIENCY

- Develop an EE action plan tailored to Sarawak's specific needs
- Implement mandatory energy audits for existing commercial buildings and industrial facilities
- Leverage federal government's ESCOs platform to facilitate supply of EE services in Sarawak

LOW-CARBON MOBILITY

- Support scaling up of public EV charging and hydrogen refueling network in line with low-carbon vehicle penetration in Sarawak
- Drive E2W adoption through promotion campaigns and policies supporting charging infrastructure development
- Transition to a low-carbon public transport system

CLEAN HYDROGEN

- Stimulate and accelerate domestic uptake of clean hydrogen
- Establish hydrogen hubs in Bintulu and Kuching
- Pursue international partnerships on long-term clean hydrogen offtake

CCUS

- Position Sarawak as a key CCUS hub for Malaysia/ APAC region
- Develop critical infrastructure for CCUS value chain in Sarawak
- Implement incentives for emitters to adopt CO_2 capture technologies at industrial facilities

ALTERNATIVE ENERGY

- Develop regulatory framework and guidelines for bioenergy and synthetic fuels/ gas production, storage, transportation and utilisation

CROSS-CUTTING ENABLERS

- Establish Sarawak Energy Authority for energy planning, licensing and permitting processes
- Set up blended finance facility to catalyse capital for strategic energy transition projects

3.3 PROJECTED EVOLUTION OF SARAWAK'S ENERGY SYSTEM

The SET-P energy system pathway strives to balance the energy trilemma while ensuring sustained economic growth for Sarawak. The pathway outlined under the SET-P will enable Sarawak to transition towards a low-carbon and more diverse energy system. The exhibit illustrates Sarawak's projected TPES by 2050, which is expected to primarily comprise of natural gas and renewables. *(S3 Exhibit 3)*

Renewable energy will play an increasingly significant role in Sarawak's power mix, with capacity expected to reach 6 GW by 2030 and 10 GW by 2035. Further potential expansion will be subject to demand build-up, technical and commercial feasibility. TPES is projected to grow up to four times from 2023 levels, with the energy sector serving as the growth engine for Sarawak's long-term economic ambitions.

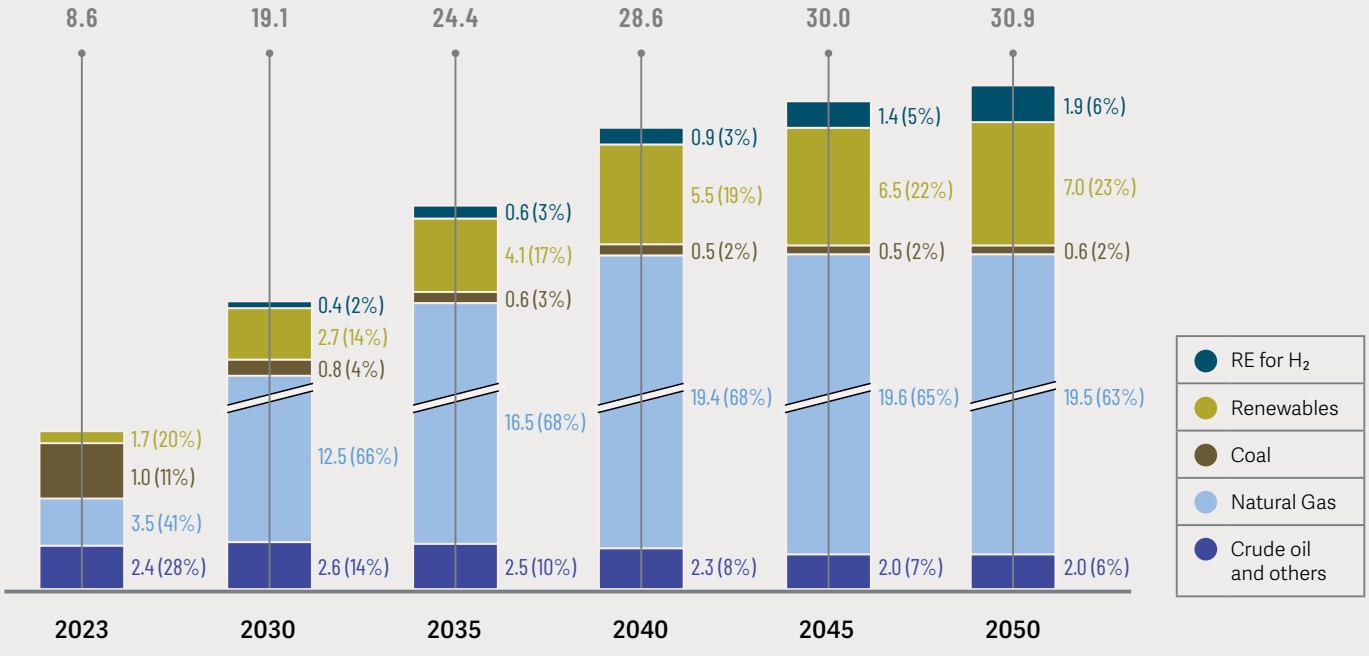
Natural gas is projected to hold a major share of TPES (~63% in 2050) driven by increased domestic utilisation as feedstock and as a power generation source to ensure energy security. The share of renewable energy, including hydropower, solar power, and bioenergy in TPES will also increase, reaching 22% of TPES, with an additional 6% dedicated renewable energy for clean hydrogen production.

Coal is expected to be phased out within the TPES by 2050 as other energy sources replace it and coal power plants in Sarawak reach their natural retirement timeline. The share of petroleum and related products in the TPES will also be reduced as we transition towards lower-carbon energy sources.

Furthermore, Sarawak plans to conduct resource assessments and studies to explore the potential of alternative energy sources beyond natural gas, hydropower, and solar PV. This initiative aims to gain a deeper understanding of energy sources that may be suitable for the state, aligning with the key objective to ensuring long-term energy security.

S3 Exhibit 3

Total Primary Energy Supply (Mtoe), by Energy Source



Source: Total Primary Energy Supply (TPES) is based on simulation of projected energy demand from power sector and Total Final Energy Consumption (TFEC) of non-power sectors (residential, transport, non-energy etc.) based on SET-P energy supply and demand projection model.

3.4 EXPECTED SOCIOECONOMIC BENEFITS

The SET-P priorities and initiatives are expected to generate positive long-term socioeconomic outcomes for businesses, the state, and the rakyat. SET-P is expected to drive growth in key emerging industries such as renewable energy, CCUS and clean hydrogen hubs, low-carbon mobility solutions and innovative energy ecosystems. By spearheading efforts in these fields, Sarawak aims to establish itself as a regional leader in sustainable development, fostering economic prosperity and employment growth.

SET-P is poised to unlock new investment opportunities valued between RM 580 billion and RM 700 billion by 2050, contributing a cumulative state GDP value-addition of up to RM 530-590 billion by 2050. The energy transition is also expected to create 80,000 jobs in 2050. The economic benefits are anticipated to reach all income groups with low- and medium-income households standing to gain the most from increased earnings. *(S3 Exhibit 4)*

S3 Exhibit 4

RM 500-600 Bn

cumulative GDP impact by 2050

Significant uplift in GDP expected driven by initiatives under SET-P

80k

new additional jobs created by 2050 vs. 2023 baseline levels

Energy transition will create substantial number of direct, high-value jobs by 2050

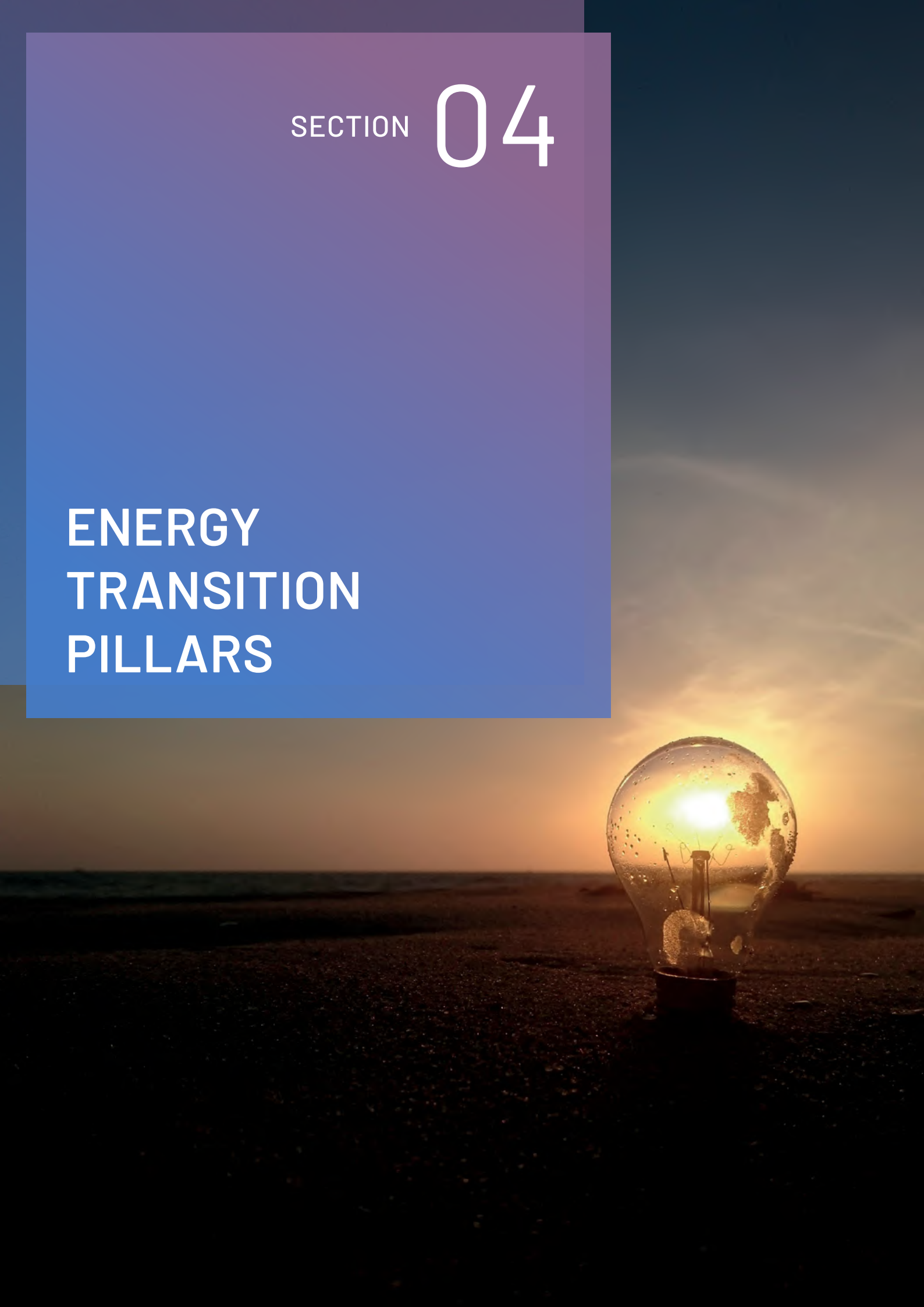
RM 580-700 Bn

cumulative investment opportunities by 2050

Investment opportunities generated from Sarawak's energy transition

SECTION 04

ENERGY TRANSITION PILLARS



The seven energy transition pillars under SET-P cut across four focus areas: Power, Transportation, Industry, and Buildings. Each pillar targets one or several of these focus areas, given their importance as a lever for these sectors, and are highly interconnected.

S4 Exhibit 1

POWER

The power sector plays a pivotal role in Sarawak's energy transition, as a major contributor to greenhouse gas emissions and a critical factor for decarbonising other power-dependent sectors.

TRANSPORTATION

The transportation sector brings a huge opportunity for Sarawak to decarbonise and reduce its energy consumption, given its role in industries and for Sarawak's residents.

The industrial sector is anchored by energy-intensive industries have benefited from the state's abundance of low-cost hydropower. Driving energy efficiency in Industry will be critical for Sarawak's energy transition.

INDUSTRY

The building sector in Sarawak offers significant potential for energy efficiency improvements, especially in urban areas like Kuching.

(RESIDENTIAL AND COMMERCIAL)

BUILDINGS

MAPPING TO PILLARS

- Renewable Energy
- Natural Gas
- Energy Efficiency
- Low-carbon Mobility
- Clean Hydrogen
- CCUS
- Alternative Energy

4.1 RENEWABLE ENERGY

OVERVIEW

Sarawak's installed power capacity is dominated by low-carbon energy sources with hydropower making up more than 60% of the total installed capacity mix in 2024.

It is critical that Sarawak maintains this strong starting point as it continues its energy transition journey. The state will need to balance the environmental sustainability of its already low-carbon power system with other important considerations of energy security and affordability moving forward.

The state has an abundance of renewable energy potential, but just ~3.5GW of total installed capacity today. Sarawak has been at the forefront of renewable energy adoption, with its first hydropower plant—Batang Ai—commencing operations back in 1985, as hydropower played a key role in stabilising Sarawak's power system.

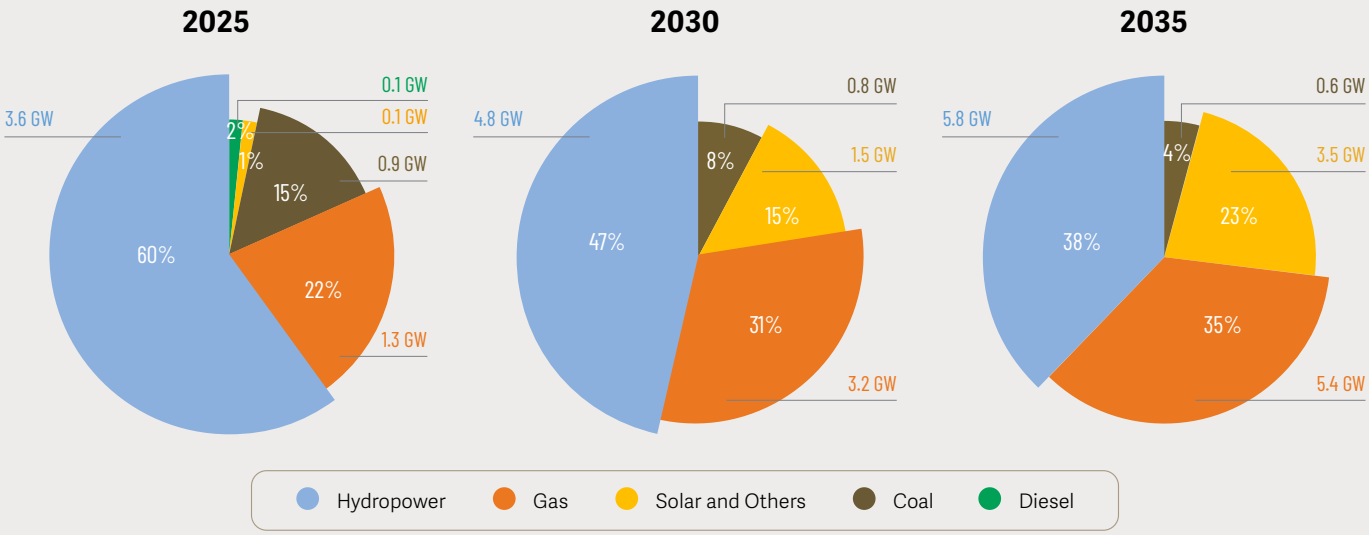
This forward thinking bodes well with the energy transition pathway which requires continuous development and growth in renewable energy technologies in the state, especially in large-scale utility solar and other more nascent technologies.

Sarawak has been at the forefront of renewable energy adoption, with more than 60% of installed capacity constituted by renewable energy

2024

S4.1 Exhibit 1

Installed Power Capacity Mix[1,2] (GW)



	2025	2030	2035
Total installed capacity (GW)	6	10	15
RE share of installed capacity[1] (%)	61	61	61

1. Installed power generation capacity excludes planned/ upcoming RE capacity for production of green hydrogen
2. Includes projected capacity from Sarawak Energy Berhad, IPPs
Source: Sarawak Energy Berhad power capacity mix plan

The exhibit above highlights the projected evolution of Sarawak's power mix. *(S4.1 Exhibit 1)*

Sarawak's power mix is expected to evolve to become cleaner and more diversified. Coal power plants are ramped down and eventually phased out by 2050, driven by the planned retirement timeline and a commitment to develop no new coal power plants.

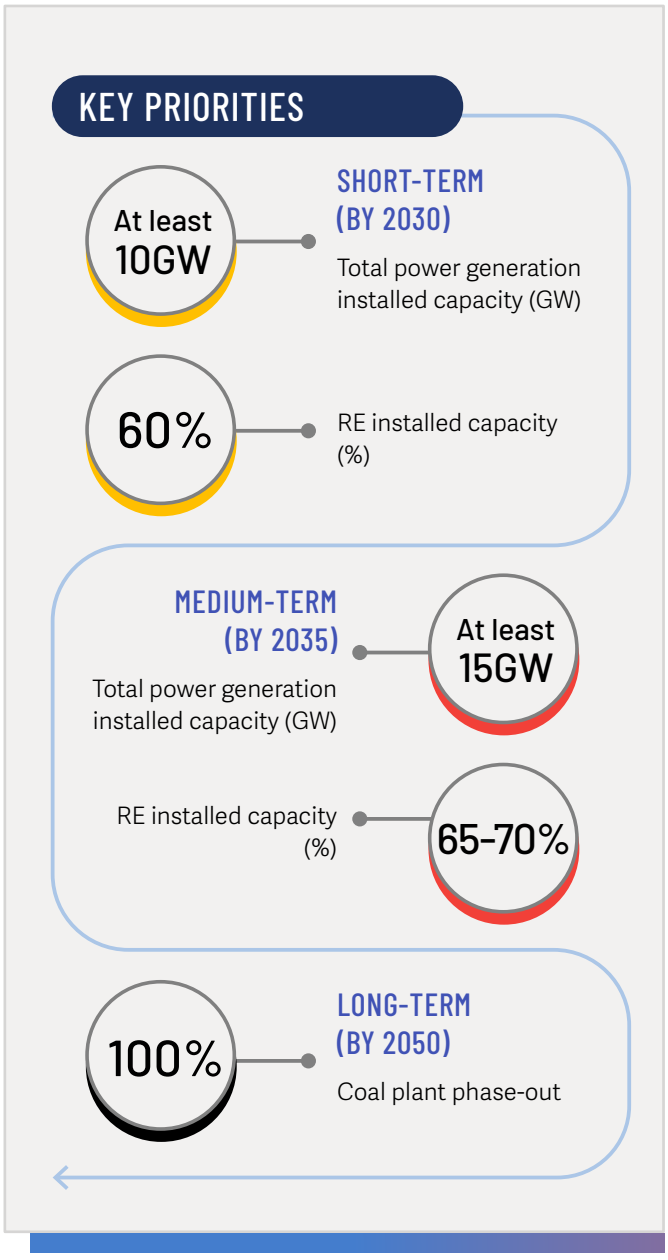
Independent Power Producers (IPPs) will play a pivotal role in supporting Sarawak's accelerated power development agenda. By mobilizing private sector capital, technical expertise, and project execution capabilities, IPPs can help fast-track the deployment of new generation capacity, particularly in strategic industrial hubs, while complementing the state's efforts to align with broader economic growth objectives.

The share of renewable energy in Sarawak's installed capacity mix will continue to grow significantly, reaching 6 GW by 2030 and 10 GW by 2035. Should it be technically and commercially feasible, Sarawak has the aspirations for renewable energy capacity to grow beyond the planned power capacity mix as economic development increases the demand for energy in Sarawak and the region. As solar power is a variable energy source, substantial Energy Storage System capacity addition will be required with an expected investment of RM40-50 billion in line with the expanding scale of solar power.

