Sabah Energy Roadmap and Master Plan 2040

Sabah Energy Roadmap and Master Plan 2040 (Sabah Energy RAMP 2040)
Sabah Energy RAMP 2040 is a dynamic and living document and will be periodically reviewed every 3 years to reflect and incorporate latest data, progress and strategies, towards continuously ensuring optimal benefits to the State of Sabah

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Foreword by Chief Minister of Sabah

Salam Malaysia Madani dan Sabah Maju Jaya

The energy sector has been a critical engine of growth for Sabah's economy over the past decades, contributing significantly to the State's economy. It has been a major source of fiscal income for Sabah whilst creating skilled jobs as well as playing an integral part in the State's trade activities within the region.

It is my aspiration to see Sabah's energy sector continuing to grow whilst contributing to positive social outcomes to uplift the quality of life of all Sabahans. Under my leadership, the State Government will continue to develop the necessary infrastructure related to the energy sector. We have been steadfast in our pursuit to take control and manage the State's energy resources towards empowering Sabah to develop and continuously grow the energy sector more effectively and efficiently.

Moving forward, the energy sector will continue to play a critical role in the development of Sabah's future economy. With the development of Sabah Energy Roadmap and Master Plan 2040 (Sabah Energy RAMP 2040), I am positive that it will help the State to strategically chart the way forward and outline key priorities for the energy sector in Sabah. The implementation of Sabah Energy RAMP 2040 will require full support and cooperation from various stakeholders in both public and private sectors. The State Government looks forward to the continued cooperation and support of all stakeholders in driving Sabah towards a greener and more sustainable future.

It is my aspiration to see Sabah's energy sector continuing to grow whilst contributing to positive social outcomes to uplift the quality of life of all Sabahans

YAB Datuk Seri Panglima Haji Hajiji Haji Noor
Chief Minister of Sabah

Foreword by Chairman of Energy Commission of Sabah

> ***Sabah Energy RAMP 2040 is the first holistic State plan which outlines Sabah's concerted effort in addressing its near-term needs while building future resilience of the energy industry***

The post pandemic era presents an opportunity for Sabah to reset its strategic direction and priorities in the energy industry through the development of the Sabah Energy Roadmap and Master Plan 2040 (Sabah Energy RAMP 2040). The Master Plan provides actionable strategic directions to help Sabah realise its overarching vision towards achieving reliable, accessible, affordable and sustainable energy for the State by 2040.

Sabah Energy RAMP 2040 is the first holistic State plan which outlines Sabah's concerted effort in addressing its near-term needs while building future resilience of the energy industry. It also aims to provide an overview of Sabah's key challenges that loom in its energy industry whilst laying out the plans and initiatives to address such issues. Over the next few years, the energy industry development in Sabah will be closely guided by the Master Plan which outlines various strategies in ensuring energy security, affordability (and accessibility) and achieving environmental sustainability in Sabah.

Moving forward, careful implementation is key for Sabah to achieve the set vision. As the State's regulator for the energy sector, the Energy Commission of Sabah (ECoS) stands ready to give total commitment in facilitating the execution of the strategies developed in the Master Plan for the benefit of the consumers and businesses.

The Master Plan was developed through extensive collaboration between numerous ministries and agencies, private sector industry associations, energy sector players and field experts. My deepest appreciation to all who have been involved in the process of developing the document.

Datuk Seri Panglima Dr. Maximus Johnity Ongkili, JP
Chairman of Energy Commission of Sabah

Preface by CEO of Energy Commission of Sabah

> ***High performing regulators play a key role in achieving good and orderly outcomes for the industry and consumers***

Through the years, the growing energy demand in Sabah calls for greater forethought in charting the way forward to balance the issues surrounding energy security, affordability, and environmental sustainability. As Sabah navigates the extraordinarily uncertain times ahead, it is crucial to ensure the energy sector will continue to serve the State's economy from a position of strength.

The energy trilemma dimensions will continue to be utilised in energy planning especially in the implementation of policies and plans as targeted by the State Government. The introduction of Sabah Energy Roadmap and Master Plan 2040 (Sabah Energy RAMP 2040) underscores the State Government's commitments towards green energy transition in Sabah. Sabah Energy RAMP 2040 outlines key priorities in spearheading a pragmatic move towards a cleaner energy mix by leveraging Sabah's abundant renewable energy sources whilst encouraging the development, commercialisation and adoption of green technologies.

In efforts to ensure continuous development of energy sector in Sabah, high performing regulators play a key role in achieving good and orderly outcomes for the industry and consumers. It is critical that regulatory policies are supported by a good governance framework. The recent transfer of energy sector regulatory power from the Federal Government to the State Government marks a significant move that empowers the State to perform its own regulatory functions. The establishment of Energy Commission of Sabah (ECoS) will safeguard the interests of consumers and energy providers in Sabah whilst continuing the State's efforts in balancing the energy trilemma dimensions.

I would like to express my heartfelt gratitude to all who worked to grapple with the big questions explored whilst developing the document. Special thanks goes to those from outside of ECoS, whose suggestions and insights have been crucial in formulating the Master Plan.

Datuk Ir. Abdul Nasser Bin Abdul Wahid
Chief Executive Officer of Energy Commission of Sabah

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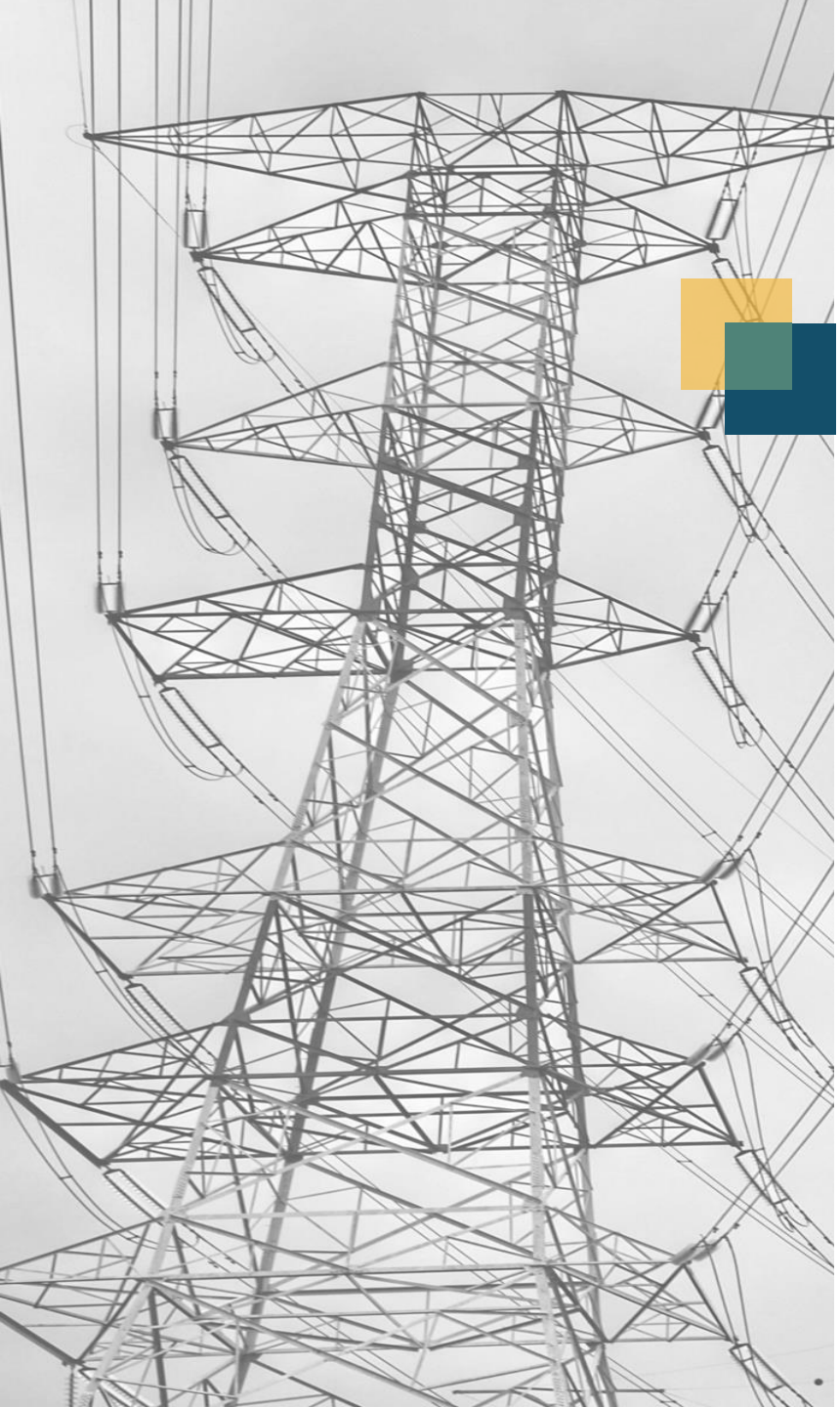
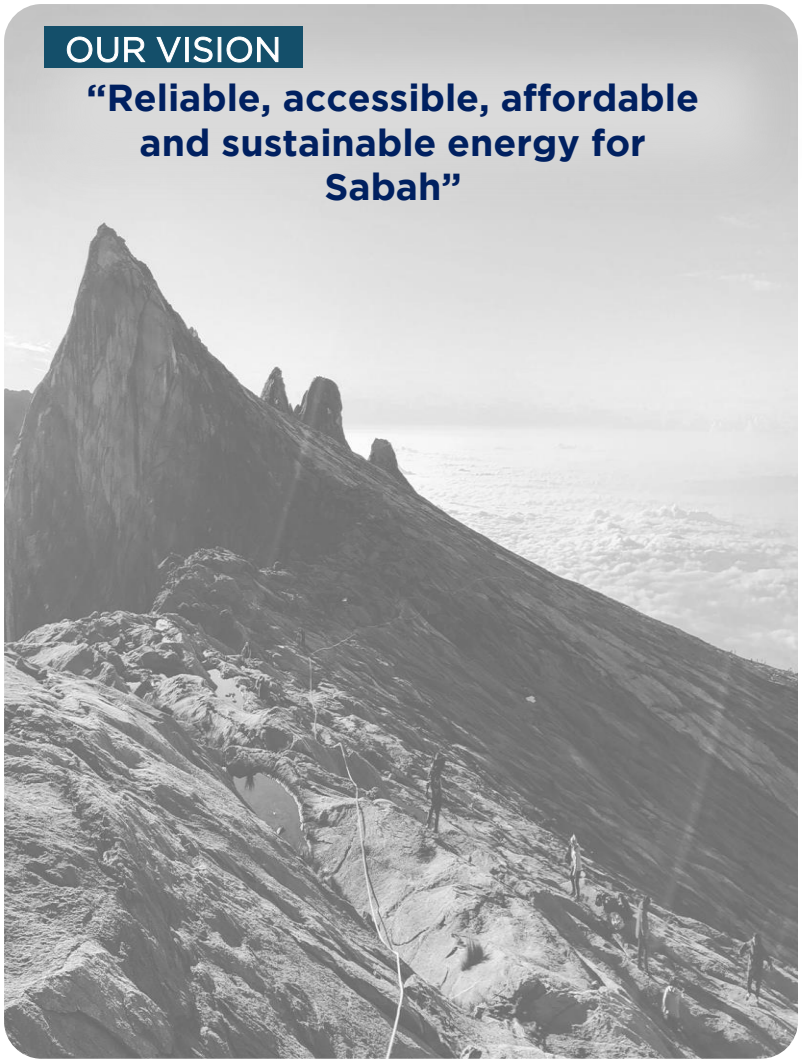


01

Executive Summary

Executive Summary



The energy sector is a pivotal ingredient for economic development of Sabah. The sector, specifically, the natural gas, has been a major source of fiscal income for the State whilst creating skilled job opportunities for the people, driving Sabah's socioeconomic development over the years.

However, the energy sector is currently hindered by various challenges and barriers arising mainly from high System Average Interruption Duration Index (SAIDI) levels,[1] heavy reliance on fossil fuels and subsidy for electricity tariff as well as insufficient infrastructure to expand the energy accessibility. Significant work and planning needs to be carried out to overcome these challenges to ensure the key aspects of the energy sector development are in place.

Sabah Energy Roadmap and Master Plan 2040 (Sabah Energy RAMP 2040) has been developed following extensive consultation to address the key challenges that encircle Sabah's energy sector. By hinging upon the energy trilemma dimensions, the Master Plan aims to strengthen Sabah's energy security, enhance energy accessibility and affordability as well as to advance Sabah's progress towards environmental sustainability.

Given the importance of the energy sector to Sabah's economy, it is crucial that the energy sector remains future-proof to domestic and global developments. Through Sabah Energy RAMP 2040, Sabah has set 7 key targets that the State aims to achieve which include improving the State's SAIDI level, enhancing energy mix diversification, achieving 100% rural electrification, realising subsidy rationalisation plan, increasing share of renewable energy in the generation mix as well as achieving low carbon aspiration and carbon neutrality by 2050.

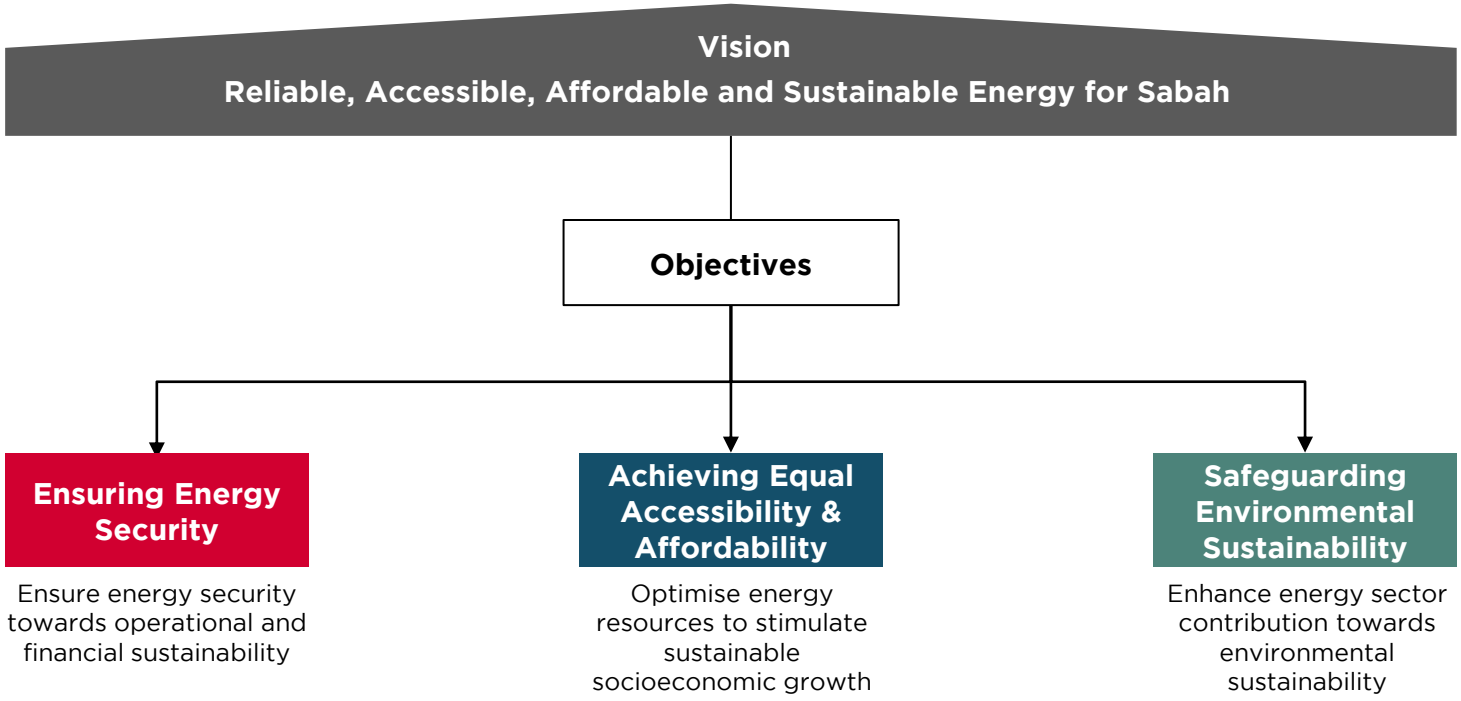
The Master Plan has outlined 16 key strategies in spearheading a pragmatic move in supporting the State's commitment towards achieving the key targets. Realisation of these key targets are crucial for Sabah to ensure its continuous economic development in the long run.