Hydropower continues to play an important role in the power mix. At the same time, natural gas power generation through combined cycled gas turbines (CCGT) will help to act as baseload power together with hydropower for the state's power mix. Development of CCGT in the power mix is important - to maintain baseload power generation capacity, as well as serve as anchor tenant for domestic gas utilisation.

As the evolution of Sarawak's power system will lead to substantial installed capacity added to the grid, it is critical that investments in grid enhancement are also made in tandem to ensure greater grid stability and flexibility. *(S4.1 Exhibit 2)*

S4.1 Exhibit 2



KEY BARRIERS

To scale up renewable energy beyond hydropower, the state will need to address several barriers that have so far limited development. From a supply perspective, one challenge highlighted by stakeholders is the need for streamlined investment guidelines for renewable energy development. The overall renewable energy project development process can be at times lengthy and difficult to navigate for project developers and investors. This has limited development—especially for independent power producers (IPPs). Looking at the long-term outlook, there will also be a need to diversify the power mix supply and not primarily rely on hydropower since its technical potential is limited and no large-scale hydropower will be allowed.

From a demand perspective, limited third-party grid access has restricted competition and limited available market options for consumers in the renewable energy industry to opt in for low-carbon power supplies. Furthermore, high upfront costs in rooftop solar installation and prolonged administrative processes have limited adoption by residential, commercial, and industrial users in buildings under the Net Energy Metering (NEM) programme. Greater liberalisation of the energy supply industry will need to be considered to stimulate the demand for renewable energy in Sarawak. As the state also expects to export low-carbon power to neighbouring states and countries, it is also critical that long-term offtake agreements are developed to avoid mismatch in demand and supply.

Additionally, grid constraints pose another challenge, particularly with the anticipated addition of variable renewable energy (VRE) sources, which could put strain on existing infrastructure. Enhancing and modernising Sarawak's power grid system will be required for greater flexibility and stability. By addressing the barriers highlighted here, Sarawak can position itself as a regional leader in renewable energy.

KEY POLICY INITIATIVES

S4.1 Exhibit 3

SET-P INITIATIVES	
R1	**Develop and promote market options to enable customers to have greater access to purchase/ subscribe to renewable energy (RE)** • Identify suitable RE market options and mechanisms to stimulate RE demand and enable long-term RE offtake agreements as required (e.g., green tariffs with renewable energy certificates (RECs) for proof of purchase, virtual PPAs for RE subscription, unbundled RECs) • Ensure green pricing options align with regulatory price caps or allowable profit margins to avoid overpricing • Evaluate supply and demand dynamics to establish minimum value of RECs
R2	**Pursue a transition towards market-oriented electricity structure that promotes transparency, operational efficiency, and system resilience, thereby fostering greater private sector participation and investment** • Create an enabling environment for IPPs to invest in Sarawak through competitive market principles driven by supply and demand dynamics • Provide pathway for increased IPP participation within Sarawak
R3	**Pursue greater grid interconnectivity and cross-border power offtake agreements within Malaysia and ASEAN countries to sell RE power** • Actively develop bilateral/multilateral power trading arrangements with partner countries to sell RE power • Collaborate with partner countries to establish new or upgrade existing grid interconnections to enable cross-border power trading • Develop commercial RE power offtake agreements with various partners to ensure long-term demand
R4	**Support the development in grid modernisation and smart grid tech to improve grid stability and accommodate higher VRE** • Develop long-term plan for increased investments of transmission and distribution network in Sarawak • Provide incentives to stimulate the technological development and adoption of smart grid technology to improve power system flexibility
R5	**Develop third-party access framework to encourage greater IPP participation in RE development and provide flexibility on power purchase agreements** • Conduct study to understand optimal framework to enable third-party access for electricity grid • Explore optimal grid access fee mechanism to partially offset increased grid investments required for increased VRE to the grid • Develop clear guidelines for IPPs on developing RE projects that allow for grid access and direct contracting with willing buyers

KEY POLICY INITIATIVES

S4.1 Exhibit 3

	SET-P INITIATIVES
R6	**Develop the Sarawak Investment Policy, which includes establishing a single-window system for RE project approval streamlining administrative processes** • Consider establishing a single-window clearance system for all regulatory and administrative approvals on RE projects to reduce administrative costs for potential RE developers and investors • Identify key incentives required to attract investors to finance large-scale RE projects • Create channels for investors to provide feedback on the RE investment process and improvements needed,
R7	**Establish solar parks/farms and explore large-scale solar auctions to drive utility-scale solar power deployment** • Identify and prioritise suitable land mass for solar park development accounting for environmental and social considerations • Pre-develop common infrastructure facilities at solar park and area and expedite statutory clearances to lower administrative costs and time required for build-up • Develop competitive bidding programme for utility-scale solar to attract wider range of project developers and investors and lower cost of solar power development
R8	**Develop energy storage solutions for grid flexibility and balancing** • Identify critical energy storage solutions that are suitable for Sarawak's power system • Establish timing and amount of financing required to onboard energy storage solutions to the grid • Provide incentives to stimulate the technological development and adoption of energy storage solutions to ensure grid reliability and stability
R9	**Enhance Net Energy Metering guidelines and initiatives** • Conduct regulatory and process mapping to simplify and standardise the process for obtaining licenses, permits, and environmental clearances for rooftop solar installation to reduce administrative costs for residential customers • Provide incentives (e.g., cash rebates) to lower upfront costs of implementing rooftop solar
R10	**Conduct resource assessments and support R&D tech for RE technologies beyond hydropower** • Conduct study to understand specific RE technical potential for resources beyond hydropower • Scale up funding support to accelerate R&D on development of emerging RE technologies

4.2 NATURAL GAS

OVERVIEW

Sarawak plays a pivotal role in Malaysia's natural gas sector, leveraging its abundant reserves to drive economic growth, energy security, and industrial development.

Sarawak's natural gas sector has become a cornerstone of its economic and energy strategies. Sarawak is home to significant natural gas reserves, primarily located offshore, and which account for over 60% of Malaysia's total gas reserves. These reserves will be key to fuel Sarawak's energy needs. With ongoing exploration and production activities, Sarawak continues to expand its natural gas potential to meet growing energy demands regionally and globally.

Natural gas has an important role to play in Sarawak's energy transition, and can act as a transition fuel away from higher GHG-intensive fossil fuels in power generation. It can also provide energy and feedstock use for industrial applications.

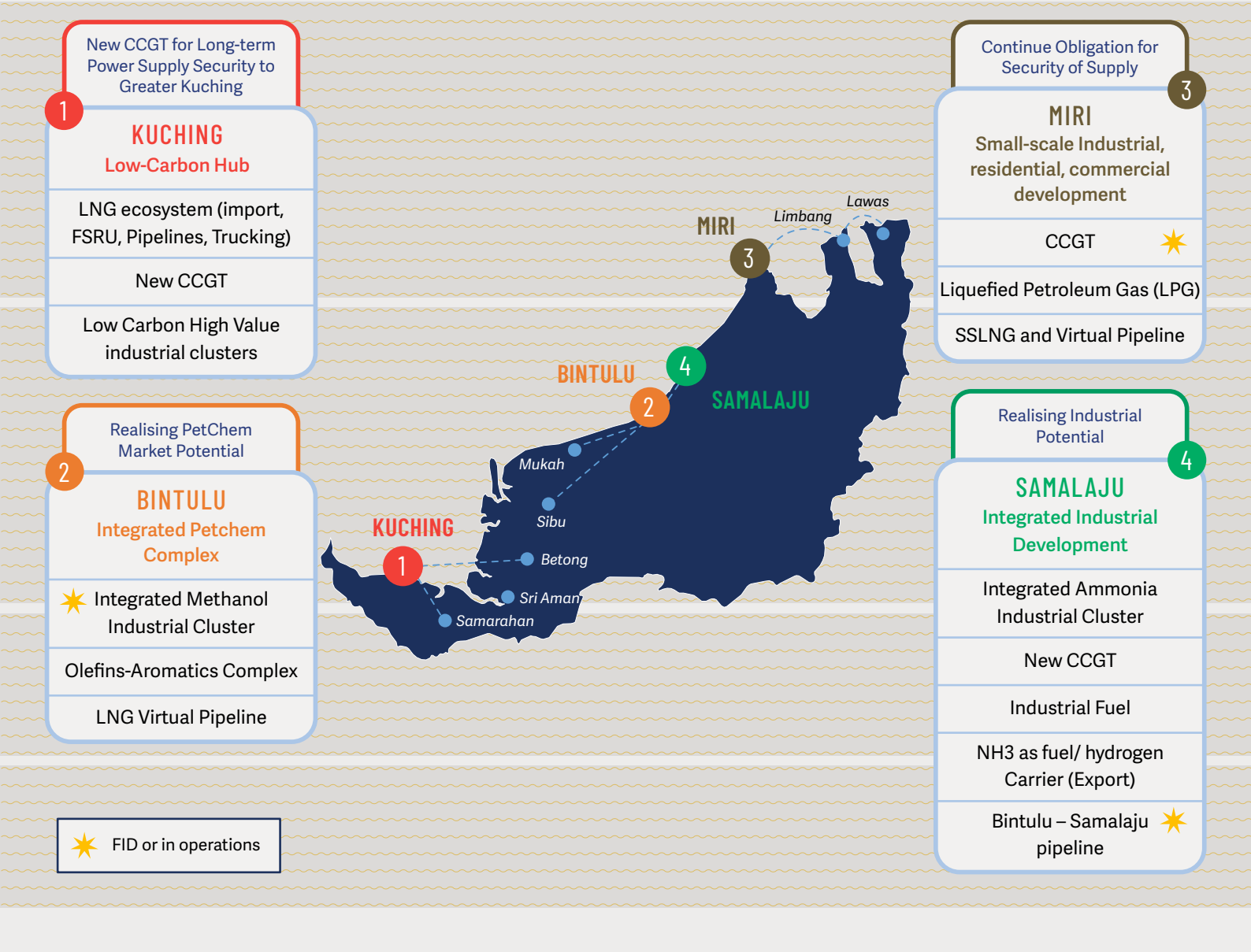
The Sarawak Gas Roadmap (SGR) has been established to strategically guide the optimisation of the state's natural gas resources. Launched in 2021, the roadmap is aimed at harnessing the state's natural gas resources to drive socio-economic transformation. The roadmap focuses on driving gas-based infrastructure and promoting downstream value-add and industrial growth through the development of four strategic gas hubs.

- **MIRI:** Miri will be the home for small-scale industrial, residential, and commercial development. The development includes energy infrastructure build-up through 500-megawatt (MW) Miri CCGT to connect Sarawak Energy Berhad's Tudan substation to supplement the energy demand for northern Sarawak.

- **BINTULU:** Currently, natural gas distribution in Bintulu primarily serves power plant, industrial, and petrochemical customers located in Kidurong industrial area. Looking ahead, the state is committed to expand natural gas access in Bintulu, primarily targeting residential, commercial, and SME industries, as well as further developing Bintulu Petrochemical Complex.

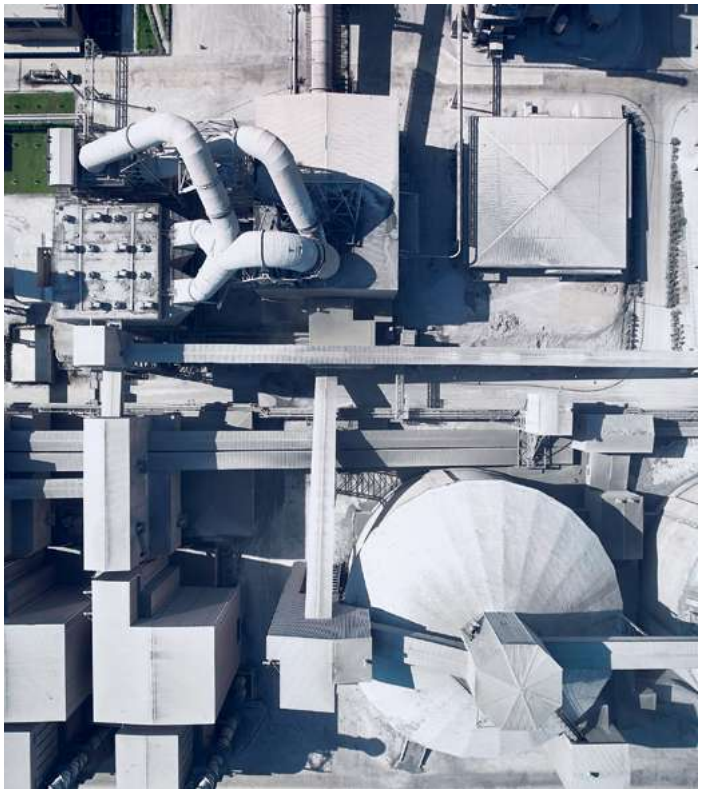
S4.2 Exhibit 1

Four Strategic Hubs identified in Sarawak Gas Roadmap (SGR) to drive downstream investment and build low-carbon economy for Sarawak & beyond



- **SAMALAJU:** Samalaju represents integrated industrial development enabled through Samalaju Pipeline (SPL) project, a key infrastructure initiative to support industrial growth in Samalaju. The proposed 65km pipeline will transport natural gas from Bintulu to the Samalaju Industrial Park (SIP). This would enable development of the new 1.5GW Samalaju power plant, provide gas to the industrial cluster and integrated ammonia complex.
- **KUCHING**: Kuching low-carbon hub will introduce low-carbon industrial clusters, world-class CCS, and unlock stranded/high CO_2 gas fields in Western Sarawak. Positioned as the gateway to Borneo, Kuching benefits from key infrastructure, including a deep-sea port which will have LNG import and regasification facilities. Over the coming years, the power supply in Kuching will transition from coal-fired generation to a new gas-fired power plant

S4.2 Exhibit 2



This expansion across gas hubs is essential to ensuring access to affordable energy to stimulate regional growth, providing energy security, and balancing environmental sustainability, which is aligned with the overarching objectives of the SET-P and PCDS 2030. The development of critical gas infrastructure as part of the roadmap will help to promote greater growth in domestic gas utilisation statewide. Policy initiatives under the SET-P are developed to support the goals and objectives of SGR and address underlying challenges and constraints.

KEY BARRIERS

While gas based development is constrained in Sarawak due to infrastructure limitation, Sarawak has the most extensive offshore gas infrastructure in Malaysia. The availability of infrastructure such as pipelines to distribute natural gas domestically is limited across the state. This restricts access to natural gas for industries and households, particularly in rural areas. The high costs associated with building and expanding pipelines, gas processing facilities, and storage systems require significant investment, which has historically deterred rapid expansion of domestic utilisation. For bulk consumers, while industries like petrochemicals and manufacturing require significant natural gas, their growth is limited by the scale and pace of economic development in Sarawak.

There is potential to enhance domestic usage through developing downstream applications for gas and increasing gas utilisation for power, industrial, commercial, and residential segments. Developing the necessary gas infrastructure and distribution network in the hubs—as per plans laid out in SGR—will be vital to ensure that different segments and industries are able to access a gas supply. These hubs, acting as central nodes for gas distribution within the 'hub-and-spoke' delivery model, will improve state-wide access to affordable gas and foster industrial investment opportunities.

To fully realise this potential, strategic coordination between state agencies, Petroleum Sarawak Berhad (PETROS), and private sector partners will be essential to accelerate infrastructure rollout, ensure supply security, and align demand planning with industrial development priorities.

KEY POLICY INITIATIVES

S4.2 Exhibit 3

	SET-P INITIATIVES
N1	**Establish strategic hubs in Kuching, Bintulu, Samalaju, and Miri to facilitate effective gas distribution** • Explore incentives for private sector investments in gas infrastructure and technology in the key hubs • Invest in the development of a comprehensive gas distribution network to enhance gas access for all energy segment users, particularly in underserved areas • Develop and expand distribution infrastructure to support domestic gas utilisation within industrial gas clusters across the strategic gas hubs
N2	**Develop gas distribution infrastructure and increase domestic gas utilisation** • Establish priority of demand for gas, focusing on Power and domestic gas utilisation • Develop and expand gas distribution infrastructure to support domestic gas utilisation within industrial gas clusters across the strategic gas hubs • Promote domestic gas utilisation across industries by encouraging downstream value-added activities that drive industrial growth and economic diversification
N3	**Establish gas utilisation guidelines to ensure long-term security/ supply and demand of gas in Sarawak** • Develop and adopt a comprehensive set of Gas Utilisation Guidelines to ensure the long-term security of gas supply and demand. • Outline key recommendations to support sustainable resource management, infrastructure planning, and energy resilience for Sarawak's future
N4	**Support the development of combined cycle gas turbine (CCGT) plants in strategic hubs** • Promote the investment incentives outlined in the Sarawak Gas Roadmap to attract strategic investors for the development of Combined Cycle Gas Turbine (CCGT) power plants • Ensure adequate infrastructure development to support CCGT plant build-up in the strategic hubs
N5	**Implement and enforce the Distribution of Gas Ordinance, 2016 (Cap. 72) to develop and regulate downstream gas utilisation** • Streamline processes for efficient procurement, distribution, and supply of gas for increased downstream utilisation of gas • Ensure the provision of a reliable gas supply for downstream utilisation at competitive and affordable prices for end consumers

4.3 ENERGY EFFICIENCY

OVERVIEW

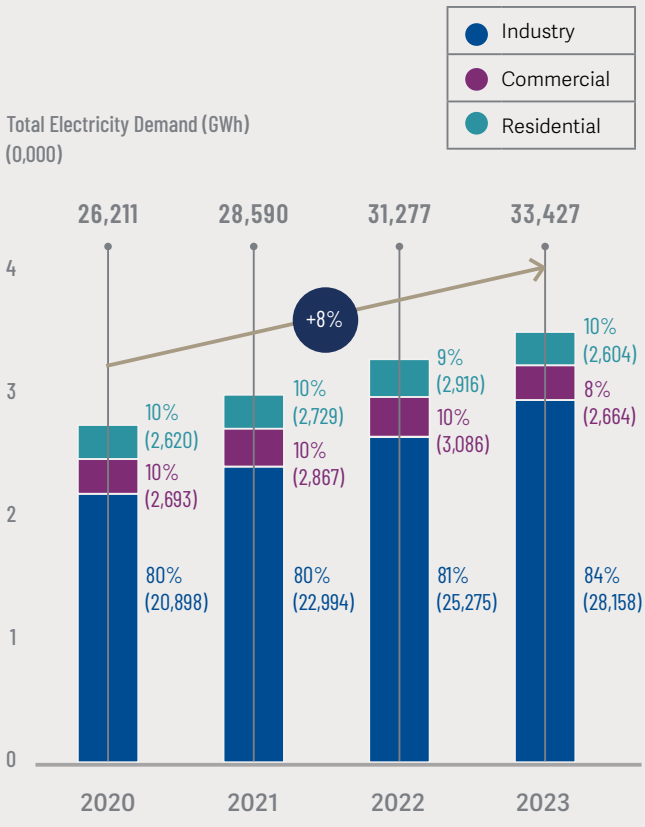
Sarawak recorded the region's highest electricity consumption per capita in 2020, at 11,477 kWh per capita.

Sarawak's energy intensity, measured as energy consumption per unit of GDP, remains relatively high compared to national and regional benchmarks. This suggests that economic output is still energy-intensive. Total energy consumption, including electricity and petroleum products continues to increase, placing pressure on infrastructure and environmental resources. Addressing energy efficiency through policy incentives, technological upgrades, and public awareness will be essential to decouple economic growth from energy consumption and ensure long-term sustainability.

In parallel, electricity demand has grown by 8% annually since 2020, driven by growth across all consumption sectors and a growing population. Although industry usage accounts for majority of electricity consumption, it is important for Sarawak to reduce electricity consumption across all sectors and manage its growth sustainably. *(S4.3 Exhibit 1)*.