Note: [1] System Average Interruption Duration Index (SAIDI) represents the average electricity interruption in minutes experienced by customers in a year that excludes unforeseeable circumstances such as extreme weather

Sabah Energy RAMP 2040: Vision and Key Objectives

Propelling Economic Growth in Sabah through Reliable, Accessible, Affordable and Sustainable Energy Sector

Looking ahead at key challenges in the energy sector, Sabah Energy Roadmap and Master Plan 2040 is developed as a guiding document to steer the domestic energy sector forward. The Master Plan crystalises the State's forward-looking aspiration, key objectives, strategic thrusts, key strategies, enablers and key targets to support Sabah's long term economic agenda



16 key strategies have been identified in striking the right balance in Sabah's energy trilemma

1 Energy Security	2 Equal Accessibility and Affordability	3 Environmental Sustainability
Action To develop comprehensive plans for Sabah to build its capacity to meet current and future energy demand	**Action** To bolster the State's ability to provide universal access to affordable and fairly priced energy for domestic, commercial and industrial use	**Action** To prepare Sabah towards an energy transition phase to mitigate and avoid potential environmental harm and climate change impacts
7 Key Strategies	**5 Key Strategies**	**4 Key Strategies**

Sabah Energy RAMP 2040 Vision, Strategic Thrusts, Key Objectives, Strategies and Enablers

Vision

Reliable, Accessible, Affordable and Sustainable Energy for Sabah

3 Strategic Thrusts

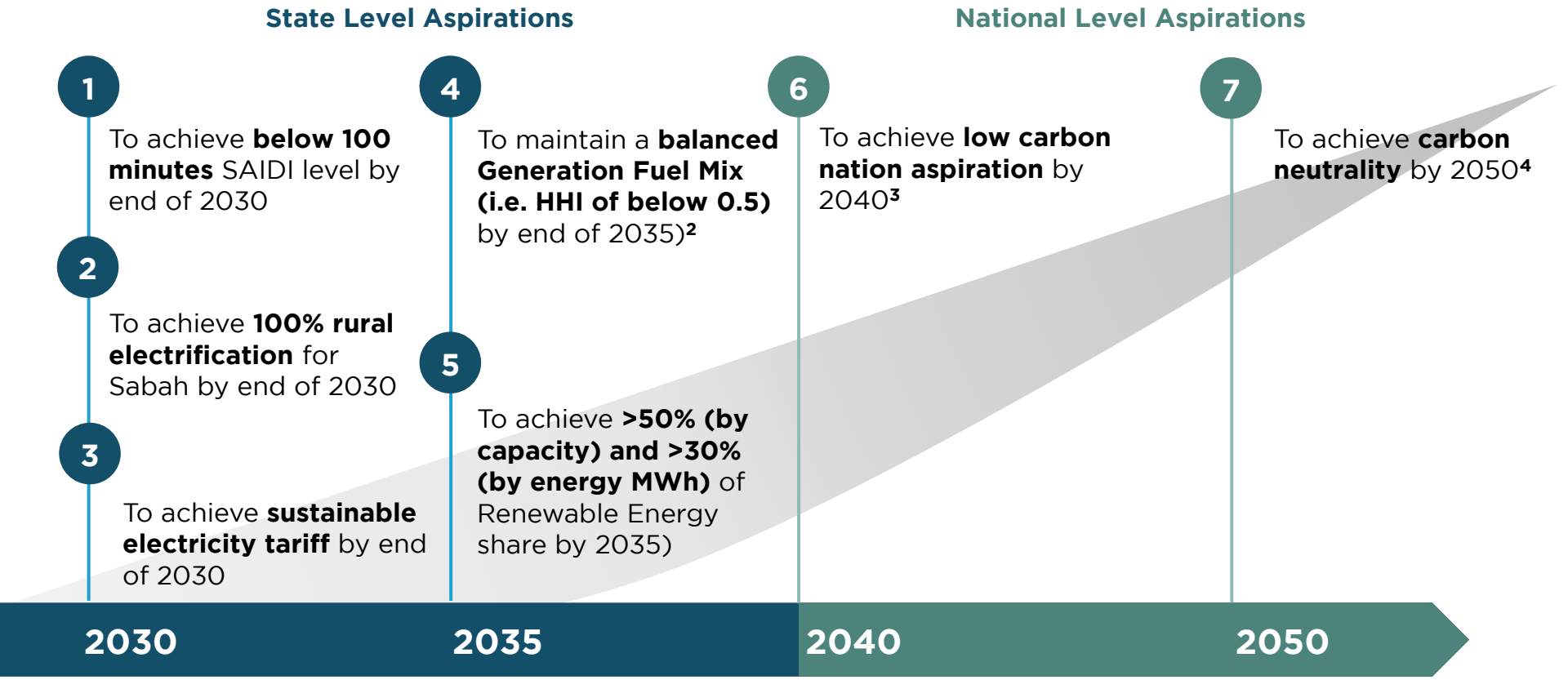
1 Energy Security	2 Equal Accessibility & Affordability	3 Environmental Sustainability
3 Key Objectives		
Ensure energy security towards operational and financial sustainability	**Optimise energy resources to stimulate sustainable socioeconomic growth**	**Enhance energy sector contribution towards environmental sustainability**
16 Strategies		
7 Strategies	**5 Strategies**	**4 Strategies**
A1 Achieve Operational Sustainability	B1 Implement Generation Optimisation Plan	C1 Increase Renewables Contribution to Sabah Generation Mix
A2 Establish State Policy for Indigenous Energy Resources	B2 Progress towards Effective Energy Tariff	C2 Expand Use of Bio-energy
A3 Improve Generation Reserve Margin	B3 Implement Energy Subsidies Rationalisation Plan	C3 Establish Sabah Energy Efficiency Action Plan (SEEAP)
A4 Improve Generation Energy Mix	B4 Achieve 100% Rural Electrification	C4 Transition Sabah towards a Carbon Neutral State
A5 Develop Integrated Gas Master Plan	B5 Optimise Hydropower Potential	
A6 Establish Resilient Cross-border Interconnectivity		
A7 Identify New Energy Sources and Technologies		

6 Enablers

Enablers					
Policy & Regulation	Governance	Human Capital & Capabilities	Research, Development & Technology	Financing & Investment	Energy Supply Industry Structural & Operational Reform

Sabah Energy RAMP 2040 Targets

Through the Master Plan, Sabah has laid out **seven** specific targets to be achieved within the medium to long term



Note: [2] The Herfindhal-Hirschman Index (HHI) score measures the diversity of generation mix by fuel types whereby the lower the score, the higher the fuel diversification and energy security
[3] Target is in-line with national commitment to becoming low carbon nation by 2040 as specified in Dasar Tenaga Negara (DTN) 2022-2040
[4] Target is in-line with national commitment to becoming carbon-neutral by 2050

Sabah Energy RAMP 2040 takes reference from key National and State long term plans

The Sabah Energy Roadmap & Masterplan 2040 emulates the key vision and agenda of national and state-level strategic policy documents

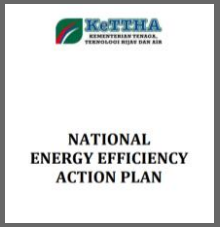
Hala Tuju Sabah Maju Jaya

Rancangan Malaysia

Wawasan Kemakmuran Bersama 2030 (WBK 2030)

Malaysia Renewable Energy Roadmap (MYRER)

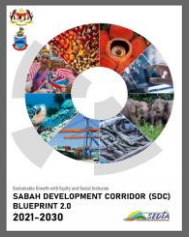
Sabah Gas Masterplan



National Energy Efficiency Action Plan 2016-2025

Dasar Tenaga Negara (DTN) 2022 - 2040

Green Technology Masterplan 2030



Sabah Development Corridor (SDC) Blueprint 2.0 2021-2030

02

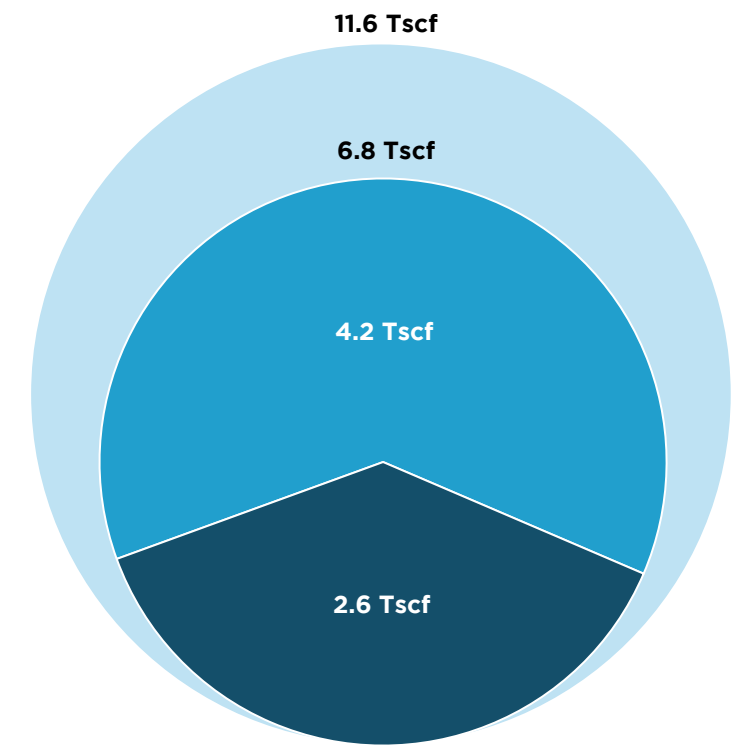
Overview: Domestic Energy Landscape

Gas Sector Overview

Sabah has over 11.6 Tscf of gas reserve as of 2019 with high potential for monetisation and power generation purpose

Sabah Gas Reserve and Monetisation Potential, 2019

Tscf

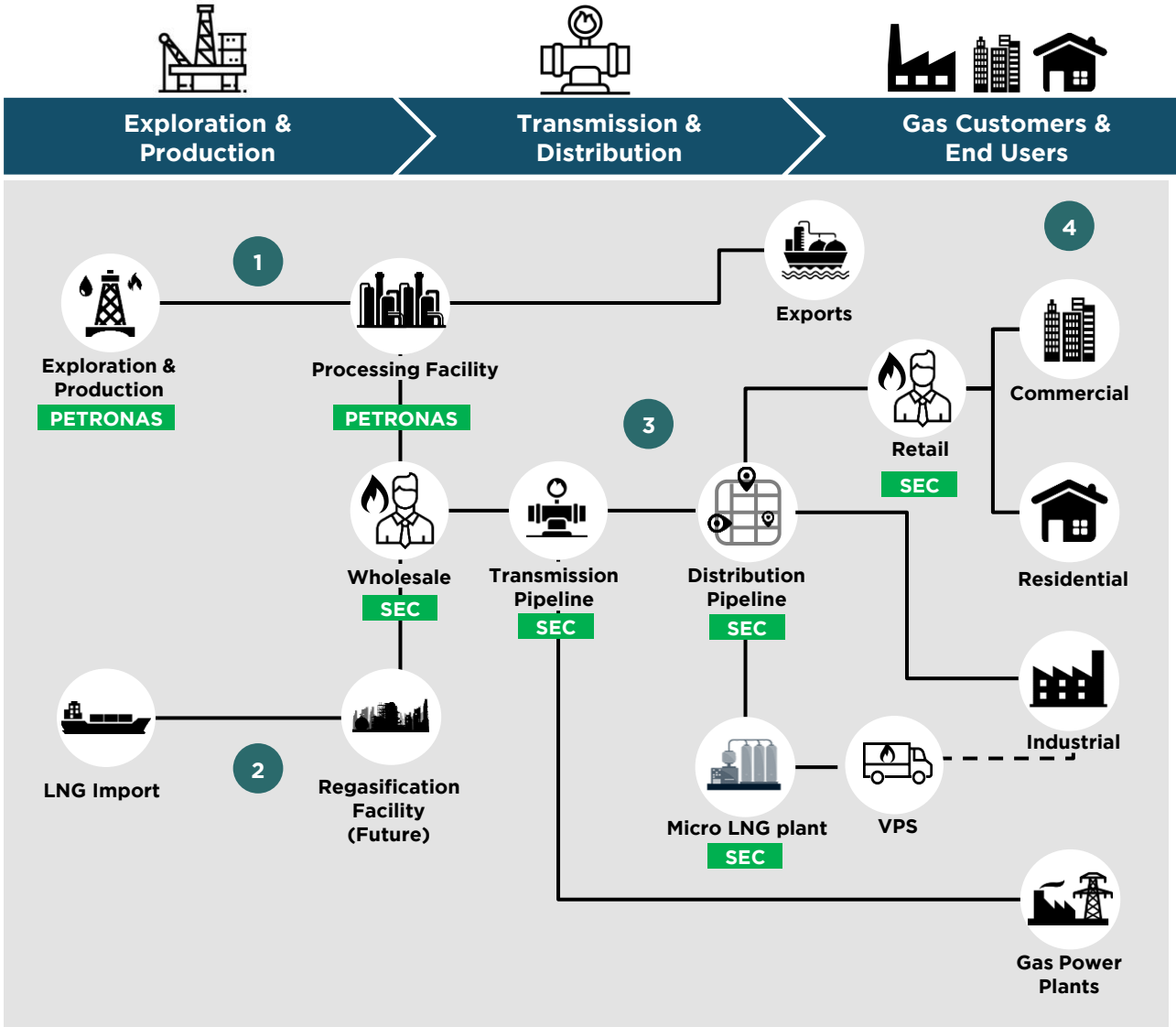


Key Highlights

- Sabah is one of the largest gas producing states in Malaysia, contributing approximately 8% of the national total gas production in 2018
- As of 2019, Sabah has over 11.67 Tscf of natural gas reserve in the State which represents roughly 15% of the national natural gas reserve
- The indigenous gas resources in Sabah are considered lean gas, which contain high concentration of methane (90%). The chemical characteristic of the gas makes it suitable for power generation and production of methane-chain petrochemicals such as methanol, urea and ammonia derivatives
- Based on Sabah Gas Masterplan, PETRONAS has identified 6.8 Tscf of gas in the West Coast of Sabah potentially available for monetisation from 2020 to 2040, subject to technical and commercial viability
- Of the 6.8 Tscf of gas identified, 62% or 4.2 Tscf of gas is committed for existing power generation and petrochemical plants across Sabah, while 2.6 Tscf is available for new industries and power plants

Source: Sabah Gas Masterplan, Suruhanjaya Tenaga

Sabah's natural gas supply value chain covers the whole process of gas supply delivery



1. Exploration & production is the segment of gas industry that involves finding gas reserves, extracting gas resources and channeling to onshore receiving terminal/processing facility

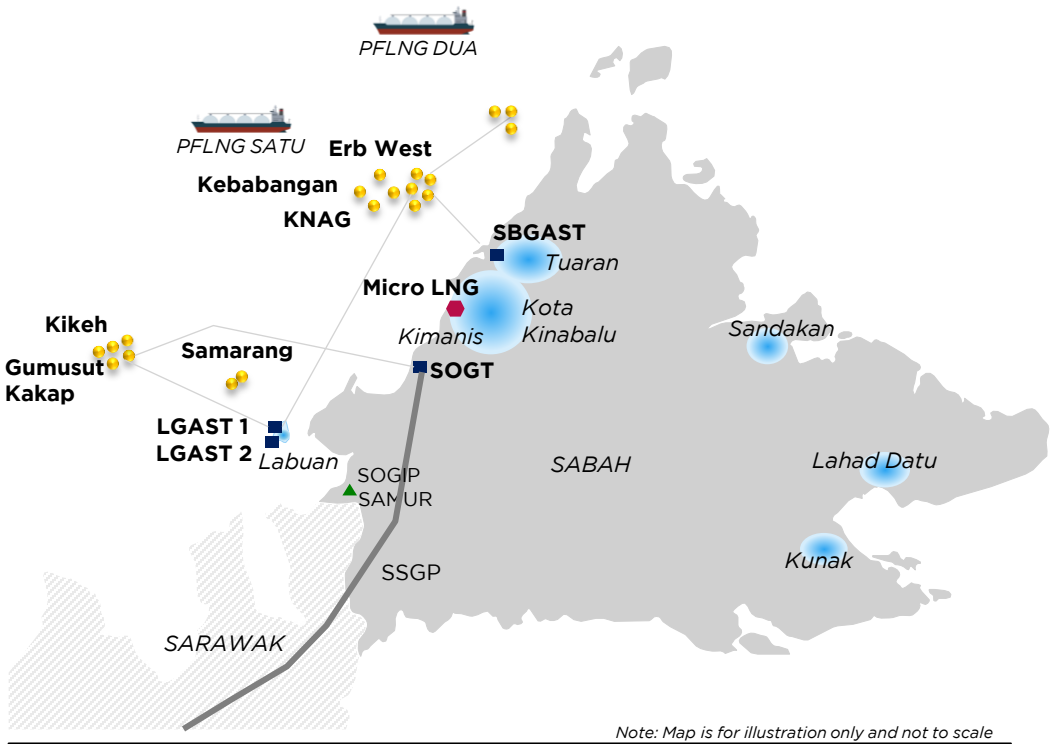
2. Imported liquefied natural gas (LNG) goes through the regasification process to be used as fuel for energy. *These processes and infrastructures are not currently available in Sabah*

3. Natural gas transmission and distribution pipeline systems transport and distribute gas to the end users of gas, e.g. power plants, industrial, commercial and residential users

4. Gas customers and gas end users can be segmented into four main categories which are power, industrial, commercial and virtual pipeline system (VPS) customers as well as residential

Source: PETRONAS, Sabah Energy Corporation (SEC)

Overview of gas supply in Sabah



Note: Map is for illustration only and not to scale

Legend

- LNG Processing Plant
- Gas Terminal
- Petrochemical Plant
- Gas Fields
- Sabah Sarawak Gas Pipeline (SSGP)
- Distribution network area under piped gas or virtual pipeline system (VPS)

Sabah Gas Infrastructure Overview (2021)

- 19 gas fields
- 5 main offshore delivery systems
- 4 onshore gas terminals:
  1. Sabah Gas Terminal (SBGAST) in Tuaran
  2. Sabah Oil and Gas Terminal (SOGT) in Kimanis
  3. Labuan Gas Terminal 1 (LGAST 1) in Labuan
  4. Labuan Gas Terminal 2 (LGAST 2) in Labuan
- 2 LNG Floaters
- Sabah-Sarawak Gas Pipeline (connecting SOGT to MLNG in Bintulu)

- Gas distribution pipelines for the area of Kinabalu Industrial Park (KKIP) and Ranca-Ranca Industrial Park, Labuan
- Micro LNG Plant in Kota Kinabalu
- Virtual pipeline system VPS-CNG for current supply area of 70km radius
- Virtual pipeline system VPS-LNG for the area of Sandakan, Lahad Datu, Kunak

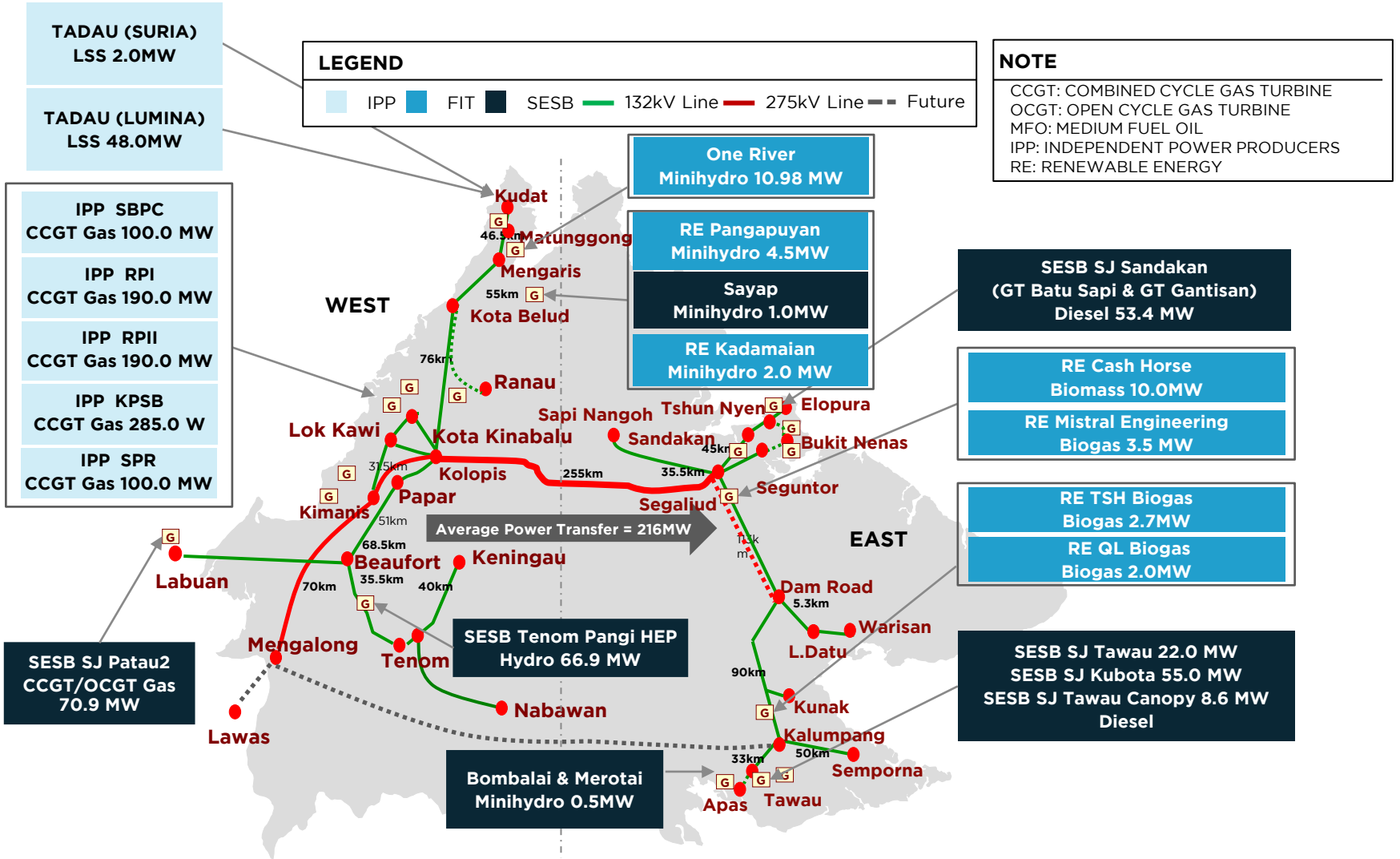
Sabah Gas Supply & Demand, mmscfd (2021)

Supply	Demand	
784	416	Domestic (53%) (Includes F.T. Labuan)
	368	LNG export (47%)

Note: KNAG: Kinabalu Non-Associated Gas project comprising 2 fields ie. Kinabalu East and Kinabalu West
Source: PETRONAS, Suruhanjaya Tenaga, Sabah Energy Corporation (SEC)

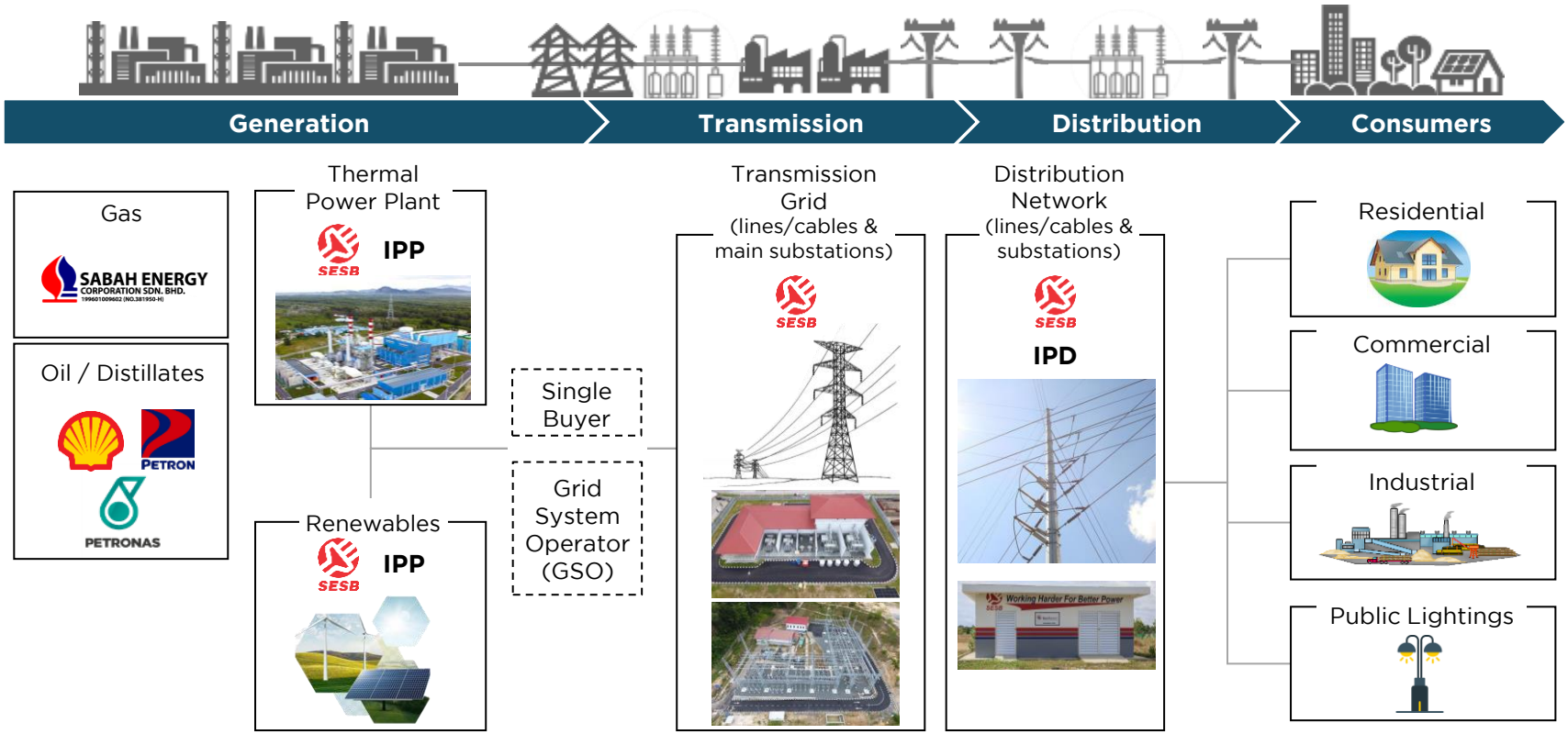
Electricity Sector Overview

The State currently has a dependable capacity for electricity of approximately 1,180 MW[5] as of 2021



Note: [5] Inclusive of Federal Territory of Labuan, Dependable Capacity excludes LSS Tadau 50MW due to intermittency
Libaran (30MW), TSH Biomass (10MW), Serudong (33MW) are not included as they were only recommissioned in 2022
Source: Sabah Electricity Sdn Bhd (SESB)

The electricity supply industry in Sabah consists of overall system, from Generation, Transmission and Distribution

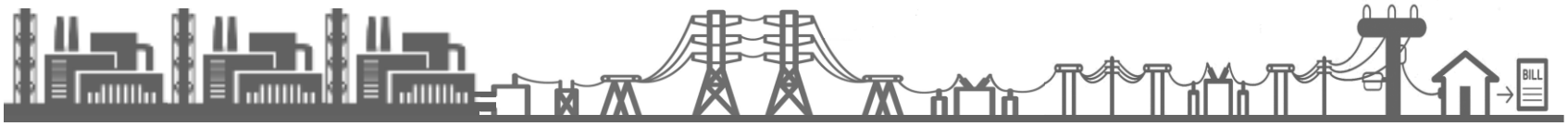


- Sabah Electricity Sdn. Bhd. (SESB) is the Vertical Integrated Utility (VIU) company for Sabah and Labuan, covering the whole value chain of generation, transmission and distribution
- In the early 1990s, the Federal Government introduced Independent Power Producers (IPPs) as a policy to liberalise the electricity sector in Malaysia and this was applied to Sabah, to lessen the financial burden of the government in capital heavy investments

Note: Independent Power Distributors (IPDs) purchase bulk electricity from SESB and distribute, sell to consumers within their licensed areas. Apart from grid connected system, there are off grid installations in remote areas which generate and distribute electricity for their own use

Source: Sabah Electricity Supply Industry Outlook 2019

Generation is the first step in the electricity supply chain where electrical power is generated from various sources before being transmitted through the transmission system



GENERATION	TRANSMISSION	DISTRIBUTION
The process of generating electric power from sources of primary energy	The bulk movement of electrical power from a generating site, such as a power plant, to an electrical substation	The final stage in the delivery of electric power, receiving power from the transmission system and distributing it to individual consumers

GAS POWER PLANT	DIESEL POWER PLANT	RENEWABLE ENERGY
79.3%	**11.8%**	**8.9%**
935.9 MW	**139 MW**	**104.6 MW**

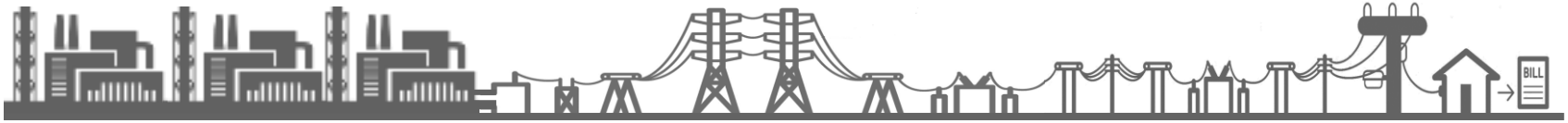
The transmission system transports power at high voltage to main intake substations where the power is transformed to distribution voltage for distribution

GENERATION	TRANSMISSION	DISTRIBUTION
The process of generating electric power from sources of primary energy	**The bulk movement of electrical power from a generating site, such as a power plant, to an electrical substation**	The final stage in the delivery of electric power, receiving power from the transmission system and distributing it to individual consumers

TRANSMISSION LINES	SUBSTATIONS[6]	TRANSFORMERS
3,154	**49**	**108**
Circuit kilometers	Substations	Transformers

Note: [6] Substations include *Pencawang Masuk Utama* (PMU) and Main Switching Substation (MSS)
Source: Sabah Electricity Sdn Bhd (SESB)

Distribution is the last mile of the electricity value chain which connects to the consumers