S4.3 Exhibit 1

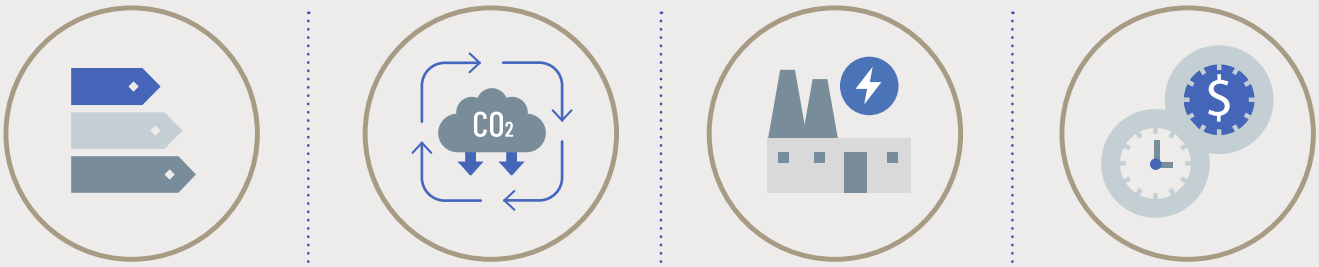
Total Electricity Demand



Source: SET-P energy demand projection model

S4.3 Exhibit 2

While some of these challenges require broader economic and infrastructural solutions, improving energy efficiency (EE) across Residential (R), Commercial (C) and Industrial (I) sectors will help:



Reduce electricity and energy consumption in line with the state's PCDS 2030 objectives to balance economic growth with environmental sustainability through responsible resource use

Lower emissions from Sarawak's energy value chain

Reduce the need for additional uninterruptible power supplies (UPS) to be developed

Generate cost savings in the long term

Promoting EE across R, C, and I sectors will set an important foundation for the state's sustainable economic growth and support long-term energy security.

The state's elevated electricity and energy intensity is primarily driven by energy-intensive industries (e.g., oil and gas, mining, large-scale manufacturing) and the abundant availability of low-cost hydropower. While some of these challenges require broader economic and infrastructure solutions, improving energy efficiency (EE) across Residential (R), Commercial (C) and Industrial (I) sectors will help reduce electricity and energy consumption, in line with the state's PCDS 2030 objectives to balance economic growth with environmental sustainability through responsible resource use. Reducing electricity consumption will also lower emissions from Sarawak's energy value chain, reduce the need for additional uninterruptible power supplies (UPS) to be developed and generate cost savings in the long-term. *(S4.3 Exhibit 2)*

While Malaysia has EE targets and initiatives at the federal level, Sarawak needs its own targeted strategy that is tailored to its distinct economy, geographical context, and infrastructure needs. Promoting EE across R, C, and I sectors will set an important foundation for the state's sustainable economic growth and support long-term energy security.

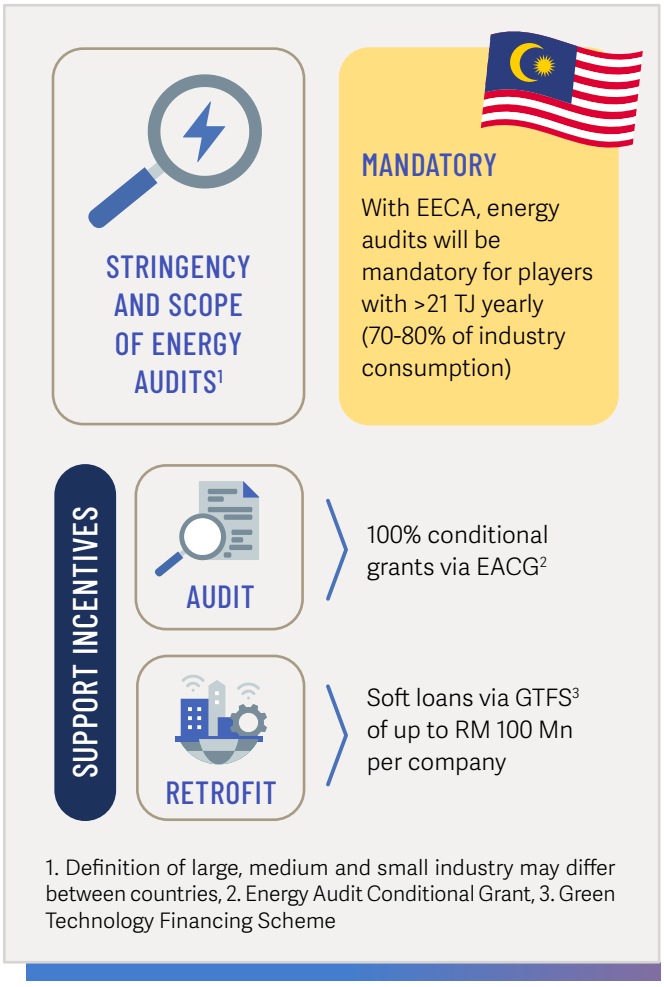
KEY BARRIERS

Sarawak's EE initiatives are limited and fragmented at present, given the absence of EE policies or a specialised body to coordinate and promote EE efforts at a state level. While many countries provide incentives for target sectors or products to improve their energy performance and efficiency, Sarawak does not have any state-level incentives or programmes to help subsidise technologies and bring down the cost of switching to lower-consumption alternatives.

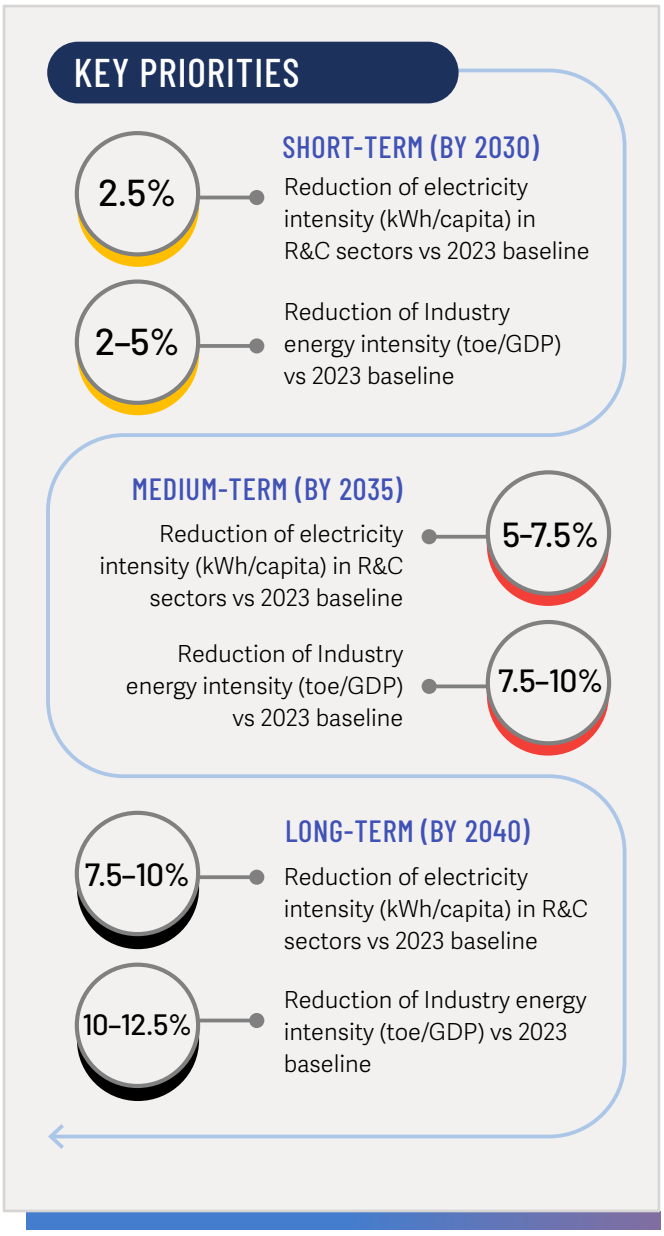
Moreover, Sarawak currently does not impose any mandatory energy use requirements or standards for buildings or facilities, which are often also implemented by countries to enforce EE standards on C and I sectors in particular. At the federal level, Malaysia mandates energy audits for players with an annual energy consumption of more than 21 terajoules (TJ) and provides grants to commercial and industrial sectors to collaborate with local energy services companies (ESCOs) to conduct energy audits for their buildings. ***(S4.3 Exhibit 3)*** Such regulations and incentives can help companies identify potential energy saving opportunities in their premises, and support demand for ESCOs to meet EE services required by these high-intensity companies.

Sarawak will therefore consider appropriate initiatives to accelerate EE efforts from both private and public sector, while ensuring that these programmes and initiatives consider state-specific contexts.

S4.3 Exhibit 3



S4.3 Exhibit 4



KEY POLICY INITIATIVES

S4.3 Exhibit 5

SET-P INITIATIVES	
E1	**Develop an EE action plan tailored to Sarawak's specific needs** • Develop an overall strategy and cohesive action plan to reduce energy consumption in residential, industrial, and commercial sectors in Sarawak • Establish Sarawak's EE policies and regulations, such as minimum efficient building codes and performance standards and mandatory energy audits • Outline key initiatives to drive EE in Sarawak across residential, commercial, and industrial sectors (e.g., promotion of 5-star rated appliances, energy efficient building design, smart devices, etc.)
E2	**Designate a lead government agency to drive and oversee EE initiatives in Sarawak** • Assign clear responsibilities and authority to the lead agency to coordinate EE efforts across sectors, facilitate inter-agency collaboration, and oversee administration and enforcement of EE regulations • Allocate dedicated funding and resources for the lead agency to implement and monitor EE programmes and initiatives
E3	**Implement mandatory energy audits for existing commercial buildings and industrial facilities** • Draft legislative framework and introduce legislation to mandate energy audits for existing commercial buildings and industrial facilities in Sarawak • Develop and publish guidelines before enforcing mandatory energy audits for existing buildings and industrial facilities, setting audit standards and list of qualified energy auditors • Provide incentives for existing building and industrial facilities to identify and implement EE initiatives (e.g., retrofits, energy management systems, smart devices, etc.) through partnerships with ESCOs
E4	**Leverage federal government's ESCOs platform to facilitate supply of EE services in Sarawak** • Streamline accreditation of ESCOs in Sarawak by implementing pre-qualification criteria for list of registered ESCOs by the Energy Commission (ST) • Collaborate with federal government to expand ESCO platform to Sarawak, promoting ESCO platform to Sarawak-based companies • Leverage knowledge sharing on ESCO platform to develop local ESCOs in Sarawak, and provide opportunity for local ESCOs to engage with federal ecosystem
E5	**Push for EE design in government buildings and public infrastructure via minimum efficient building codes and performance standards** • Accelerate the adoption of EE design by prioritising Building Energy Index (BEI)-certified projects with a long-term transition to Green Building Index (GBI)-certified projects in Sarawak, while evaluating the need for incentives and developing implementation mechanisms • Finalise amendments to the Buildings Ordinance to enforce Minimum Energy Performance Standards (MEPS) and GBI for new government buildings and public infrastructure
E6	**Implement EE programmes for government buildings** • Conduct energy audits for government buildings to identify inefficiencies • Implement phased transition to EE-alternatives in government buildings, such as for air conditioning systems, lighting, and appliances • Implement building automation systems to optimise energy management in government facilities

4.4 LOW-CARBON MOBILITY

4.4.1 LAND

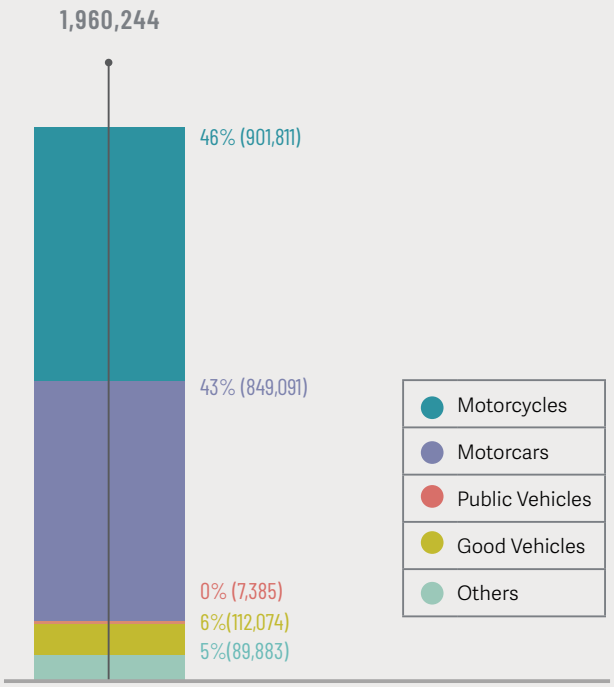
OVERVIEW

Land transport is critical in providing connectivity to key economic centres in Sarawak and offers significant opportunity for Sarawak to reduce its energy consumption through low-carbon mobility measures. State and national policies, including PCDS 2030, National Transport Policy (NTP), Low Carbon Mobility Blueprint (LCMB) and the National Energy Transition Roadmap (NETR) underscore the urgency of this transition.

With 1.9 million registered motor vehicles in the state, Sarawak's population heavily relies on private transport modes to navigate around the state's vast and sprawling geography. *(S4.4 Exhibit 1*) Addressing this reliance requires sustainable solutions that recognise the state's specific challenges and leverage its natural advantages. For instance, public transport systems are viable in urban centres like central Kuching but must be expanded with flexible feeder systems to serve its suburban populations effectively. Adoption of low-carbon mobility must tackle affordability, range anxiety amongst transport users, and infrastructure gaps, particularly in remote areas. Transport infrastructure planning must be targeted to meet the state population's diverse needs effectively.

S4.4 Exhibit 1

Total Number of Motor Vehicles Registered in Sarawak, 2022



Source: DOSM

Moreover, Sarawak's emerging hydrogen production capacity is a key advantage that can be leveraged to enable the development of a clean hydrogen transport ecosystem which includes hydrogen-powered ART and buses to complement electrification efforts.

It is imperative for Sarawak to take proactive measures to strengthen its energy security and transition readiness, keeping pace with global and national shifts towards low-carbon mobility, while ensuring its strategy remains practical and inclusive to address the needs of its communities.

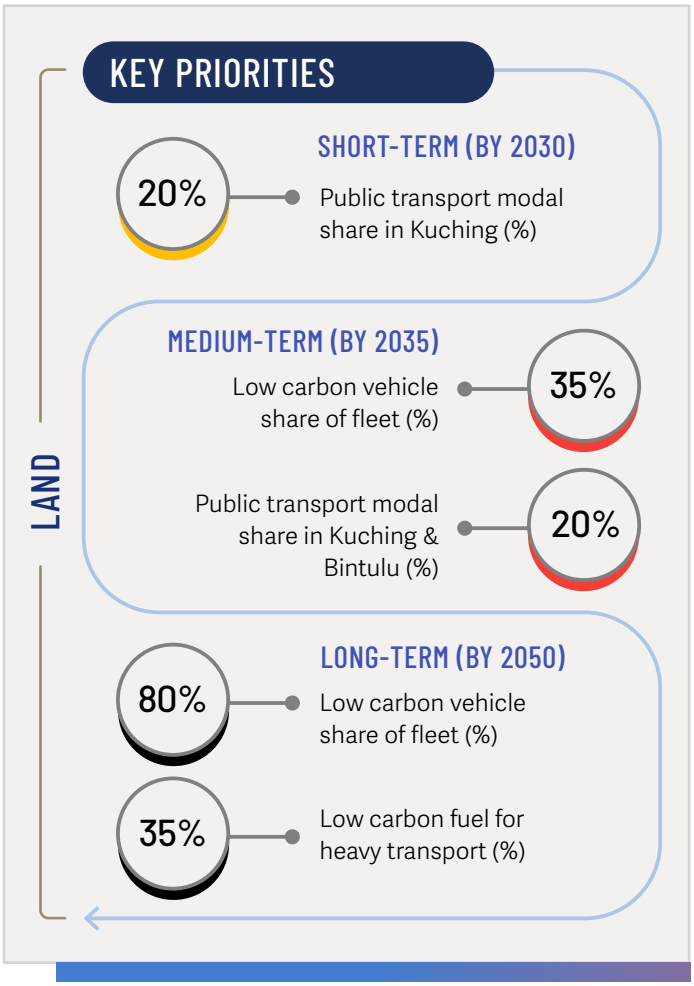
KEY BARRIERS

Sarawak faces unique challenges in decarbonising its land transport sector. Public transport adoption remains significantly lower than the national average, even in urban areas like Kuching and Bintulu. This is driven by insufficient public transport infrastructure, fragmented connectivity, and poor service reliability, which reinforce the public's strong preference for private transport.

Electrification of Sarawak's transport sector also faces hurdles. The high purchase price of electric vehicles (EVs) compared to internal combustion engine (ICE) models makes EVs less accessible to much of the population. Range anxiety is a notable concern, amplified by Sarawak's sprawling geography and long travel distances. This is further compounded by the limited availability of charging infrastructure. Infrastructure challenges extend beyond charging stations—Sarawak's power grid and electricity generation capabilities will need to be upgraded and expanded to support the widespread adoption of EVs.

While hydrogen-powered fuel cell EVs offer advantages such as quicker refuelling and longer driving ranges, significant challenges remain, particularly for light vehicles. These include complex storage requirement, higher costs, lower energy efficiency compared to battery EVs, and a lack of refueling infrastructure.

S4.4 Exhibit 2



KEY INITIATIVES

S4.4 Exhibit 3

	SET-P INITIATIVES
L1	**Support scaling up of public EV charging and hydrogen refuelling network in line with low-carbon vehicle penetration in Sarawak** • Streamline approval process for installing public EV chargers and hydrogen refuelling stations by publishing clear guidelines • Facilitate access to financing instruments, e.g., public-private partnership (PPP) guidelines, applicable to co-fund public EV chargers and hydrogen refuelling station • Track the availability and progress of EV chargers and hydrogen refuelling station rollout in coordination with federal efforts (e.g., MEVnet) • Explore developing tariffs specific for EV charging infrastructure
L2	**Drive E2W adoption through promotion campaigns and policies supporting charging infrastructure development** • Launch targeted campaigns to highlight federal incentives and the environmental benefits of two-wheeled electric vehicles (E2W), tailored to prospective user segments • Implement policies to support the development and deployment of charging solutions such as battery-swap stations (BSS), licensing processes, land use regulations, and standardised rules for BSS
L3	**Transition to a low-carbon public transport system** • Implement strategies to improve accessibility, reliability, and convenience of public transport to shift riders from private vehicles • Facilitate the rollout of autonomous rapid transit (ART) systems and hydrogen-powered buses with supporting infrastructure

4.4.2 AVIATION

OVERVIEW

Aviation plays a critical role in Sarawak, enabling connectivity across its vast geography and linking the state to regional and international markets. With the highest number of in-state flights in Malaysia, at 357 roundtrips per week, the decarbonisation of the aviation sector is a priority. *(S4.4 Exhibit 4)* Sustainable aviation fuel (SAF) will be a critical lever to enable emissions reduction. With its abundant natural resources, Sarawak is strategically positioned to become a hub for SAF production in support of its transition towards sustainable aviation.

Sustainable aviation fuel (SAF) will be a critical lever to enable emissions reduction.

S4.4 Exhibit 4

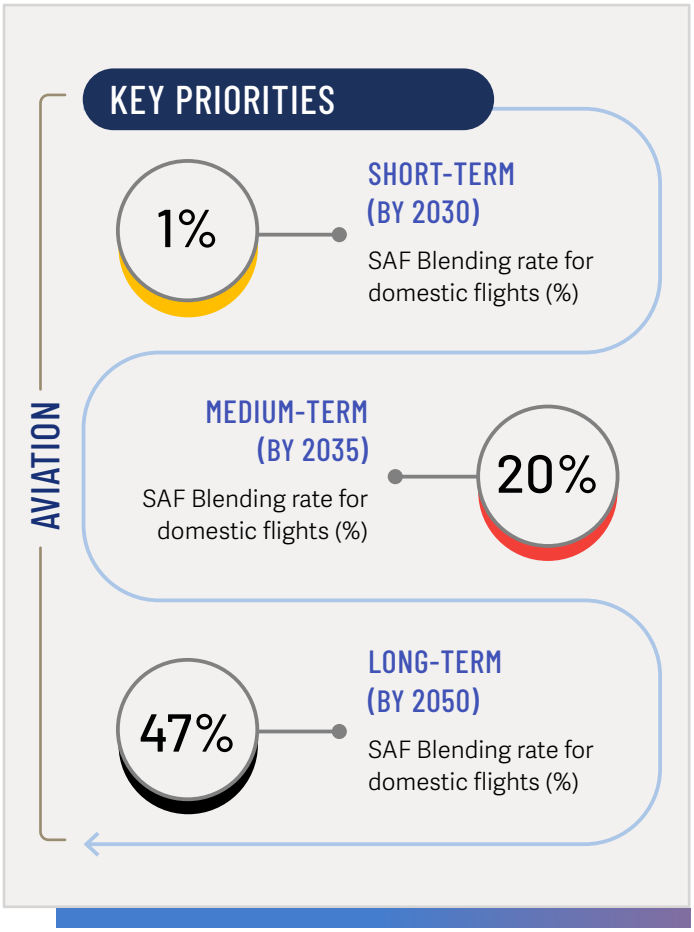
Domestic Flight Routes in Sarawak

357 No. of roundtrip flights per week in Sarawak

KEY BARRIERS

SAF utilisation in Sarawak remains limited, constrained by low supply and demand due to its high price premium. Despite Sarawak's potential to catalyse local production, key challenges include identifying the most commercially viable feedstock, ensuring a stable and consistent supply, and scaling up production capacity. Addressing these barriers is critical to achieving economies of scale. This barrier is also addressed in detail under the bioenergy and synthetic fuels sub-sections in the Alternative Energy pillar.

S4.4 Exhibit 5



KEY INITIATIVES

S4.4 Exhibit 6

	SET-P INITIATIVES
L4	**Advance sustainable aviation fuel adoption** • Conduct detailed study to establish phased SAF blending targets for domestic flights • Facilitate collaboration with industry stakeholders to develop fiscal (e.g., reduced airport fees) and operational (e.g., priority landing slots) initiatives that encourage SAF adoption • Oversee the enforcement of the blending mandate by establishing fuel usage reporting systems and regular audits

4.4.3 MARINE

OVERVIEW

The ports in Kuching, Rajang, Miri, and Bintulu are vital hubs in supporting Sarawak's trade, connectivity, and integration with international supply chains while serving its domestic logistics and coastal communities. As the sector continues to modernise, low-carbon mobility will become a core focus in Sarawak's maritime and riverine industry to ensure sustainability and alignment with global decarbonisation trends.

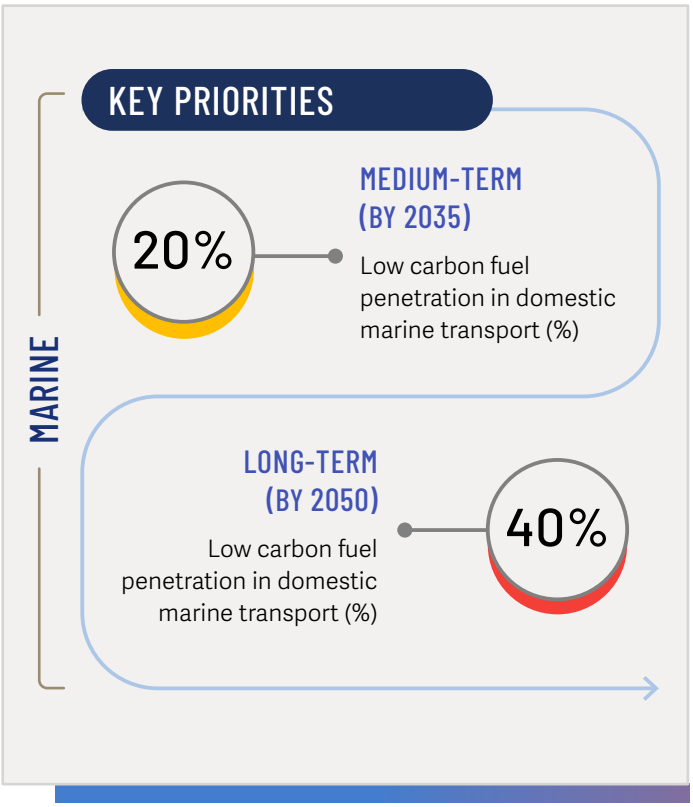
Under the PCDS 2030, Sarawak has proposed catalytic initiatives to promote green infrastructure and sustainable practices in its ports. These efforts aim to improve energy efficiency, reduce emissions, and adopt eco-friendly operations that align with international maritime standards. To achieve this shift, it is crucial for Sarawak to transition from diesel dependency to a cleaner fuel mix, beginning with domestic port operations and vessel usage.

As the sector continues to modernise, low-carbon mobility will become a core focus in Sarawak's maritime and riverine industry to ensure sustainability and alignment with global decarbonisation trends.

KEY BARRIERS

The development of a sustainable marine sector faces significant challenges, primarily stemming from the relative nascency of low-carbon fuel alternatives. Alternative fuels have not yet achieved the necessary technical maturity or economic viability, and there is considerable uncertainty about which clean fuel will dominate in the future. Compounding these challenges is the substantial infrastructure transformation required for vessels and ports to support the transition to sustainable maritime operations.

S4.4 Exhibit 7



KEY INITIATIVES

S4.4 Exhibit 8

SET-P INITIATIVES	
L5	**Advance low-carbon marine fuel adoption with improved port infrastructure support** • Explore the use of ammonia and methanol as transition marine fuels in the short and medium term • Promote adoption of alternative low-carbon fuels in alignment with federal decarbonisation target and in collaboration with industry players • Facilitate the enhancement/upgrade of port infrastructure to provide low-carbon fuelling options, including storage and bunkering facilities for alternative fuels

4.5 CLEAN HYDROGEN

OVERVIEW

Clean hydrogen, or low-carbon hydrogen, is pivotal to the energy transition, with global demand forecasted to reach 430 million tonnes per annum (Mtpa) by 2050 according to International Energy Association's (IEA's) Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach report.Clean hydrogen includes both (1) green hydrogen, produced via electrolysis using renewable electricity and (2) blue hydrogen, produced using fossil fuels with carbon capture and storage. *(S4.5 Exhibit 1)* Its versatility in form and application makes it suitable for decarbonising hard-to-abate sectors such as heavy industry, aviation, and maritime transport.

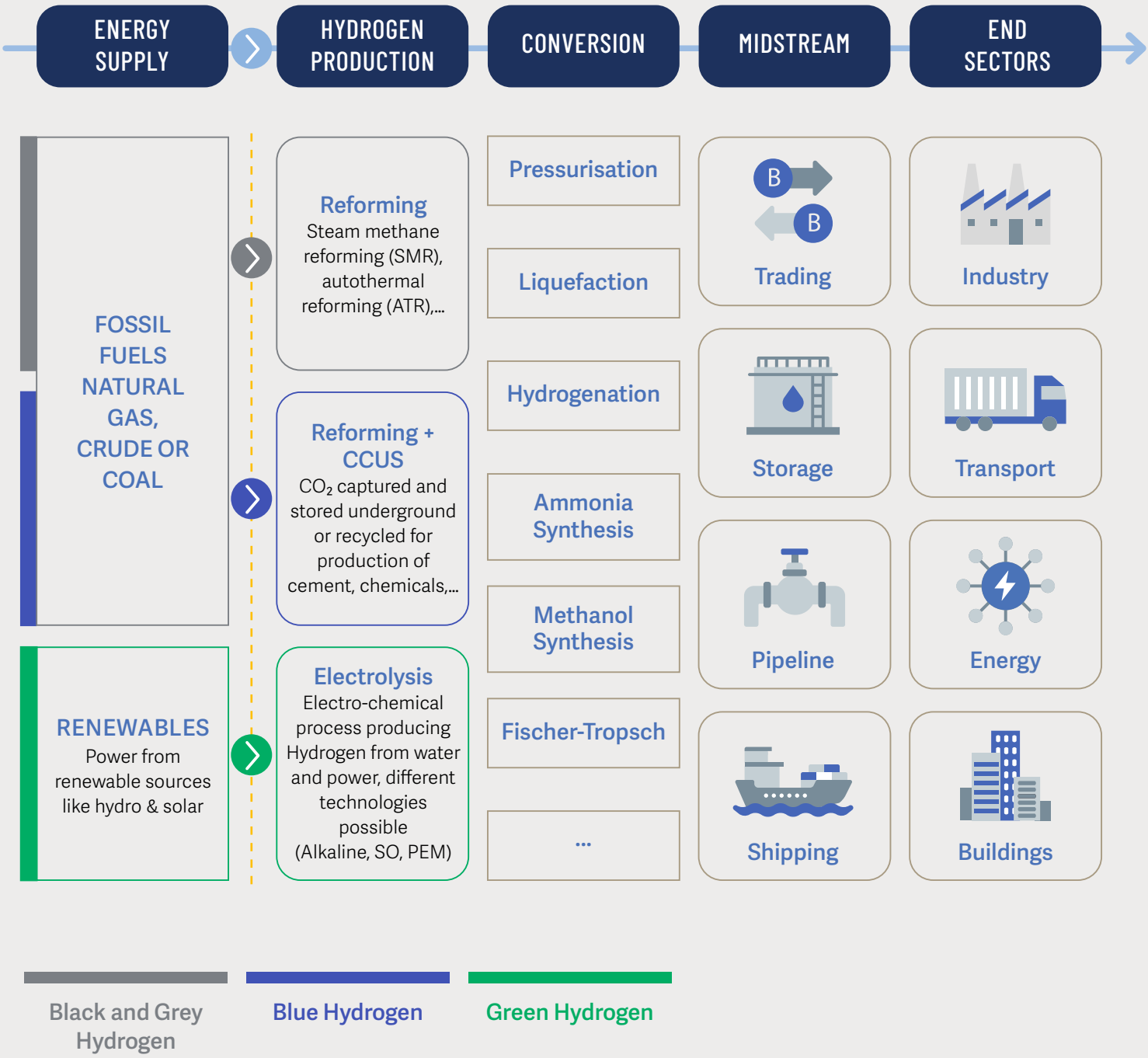
Sarawak is poised to play a pivotal role in Malaysia's ambition to develop its clean hydrogen industry, capitalising on its abundant renewable energy resources and fast-developing carbon capture capabilities. Sarawak is emerging as a leader in clean hydrogen development, with its hydrogen hub development well underway, led by projects like H2biscus and H2ornbill.

Sarawak aims to further solidify its ambition to stimulate the hydrogen economy and become a regional hydrogen leader. The state aim to build a robust hydrogen ecosystem, develop and expand domestic hydrogen utilisation in industries, transportation, and power generation, and position Sarawak as a key exporter of hydrogen.

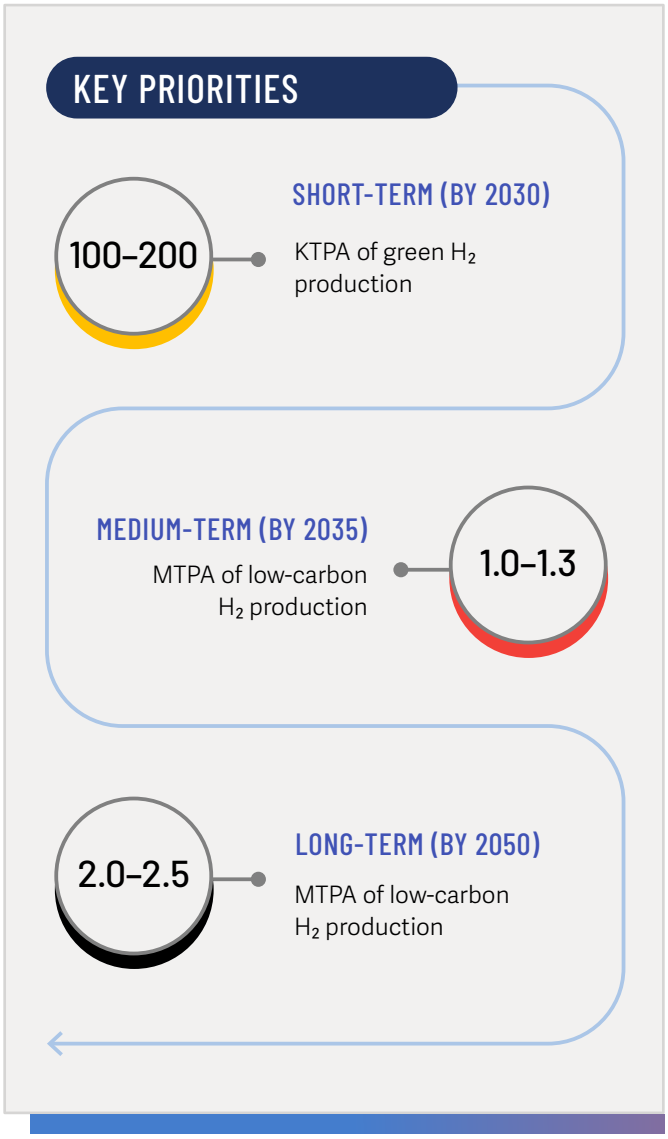
Sarawak is poised to play a pivotal role in Malaysia's ambition to develop its clean hydrogen industry, capitalising on its abundant renewable energy resources and fast-developing carbon capture capabilities.

S4.5 Exhibit 1

Clean Hydrogen Value Chain



S4.5 Exhibit 2



KEY BARRIERS

While clean hydrogen holds significant potential in Sarawak, several challenges must be addressed to drive industry growth. Green hydrogen remains costly due to expensive electrolysers, while blue hydrogen relies on natural gas reforming with CCS, which adds on to the overall cost of production. Furthermore, the development of hydrogen-specific infrastructure, such as storage tanks, pipelines, and refuelling facilities, requires substantial investment, presenting scalability challenging without clear economic returns.

With limited domestic demand and uncertainty around market uptake, Sarawak must catalyse local utilisation while securing stable, long-term international commitments to support large-scale hydrogen production.

KEY INITIATIVES

S4.5 Exhibit 3

SET-P INITIATIVES	
H1	**Stimulate and accelerate domestic uptake of clean hydrogen** • Collaborate closely with industry to identify barriers to hydrogen adoption in prospective domestic sectors, such as steel, chemicals, refining, and transport • Explore and design targeted incentive schemes for industries to switch to hydrogen, in alignment with federal schemes such as Green Investment Tax Allowance (GITA) and Green Income Tax Exemption (GITE)
H2	**Establish hydrogen hubs in Bintulu and Kuching** • Consolidate infrastructure for hydrogen production to lower the initial capital costs and enable economies of scale for clean hydrogen • Upgrade and expand the port facilities in Bintulu and Kuching to support the export of hydrogen derivatives to international markets
H3	**Pursue international partnerships on long-term clean hydrogen offtake** • Negotiate long-term hydrogen supply contracts with key markets such as South Korea, Japan, and Singapore to ensure a steady demand for Sarawak's clean hydrogen
H4	**Establish Sarawak Certification Platform to provide certification required by export destination** • Adopt a system to account for GHG emissions and other critical data from the production and export of hydrogen, ensuring harmonisation with international hydrogen certification standards and trade partners • Centralise the platform streamlining data input from operators to provide standardised certification outputs for export destinations
H5	**Advance development and commerciality of critical technologies** • Collaborate with industry players to drive R&D initiatives on hydrogen value chain advancements, including the development of critical technologies such as hydrogen fuel cell component parts • Explore and research downstream applications for clean hydrogen in prospective sectors to demonstrate feasibility and scalability • Continuously explore ways to lower the cost of hydrogen production, i.e., improving electrolyzer efficiency & technology, establishing economies of scale, optimising supply chain & infrastructure, developing policy support & market instruments etc.

4.6 CARBON CAPTURE, UTILISATION AND STORAGE

OVERVIEW

CCUS represents a significant economic opportunity for Sarawak, aligning with the global push for decarbonisation and the state's ambition to become a leader in low-carbon energy. Leveraging its natural resources, strategic location, and energy expertise, Sarawak is well positioned to capitalise on the emerging CCUS market.

Petroleum Sarawak Berhad (PETROS) was issued the first license for Carbon Storage to begin its strategic role as Resource Manager for Sarawak's Carbon Capture Utilisation and Storage (CCUS) endeavour.

CCUS in Sarawak is a key economic enabler and remain a priority for PETROS and other players in Sarawak.

1) **Enable Commercialisation of Stranded Sour Gas Fields (Long-Term Energy Security)**
   Stranded sour gas fields—gas reserves with high CO_2 content and limited market access—are typically considered uneconomical due to the cost and complexity, however, CCS solutions can help to unlock production from these stranded high CO_2 fields in Sarawak. Sarawak's CCUS storage and solutions will enable large scale sour gas development in the Kasawari and Lang Lebah fields which otherwise are environmentally unfeasible to be developed.

2) **Accelerate Local Industries Towards a Low-Carbon Future**
   Transitioning local industries—especially energy-intensive and heavy CO_2 emitting sectors such as power generation and manufacturing—towards cleaner operations is critical.

3) **Integrating Foreign Emissions Decarbonisation with Investment Value Creation in Sarawak**
   Sarawak can position itself as a carbon services hub, offering carbon capture, utilisation, and storage (CCUS), hydrogen, and other decarbonisation solutions to international players.

4) **Decarbonisation to Support Global Net Zero Aspirations**
   Sarawak's efforts in carbon capture, clean energy production, and industrial transformation can contribute significantly to international climate targets. By becoming a proactive player in the global decarbonisation ecosystem, Sarawak not only supports climate action but also builds strategic partnerships.

There are several key factors supporting CCUS as an economic opportunity in Sarawak.

- **Geological storage potential**: Sarawak's offshore basins and depleted oil and gas reservoirs provide ideal geological formations for carbon dioxide (CO_2) storage. These reservoirs, together with saline aquifers can be repurposed for large-scale carbon sequestration projects.

- **Integration with existing oil and gas infrastructure**: Sarawak's established oil and gas sector, including LNG production, gas processing and petrochemical industry can seamlessly integrate CCUS technology. Existing pipelines and facilities have the potential to be repurposed to transport and store CO_2, reducing initial capital costs. Opportunities for blue hydrogen production (using natural gas with CCUS) further enhance the commercial viability of CCUS projects.

- **Technology and innovation leadership**: Sarawak's expertise in the upstream sector combined with potential in CCUS establishes Sarawak as a technological leader in Southeast Asia, setting a benchmark for innovation in carbon management.

- **Policy framework**: Sarawak is also a favourable investment hub for CCUS initiatives, having established regulations under the Land Code Ordinance (Cap. 81) and Land (Carbon Storage) Rules 2022 as well as designating Petroleum Sarawak Berhad (PETROS) to be the state's CCUS resource manager.

KEY BARRIERS

Developing CCUS in Sarawak presents a range of challenges that span across technical, economic, regulatory, and social dimensions. Addressing these challenges is crucial for Sarawak to establish itself as a leader in CCUS and maximise the associated economic and environmental benefits.

CCUS projects often struggle to compete with other decarbonisation technologies due to high operational costs, making economic feasibility a significant barrier. Establishing CCUS infrastructure, such as capture facilities, transport pipelines, terminals and storage reservoirs, involves substantial upfront capital expenditure. The lack of a well-established market for CO_2 utilisation or storage services limits potential return on investment (ROI). Insufficient fiscal incentives, such as tax breaks or subsidies and carbon tax, make it harder for businesses to justify investment in CCUS technologies.