GENERATION	TRANSMISSION	DISTRIBUTION
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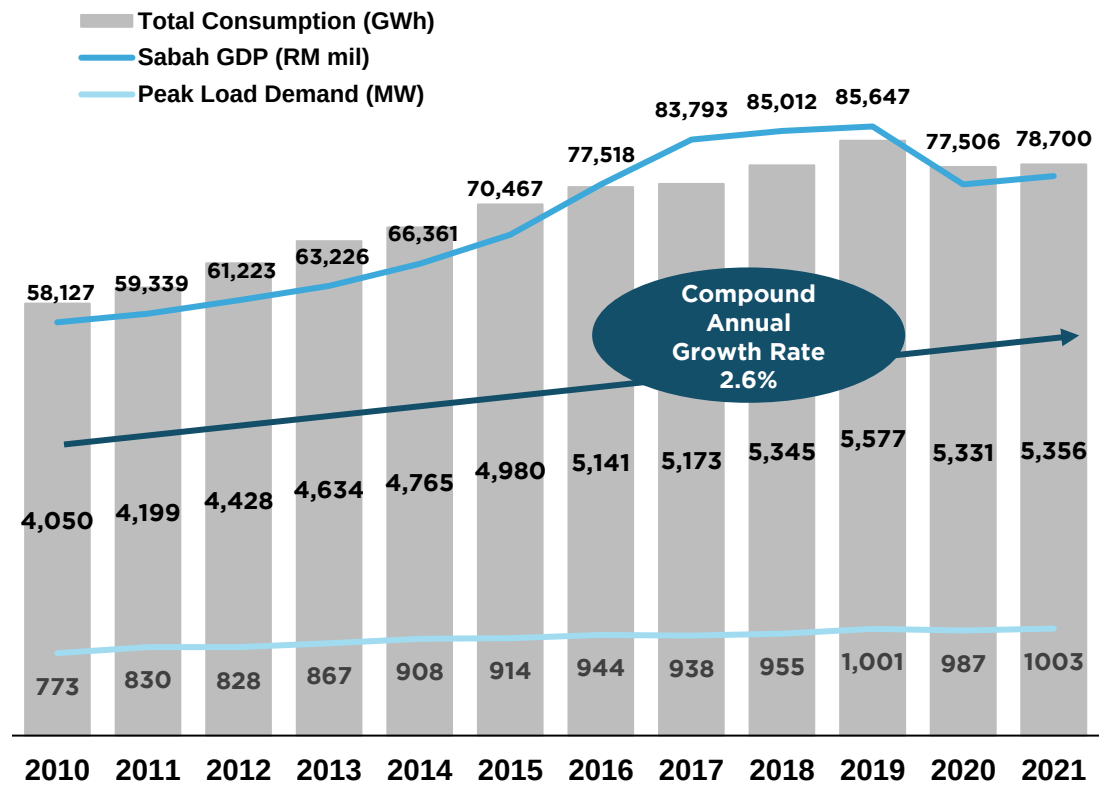
OVERHEAD LINE	UNDERGROUND CABLE	SUBSTATIONS[7]	TRANSFORMERS
23,426 km Overhead Line	**1,697 km** Underground Cable	**8,676** Substations	**8,518** Transformers

Note: [7] Substations include *Pencawang Pembahagian Utama* (PPU), *Stesen Suis Utama* (SSU), and *Pencawang Pembahagian/Pencawang Elektrik* (PP/PE). Transformers are installed in both PPU and PP/PE whilst SSU only comprises of switchgears

Source: Sabah Electricity Sdn Bhd (SESB)

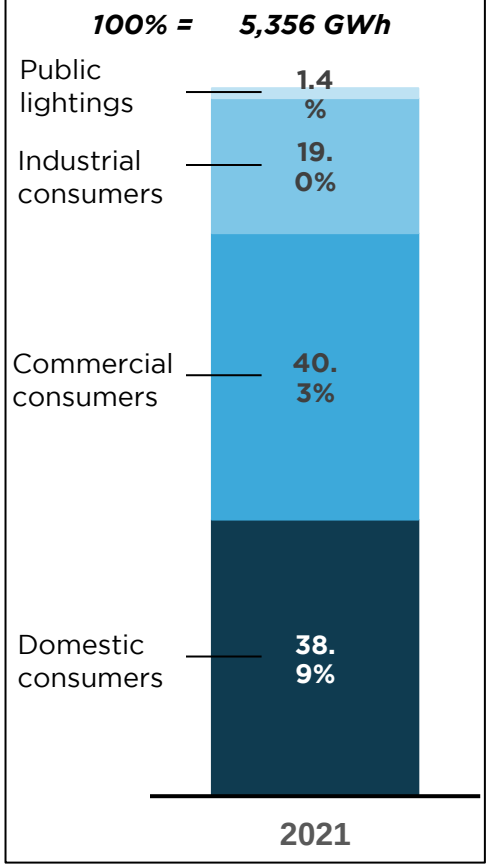
As the economy continues to grow, Sabah has witnessed a steady increase in its peak demand and electricity consumption within the State

Sabah's Electricity Total Consumption, Peak Load Demand & GDP, 2010-2021
GWh, MW, RM mil



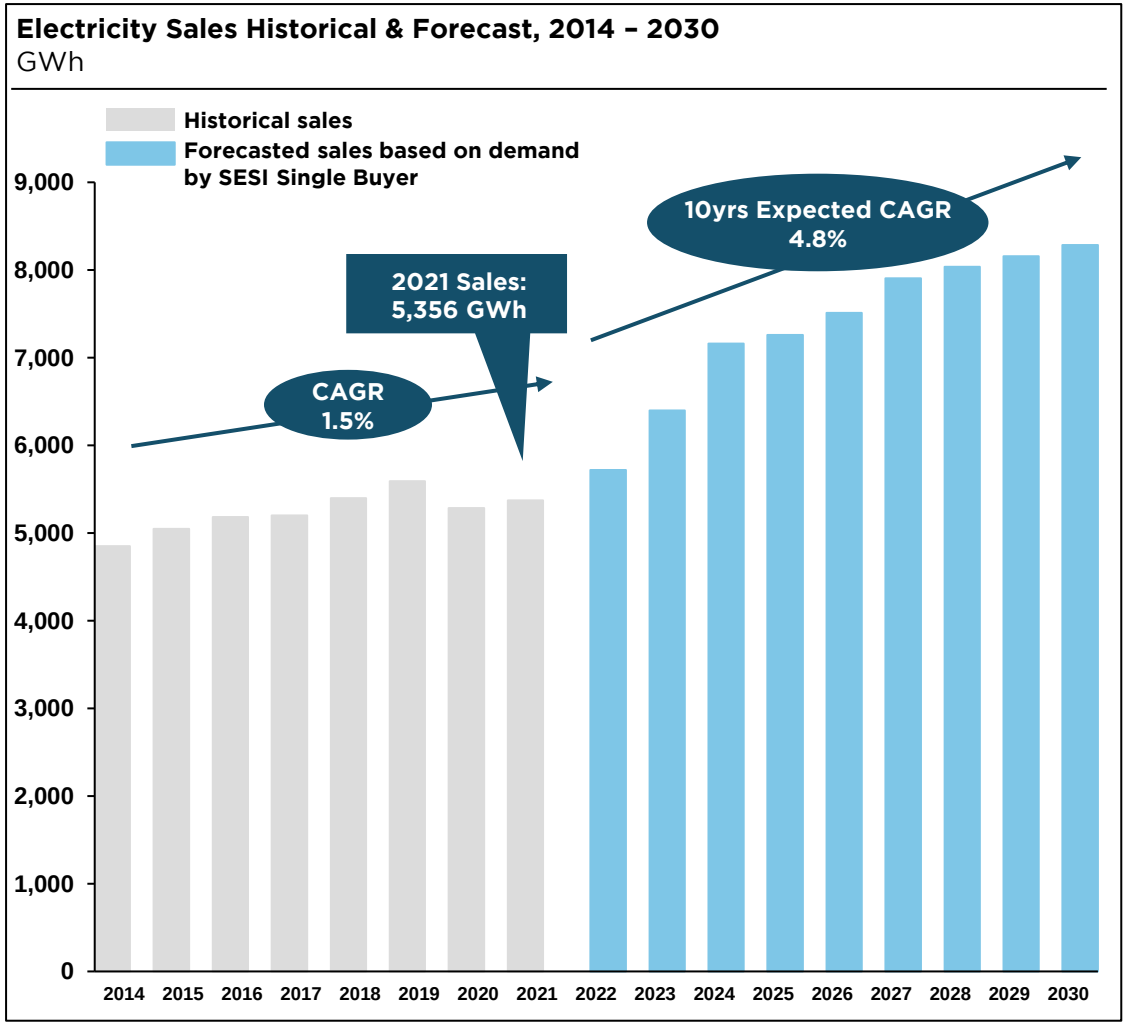
1,003 MW peak load demand is the highest ever recorded for Sabah

Breakdown of Electricity Demand By Sector, 2021



Note: The negative growth post 2019 was due to the Covid 19 pandemic
Source: Sabah Electricity Sdn Bhd (SESB)

With the expected five fold growth in the industrial sector by 2030, demand for electricity in Sabah will continue to increase at a CAGR of approximately 5% in the next 10 years



Key Driving Factors

Economic Growth
Sabah's economy is projected to grow, driven by the services sector, which contributes an estimated 40% of state economy

Industrial Sector
Sabah State Government is committed to develop the industrial sector with the aim of GDP contribution of 35% in 2030 from 7.6% in 2019. The high increase in forecast for 2023 and 2024 are due to new step loads of big foreign investors coming into the State

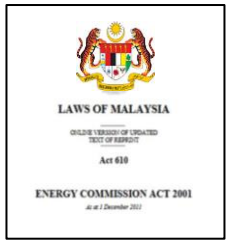
Tourism Industry
Tourism is Sabah's key industry and is expected to recover (post-pandemic) and increase in the future

Increasing Population
Sabah's population is expected to increase by 39% in 2030 (3.4 million in 2022 to 4.7 million in 2030)

Note: CAGR – Compound Annual Growth Rate
Source: Hala Tuju Sabah Maju Jaya 2021 - 2025, Department of Statistics Malaysia (DOSM), Sabah Tourism, Jawatankuasa Perancangan dan Pelaksanaan Pembekalan Elektrik dan Tarif (JPPPET) Sabah

Transition of Sabah's Energy Regulatory Framework

The devolution of power from the Federal Government to Sabah State Government includes legislations and regulations taken over by Sabah State Government



Devolution of Powers from Federal to State under Article 95c of Federal Constitution

State Enactments

Previous state (2002 to 2022)

Legislation

- Energy Commission Act
- Electricity Supply Act
- Gas Supply Act
- Renewable Energy Act
- Sustainable Energy Development Authority Act

Regulatory Authorities

Suruhanjaya Tenaga
Energy Commission

Sustainable Energy Development Authority MALAYSIA
seda

Post-devolution of power to Sabah (2023 and beyond)

Legislation

- Energy Commission Enactment
- Electricity Supply Enactment
- Gas Supply Enactment
- Renewable Energy Enactment

Regulatory Authority

ENERGY COMMISSION OF SABAH

Overview of the New Regulatory Body for Sabah's Energy Sector: Energy Commission of Sabah

2023 and Beyond

- Energy Commission of Sabah (ECoS) is established on 10th January 2023 upon the gazettement of the Energy Commission of Sabah Enactment 2023
- ECoS is a statutory body of the State Government of Sabah and is the State's regulator for the energy sector
- The body aims to deliver secure, sustainable, affordable and accessible energy for the State of Sabah

Primary roles of Energy Commission of Sabah (ECoS)

Economic Regulation

- To promote economic regulation in the generation, transmission, distribution, supply and use of electricity and in the reticulation and use of gas
- To enable fair and efficient market conduct, and promote and safeguard competition

Technical Regulation

- To ensure security, reliability, efficiency, quality and sustainability of electricity and gas supply in the State
- To promote the use of renewable energy and the conservation of non-renewable energy

Safety Regulation

- To ensure safety in the operations and maintenance of electricity supply and gas distribution systems
- To protect consumers and the public from the potential dangers of the electrical and gas distribution installations of utility provider(s)
- To protect consumers from the potential dangers from the use of electricity and gas within their premises

03

Case for Change: Weathering through Energy Challenges towards a Greener Future

BACKGROUND

The Energy Trilemma

- The Energy Trilemma centers around striking the balance between three often conflicting challenges – ensuring energy security, affordability (and accessibility), and achieving environmental sustainability
- For Sabah, the Energy Trilemma highlights certain challenges that the State must overcome in order to strike the balance between all three elements of the trilemma
- Energy security, at least within the context of Sabah's energy landscape, refers to the importance of avoiding heavy dependance on a single energy source for power generation and adequacy of supply. Currently, Sabah's generation mix relies heavily on natural gas (86%) and reserve margin sits below 20%. Additionally, the sole 275kV Sabah backbone grid responsible for exporting power from the West Coast to East Coast poses a security risk for the East Coast and is in critical need for reinforcement. As the demand for electricity in Sabah continues to rise, there is an urgent need to find long term solutions to ensure greater energy security and to boost economic activities within the State
- Universal access to reliable and affordable energy remains a major issue in Sabah, especially in rural areas. At present, the State's tariff rates are heavily subsidised, thus posing complications for the State's electricity supply industry to continuously locate and develop affordable generation sources which are key to setting a reasonable tariff. Additionally, with energy demand anticipated to substantially grow alongside increasing energy prices, setting a reasonable tariff continues to be a growing challenge for the State. This challenge is further compounded by the complexities often accompanied by ensuring that accessible energy is expanded within rural areas
- The climate crisis has remained high on the global agenda in recent years. Domestically, Sabah faces various challenges in diversifying its generation mix and increasing its renewables penetration. Despite the abundant renewable energy potential across the State, Sabah struggles to develop its renewable energy sector due to pricing and complex infrastructural barriers. While it is understood that energy transition is key to mitigating climate change, there is a need to recognise and identify alternative energy sources that fit Sabah's circumstance in addressing the Energy Trilemma

Quick Snapshot

1 Energy Security
- Highly dependent on gas (86%)
- Low Reserve Margin of 17.6% and 332 minutes SAIDI as of 2021
- Infrastructure & grid limitations

2 Affordability & Equity
- Average base tariff at 34.52 cent/kWh, which is 30-40% lower than its true cost of supply
- Highly subsidised by the Government to make it affordable to consumers
- 98.3% rural electrification

3 Environmental Sustainability
- Challenges in development of renewables due to remoteness and widely dispersed sources
- Pricing barriers in the subsidised energy regime

Source: Suruhanjaya Tenaga, Sabah Electricity Supply Industry Outlook 2019, Sabah Electricity Sdn Bhd (SESB) Annual Report Card 2021

BACKGROUND

Ensuring a Reliable Energy Supply for Sabah Post-COVID 19

- Between 2019 and 2021, system peak demand (MW) saw no growth while electricity consumption (GWh) a decline of 4%. This provided the power system temporary respite from the delay in generation projects such as the East Coast repowering, FiT and Large-Scale Solar projects, and transmission and distribution projects due to various constraints, including but not limited to the Movement Control Order (MCO) and the Conditional Movement Control Order (CMCO) throughout Sabah during the pandemic.

- The total dependable capacity of 1,179 MW in 2021 gave a tight reserve margin of 17.6% – a level well below the optimum value of 30% due to delays in generation projects, which further aggravated the unsatisfactory performance of existing power plants caused by their inability to shutdown to do the much-needed maintenance works.

- Natural gas continues to dominate Sabah's generation energy mix at over 86%, with gas IPPs in the West Coast being major contributors. New gas plants will still be needed to meet the short to medium term due to their much shorter implementation periods compared to other generation plants such as hydro.

- Diesel is still an important source of generation for the East Coast, which contributes 6.7% of the total generation mix. These plants will be gradually phased out with the upgrading of the transmission link (Segaliud – Dam Road 275 kV) to enable more power to be exported from the West Coast, and will be further reinforced with the necessary completion of the proposed Southern Link to complete the 275kV transmission backbone loop.

- Renewable energy constitutes a small share of the generation mix at 7.3%. Biomass contribution declined due to 2 FiT plants' inability to secure feedstock. Despite numerous challenges, renewable energy presents an opportunity for the State to harness its rich indigenous resources to meet its energy needs.

- The State's gas industry, however, remains nascent compared to Peninsular Malaysia, thus prompting the State via its GLCs to raise investments into its infrastructure to unlock the State's economic potential.