For Sarawak to act as a regional CCUS hub, agreements with neighbouring countries for CO_2 import/export need to be established, which can be complex and time-consuming. This requires both federal and state ministries to work collaboratively to enable government-to-government agreements.

Addressing these barriers will be critical for Sarawak to fully unlock its carbon storage potential and establish itself as a leader in regional CCUS development.

S4.6 Exhibit 1

2022

LAND CODE 1958; LAND (CARBON STORAGE) RULES, 2022

Land Code was amended in 2022 with the Land Code (Amendment) Bill, to regulate and control use of land, onshore and offshore, for the storage, retention, capture and sequestration of CO_2 or other GHGs

FORESTS (FOREST CARBON ACTIVITY) RULES, 2022

Provides the regulatory framework for an entity to obtain a permit and license to carry out forest carbon projects in Sarawak

2023

ENVIRONMENT (REDUCTION OF GREENHOUSE GASES EMISSION ORDINANCE), 2023

Specified CCUS and low-carbon activities such as carbon capture and storage, direct air capture, forest carbon activities, and energy efficiency projects are eligible for the issuance of Carbon Credit Units, subject to compliance with applicable standards and verification by an appointed Carbon Standard Administrator

NOTE: *Regulations on the use of facilities to capture and store GHGs is under the Land (Carbon Storage) Rules, 2022.*

The approval of the CCUS activities is also under the Land (Carbon Storage) Rules, 2022. Rule 11 of the Environment (Reduction of Green-house Gases Emission) Ordinance, 2023 only entitles a specified types of activities to be issued with carbon credit units.

PETROS CCUS GUIDELINE (PC+G)

Guiding document for managing CCUS operations in Sarawak, for CCUS contractors

QUALIFICATIONS AND REGISTRATION OF ACCREDITED EXTERNAL AUDITORS, RULES 2024

Provides rules and guidelines to ensure that auditors responsible for environmental reports are properly qualified and adhere to a strict code of conduct

FLARING AND VENTING RULES, 2024

Implements strict rules that controls flaring and venting activities in Sarawak, requiring approval from the Controller of Environmental Quality for Sarawak

S4.6 Exhibit 2

KEY PRIORITIES

SHORT-TERM (BY 2030)

2-3

CO_2 storage sites operationalised by 2030

MEDIUM-TERM (BY 2035)

CO_2 storage capacity utilised by 2035 (MMtpa)

10–20

KEY INITIATIVES

S4.6 Exhibit 3

SET-P INITIATIVES	
C1	**Position Sarawak as a key CCUS hub for Malaysia/APAC region** • Unlock the economic potential of stranded sour gas fields that are currently undeveloped due to technical, economic, or environmental challenges • Expedite the decarbonisation of key industrial sectors—particularly power generation, manufacturing, and other energy-intensive activities—to align with Sarawak and Malaysia's climate goals and international commitments • Work with the federal government to establish Sarawak as a key carbon storage hub for international partners involved in Malaysia's cross-border agreements • Identify and implement key necessary elements or policy enablers required at the state level for Sarawak to be a CO_2 storage hub for cross-border CCS agreements signed with Malaysia
C2	**Develop critical infrastructure for CCUS value chain in Sarawak** • Develop essential infrastructure over the next decade to enable CO_2 transport into Sarawak — including offshore and onshore pipelines, shipping terminals, integrated CO_2 collection network, etc. • Forge strategic partnerships with international companies and investors to develop CCUS projects in Sarawak, such as through bids like the Sarawak Bid Round (SBR) • Provide enabling environment (i.e., policies, permitting processes, incentives) for the development of CCUS infrastructure for Sarawak's CO_2 transportation and storage route
C3	**Implement incentives for emitters to adopt capture technologies at industrial facilities** • Leverage federal incentives for CCUS activities (e.g., investment tax allowances, income tax exemptions, etc.) to support carbon capture projects by emitters in Sarawak • Support research and development of cost-effective capture technologies that can be used in Sarawak, such as through the Centre of Excellence to be set up under SET-P
C4	**Support the development of CO_2 storage sites in Sarawak via clear permitting processes** • Continue to ensure clear processes and criteria for the permitting of storage sites in Sarawak • Review the Land Code 1958, Land (Carbon Storage) Rules 2022, as needed, to ensure that storage regulations are updated and aligned to international best practices for safe and permanent long-term storage

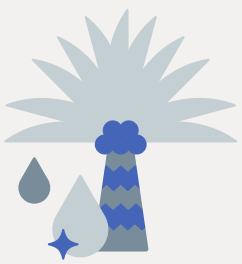
4.7 ALTERNATIVE ENERGY

In order to ensure energy security for Sarawak through a diversified energy mix, it is important to look beyond conventional energy sources to other alternative energy sources.

Under the SET-P, bioenergy and synthetic fuels are identified as potential alternative energy sources for Sarawak's long-term energy mix ***(S4.7 Exhibit 1).*** Additionally, nuclear technology and coal power generation combined with CCS technology will be studied to understand the feasibility to be deployed as a power source in Sarawak.

S4.7 Exhibit 1

Under the SET-P, **two** potential alternative energy technologies considered:



Bioenergy

Sarawak's abundant resources, including palm oil residues, woody biomass, sago waste, and municipal waste, present significant potential for bioenergy development

Synthetic Fuels and Gas

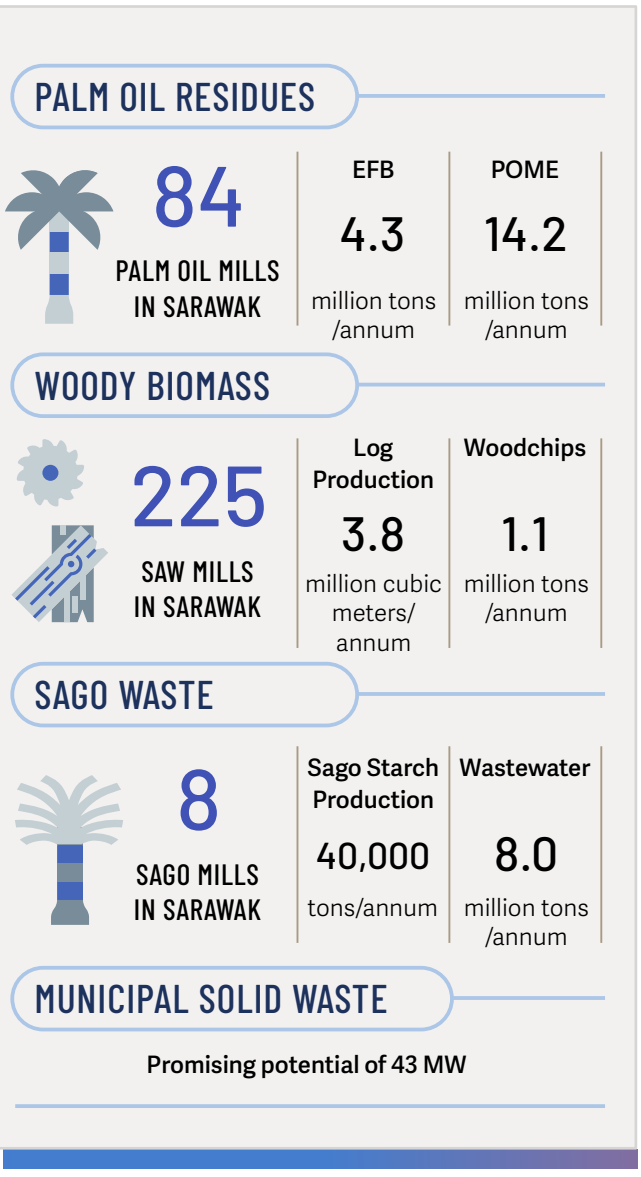
Synfuels and Syngas are essential for transport, power, buildings and industrial sectors that are challenging to electrify, and has potential to support sustainable fuel production in Sarawak if using clean feedstocks

4.7.1 BIOENERGY

OVERVIEW

Sarawak is endowed with a wealth of natural resources and a favourable climate, factors that make it a prime candidate for the development of bioenergy. As global energy demands shift towards more sustainable and renewable sources, Sarawak stands at the forefront with significant potential to harness bioenergy from its abundant biomass resources.

S4.7 Exhibit 2



Sarawak's rich resources, including palm oil residues, woody biomass, sago waste, and municipal waste, present significant potential for bioenergy development. *(S4.7 Exhibit 2)* These byproducts, traditionally seen as waste, are now being recognised for their potential in energy production. Sarawak produces over 25% of Malaysia's palm oil, and the associated waste from palm oil production is particularly viable for conversion into bioenergy. These feedstocks can be used to produce diverse end products such as biogas, biofuels, pellets, and biochemicals like bioplastics. *(S4.7 Exhibit 3)* Sarawak has begun driving efforts to explore and expand bioenergy applications across the value chain and position the state as a key player in the bioeconomy, such as through partnerships with Peninsular Malaysia and international players that are leading in bioenergy production and development.

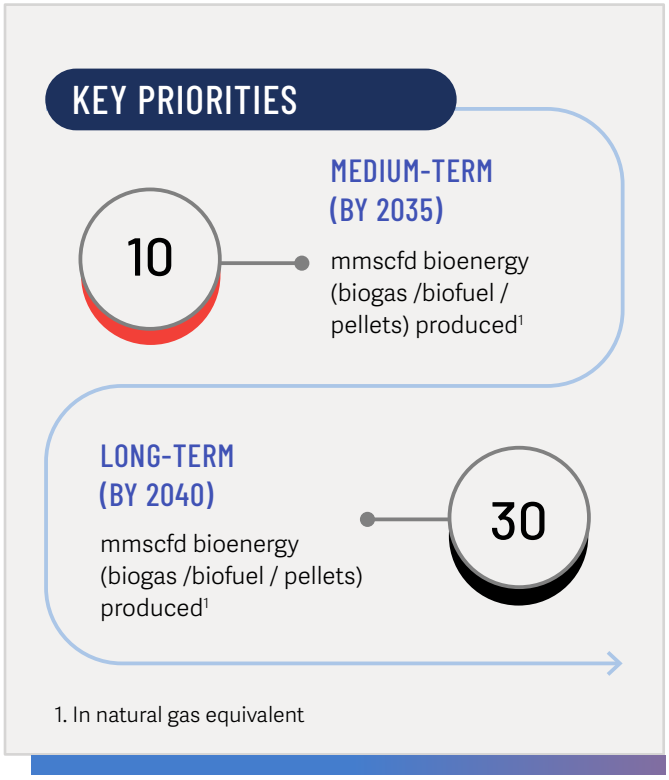
Sarawak's bioenergy potential is an exciting prospect for sustainable development. With its abundant resources and the growing need for renewable energy sources, Sarawak could become a model of bioenergy excellence in Southeast Asia. However, realising this potential will require coordinated efforts between the government, private sector, and local communities, alongside significant investments in technology and infrastructure. As global trends continue to favour sustainable solutions, Sarawak's journey towards a greener future looks promising.

KEY BARRIERS

Despite the abundance of feedstocks in Sarawak, most remain underutilised due to operational and economic challenges. Key barriers include unattractive feed-in tariffs for biogas and waste-to-energy (WtE) projects, high capital expenditure coupled with limited financing schemes, and complex logistics with high costs for biomass aggregation from remote and scattered sites. The relevant physical infrastructure needs to be designed and built to ensure that there ready supply of feedstock for bioenergy utilisation. Additionally, inconsistent feedstock availability and security, along with a labour shortage in managing upstream biomass resources, further hinder the commercial viability of bioenergy projects in Sarawak.

The success of bioenergy in Sarawak also hinges on an appropriate regulatory framework, supportive policies, and incentives from the government. Policies that facilitate investment in bioenergy infrastructure, provide tax incentives, and establish clear guidelines for biomass use are crucial.

S4.7 Exhibit 4



KEY INITIATIVES

S4.7 Exhibit 5

SET-P INITIATIVES	
A1	**Develop regulatory framework and guidelines for bioenergy production, storage, transportation, and utilisation** • Create guidelines for sustainable feedstock sourcing, aligned with international standards and regulations • Establish minimum input feedstock criteria for producing bioenergy (e.g., biofuel, biogas, pellets, etc.)
A2	**Explore incentives for companies supplying biomass and investing in bioenergy or WtE technologies** • Improve bankability and economics of bioenergy projects through incentives such as grants, tax breaks, or subsidies • Encourage use of bioenergy blending in different applications to ensure steady demand
A3	**Co-develop biomass feedstock aggregation platform with private sector partners** • Build efficiencies of scale via aggregation platform to collect, process, and store biomass feedstocks from multiple sources (e.g., palm oil mills from plantations across the state) • Support platform with improved network for transportation and connectivity of feedstock supply in remote areas such as villages

4.7.2 SYNTHETIC FUELS AND GAS

OVERVIEW

With global shifts towards cleaner energy sources, synthetic fuels (synfuels) such as methanol, ammonia, and ethanol present an opportunity for Sarawak to diversify its energy sector and contribute to environmental sustainability. Synfuels are liquid fuels derived from hydrogen, carbon monoxide, and oxygen, rather than crude oil. Power-to-X represents a game-changer for deep decarbonisation. It enables us to use renewable energy more flexibly, replace fossil fuels in sectors that cant be directly electrified and build a circular, integrated energy economy There are several synthetic fuels that can be produced with select examples provided below.

- **Kerosene:** Kerosene is a type of synthetic fuel produced from carbon dioxide, water, and low-carbon energy. The production process involves creating a synthetic gas from these components, which is then converted into e-kerosene. This synfuel can be used as an alternative fuel for aviation use.

- **Methanol:** The production process for methanol involves synthesising methanol using hydrogen generated from renewable energy sources and CO_2 captured from industrial emissions or direct air capture. Methanol can be used to decarbonise existing methanol-based chemical value chains and serves as an attractive renewable transport fuel due to its energy density and relatively low production cost. It is particularly beneficial for applications in maritime shipping and as a chemical intermediate, offering significant potential for reducing greenhouse gas emissions.

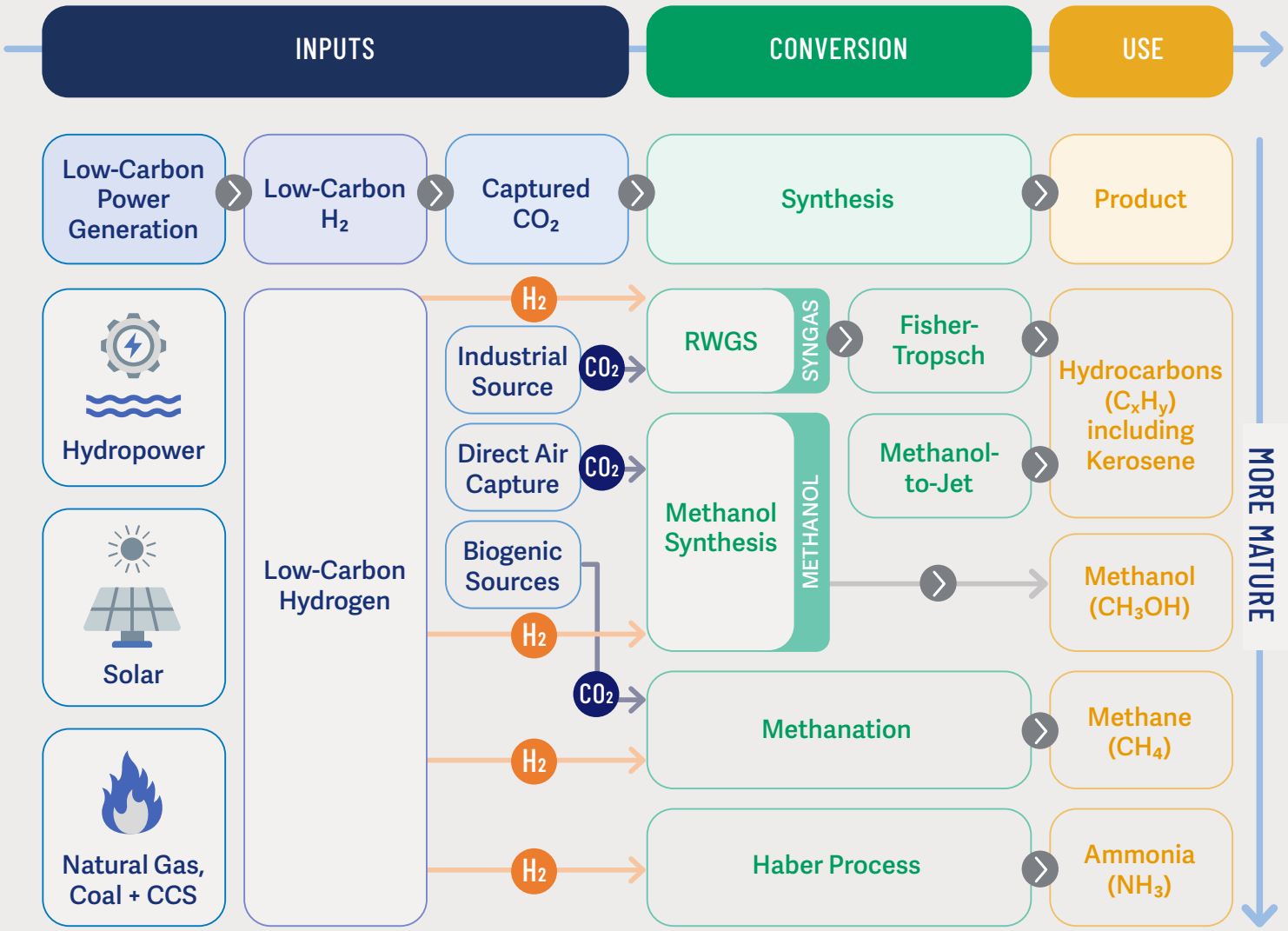
- **Methane:** Synthetic methane produced through a process that involves capturing CO_2 and combining it with hydrogen produced from renewable energy sources. This process, known as methanation, results in a fuel that can be used similarly to natural gas but with significantly lower carbon emissions. Methane can leverage existing gas infrastructure, making it a practical option for decarbonising gas networks without the need for extensive retrofitting.

- **Ammonia:** The production process involves synthesising ammonia from nitrogen (N_2) and hydrogen (H_2), where the hydrogen is generated through electrolysis powered by renewable electricity. This process is known as the Haber-Bosch process, which is well-established and widely used in industrial applications. Ammonia is considered a zero-emission fuel when produced from renewable sources, and it has significant potential for use in various sectors, including shipping and power generation.

The exhibit below shows in detail the typical production routes for low-carbon synthetic fuels.

S4.7 Exhibit 6

Typical Production Routes for Low-Carbon Synthetic Fuels



Synfuels are essential for transportation sectors that are challenging to electrify, as they offer the same high energy density as fossil fuels and can be seamlessly used with existing infrastructure. They can also be synthesised from feedstocks such as blue or green hydrogen and CO_2 captured from industrial sites, offering a low-carbon fuel.

Sarawak currently has the capacity to produce up to 1.75 Mtpa of methanol in Bintulu as part of the Sarawak Methanol Complex. While existing production facilities do not use low-carbon feedstocks, the increasing availability of blue and green hydrogen in the region means the transition to low-carbon synfuels can support sustainable fuel production in Sarawak. As next steps, the Sarawak Government has committed to investing RM5-6 billion for the construction of an upcoming low-carbon ammonia and urea plant project, demonstrating the state's commitment to transition to low-carbon synfuel production.

KEY BARRIERS

Sarawak faces several key barriers to the development of synfuels. One of the challenges is the heavy reliance on the availability and consistent supply of key feedstocks such as hydrogen, natural gas, and carbon dioxide. These inputs are essential for various synfuel production processes, including Fischer-Tropsch synthesis and power-to-liquid technologies. The volume and quality of feedstock directly impact production scalability. While Sarawak is endowed with natural gas reserves and is exploring hydrogen initiatives, these resources must be efficiently harnessed and expanded to support a viable synfuel industry. Moreover, capturing and utilising carbon dioxide at scale requires advanced carbon capture and storage (CCS) infrastructure, which is still underdeveloped in the region.

Another critical barrier is the absence of established infrastructure for the distribution and bunkering of synfuels. Synfuels, particularly those intended for marine and aviation uses, require specialised facilities for storage, handling, and refuelling. Due to the current low economies of scale in synfuel production, operational costs remain high, making it less attractive for private investors without government support.

The development of a robust synfuel industry also depends heavily on a conducive policy environment. At present, the regulatory and incentive framework to encourage investment and innovation in synthetic fuel technologies has yet to be significantly developed in Sarawak.

KEY INITIATIVES

S4.7 Exhibit 7

SET-P INITIATIVES	
A4	**Develop and implement initiatives to grow synfuel production and utilisation in Sarawak** • Explore the potential to increase adoption of synfuels and gas in domestic transportation (e.g., through SAFs) and also for industry, buildings and power sector • Develop a synfuel export strategy for Sarawak to support demand for domestic production • Provide enabling environment (i.e., policies, incentives) to support low-carbon synfuel production, including bunkering and distribution infrastructure

4.7.3 ADDITIONAL ALTERNATIVE ENERGY SOURCES

OVERVIEW

As part of efforts to ensure Sarawak's energy security, there are plans to study and research additional energy sources that could potentially be deployed in Sarawak.

Nuclear Technology

Exploring nuclear technology as a viable option for long-term energy security is becoming increasingly important in the face of growing global energy demands and the urgent need to reduce carbon emissions. Nuclear energy offers a stable, low-carbon power source capable of producing large amounts of electricity continuously, unlike some renewable sources that depend on weather conditions. Modern advancements in nuclear reactor designs, including small modular reactors (SMRs) and next-generation fission and fusion technologies, promise enhanced safety, reduced waste, and greater efficiency.

Nuclear Small Modular Reactor (SMR) is a novel application of nuclear technology that provides zero-carbon, dependable power. These reactors are much smaller than the traditional nuclear reactors, with capacities of less than 300 MW. Advanced technologies enable modular/ standardised designs and passive safety systems ensure greater safety measurements.

Nuclear energy could provide baseload power and complement the renewables ramp-up in Sarawak as well as be used a feedstock for hydrogen production. Nevertheless, further research and development specific to Sarawak will need to be conducted to ensure that such technology can be deployed safely since the technology remains quite nascent still.

Coal Power Retrofitted with CCS Technology

Retrofitting coal with CCS technology refers to the process of installing CCS systems onto existing coal-fired power plants to reduce their carbon emissions. This approach can be viewed as a transitional solution to reduce the environmental impact of coal power while maintaining energy security and grid reliability for Sarawak. Few companies have successfully implemented recycling and reuse of most by-products, significantly reducing CO_2 emissions. This includes advancements in energy efficiency, however, additional research needs to be undertaken to understand commercial viability of deploying this technology.

Moving forward, feasibility studies will be carried out in the short-term to assess the technical, economic and environmental viability of these technologies to be used in the context of Sarawak.

KEY INITIATIVES

S4.7 Exhibit 8

	SET-P INITIATIVES
A5	**Study the potential of Nuclear Technology in Sarawak** • Conduct study to evaluate the feasibility of Nuclear technology deployment in Sarawak • Collaborate with research institutions to pilot and test the feasibility of nuclear technologies as viable energy source in Sarawak
A6	**Study the potential of clean coal power generation with CCUS** • Conduct study to evaluate the feasibility of deploying coal power together with CCUS technology in Sarawak • Evaluate techno-economic and environmental feasibility of coal power and CCUS to test viability as a low-carbon energy source

SECTION 05

ENERGY TRANSITION ENABLERS

To facilitate and accelerate Sarawak's energy transition journey, several key enablers that cut across energy transition pillars have been identified. These enablers underscore the critical cross-cutting initiatives necessary to support the effective implementation of measures identified under each energy transition pillar.

5.1 GOVERNANCE & REGULATIONS

OVERVIEW

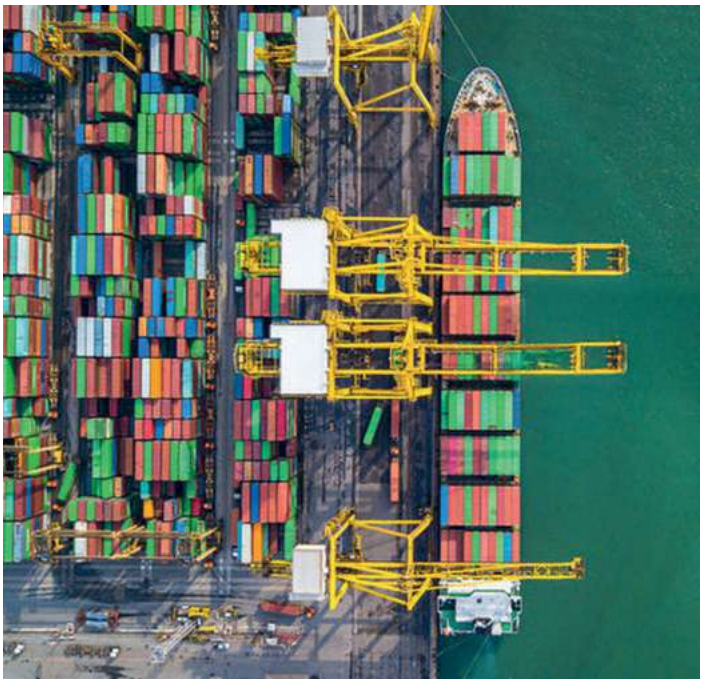
The SET-P is aligned with the vision of PCDS 2030 for Sarawak to be a developed state by 2030, as it supports all three key pillars of Economic Prosperity, Inclusive Society, and Environmental Sustainability.

The SET-P will act as the guiding policy that ties together other energy-related policies including the Sarawak Hydrogen Economy Roadmap and Sarawak Transport Masterplan that are being developed in parallel to ensure alignment in policy initiatives.

At the same time, the SET-P has also been formulated to harmonise with policies such as the Sarawak Sustainability Blueprint and the Sarawak Net Zero and Carbon Plan which has a wider scope of accelerating decarbonisation and low-carbon economic growth in areas beyond the energy sector.

KEY BARRIERS TO BE ADDRESSED

Planning for Sarawak's energy demand spans key sectors, including transportation, residential, industrial, and commercial. Managing the energy transition is inherently complex, involving multiple ministries and government agencies with distinct roles and responsibilities. Poor coordination in regulating and governing the energy system can result in misaligned policies being formulated and rolled out, fragmented implementation, and a lack of regulatory clarity and certainty for industry stakeholders.



The rapid pace of the energy transition demands robust governance to enable strategic, long-term planning while remaining agile in addressing sudden challenges and seizing emerging opportunities.

To ensure cohesive management of energy-related issues, Sarawak's energy governance must be comprehensive, transparent, and well-coordinated. Strong governance involves clear regulatory oversight, effective strategic planning, and seamless coordination among key ministries, agencies, and industry stakeholders. A designated government entity will be essential for tracking progress and supporting the implementation of the SET-P and its policy initiatives.

KEY INITIATIVES

S5.1 Exhibit 1

	SET-P INITIATIVES
EN1	**Set up the Sarawak Energy Council to monitor energy transition progress** • Establish a Sarawak Energy Council chaired by the Sarawak Premier to monitor implementation of SET-P initiatives and projects • Empower Council to ensure proper governance of Sarawak's energy transition progress
EN2	**Establish Sarawak Energy Authority for energy planning, licensing, and permitting processes** • Develop and set up independent energy authority for Sarawak to promote reliable and low-carbon energy supply at affordable pricing for consumers • Authority to be responsible for long-term electricity planning (i.e., setting power tariffs, grid investments, consumer protection, licensing and permitting) • Authority will also govern regulatory matters related to natural gas and hydrogen • Authority will provide market oversight and promote competitive, flexible, and secure energy markets

5.2 FINANCING & INVESTMENTS

OVERVIEW

Sarawak's energy transition will require significant investments that necessitate leveraging capital from a variety of funding sources. This includes both public and private sources of funding to ensure energy transition priorities can be achieved without overburdening public resources.

The estimated energy transition investment opportunities resulting from Sarawak's energy transition range between RM580-700 billion across all energy transition pillars. *(S5.2 Exhibit 1)*

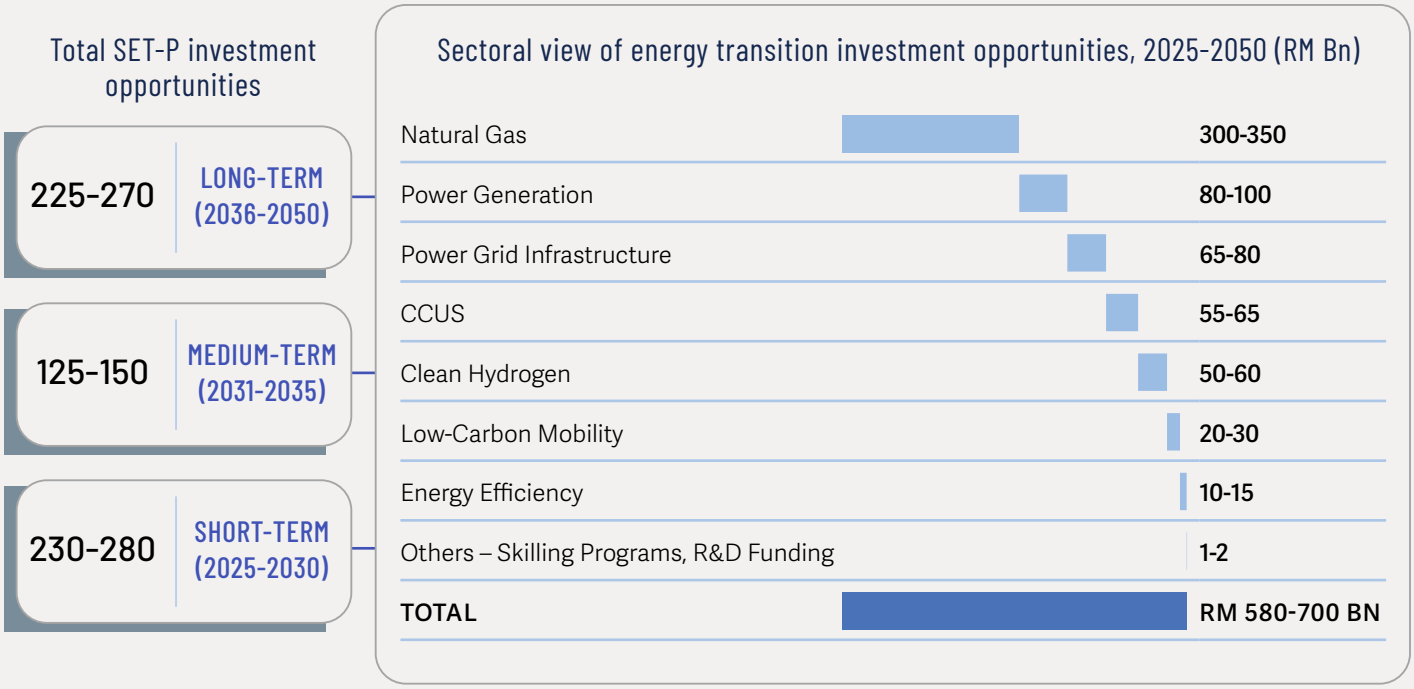
The majority of investments required for Sarawak will be in the short/medium term (2025 to 2035) with these investments making up ~60% of energy transition investment opportunities. This is primarily driven by the need to develop large-scale supporting infrastructure for key energy transition pillars such as natural gas hubs, clean hydrogen hubs, CCUS hubs, and utility-scale solar power. It is essential to establish the necessary infrastructure in the short-term to enable rapid scaling in the future.

Breaking down the investment opportunities by pillars, the largest share will be for natural gas (~50% of total share) in scale up for the appropriate infrastructure to support the development of natural gas hubs in Kuching, Bintulu, Samalaju, and Miri. This is in line with the ambitions and visions set out under the Sarawak Gas Roadmap to leverage domestic gas resources to drive sustainable development across Sarawak.

The state will also see significant investments required for power sector development, which includes renewable energy development in line with priorities set by Sarawak Government, investments in grid infrastructure modernisation, and energy storage development. The total share for this development is ~25% of Sarawak's energy transition investment opportunities.

S5.2 Exhibit 1

Timeline view of energy transition investment opportunities (RM Bn)



Source: SET-P investment projection model

CCUS and clean hydrogen investments have the next largest share of funding requirements with both pillars making up ~20% of the total. These funding requirements are driven by the necessity to establish large-scale infrastructure for advancing CCUS and clean hydrogen production.

Further investments will also be required for low-carbon mobility, which includes investments in public transport infrastructure (e.g., ART development in Kuching and Bintulu), hydrogen refuelling stations, EV charging infrastructure, as well as scaling up domestic low-carbon marine and aviation fuel capabilities. Investments for energy efficiency adoption and the development of R&D and skilling programmes focused on energy transition will also be required.

KEY BARRIERS TO BE ADDRESSED

There are several investment barriers that may obstruct the deployment of capital for Sarawak's energy transition that will need to be addressed. The barriers include, but are not limited to, the following:

- **Technology risk:** Key emerging technologies necessary for energy transition can be capital-intensive and possess project execution risk profiles that may make them less attractive to some investors. In the case of Sarawak, this may apply to CCUS, clean hydrogen, and energy storage projects which are at more nascent stages of commercial development. These factors may make it difficult for financial institutions and banks to commit large investments, especially in long-term, large-scale energy transition infrastructure.

- **Project execution risk:** Other energy transition projects may also face challenges related to implementation and construction which may affect the ability to attract investors. This may apply to nascent energy transition projects such as CCUS, clean hydrogen, and energy storage, but also apply to more mature technologies such as hydropower.
- **Lack of scalability in projects:** Certain energy transition projects may also have issues with scaling to a ticket size that is financially viable and attractive to institutional investors and banks. Limited initiatives targeting project aggregation affects bioenergy and energy efficiency projects from accessing necessary capital to fund these projects.

Therefore, it is critical that diverse capital pools are leveraged to facilitate the state's energy transition.

SHORT-TERM ENERGY TRANSITION INVESTMENT OPPORTUNITIES

From a short-term view, the energy transition investment opportunities in Sarawak can be broken down into three types of categorisations—market-rate returns, below-market-rate returns, and no expected market returns.

Investments in utility-scale solar power generation, hydropower, grid infrastructure expansion and upgrade, as well as the majority of natural gas investments in Sarawak, can largely be classified as having market-rate returns. Such projects are generally able to obtain financing from the capital markets and financial institutions. Nevertheless, robust regulatory and policy initiatives—as detailed in the previous section—are essential to ensure these investments are developed within the required timeframe.

The next categorisation is for investments that have no expected financial returns and are typically focused on fulfilling public service obligations or advancing social objectives. For Sarawak's energy transition, these include initiatives such as upskilling and reskilling programmes to support workers affected by the energy transition, as well as efforts to improve and upgrade urban public transport infrastructure.

Investments in utility-scale solar power generation, hydropower, grid infrastructure expansion and upgrade, as well as the majority of natural gas investments in Sarawak, can largely be classified as having market-rate returns.

Thirdly, a large segment of energy transition investments in Sarawak can be categorised as having below-market returns. The relevant pillars under this categorisation are clean hydrogen, CCUS, low-carbon mobility for light and heavy vehicles, energy efficiency, and energy storage solutions. These investments are still quite nascent in Sarawak, which implies project execution risk and difficulty for investors to assess risk/return profiles. Furthermore, a portion of the investment requirements for the natural gas hubs (i.e., transport terminals, supporting infrastructure such as roads and bridges) may be considered sub-commercial and require regulatory support.

Therefore, it is crucial to implement enabling policy initiatives to enhance the bankability of below-market-return investments for investors and project developers. Establishing a blended finance facility targeted at supporting such projects can improve their financial viability. Risk mitigation measures and/or subordinate capital instruments offered by the Sarawak Government can play a vital role in de-risking these investments and attracting the necessary capital.

Additionally, utilising public-private partnership (PPP) structures can help distribute both the costs and execution risks associated with energy transition projects. These policy initiatives are discussed in greater detail in the sub-section below.

KEY INITIATIVES

S5.2 Exhibit 2

	SET-P INITIATIVES
EN3	**Set up blended finance facility to catalyse capital for strategic energy transition projects** • Identify critical energy infrastructure projects that require financing • Study possible blended finance models appropriate for Sarawak's context to help fund the energy transition • Seek to attract public and private capital from foreign and domestic entities that are interested to participate in these energy transition infrastructure projects • Modalities of ownership and execution of blended finance facility to be determined by MEESty and SFSO
EN4	**Develop PPP mechanisms for identified energy transition projects as part of Sarawak PPP masterplan development** • Roll out PPP masterplan for Sarawak that provides guidance on overall PPP development • Ensure PPP framework is fit-for-purpose for energy transition projects • Establish criteria for selecting PPP projects, such as environmental impact, financial viability, and alignment with energy transition goal
EN5	**Enhance energy transition incentives, funding and investments** • Identify priority areas that require incentives to drive energy transition in Sarawak • Ensure appropriate policy incentives and funding are provided for key energy transition technologies and strategic projects

5.3 INFRASTRUCTURE

OVERVIEW

The development of both physical infrastructure and digital infrastructure is extremely crucial to facilitate the advancement of the energy transition in Sarawak.

Future energy infrastructure investments in Sarawak are essential for several reasons, including supporting the energy transition, improving energy access, and maintaining national energy security. Given the lengthy lead times required for some infrastructure projects, it is crucial that these investments are made promptly and efficiently to maximise the use of fiscal resources through smart financing and funding strategies. These investments will play a critical role over the next two decades.

Sarawak has already been successful in driving large-scale infrastructure development through the SCORE, which has attracted investments for the development of strategic industrial facilities and key public infrastructure.

The energy transition will require further build out of large-scale infrastructure such as utility-scale solar, CCUS hubs and clean hydrogen hubs, together with supporting infrastructure and networks to ensure sufficient connectivity and accessibility. Infrastructure for energy distribution, including the development of both physical and virtual pipeline infrastructure, is crucial to improve energy access and boost the economic competitiveness of industrial clusters. In the power sector, substantial investments are required to expand grid infrastructure, which will enhance the reliability of electricity supply

and extend rural electrification. Investments in grid infrastructure will increase power system capacity, accommodate higher levels of VRE, and meet growing EV charging demands. Grid modernisation and digitisation are critical for enabling advancements in the power sector, particularly through the implementation of smart grids and future grid initiatives.

Digital infrastructure such as data platforms can help play a key role in enabling regulatory authorities and entities to track the progress of the state's energy transition. Ensuring transparent data access also provides greater visibility to potential investors and project developers on the possible energy transition opportunities in Sarawak that can be capitalised.

Building on this digital foundation, establishing standardised data governance frameworks and real-time reporting mechanisms will be critical to ensure accuracy, interoperability, and accountability across stakeholders

KEY BARRIERS TO BE ADDRESSED

The built infrastructure for Sarawak's energy transition for emerging technologies such as CCUS hubs and clean hydrogen hubs are still in fairly early stages of development, while more mature technologies such as solar photovoltaic (PV) and EV charging infrastructure will require greater build out of supporting infrastructure such as the grid network to enable the growth of these technologies. Support will be required to ensure investments are provided for sufficient development of infrastructure needed for the energy transition.