Quick Facts 2021

Total Dependable Capacity

1,179MW

Total Reserve Margin

17.6%

Generation Energy Mix by Fuel Type

Natural Gas

5,548 GWh

Diesel

430 GWh

Hydro

375 GWh

Bio-energy

87 GWh

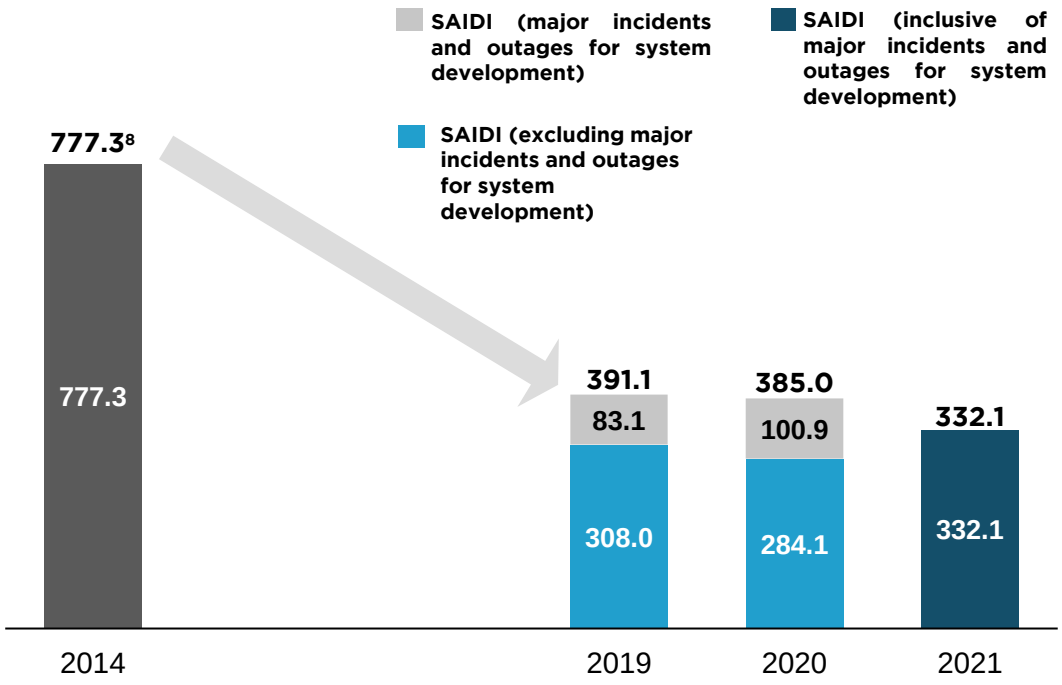
Solar

80 GWh

Source: Sabah Electricity Sdn Bhd (SESB)

Key Challenge 1
High yearly SAIDI levels

Yearly SAIDI for Sabah
SAIDI (Minutes/Consumer/Year)



SAIDI levels have improved, though extensive improvement is needed to further decrease SAIDI levels. As the system improves, more capital heavy and high technology solutions are required.

Note: Prior to 2021, major incidents were excluded in reporting but have been included since 2021 as required by ST. Comparing the data over the 3 years, SAIDI has shown improvement, however at a slow rate.

Major Incidents are incidents such as total power station unplanned outages, Transmission or Distribution Main Intake Substation total loss of load, Transmission or 33kV Distribution line unplanned outages with load loss

Key Highlights

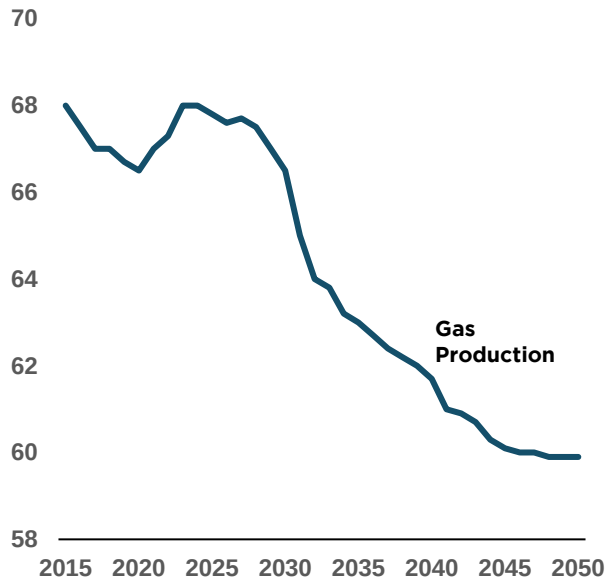
- System Average Interruption Duration Index (SAIDI) represents the average electricity interruption in minutes experienced by customers in a year that excludes unforeseeable circumstances such as extreme weather
- While levels of interruptions experienced by customers in Sabah has improved by 57.3% since 2014, Sabah still experiences outages due to major incidents which affect wide areas in the State, mainly due to Generation or Transmission faults or 'trippings', while Distribution interruptions are localised but occur more frequently

Note: [8] In 2014, SAIDI was captured utilising LGBNet system. However, since 2019 SESB migrated to a more integrated and accurate system (eCOMS) to capture SAIDI
Source: Sabah Electricity Sdn Bhd (SESB)

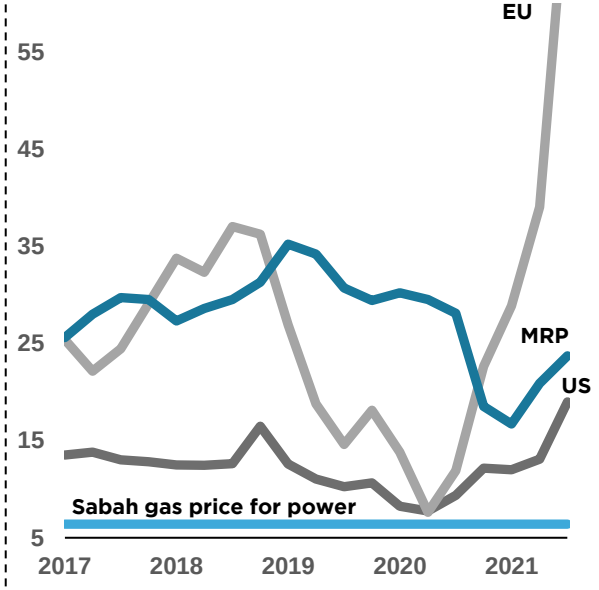
Key Challenge 2

Heavy reliance on natural gas for power generation with depleting future gas reserves

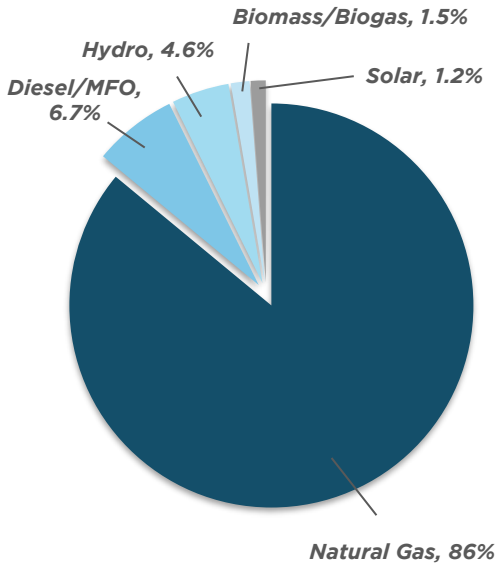
Malaysia Gas Production, 2015 – 2050 (forecast)
Billion Standard Cubic Metre (bscm)



Global Natural Gas Prices, 2017 – 2021
RM/mmbtu



Power Generation Mix, 2021
%



Key Highlights

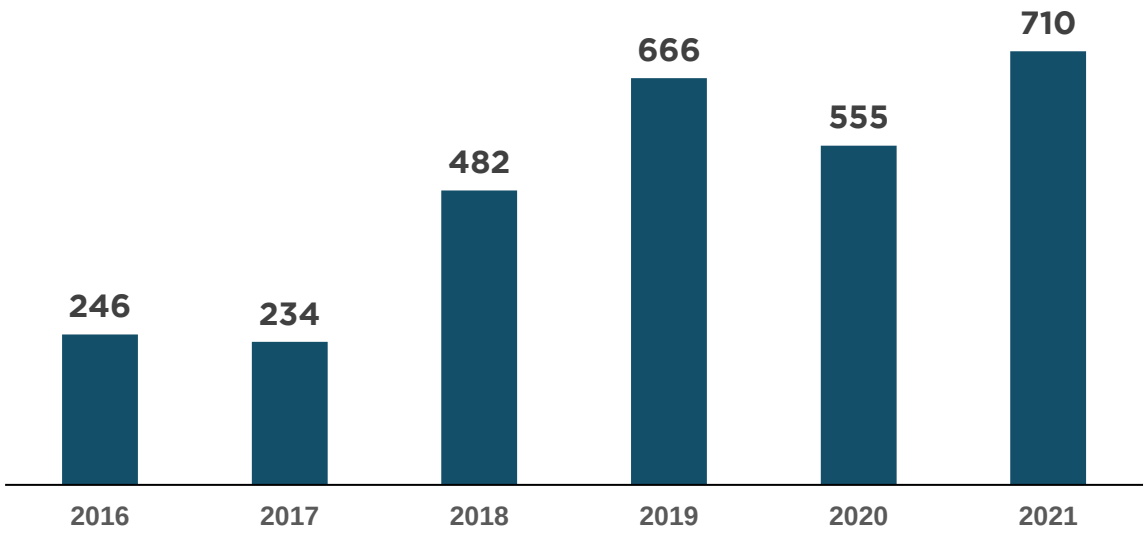
- As of 2021, over 86% of Sabah's generation mix is comprised of natural gas. The heavy reliance on natural gas is putting Sabah's energy security at risk. As production of natural gas is projected to decline in the long term, the State needs to explore alternative sources of energy to meet its long-term requirements
- Despite Sabah's lower domestic gas price for power generation due to it being regulated by the Federal Government, the prices of natural gas are expected to increase in the long term as market demand increases and cost of exploration and production becomes higher

Note: MRP – Malaysia Reference Price. Refers to Malaysia's LNG unit export price
Source: The Oxford Institute for Energy Studies, Sabah Electricity Sdn Bhd (SESB)

Key Challenge 3

High dependency on subsidy support from the Government for Sabah Electricity Supply Industry (SESI)

Annual Subsidy Support for SESI, 2016-2021
RM Million



Total Subsidy:
RM 2.89 Billion

Fuel Subsidy:
RM 1.27 Billion (44%)

Other Subsidies:
RM 1.62 Billion (56%)

Key Highlights

- Between 2016 to 2021, the Federal Government has spent over RM 2.89 billion in subsidy support for Sabah Electricity Supply Industry (SESI). 44% (RM 1.27 billion) of the total subsidy comes in the form of fuel subsidy due to the State's significant reliance on diesel & MFO for power generation, while the other 56% (RM 1.62 billion) is mainly for Tariff Support Subsidy (TSS) and Large-Scale Solar (LSS) Subsidy

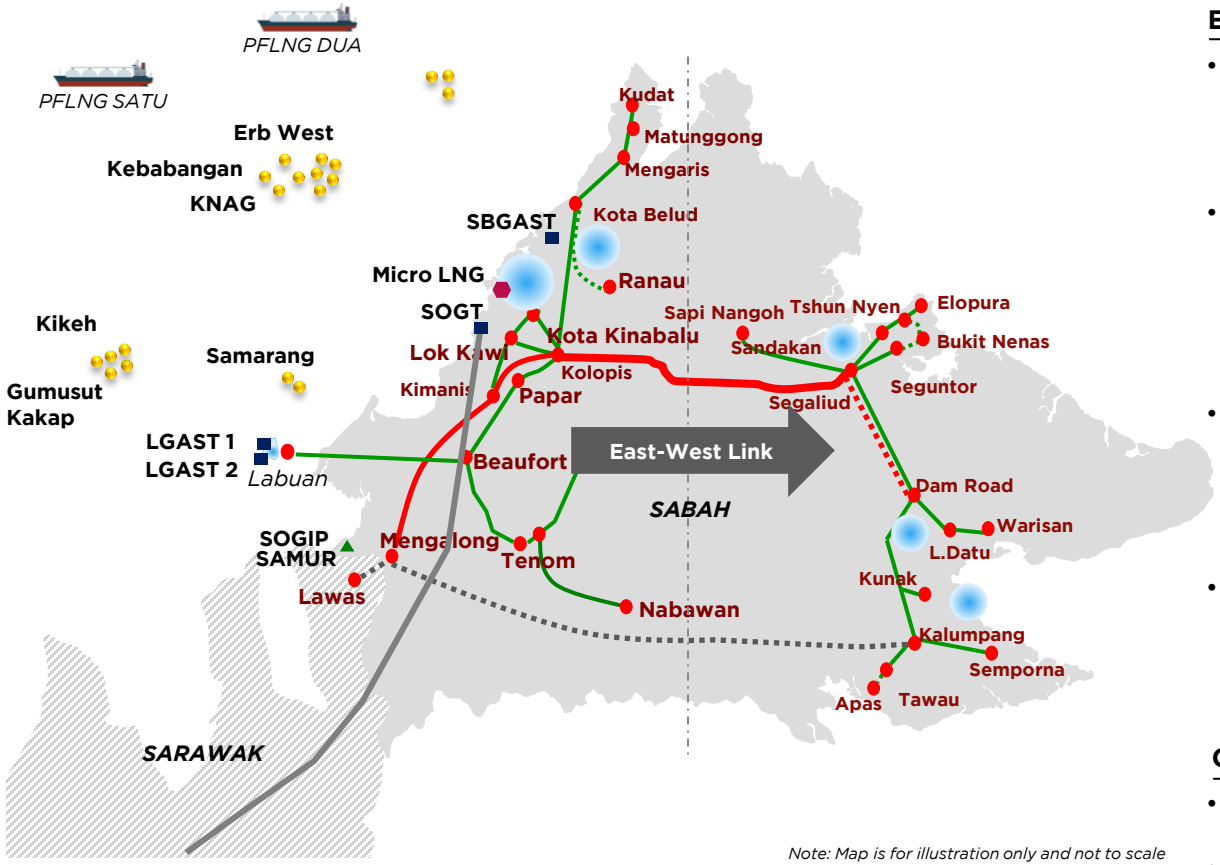
- As Sabah's electricity tariff rates continue to be heavily subsidised, there is great concern over the State's ability in safeguarding its energy security and expanding its energy accessibility. The mismatch between the tariff and the cost of electricity supply poses a huge challenge for the utility provider especially in meeting the growing demand in the future as well as expanding accessibility in the rural areas

Note: The sharp increase in annual subsidy after 2017 was due to the introduction of Tariff Support Subsidy (TSS) in 2018 to meet the revenue vs. cost gap. For further details please refer to Strategy B3, page 106.

Source: Sabah Electricity Sdn Bhd (SESB)

Key Challenge 4

Mountainous terrains and dispersed population in delivering energy across Sabah



Note: Map is for illustration only and not to scale

Legend

Gas

- LNG Processing Plant
- Gas Terminal
- Petrochemical Plant
- Sabah Sarawak Gas Pipeline (SSGP)
- Virtual Pipeline System (VPS)
- Gas Fields

Electricity

- 275kV line
- 132kV line
- Future Southern Link
- Future Segaliud – Dam Road Link

Note: Locations on unelectrified rural areas available in Strategy B4, p. 109
Source: Sabah Electricity Outlook 2019, Sabah Gas Masterplan

Electricity

- Sabah's population is largely concentrated along the West Coast and East Coast, which are divided by a trail of mountains featuring the State's highest peaks, while smaller villages are scattered across the State
- The combination of a dispersed population and mountainous terrain poses challenges for the energy sector in Sabah where the grid is currently divided between the West Coast and the East Coast, both of which are connected via the 275kV East-West Link transmission line (also known as the Kolopis-Segaliud line)
- This single transmission line transfers necessary power from the West Coast to the East Coast to cover the shortfall of capacity. The East-West Link is currently undergoing upgrading to address its design limitations in transferring sufficient power for future growing demand
- The diesel power plants in the East Coast, however, will be gradually phased out with the upgrading of the transmission link (Segaliud – Dam Rd 275 KV) to enable more power to be exported from the West Coast and the completion of the Sabah Grid with Southern Link

Gas

- The gas resources in Sabah are highly concentrated in the West Coast
- Due to the mountainous nature of the State, the gas supply in Sabah is supplied through different means between the West Coast and East Coast
- The gas supply in the West Coast is predominantly served via pipelines and small virtual pipeline system (VPS) coverage, while the East Coast is supplied gas via LNG-VPS due to the lack of infrastructure and a fragmented customer market

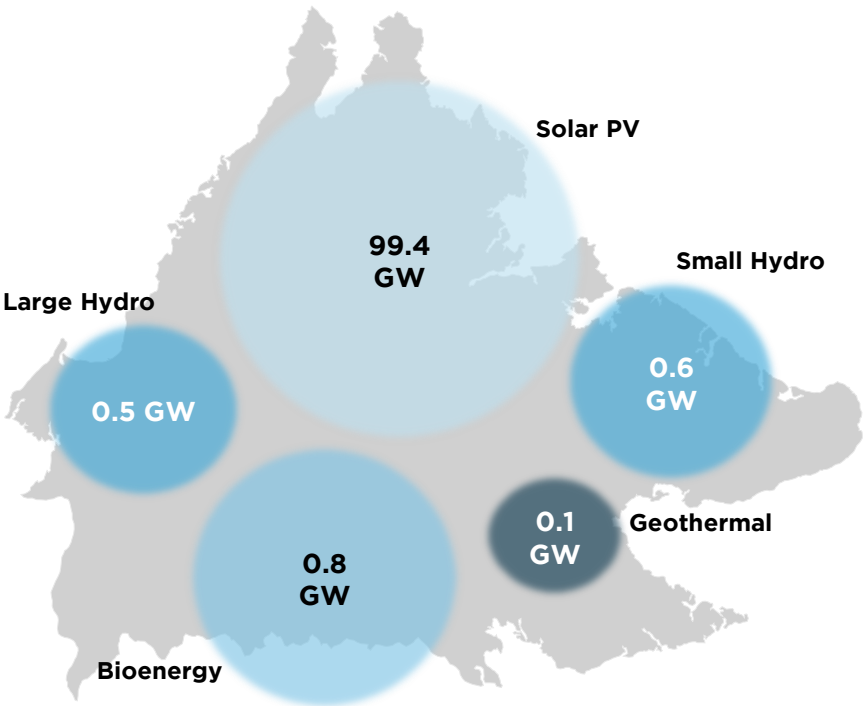
Key Challenge 5

Underutilised renewable energy in Generation Mix despite Untapped Potential in State

Sabah Renewable Energy Resource Potentials by Locations

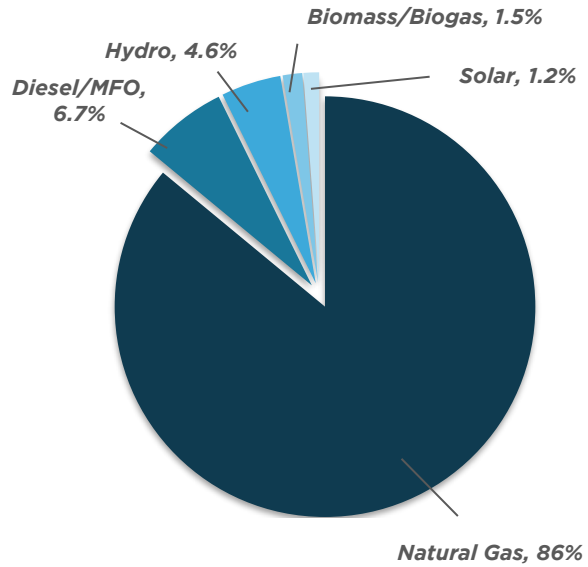
GW,MW

Total RE Resource Potential : 101 GW



Power Generation Mix, 2021

%



Key Highlights

- According to the Sustainable Energy Development Authority (SEDA), Sabah has a wealth of renewable energy resources readily available for power generation use that is severely underutilised
- As previously highlighted, power generation in Sabah relies heavily on natural gas (86%) whereas renewable energy comprises a meager 7.3% of the State's total power generation mix, despite its long-term benefits for environmental sustainability and the State's energy security

Source: Malaysia Renewable Energy Roadmap (MYRER), Sabah Electricity Sdn Bhd (SESB)

In summary, energy challenges for Sabah are essentially focused on 5 major themes

Challenge	Description
1 High SAIDI	• Sabah has had to manage high SAIDI levels over the years, which are attributable to distribution network of bare conductors and long distribution lines due to dispersed population, worsened by the utility's previously poor financial position to invest in capital expenditure. Going forward, initiatives to replace bare conductors are on-going, but will take time to complete and to produce results • Strategic projects funded by government grants amounting to RM 2.295 billion were implemented under Sabah Special Project Planning and Delivery Unit (SAPADU) to improve Transmission and Distribution upstream adequacy and reliability, but long delays had impacted the realisation of the projects' benefits. With most of these projects being completed or near completion, the grid system is expected to improve. However, further strengthening is still needed in the Transmission and Distribution infrastructures which are estimated to cost within the range of RM 2 billion including the 275kV Southern Link • Generation adequacy and reliability is a pressing issue as ageing plants are extended over its productive life cycle, while tight reserve margin poses a challenge to allow power plants to undergo much needed maintenance due to delays in new plant up
2 Heavy Reliance on Natural Gas	• The future long-term projection of depleting supply of natural gas poses an energy security risk to Sabah as the State continues to rely heavily on natural gas for power generation • As the cost of natural gas production is anticipated to further increase due to future exploration & production from more challenging fields, it is imperative for the State to diversify its generation mix by leveraging its untapped renewable and new energy potentials and reducing its reliance on natural gas for power generation
3 Heavy Reliance on Subsidy	• Sabah's cost of electricity supply is high with 64% of the total cost deriving from generation • Especially in the East Coast, generation of electricity is highly dependent on diesel and Medium Fuel Oil (MFO) subsidies while Large Scale Solar is being subsidised for its entry into Sabah generation mix • Sabah will need to move towards market pricing while improving operational efficiency and optimising generation cost for a sustainable electricity supply industry

In summary, energy challenges for Sabah are essentially focused on 5 major themes

Challenge	Description
4 **Lack of Energy Accessibility**	• Providing accessibility to electricity supply and gas supply infrastructure especially in the East Coast of Sabah remains a huge challenge for the State Government due to its mountainous terrains and the fragmented nature of the State's population • Additionally, gas fields are currently only available off the West Coast of Sabah and it is not viable to supply to the East Coast via pipelines • Addressing the issue of meeting last mile needs for electricity and energy infrastructures, especially for remote communities and areas, will continue to be one of the Sabah's priorities in the energy sector
5 **Underutilisation of Renewables in Generation Mix**	• As of 2021, renewable energy only constitutes 7.3% of Sabah's generation mix. According to Malaysia Renewable Energy Roadmap (MYRER), Sabah has a total of over 101 GW renewables potential across the State readily exploitable for renewable power generation • Despite the abundant renewable energy potential across the State, Sabah struggles to develop its renewable energy sector due to pricing and infrastructural reasons. The huge financial cost involved in conducting feasibility and exploration assessment as well as developing the required infrastructures may impede utility players from pursuing renewable energy developments. For example, a large hydro project requires a large sum of investment to cover the costs of both feasibility assessment and an extensive infrastructure development which may only be recuperated through higher tariff rates • Additionally, the dispersion of locality for sources of renewable energy also presents a huge challenge for Sabah. For example, the lack of ready infrastructure poses a great challenge for the State to fully realise its potential in the biomass industry

04

Sabah Energy Roadmap and Master Plan

Strategic Thrusts & Strategies

Sabah Energy Roadmap & Master Plan 2040 Vision, Objectives and Strategic Thrusts

Vision

Reliable, accessible, affordable and sustainable energy for Sabah

3 Strategic thrusts

1 Energy Security	2 Equal Accessibility & Affordability	3 Environmental Sustainability

3 Key Objectives

Ensure energy security towards operational and financial sustainability	Optimise energy resources to stimulate sustainable socioeconomic growth	Enhance energy sector contribution towards environmental sustainability

16 Strategies

7 Strategies	5 Strategies	4 Strategies
A1 Achieve Operational Sustainability	B1 Implement Generation Optimisation Plan	C1 Increase Renewables Contribution to Sabah Generation Mix
A2 Establish State Policy for Indigenous Energy Resources	B2 Progress towards Effective Energy Tariff	C2 Expand Use of Bio-energy
A3 Improve Generation Reserve Margin	B3 Implement Energy Subsidies Rationalisation Plan	C3 Establish Sabah Energy Efficiency Action Plan (SEEAP)
A4 Improve Generation Energy Mix	B4 Achieve 100% Rural Electrification	C4 Transition Sabah towards a Carbon Neutral State
A5 Develop Integrated Gas Master Plan	B5 Optimise Hydropower Potential	
A6 Establish Resilient Cross-border Interconnectivity		
A7 Identify New Energy Sources and Technologies		

6 Enablers

Enablers					
Policy & Regulation	Governance	Human Capital & Capabilities	Research, Development & Technology	Financing & Investment	Energy Supply Industry Structural & Operational Reform

Strategic Thrust 1

Strategic Thrust 1: Energy Security
Ensure energy security towards operational and financial sustainability

Overall Objective
Leverage, optimise and diversify the use of indigenous and non-indigenous energy resources to ensure energy is readily available and reliable for Sabah

Ensure energy security towards operational and financial sustainability

Strategies	Description
Strategy A1 **Achieve Operational Sustainability**	• Ensure sustainable Sabah Electricity Supply Industry (SESI) through the implementation of SESB sustainability and transformation plan • Improve sustainability and reliability of gas distribution in Sabah through gas infrastructure development and economic growth
Strategy A2 **Establish State Policy for Indigenous Energy Resources**	• Establish a policy that ensures indigenous sources of energy are utilised in a sustainable manner to ensure energy security for current and future generations
Strategy A3 **Improve Generation Energy Mix**	• Diversification of energy/fuel mix from over dependency on natural gas (currently at 86% of Sabah power generation energy/fuel mix) towards achieving Herfindahl-Hirschmann Index (HHI) of below 0.5 by end of 2035
Strategy A4 **Improve Generation Reserve Margin**	• Enhance reserve margin from 16% in 2021 towards the industry standard of 30% to 35% by 2030 to cater for organic demand and large scale/step-load demand due to Sabah's industrialisation development agenda, while implementing short-term mitigation measures to ensure sufficient reserve margin to meet current requirement
Strategy A5 **Develop Integrated Gas Master Plan**	• Develop an integrated gas master plan to unlock production potential and optimise utilisation of Sabah natural gas in a sustainable manner to spur the State's economic growth whilst ensuring long term self sufficiency
Strategy A6 **Establish Resilient Cross-border Interconnectivity**	• Implement effective cross border transmission interconnectivity to improve system security and contingency whilst leveraging on Sabah's strategic location and position the State as a key energy exporter and power wheeler to its regional neighbours
Strategy A7 **Identify New Energy Sources and Technologies**	• Develop Sabah New Energy Roadmap to bolster energy supply to avoid an energy crisis in Sabah due to diminishing supply of gas and leverage on new sources and technological advancements for power generation

Strategic Thrust 2

Strategic Thrust 2: Equal Accessibility & Affordability
Optimise energy resources to stimulate sustainable socioeconomic growth

Overall Objective
Contribute to fiscal stability by optimising fiscal inflows and outflows in the energy sector to support economic development, ensure equitable distribution of benefits to Sabahans and cost effectiveness to utility provider

Optimise energy resources to stimulate sustainable socioeconomic growth

Strategies	Description
Strategy B1 **Implement Generation Optimisation Plan**	• Ensure that the optimised Power Development Plan (PDP) is carried out accordingly based on availability of affordable energy source coupled with key transmission development plan (i.e. Southern Link)
Strategy B2 **Progress towards Effective Energy Tariff Design**	• Enhance implementation of tariff restructuring via Incentive Based Regulations (IBR) based on cost of supply with subsidies for targeted groups and attractive/affordable tariff to industries • Implementation of Incentive Based Regulations (IBR) for gas asset operations upon reaching industry maturity
Strategy B3 **Implement Energy Subsidies Rationalisation Plan**	• Implement gradual subsidy rationalisation plan through energy pricing towards market parity and cost optimisation
Strategy B4 **Achieve 100% Rural Electrification**	• Accelerate Government's rural electrification supply programme (BELB) • Explore indigenous renewable energy resources to enhance rural energy access at an affordable level and in a sustainable manner towards achieving 100% rural electrification
Strategy B5 **Optimise Hydropower Potential**	• Improve the energy mix in Sabah by harnessing and realising the full potential of Sabah's hydropower, towards strengthening and enhancing the electricity supply in the State • Increase the contribution of renewables in the energy generation mix of Sabah

Strategic Thrust 3

Strategic Thrust 3: Environmental Sustainability
Enhance energy sector contribution towards environmental sustainability

Overall Objective
Improve energy sector contribution to environmental sustainability to support the State in meeting international climate change obligations and ambitions, as well as to ensure Sabah's economy remains attractive for international and local investments and is competitively positioned, given global ESG investing trends

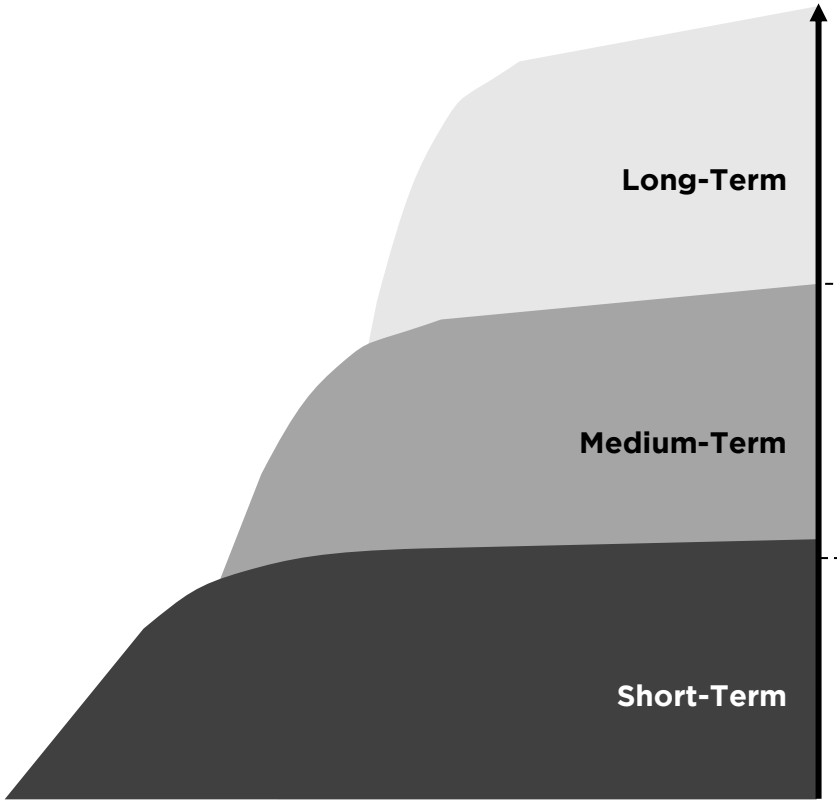
Enhance energy sector contribution towards environmental sustainability

Strategies	Description
Strategy C1 **Increase Renewables Contribution to Sabah Generation Mix**	• Diversify Sabah's generation mix with specific focus provided to environmentally sustainable and renewable resources namely hydro, solar and bio-energy whilst exploring other new renewables potentials
Strategy C2 **Expand Use of Bio-energy**	• Establish an appropriate State Policy to boost utilisation of oil palm biomass as source of renewable energy • Coordinate with government agencies and industry players to develop, plan and implement Sabah Biomass Industry Development Plan • Facilitate last-mile inter-connectivity for potential bioenergy plants with the nearest grid points • Explore Sabah's solid waste-to-energy (WTE) combustion potential as additional fuel source for power generation
Strategy C3 **Establish Sabah Energy Efficiency Action Plan (SEEAP)**	• Implement Sabah Energy Efficiency Action Plan (SEEAP) focusing on government policy and regulatory enablers to enhance Energy Efficiency (EE) implementation by public and private buildings, EE appliances and to promote co-generation
Strategy C4 **Transition Sabah towards a Carbon Neutral State**	• Develop implementation plan for energy transition from fossil fuels to renewable energy towards carbon neutrality in 2050 • Leverage on the national drive towards achieving Sustainable Development Goals (SDG) and Climate Change Committee (at state and national level) • Leverage on Sabah's renewable energy potentials for carbon market participation • Explore carbon taxation implications and recommendations • Introduce green mobility (electric vehicles, hydrogen, biofuel etc)

Timeline of projects

Project Classification Framework

Timeline Categories



Long-term: 2031-2040

- Long-term projects refer to projects requiring a longer period of completion and are planned to commence at a later period in 2031 and complete within the nine-year (9) span by 2040

Medium-term: 2026-2030

- Medium-term projects refer to projects that will commence in 2026 and complete within the four-year (4) span by 2030

Short-term: 2023-2025

- Short-term projects refer to projects that are currently in progress and will be completed by 2025, as well as projects that will commence in 2023 and complete by 2025

Note: The Sabah Energy RAMP 2040 is a living and dynamic document that will undergo periodic reviews every three years to include the latest data, progress, and strategies