Furthermore, in terms of digital infrastructure in the energy sector, there are gaps in the availability of energy sector data in Sarawak that need to be addressed. Currently, there is an absence of an up-to-date data platform that incorporates comprehensive information on Sarawak's energy sector. This barrier limits accessibility to all stakeholders on understanding the current state of the energy sector. Addressing this barrier can provide greater transparency to prospective energy sector project developers and investors on critical information required for decision-making.

KEY INITIATIVES

S5.3 Exhibit 1

SET-P INITIATIVES	
EN6	**Expand industry coverage of Sarawak Corridor of Renewable Energy (SCORE) for energy transition projects** • Explore expanding scope of SCORE to cover additional industries (e.g., CCUS, solar, H_2) • Facilitate incentives to be provided for new available opportunities in the energy transition within SCORE
EN7	**Establish a Special Economic Zone (SEZ) focused on low-carbon and energy transition economic activities** • Collaborate with the federal government on development and setup of SEZ in Sarawak • Identify suitable geographical areas within Sarawak for SEZ (e.g., Bintulu, Kuching) • Study and prioritise key incentives and programmes required for low-carbon SEZ to attract investors and project developers
EN8	**Develop Energy Sector Data Platform to ensure reliable and accurate publicly available data** • Coordinate efforts with key public and private energy sector players to understand key data sources and data availability for important energy sector metrics • Ensure standardised collection of accurate and reliable energy-related data from • Establish publicly available energy data platform that is regularly updated with key information on the energy sector for ease of monitoring SET-P implementation and ensure public accountability

5.4 TECHNOLOGY & INNOVATION

OVERVIEW

The development of energy transition technologies is constantly evolving, and it is critical that sufficient efforts are being put in place to support research & development (R&D) as well as ongoing innovation. Creating the optimal conditions and ecosystem to drive innovation and accelerate new energy technology adoption is essential for Sarawak to gain a competitive edge and position itself as a regional leader in the energy sector.

Technology in Sarawak will play a crucial role in the energy transition across various sectors such as renewable energy, low-carbon mobility, and emerging fields like hydrogen and CCUS.

Technology in Sarawak will play a crucial role in the energy transition across various sectors such as renewable energy, low-carbon mobility, and emerging fields like hydrogen and CCUS. It will allow Sarawak to gain a first-mover advantage in these areas, accelerating domestic value realisation and boosting technology-driven exports. To enhance their technology agenda in the energy sector, Sarawak needs to take a pragmatic approach across selected technologies:

- **Renewable energy (Solar)**: As solar energy becomes more cost-effective, there's a growing opportunity to expand solar penetration in the power mix in Sarawak. A key focus is on improving the environmental sustainability of large-scale solar farms by researching optimal crops and dual use of land specific to local contexts. This can enhance competitiveness through additional revenue streams and better land use throughout the solar lifecycle. Additionally, maintaining biodiversity should also be researched to complement the environmental benefits of solar power. Sarawak has already initiated investment in floating solar technologies to capitalise on synergies with existing hydroelectric resources. Efforts should also focus on maximising rooftop solar potential, tailored to local specifics. With Malaysia becoming a hub for manufacturing of solar PV cells, Sarawak should aim to attract investors to expand the value chain by fostering innovation and differentiating its PV technology from lower-cost producers.

- **Energy efficiency**: The focus for energy efficiency is on integrating smart devices and digital technologies aligned with national and global economic policies. Strategic support for local companies and targeted R&D investments are crucial. Sarawak needs to carefully choose focus areas for R&D where it can achieve regional leadership and avoid fields where neighbouring countries have significant advancements to ensure effective use of resources and maximise returns.

- **Clean hydrogen**: Sarawak has a significant opportunity to develop its clean hydrogen economy, leveraging its rich natural resources to produce cost-competitive blue and green hydrogen. Sarawak is strategically positioning itself as a green hydrogen export hub, focusing on developing and localising key technologies for hydrogen production and transportation. Key areas include improving electrolyser efficiency and cost, exploring optimal hydrogen transport methods such as ammonia or liquid hydrogen, and enhancing safety and operational cost-efficiencies. Partnerships and technology transfers with international entities will be critical to advance these technologies and strengthen Sarawak's position in the regional and global hydrogen market.

- **Bioenergy-linked technology:** For first-generation and second-generation bioenergy, there is a need to focus on making energy generation cost-effective on the supply side. Sarawak needs to focus on reducing costs related to feedstock aggregation and transportation, improve pre-treatment processes to expand the range of viable feedstocks, and enhance energy conversion efficiency, especially leveraging the state's large palm oil sector. On the demand side, research and development should aim to boost technical and commercial viability in emerging sectors.

- **New energy sources**: Sarawak is already exploring R&D in emerging energy technologies like ocean energy systems such as wave/kinetic energy and plans to explore potential new energy sources such as nuclear and clean coal to secure an early-mover advantage, leveraging its geographical strengths. The strategy should include providing incentives for R&D, scaling of pilot projects, focusing on reducing capital costs and improving efficiency. This approach is part of a broader effort to also advance in other potential energy technologies like next-generation bioenergy.

KEY BARRIERS TO BE ADDRESSED

Although there has been increased interest in recent years on the research and development of energy transition technologies in Sarawak, these efforts are not necessarily being coordinated between academic institutions, industry players, and government agencies. Addressing the energy transition requires a unified approach to research and development.

A coordinated ecosystem for R&D around the energy transition can help drive synergy by eliminating redundant research efforts, ensure efficient resource allocation, and accelerate targeted technological innovation. It can help drive the process for technological breakthroughs such as battery storage technologies or clean hydrogen production. Moreover, by facilitating and coordinating research efforts, it can bridge the gap between research and real-world application, enabling rapid testing and scaling of cutting-edge and commercially viable energy transition solutions that are relevant for Sarawak.

KEY INITIATIVES

S5.4 Exhibit 1

	SET-P INITIATIVES
EN9	**Establish a centre of excellence to drive R&D and innovation for the energy transition** • Set up dedicated research centre to drive R&D and technological advancements in energy transition technologies (e.g., bioenergy, sustainable aviation fuel, clean H_2, new RE sources) • Partner with lead research and academic institutions on developing technical capabilities and knowledge of local experts for the energy transition • Utilise the centre to be an innovation hub for emerging technologies and startups

5.5 WORKFORCE & SKILLING

OVERVIEW

Workforce and skilling are crucial factors in enhancing the resilience and competitiveness of Sarawak's energy sector. The shift towards low-carbon energy is expected to create new job opportunities, reshaping the employment landscape for the energy sector. There are several intended benefits arising from setting the right platform through workforce development:

- **Competitive advantage**: Leveraging human capital can differentiate Sarawak and attract foreign investments, particularly in sectors like renewables, CCUS, clean hydrogen, and alternative energy, which are pivotal for energy transition.
- **Efficiency and innovation**: A skilled workforce enables a more efficient and innovative energy sector, leading to long-term benefits such as cost-competitive energy production that benefits both businesses and the rakyat.
- **Sector resilience**: Human capital in Sarawak is expected to meet the requirements of diversified energy sources, reducing dependence on conventional fuels and enhancing sector resilience

The ongoing development of human capabilities is vital for sustaining employment growth and the contribution of the energy sector to Sarawak's GDP and job multipliers. As the economic opportunity associated with energy sector transition shapes up in Sarawak, the ability of the workforce to adapt is crucial to ensuring employment growth and equitable energy transition. Greater efforts will be needed to ensure that the Sarawak workforce is sufficiently prepared for the changes in jobs because of the energy transition. There is a lack of a programmatic initiative in place that focuses on upskilling and reskilling existing workforce with new skills as well as preparing the long-term workforce to meet future energy sector needs. It is imperative that any workers affected by the energy transition in Sarawak are provided fair opportunities to learn new relevant skills and have access to high-value jobs.

KEY BARRIERS TO BE ADDRESSED

Key barriers to be addressed for a fair and just transition in the energy sector workforce include:

- **Changes in the employment landscape**: The transition to a low-carbon economy will result in job reductions in GHG-intensive sectors but will be mitigated by creation of jobs in new low-carbon sectors. The key issue lies in balancing job losses in traditional industries with job creation in these new sectors.
- **Skills mismatch required for new jobs in the energy transition:** The existing workforce skills are mismatched with those required for emerging energy technologies. Technologies such as hydrogen and CCUS demand specific technical expertise, which necessitates substantial upskilling efforts and new targeted skilling programmes.

KEY INITIATIVES

S5.6 Exhibit 1

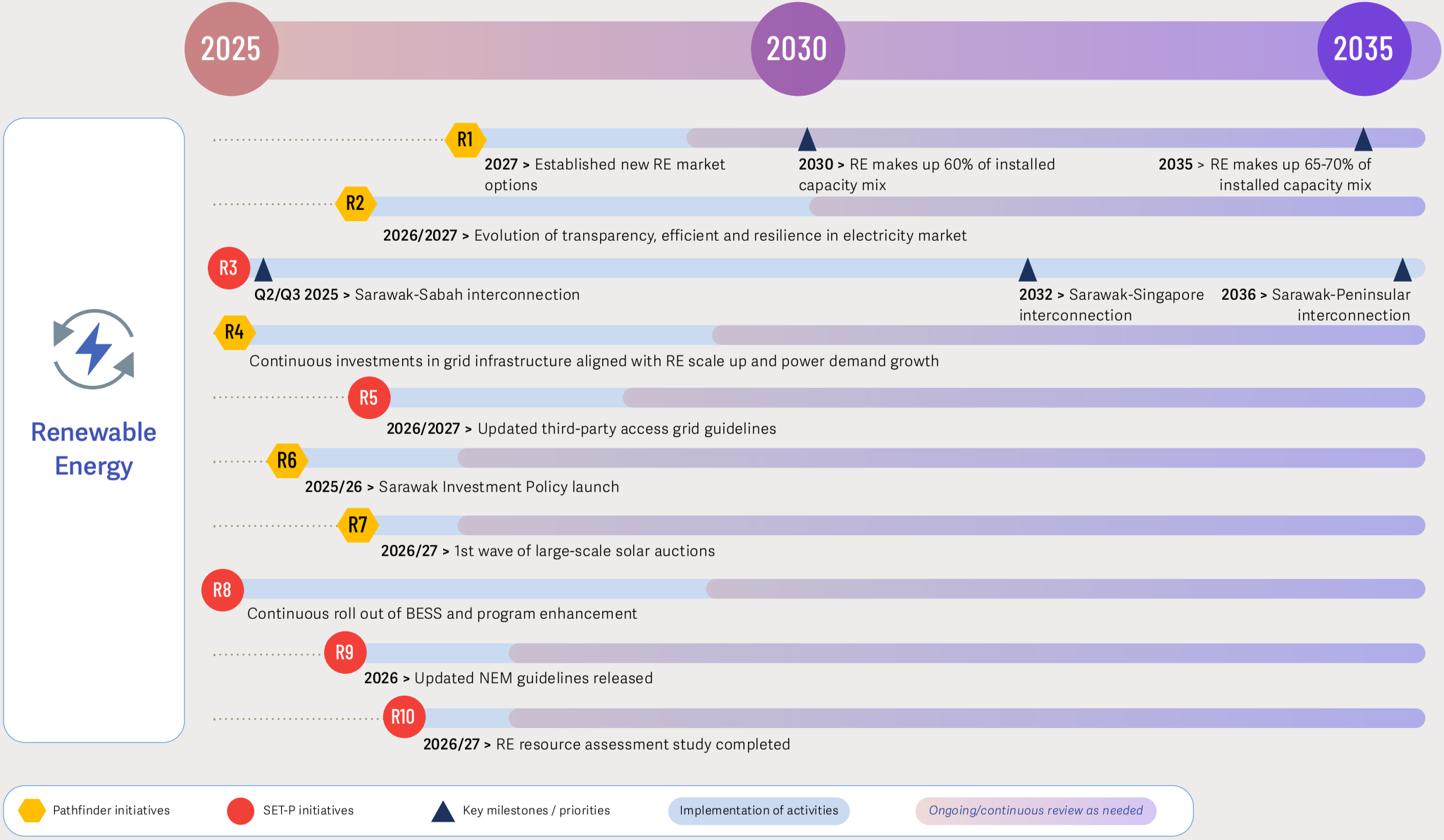
SET-P INITIATIVES	
EN10	**Launch energy transition skilling programme to ensure a skilled workforce tailored for long-term success** • Collaborate with academic and industry existing reskilling and upskilling programmes to equip energy sector labour force with necessary skills • Set up partnerships with local universities and industry players on developing academic programmes (TVET and degree programmes) focused on developing skills needed for new industries from the energy transition

SECTION 06

ROADMAP VIEW OF THE SARAWAK ENERGY TRANSITION POLICY

S6 Exhibit 1

This exhibit represents an illustrative roadmap and timeline view of the SET-P over the next 10 years. This view highlights the key initiatives, milestones, and activities across the various SET-P pillars and enablers that will drive the energy transition and decarbonisation agenda in Sarawak.



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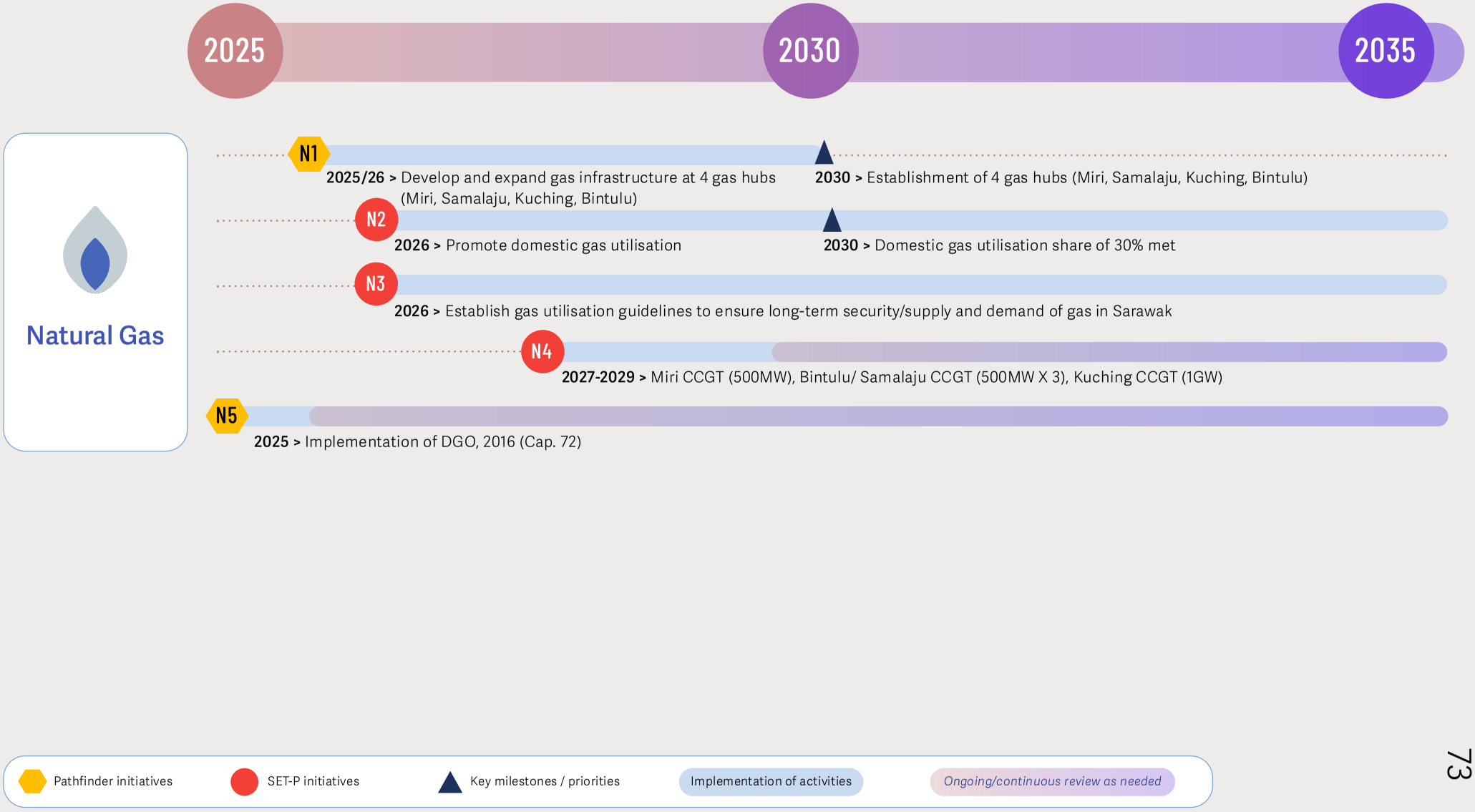

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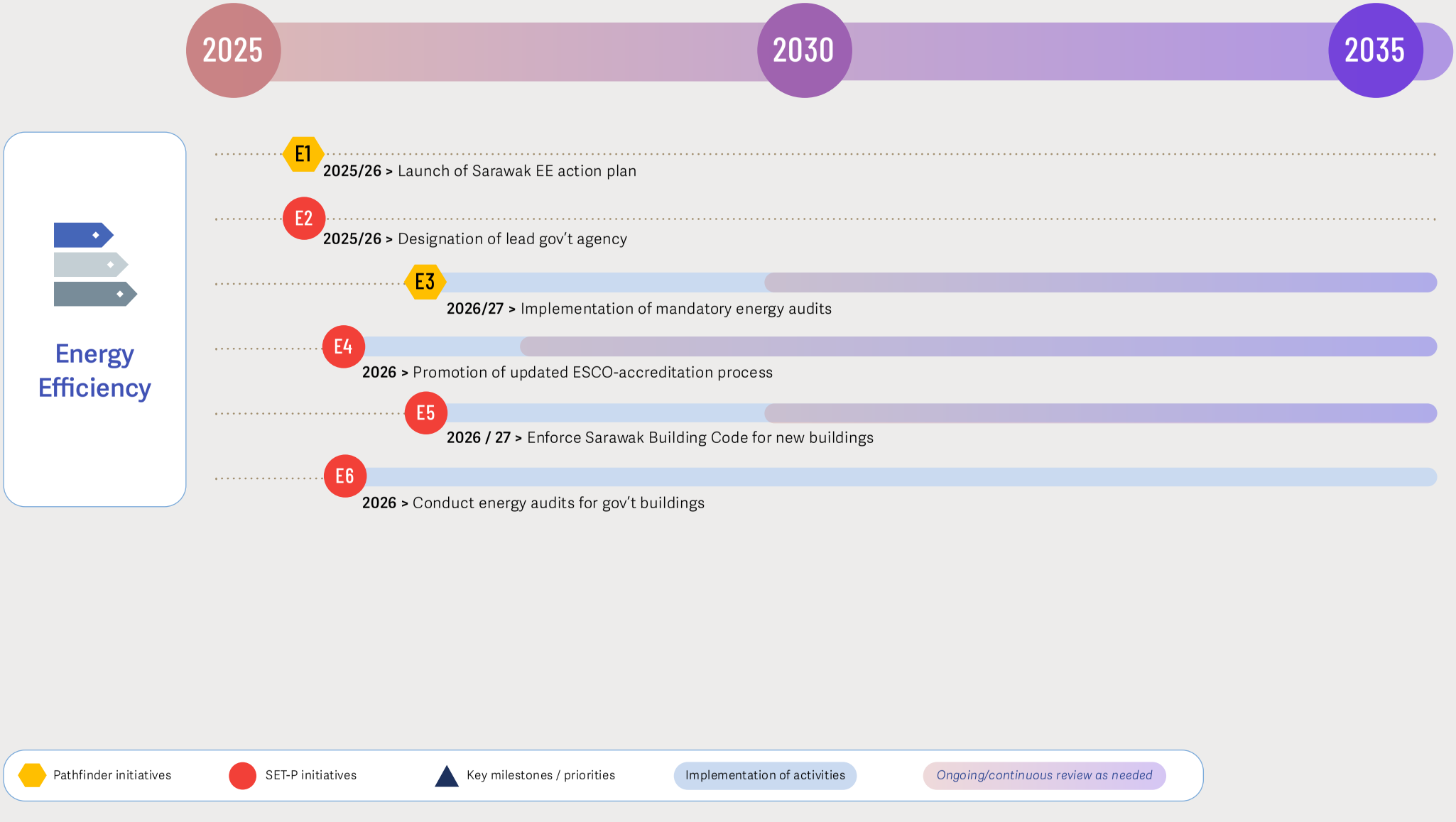