05

Enablers, Targets & Governance

In order to realise the strategies, six (6) key enablers have been identified

Enabler:
Strengthen energy sector for effective delivery

1 Governance

Strengthen the governance structure for holistic energy sector planning, policy development and implementation of key strategies and initiatives through the development of the Sabah Energy Council and multi-agency collaboration and coordination

2 Human Capital and Capabilities

Monitor progress of all workplace and human capital building initiatives crafted by industry and distinct government agencies, with specific priorities provided to initiatives that focus on upskilling local human capital in areas such as IT, engineering and management, to ensure that local talent meet the needs of local and international investors

3 Policy and Regulations

Develop action plans to shape energy markets in driving efficiency gains, exploring new business models as well as streamlining regulations and standards

4 Research, Development & Technology

Facilitate conditions to foster, develop and commercialise innovation and new technologies to create technological advantages across the energy sector via close collaboration between universities, research institutions and industry players

5 Financing and Investments

Promote access to financing and investment required for energy-related projects and infrastructure through close coordination and facilitation to ensure sustainable operations of the energy industry and energy transition towards promoting green financing in line with ESG standards and criteria required by investors

6 Energy Supply Industry Structural & Operational Reform

Establish comprehensive study on the optimisation of the energy industry structure in ensuring effective operations of the utility companies and other players within the energy value chain, towards greater transparency, and operational efficiency, as well as ensuring sustainable operational and financial performance of the whole industry, anchored on ensuring benefits to the consumers

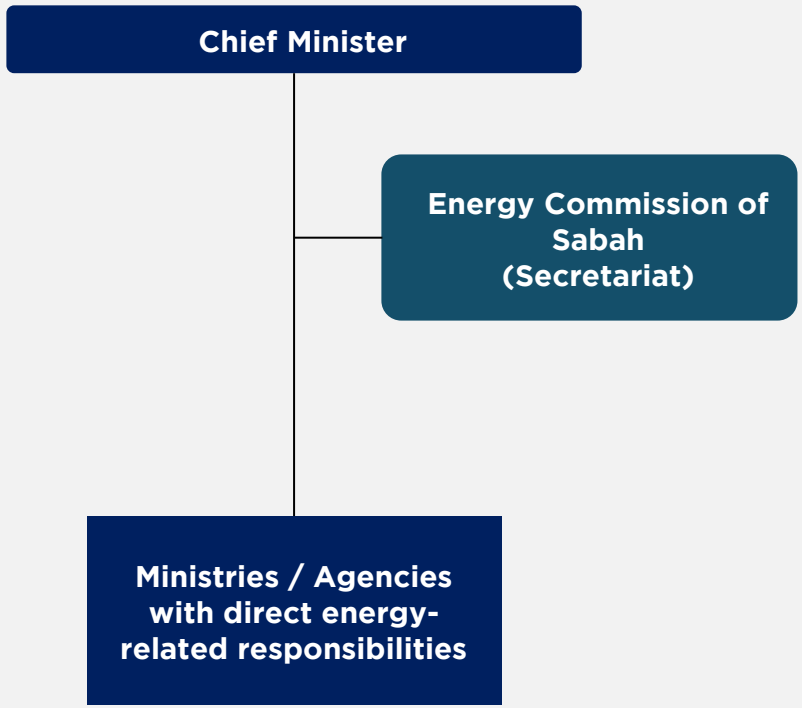
Sabah envisions towards reaching these targets in the medium and long term

No.	State-Level Targets	Indicators	Current Performance
1	To achieve **below 100 minutes SAIDI** by end of **2030**	**SAIDI**	332.1 minutes as of 2021
2	To achieve **100% rural electrification** for Sabah by end of **2030**	**Rural Electrification**	98.3% rural electrification for Sabah as of 2021
3	To achieve **sustainable electricity tariff** for Sabah by end of **2030**	**Energy Subsidy Rationalisation Plan**	Heavily subsidised as of 2021
4	To maintain a **balance Generation Fuel Mix (i.e. HHI of below 0.5)**[9] by end of **2035**	**Energy Mix Diversification**	Herfindahl-Hirschmann Index (HHI) of 0.79 as of 2019
5	To achieve **>50% (by capacity) and >30% (by energy MWh)** of renewable energy share by **2035** Compared to 40% (by capacity) and 27% (in GWh) of national target by 2035	**Renewable Energy Share of Generation Mix**	7.3% as of 2021
	National-Level Targets	**Indicators**	**Current Performance**
6	To achieve **low carbon nation aspiration** by **2040**	**Carbon Intensity Target**	Not Available (To establish inventory in 2024)
7	To achieve **carbon neutrality** by **2050**[10]		

Note: [9] The Herfindhal-Hirschman Index (HHI) score measures the diversity of generation mix by fuel types whereby the lower the score, the higher the fuel diversification and energy security
[10] Target is in-line with national commitment to becoming carbon-neutral by 2050
Source: Malaysia Renewable Energy Roadmap (MYRER)

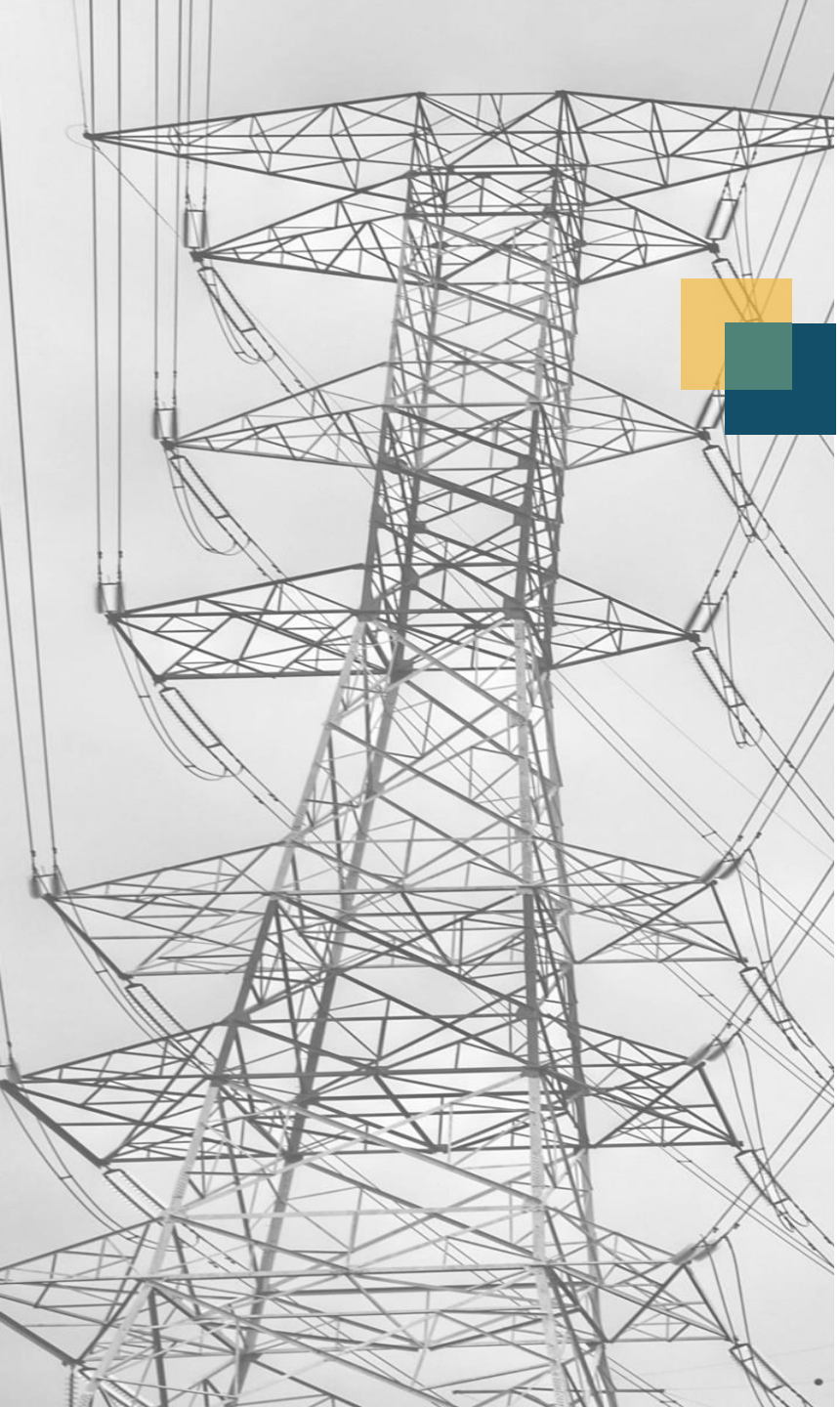
The State Energy Council will be established as the main committee to oversee the implementation, coordination and tracking of the priorities and strategies

Structure of State Energy Council



Key Highlights

- Sabah will establish a Sabah Energy Council wherein the Chief Minister will lead the council with the support of the Energy Commission of Sabah (ECoS) serving as the council's secretariat
- As the council's secretariat, ECoS will be responsible for coordinating, monitoring and tracking the progress of the priority strategies and leading the periodical review process of the Masterplan and relevant policy directions
- Additionally, energy-related ministries and agencies in Sabah will be supporting and representing the council
- The Sabah Energy Council will serve to ensure the effective implementation of the energy policies and strategies stated in the Sabah Energy Roadmap and Master Plan 2040



06

Strategy Summary

Strategic Thrust 1

Strategic Thrust 1: Energy Security
Ensure energy security towards operational and financial sustainability

Overall Objective
Leverage, optimise and diversify the use of indigenous and non-indigenous energy resources to ensure energy is readily available and reliable for Sabah

Ensure energy security towards operational and financial sustainability	
Strategies	**Description**
Strategy A1 **Achieve Operational Sustainability**	• Ensure sustainable Sabah Electricity Supply Industry (SESI) through the implementation of SESB sustainability and transformation plan • Improve sustainability and reliability of gas distribution in Sabah through gas infrastructure development and economic growth
Strategy A2 **Establish State Policy for Indigenous Energy Resources**	• Establish a policy that ensures indigenous sources of energy are utilised in a sustainable manner to ensure energy security for current and future generations
Strategy A3 **Improve Generation Energy Mix**	• Diversification of energy/fuel mix from over dependency on natural gas (currently at 86% of Sabah power generation energy/fuel mix) towards achieving Herfindahl-Hirschmann Index (HHI) of below 0.5 by end of 2035
Strategy A4 **Improve Generation Reserve Margin**	• Enhance reserve margin from 16% in 2021 towards the industry standard of 30% to 35% by 2030 to cater for organic demand and large scale/step-load demand due to Sabah's industrialisation development agenda, while implementing short-term mitigation measures to ensure sufficient reserve margin to meet current demand
Strategy A5 **Develop Integrated Gas Master Plan**	• Develop an integrated gas master plan to unlock production potential and optimise utilisation of Sabah natural gas in a sustainable manner to spur the state economic growth whilst ensuring long term self sufficiency
Strategy A6 **Establish Resilient Cross-border Interconnectivity**	• Implement effective cross border transmission interconnectivity to improve system security and contingency whilst leveraging on Sabah's strategic location and position the State as a key energy exporter and power wheeler to its regional neighbours
Strategy A7 **Identify New Energy Sources and Technologies**	• Develop Sabah New Energy Roadmap to bolster energy supply to avoid an energy crisis in Sabah due to diminishing supply of gas and leverage on new sources and technological advancements for power generation

Strategy A1: Achieve Operational Sustainability

A1	Achieve Operational Sustainability

Key Objective

- Ensure operational sustainability in Sabah Electricity Supply Industry (SESI) through implementation of Sabah Electricity Sdn Bhd (SESB) sustainability and transformation plan
- Improve sustainability and reliability of gas distribution in Sabah through gas infrastructure development and economic growth[11]

Description of Initiative

- Business re-engineering to ensure long term sustainability of SESB by leveraging on SESB's transformation plan 2030
- Long term tariff design and restructuring strategy to achieve financial sustainability[12]
- Continued Government assistance in capital expenditure and operational subsidy requirement prior to financial sustainability of SESB
- Optimal use of indigenous energy sources via optimum design for maximum efficiency. For example, refurbishing less efficient plants and developing optimal sizing of new plants
- Strengthen SESI's transmission and distribution network performance in essential areas for improved loop and new source plant-ups
- Prevent major incidents in transmission networks, off-grid and rural generation stations via reinforcement and upgrade of primary and secondary equipment for all regions
- Collaborate with relevant government authorities to prevent non-technical losses such as meter tampering and illegal tapping
- Improve supply reliability and System Average Interruption Duration Index (SAIDI) with specific focus on reducing breakdown of generation, transmission and distribution network through operational maintenance excellence, targeted asset replacement, distribution automation etc
- Support the development of gas industry value chain in tandem with infrastructure development through State GLCs[13]

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)
- Sabah Electricity Sdn Bhd (SESB)
- Sabah Energy Corporation (SEC)

Relevant Stakeholders

- Sabah State Government
- Ministry of Finance
- Ministry of Economy
- Ministry of Natural Resources, Environment and Climate Change (NRECC)
- PETRONAS
- TNB
- Local Councils and Enforcement Authorities

Implementation timeline	Strategy Type
2023 Onwards	Achieve operational sustainability by 2030

Note: [11] Initiative will be elaborated further in Strategy A5 – Develop Integrated Gas Master Plan
[12] Initiative will be elaborated further in Strategy B2 – Progress towards Effective Energy Tariff
[13] Initiative will be elaborated further in Strategy A5 – Develop Integrated Gas Master Plan

Strategy A2: Establish State Policy for Indigenous Energy Resources

A2	Establish State Policy for Indigenous Energy Resources		
Key Objective • Establish a policy that ensures indigenous sources of energy are utilised in a sustainable manner to ensure energy security for current and future generations **Description of Initiative** • Develop appropriate policy for Sabah to strike a balance between short-term economic returns and long-term benefits to the State with specific focus provided to decoupling environmental degradation from economic growth, applying sustainable life cycle practice and procurement process, and seizing opportunities for development • Craft an appropriate policy to optimise the utilisation of indigenous resources such as natural gas, coal, geothermal, hydro,[14] solar, wind and tidal in an efficient, welfare-generating manner that ensures shared prosperity for Sabah[15]	**Stakeholders** **Lead Entity** • Energy Commission of Sabah (ECoS) • Sabah Energy Corporation (SEC) • SMJ Sdn Bhd **Relevant Stakeholders** • Sabah State Government • Sabah Electricity Sdn Bhd (SESB) • PETRONAS • Department of Mineral and Geoscience Sabah • Sustainable Energy Development Authority (SEDA) • Ministry of Economy	**Implementation timeline** 2023 Onwards	**Initiative Type** Continuous

Note: [14] Hydropower will be elaborated further in Strategy B5 – Optimise Hydropower Potential
[15] Initiative will be elaborated further in Strategy A7 – Identify New Energy Technologies

Strategy A3: Improve Generation Energy Mix

A3	Improve Generation Energy Mix	
Key Objective • Diversification of energy/fuel mix from over dependency on natural gas (currently at 86% of Sabah power generation energy/fuel mix) towards achieving Herfindahl-Hirschmann Index (HHI) of below 0.5 by end of 2035 **Description of Initiative** • Leverage on hydropower potential across Sabah • Expand other indigenous sources of renewable energy • Expediate cross-border imports through interconnectivity with Sarawak and Kalimantan Utara[16] • Expedite introduction of New Energy Sources and Technology[17]	**Stakeholders** **Lead Entity** • Energy Commission of Sabah (ECoS) • Sabah Electricity Sdn Bhd (SESB) **Relevant Stakeholders** • Sabah State Government • Sarawak Energy Bhd (SEB) • Single Buyer	
	Implementation timeline	**Initiative Type**
	2023 Onwards	Continuous

Note: [16] Initiative will be elaborated further in Strategy A6 – Establish Resilient Cross-border Interconnectivity
[17] Initiative will be elaborated further in Strategy A7 – Identify New Energy Technology