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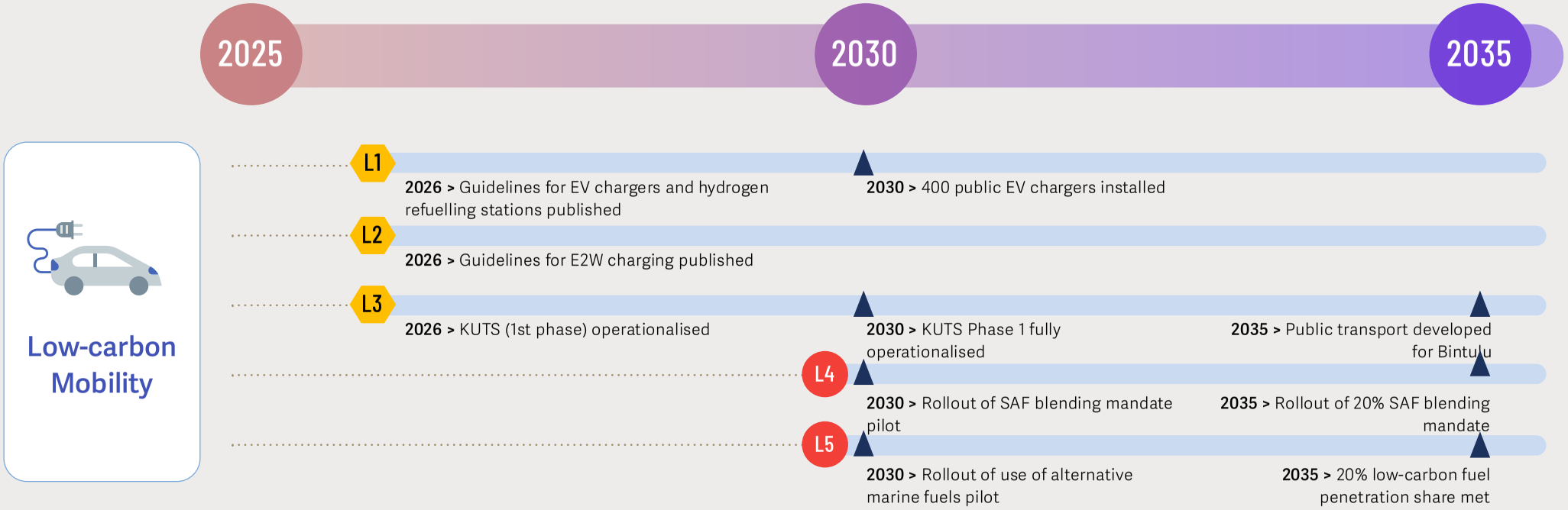

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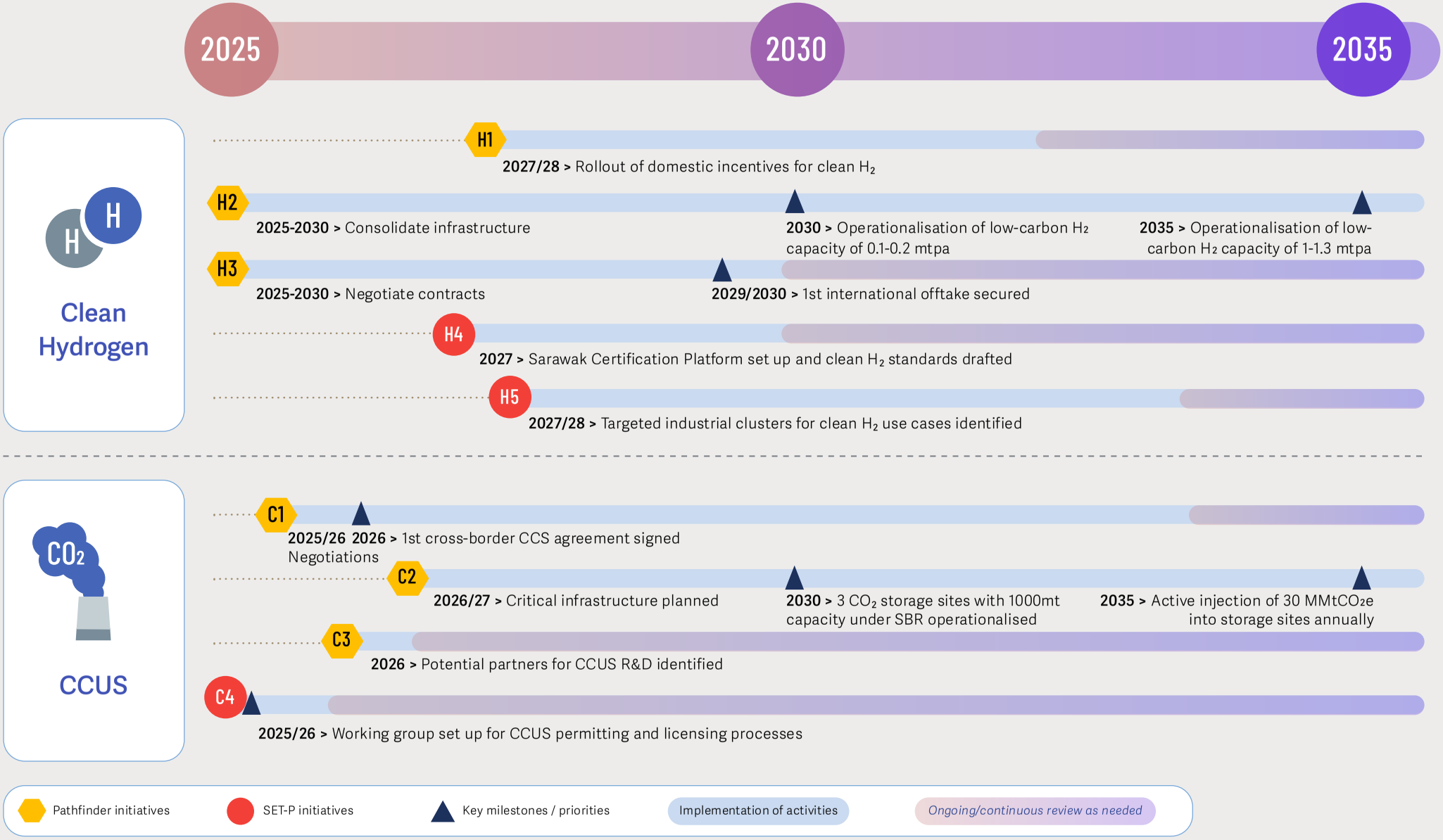

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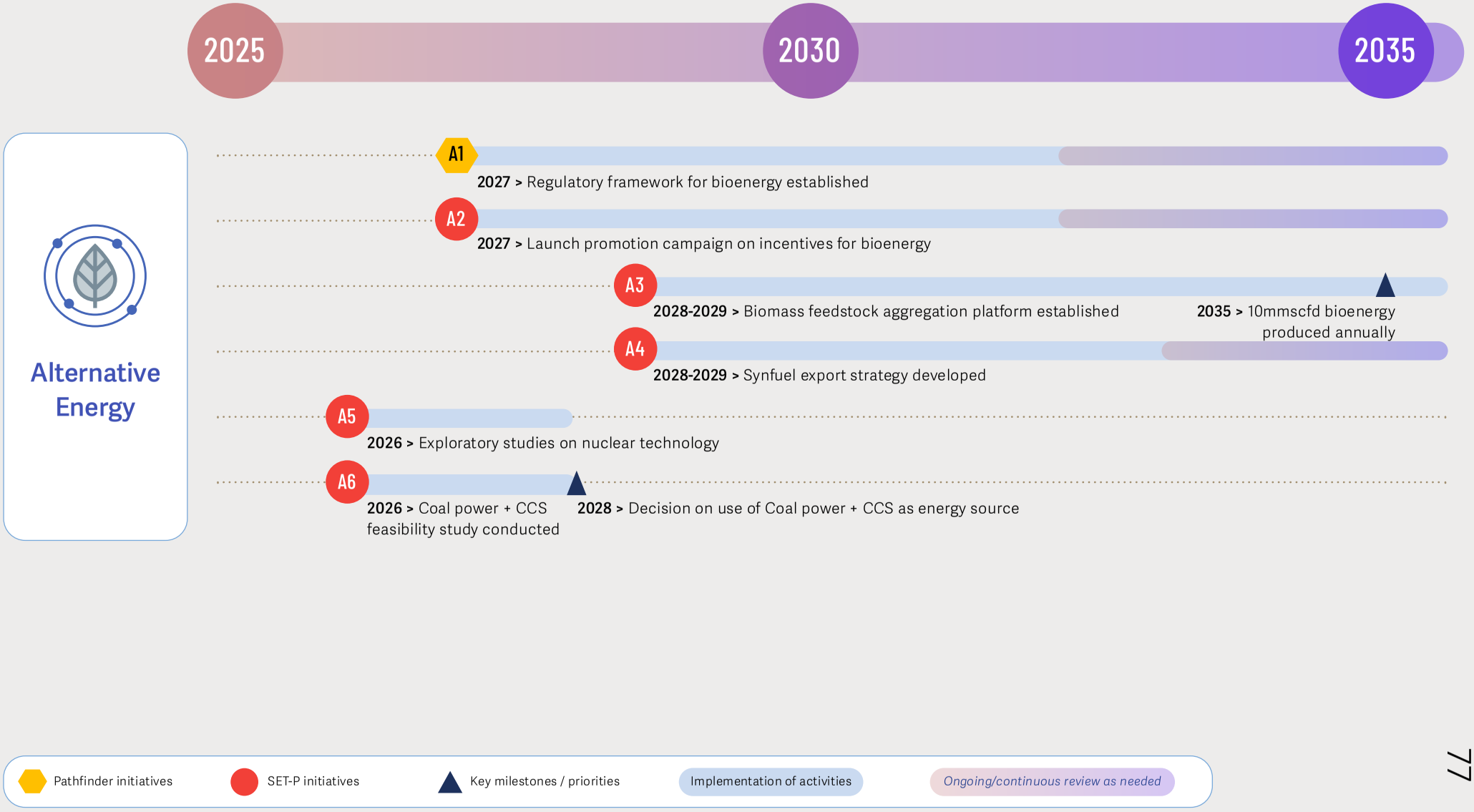

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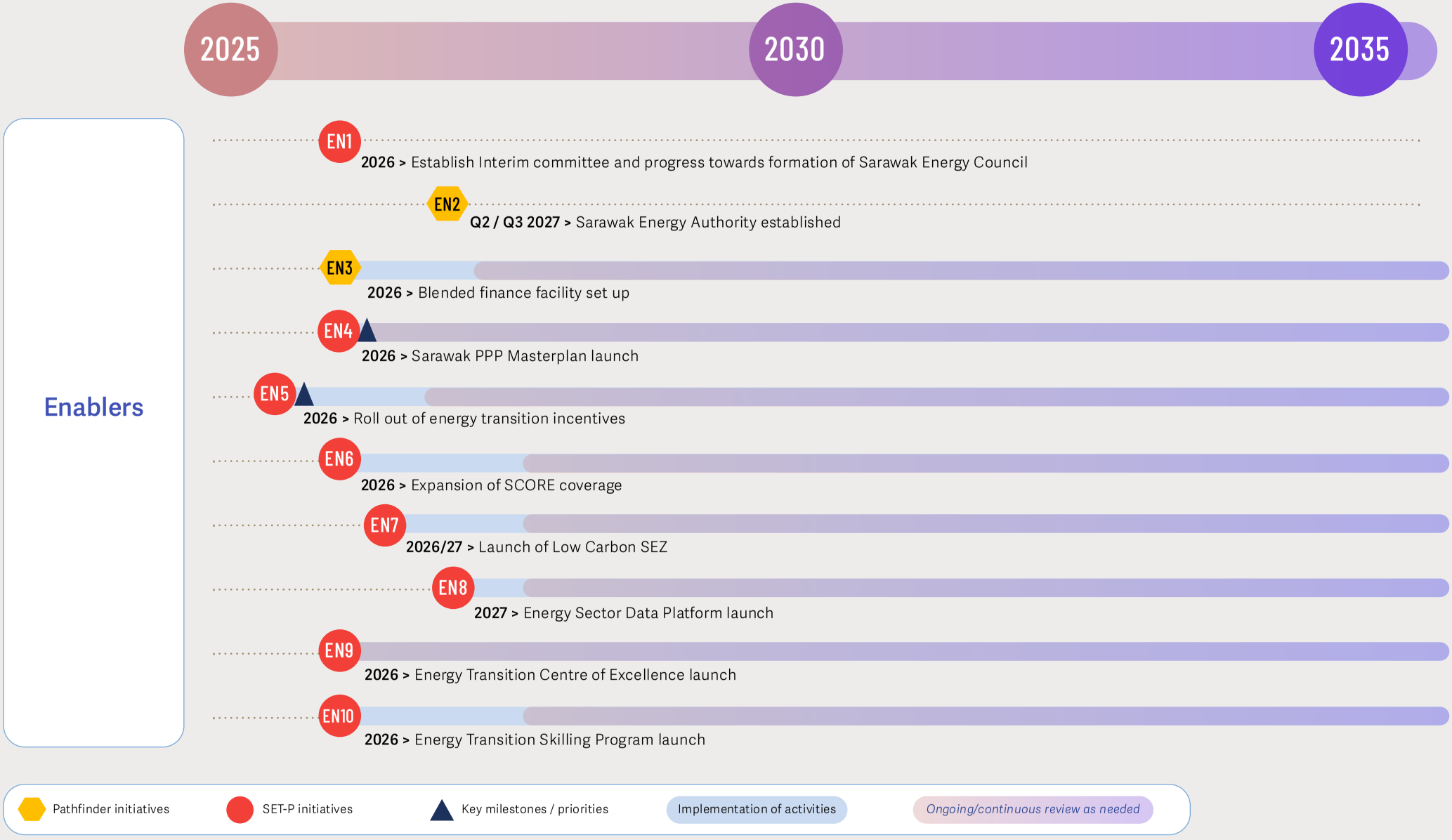

SECTION 07

CONCLUSION

The Sarawak Energy Transition Policy sets forward an ambitious pathway for the state in addressing the intricacies of navigating the energy transition, which is a critical issue that all states and nations will need to address.

Sarawak has plans to transform into a thriving low-carbon economy with new economic growth areas that provide socioeconomic opportunities for the rakyat. This is aligned with Malaysia's national commitment to achieve net-zero GHG emissions as early as 2050, and the federal government's plans for ensuring a just energy transition under the NETR.

Sarawak will prioritise the key energy transition pillars highlighted in the policy framework, which includes improving energy efficiency across customer segments, diversifying renewable energy sources beyond hydropower, expanding domestic natural gas utilisation in Sarawak, decarbonising different transport modes, commercialising and scaling clean hydrogen and CCUS, and exploring alternative energy to ensure the state's long-term energy security. Strengthening energy infrastructure and enabling greater capital flow into Sarawak to maintain its strong progress in the energy transition will also be integral, with energy security remaining a critical issue moving forward.

The SET-P provides a clear signal on the Sarawak Government's vision and ambition in exploring new and diverse energy sources, building future domestic capabilities and jobs, and driving a strong demand for the low-carbon economy. This approach reinforces the state's commitment to a just energy transition that benefits the rakyat, fosters business opportunities, and promotes technological innovation with coordination across the public.

ACKNOWLEDGEMENT

WE EXTEND OUR UTMOST APPRECIATION TO THE RIGHT HONOURABLE PREMIER OF SARAWAK, DATUK PATINGGI TAN SRI (DR) ABANG HAJI ABDUL RAHMAN ZOHARI BIN TUN DATUK ABANG HAJI OPENG, FOR HIS VISIONARY LEADERSHIP AND STRATEGIC GUIDANCE.

His unwavering commitment and invaluable advice have been instrumental in shaping the Sarawak Energy Transition Policy (SET-P) into a comprehensive framework that will drive the state toward a secure, equitable, and low-carbon energy future for Sarawak.

Our sincere gratitude is also extended to the Honourable Deputy Minister of Energy and Environmental Sustainability Sarawak (MEESty), Datuk Dr. Haji Hazland bin Abang Haji Hipni, for his steadfast support, insightful counsel, and significant contributions throughout the development of this transformative policy.

On behalf of MEESty, we wish to extend our deepest appreciation and gratitude to all individuals, departments and agencies that have contributed their expertise, dedication and time to ensure the successful completion of the SET-P.

Our heartfelt thanks go to Petroleum Sarawak Berhad (PETROS) for their financial support, which has been instrumental in facilitating the completion of this important study.

We also express our sincere gratitude to the SET-P Technical Working Group, comprising esteemed members from PETROS, Sarawak Energy Berhad and SEDC Energy Sdn. Bhd., for their unwavering commitment, invaluable insights, and dedicated efforts throughout the policy formulation process.

We acknowledge and deeply appreciate the contributions of all stakeholders, both directly and indirectly involved. Your valuable feedback, constructive inputs, and thoughtful perspective have greatly enriched the SET-P and ensured it reflects the aspirations and needs of Sarawak.

Thank you all for your collective efforts and contributions towards the realisation of this significant milestone.

ABBREVIATIONS

ART	Autonomous Rapid Transit
ASEAN	Association of Southeast Asian Nations
BESS	Battery Energy Storage System
BSS	Battery Swapping Stations
Bn	Billion
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CO2	Carbon Dioxide
EV	Electric Vehicles
E2W	Electric Two-Wheel Vehicles
EE	Energy Efficiency
ESCOs	Energy Services Companies
FDI	Foreign Direct Investments
GW	Gigawatt
GHG	Greenhouse Gas
GDP	Gross Domestic Product
H2	Hydrogen
ICE	Internal Combustion Engine
IPP	Independent Power Producer
ktoe	Kilotonnes Of Oil Equivalent
Ktpa	Kilotonnes Per Annum
KUTS	Kuching Urban Transportation System
kWh	Kilowatt-Hour
LCMB	Low Carbon Mobility Blueprint
LNG	Liquefied Natural Gas
Mtoe	Million Tonnes of Oil Equivalent
Mtpa	Million Tonnes Per Annum
MMscf	Million Standard Cubic Feet
MEESty	Ministry of Energy and Environmental Sustainability Sarawak

NETR	National Energy Transition Roadmap
NEM	Net Energy Metering
NTP	National Transport Policy
OTEC	Ocean Thermal Energy Conversion
PETROS	Petroleum Sarawak Berhad
PCDS 2030	Post COVID-19 Development Strategy 2030
PPP	Public-Private Partnership
REC	Renewable Energy Certificates
R&D	Research and Development
RM	Ringgit Malaysia
ROI	Return on Investment
SPL	Samalaju Pipeline
SIP	Samalaju Industrial Park
SCORE	Sarawak Corridor of Renewable Energy
SET-P	Sarawak Energy Transition Policy
ST	Energy Commission
SGR	Sarawak Gas Roadmap
SMEs	Small to Medium-Sized Enterprises
SMR	Small Modular Reactor
PV	Solar Photovoltaic
SAF	Sustainable Aviation Fuel
SDGs	Sustainable Development Goals
Synfuel	Synthetic Fuel
TJ	Terajoules
TPES	Total Primary Energy Supply
TVET	Technical and Vocational Education and Training
UPS	Uninterruptible Power Supplies
VRE	Variable Renewable Energy
WtE	Waste-to-Energy

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