Strategy A4: Improve Generation Reserve Margin

A4	Improve Generation Reserve Margin	
Key Objective • Enhance reserve margin from 16% in 2021 towards the industry standard of 30% to 35% by 2030 to cater for organic demand and large scale/step-load demand due to Sabah's industrialisation development agenda, while implementing mitigation measures to ensure sufficient reserve margin to meet load demand **Description of Initiative** • Fast track implementation of stopgap measures based on the immediate prioritised projects to avoid energy crisis in Sabah • Establish mitigation plans with specific focus on the demand side management[18] • Develop a robust Power Development Plan (PDP) to ensure sufficient reserve margin to respond to dynamic load demand alongside timely management investment in generation unit plant-ups in line with grid infrastructure development • Balance the cost of developing infrastructure towards improving the reserve margin	**Stakeholders** **Lead Entity** • Energy Commission of Sabah (ECoS) • Single Buyer **Relevant Stakeholders** • Sabah State Government • Sabah Electricity Sdn Bhd (SESB) • Sabah Energy Corporation (SEC)	
	Implementation timeline	**Initiative Type**
	2023 Onwards	Continuous

Note: [18] Initiative will be elaborated further in Strategy C3 – Establish Sabah Energy Efficiency Action Plan (SEEAP)

Strategy A5: Develop Integrated Gas Master Plan

A5	Develop Integrated Gas Master Plan

Key Objective

- Develop an integrated gas master plan to unlock production potential and optimise utilisation of Sabah's natural gas in a sustainable manner to spur the State's economic growth whilst ensuring long term self sufficiency

Description of Initiative

- Continuous forward planning to ensure demand-led and cost-efficient large energy-intensive investments, such as gas exploration towards meeting the energy and industry demand, which will lead to greater private sector investment for natural gas infrastructures
- Cohesive collaboration and alignment between the State and Federal stakeholders in establishing the Integrated Gas Masterplan, in prioritising the needs of Sabah State over other interests as well as in anticipation of more expensive cost of gas from deeper fields
- Leverage on the Commercial Collaborative Agreement (CCA) to safeguard the interest of Sabah and for the State to deploy more strategic and integrated approach to influence gas planning and priority setting in the development of the whole value chain of Sabah gas industry
- Expand the gas infrastructure access via potential new pipeline network, enhanced gas grid for system redundancy and Virtual Pipeline System (VPS) for gas distribution
- Leverage on the implementation of new gas projects and industries that will optimise the use of natural gas for Sabah to maximise downstream activities and long-term economic spin-offs for the State
- Expand the gas investment and infrastructure in the East Coast including exploring offshore sources of gas that can be brought to the mainland of the East Coast towards security of supply and to spur industrial growth
- Explore development of Regasification Terminal (RGT) based on market demand and as part of Sabah indigenous natural gas resource management

Stakeholders

Lead Entity

- SMJ Sdn Bhd
- Sabah Energy Corporation (SEC)
- PETRONAS

Relevant Stakeholders

- Sabah State Government
- Energy Commission of Sabah (ECoS)
- Sabah Electricity Sdn Bhd (SESB)
- Sabah Oil and Gas Development Corporation (SOGDC)
- Malaysian Investment Development Authority (MIDA) Sabah
- Potential Investors

Implementation timeline	Initiative Type
2023 Onwards	Continuous

Strategy A6: Establish Resilient Cross-border Interconnectivity

A6	Establish Resilient Cross-border Interconnectivity

Key Objective

- Implement effective cross border transmission interconnectivity to improve system security and contingency whilst leveraging on Sabah's strategic location to position the State as a key energy exporter and power wheeler to its regional neighbours

Description of Initiative

- Leverage on Sabah's strategic location to regional neighbours such as the Philippines for power wheeling and North Kalimantan as a key electricity supplier
- Leverage on Sabah-Sarawak interconnectivity and future interconnectivity with regional ASEAN Power Grids (APG) to enable cost-effective supply, strengthen energy security and support the transition into greener energy
- Carry out joint interconnection study with relevant utilities for Grid Stabilisation and Spinning Reserve provision

Stakeholders

Lead Entity

- Sabah State Government
- Energy Commission of Sabah (ECoS)
- Sabah Electricity Sdn Bhd (SESB)

Relevant Stakeholders

- Sarawak State Government
- Sarawak Energy Bhd (SEB)
- BIMP-EAGA Business Council
- Philippines Energy Regulatory Commission
- Kementerian Energi dan Sumber Daya Mineral (ESDM)
- Mindanao Development Authority (MinDa)
- Perusahaan Listrik Negara Indonesia (PLN)
- Palawan Council for Sustainable Development

Implementation timeline	Initiative Type
2024 Onwards	Continuous

Strategy A7: Identify New Energy Sources and Technologies

A7	Identify New Energy Sources and Technologies

Key Objective

- Develop Sabah New Energy Roadmap to bolster energy supply to avoid an energy crisis in Sabah due to diminishing supply of gas and leverage on new sources and technological advancements for power generation

Description of Initiative

- Explore and identify new energy technologies adaptation including utility scale battery energy storage system (BESS), small modular reactor (SMR), green hydrogen, green ammonia and lower head hydropower
- Explore and identify transitional fuels such as synthesis gas as well as other forms of hydrogen fuel (apart from green hydrogen) to achieve energy trilemma objectives by optimising the power capacity mix, factoring in rapidly evolving global policies and technology trends and to avoid energy crisis in light of increasing cost of gas
- Introduce new energy sources/technologies beyond existing renewable energy (such as solar, geothermal, wind, hydro and biomass) into Sabah's capacity mix in a comprehensive and integrated manner that considers technical, economic and social outcomes and facets of the technology
- Develop and examine feasibility of small-scale pilot projects for new technologies to identify any technical, economic, or social issues that may arise prior to scale-up
- Develop and scale-up successful and promising pilot projects to achieve economies of scale and reduce the cost of energy production
- Implement regulatory framework that includes policies regulations and incentives that encourage the use of new energy sources/technology and discourage the use of fossil fuels to support introduction of variation into capacity mix

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)

Relevant Stakeholders

- Sabah Electricity Sdn Bhd (SESB)
- Sabah Energy Corporation (SEC)
- PETRONAS

Implementation timeline	Initiative Type
2025 Onwards	Continuous

Strategic Thrust 2

Strategic Thrust 2: Equal Accessibility & Affordability
Optimise energy resources to stimulate sustainable socioeconomic growth

Overall Objective
Contribute to fiscal stability by optimising fiscal inflows and outflows in the energy sector to support economic development, ensure equitable distribution of benefits to Sabahans and cost effectiveness to utility provider

Optimise energy resources to stimulate sustainable socioeconomic growth

Strategies	Description
Strategy B1 **Implement Generation Optimisation Plan**	• Ensure that the optimised Power Development Plan (PDP) is carried out accordingly based on availability of affordable energy source coupled with key transmission development plan (i.e. Southern Link)
Strategy B2 **Progress towards Effective Energy Tariff Design**	• Enhance implementation of tariff restructuring via Incentive Based Regulations (IBR) based on cost of supply with subsidies for targeted groups and attractive/affordable tariff to industries • Implementation of Incentive Based Regulations (IBR) for gas asset operations upon reaching industry maturity
Strategy B3 **Implement Energy Subsidies Rationalisation Plan**	• Implement gradual subsidy rationalisation plan through energy pricing towards market parity and cost optimisation
Strategy B4 **Achieve 100% Rural Electrification**	• Accelerate Government's rural electrification supply programme (BELB) • Explore indigenous renewable energy resources to enhance rural energy access at an affordable level and in a sustainable manner towards achieving 100% rural electrification
Strategy B5 **Optimise Hydropower Potential**	• Improve the energy mix in Sabah by harnessing and realising the full potential of Sabah's hydropower, towards strengthening and enhancing the electricity supply in the State • Increase the contribution of renewables in the energy generation mix of Sabah

Strategy B1: Implement Generation Optimisation Plan

B1	Implement Generation Optimisation Plan

Key Objective

- Ensure that the optimised Power Development Plan (PDP) is carried out accordingly based on available optimal cost and affordable energy sources coupled with key transmission development plan (i.e. Southern Link)

Description of Initiative

- Leverage on Power Development Plan (PDP) initiatives that provide specific focus on optimising generation cost
- Implement and complete the Southern Link project (275kV transmission line from Sipitang to Tawau) to leverage on the lower energy cost from the West Coast to supply sufficient power to the East Coast of Sabah whilst displacing the old uneconomical (high cost) Diesel Power Plants in the East Coast. The Southern Link project will also create a resilient grid with the necessary redundancy for the transmission system and reduce transmission system losses (compared to operating the existing single transmission line from West to East Coast)
- Leverage on available and affordable energy in the West Coast such as natural gas, hydropower and energy import from Sarawak, which would enable better supply reliability and security in the East Coast
- Explore future implementation of New Enhanced Dispatch Agreement (NEDA) to improve cost efficiency via competitive dispatch arrangement in the long term to ensure energy demand in Sabah is met at least cost

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)
- Single Buyer

Relevant Stakeholders

- Federal Government
- Sabah State Government

Implementation timeline	Initiative Type
2023 Onwards	Continuous

Strategy B2: Progress towards Effective Energy Tariff Design

B2	Progress towards Effective Energy Tariff Design

Key Objective

- Enhance implementation of tariff restructuring via Incentive Based Regulations (IBR) based on cost of supply with subsidies for targeted groups and attractive/affordable tariff to industries
- Implementation of Incentive Based Regulations (IBR) for gas asset operations upon reaching industry maturity

Description of Initiative

- Incentive Based Regulation (IBR) has begun in 2022 which includes implementing Imbalance Cost Pass-Through (ICPT) to ensure efficient and reliable electricity supply at the allowable regulated cost to cater for movement of fuel prices and cost variables
- Future implementation of IBR for gas asset operator to ensure effective return and cost of the asset operations to the consumers and operators
- Explore mechanisms of Enhanced Time of Use (ETOU) to offer different tariff rates at different times of the day
- Introduce special tariff crafted to different types of industrial and commercial consumers on a case-to-case basis
- Explore additional categories of tariffs to cater for higher voltage consumers

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)

Relevant Stakeholders

- Sabah State Government
- Sabah Electricity Sdn Bhd (SESB)
- Sabah Energy Corporation (SEC)

Implementation timeline	Initiative Type
2025 Onwards	Continuous

Strategy B3: Implement Energy Subsidies Rationalisation Plan

B3	Implement Energy Subsidies Rationalisation Plan

Key Objective

- Implement gradual subsidy rationalisation plan through energy pricing towards market parity and cost optimisation

Description of Initiative

- Rationalise electricity subsidies to ensure the long-term sustainability of Sabah Electricity Supply Industry (SESI)
- Implement tariff restructuring as per Incentive-Based Regulation (IBR) mechanism in conjunction with cost efficiency focused initiatives such as system loss reduction programmes, internal efficiency initiatives, generation optimisation plan etc[19]
- Provision of subsidies for targeted groups to ensure such groups remain protected
- Conduct assessment of gas pricing to reflect sustainable cost for upstream development whilst remaining affordable for the end users

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)
- UPEN Sabah

Relevant Stakeholders

- Sabah State Government
- Sabah Electricity Sdn Bhd (SESB)
- Ministry of Finance (MoF)
- Ministry of Natural Resource, Environment and Climate Change (NRECC)
- Ministry of Economy
- Sabah Energy Corporation (SEC)
- SMJ Sdn Bhd
- PETRONAS

Implementation timeline	Initiative Type
2025 Onwards	Continuous

Note: [19] Initiative will be elaborated further in Strategy B2 – Progress towards Effective Energy Tariff

Strategy B4: Achieve 100% Rural Electrification

B4	Achieve 100% Rural Electrification

Key Objective

- Accelerate Government's *Projek Bekalan Elektrik Luar Bandar* (BELB) programme
- Explore indigenous renewable energy resources to enhance rural energy access at an affordable level and in a sustainable manner towards achieving 100% rural electrification

- **Description of Initiative**
- Complete *Projek Bekalan Elektrik Luar Bandar* (BELB) to expand on-grid and off-grid (solar hybrid isolation station) under the Federal Government Malaysia Plan
- Facilitate the expansion of rural electrification access towards reaching 100% electrification through micro grids by optimising renewable sources such as hybrid solar and mini hydro in collaboration between non-governmental organisations (NGOs) and communities
- Explore the implementation of self-sustaining and maintenance model for mini/micro grids with renewable energy sources to ensure long-term sustainability
- Leverage on ECoS' position as regulator by coordinating both Federal Governments BELB plans as well as NGOs initiatives in achieving 100% rural electrification

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)
- Ministry of Rural and Regional Development (KKDW)

Relevant Stakeholders

- Sabah Electricity Sdn Bhd (SESB)
- UPEN Sabah
- Non-Governmental Organisations (NGOs)

Implementation timeline	Initiative Type
2023 Onwards	Continuous

Strategy B5: Optimise Hydropower Potential

B5	Optimise Hydropower Potential

Key Objective

- Improve the energy mix in Sabah by harnessing and realising the full potential of Sabah's hydropower, towards strengthening and enhancing the electricity supply in the State
- Increase the contribution of renewables in the energy generation mix of Sabah

Description of Initiative

- Acquire expert consultants and engineers to conduct a Hydropower Development Masterplan to identify and map out rivers throughout the State that wield optimal potential as future hydro power plant project sites via various technically viable schemes to further bolster Sabah's plan in increasing the share of renewables within the State's generation mix
- Introduce government-led initiatives to conduct feasibility and engineering design via Public-Private Partnership (PPP) model for potential sites from the Hydropower Development Masterplan
- Implement potential projects via competitive open bidding mechanism to ensure best tariff option and credible project proponents for project delivery

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)

Relevant Stakeholders

- Sabah State Government
- Sabah Electricity Sdn Bhd (SESB)
- Single Buyer
- Ministry of Natural Resources, Environment & Climate Change (NRECC)

Implementation timeline	Initiative Type
2023 Onwards	New Initiative

Strategic Thrust 3

Strategic Thrust 3: Environmental Sustainability
Enhance energy sector contribution towards environmental sustainability

Overall Objective
Improve energy sector contribution to environmental sustainability to support the State in meeting international climate change obligations and ambitions, as well as to ensure Sabah's economy remains attractive for international and local investments and is competitively positioned, given global ESG investing trends

Enhance energy sector contribution towards environmental sustainability

Strategies	Description
Strategy C1 **Increase Renewables Contribution to Sabah Generation Mix**	• Diversify Sabah's Generation Mix with specific focus provided to environmentally sustainable and renewable resources namely hydro, solar, bio-energy and geothermal whilst exploring other new renewables potentials
Strategy C2 **Expand Use of Bio-energy**	• Establish an appropriate State Policy to boost utilisation of oil palm biomass as source of renewable energy • Coordinate with government agencies and industry players to develop, plan and implement Sabah Biomass Industry Development Plan • Facilitate last-mile inter-connectivity for potential bioenergy plants with the nearest grid points • Explore Sabah's solid waste-to-energy (WTE) combustion potential as additional fuel source for power generation
Strategy C3 **Establish Sabah Energy Efficiency Action Plan (SEEAP)**	• Implement Sabah Energy Efficiency Action Plan (SEEAP) focusing on government policy and regulatory enablers to enhance Energy Efficiency (EE) implementation by public and private buildings, EE appliances and to promote co-generation
Strategy C4 **Transition Sabah towards a Carbon Neutral State**	• Develop implementation plan for energy transition from fossil fuels to renewable energy towards carbon neutrality in 2050 • Leverage on the national drive towards achieving Sustainable Development Goals (SDG) and Climate Change Committee (at state and national level) • Leverage on Sabah's renewable energy potentials for carbon market participation • Explore carbon taxation implications and recommendations • Introduce green mobility (electric vehicles, hydrogen, biofuel etc)

Strategy C1: Increase Renewables Contribution to Sabah Energy Mix

C1	Increase Renewables Contribution to Sabah Energy Mix

Key Objective

- Diversify Sabah's generation mix with specific focus to develop environmentally sustainable renewable resources namely hydro, solar, bio-energy and geothermal whilst exploring other new renewables potentials

Description of Initiative

- Promote Large Scale Solar (LSS) Scheme to encourage large-scale uptake of solar as energy source for generation mix
- Explore the expansion of Self-Consumption (SelCO) to further bolster encouragement of renewables uptake
- Revive the geothermal project through competitive and transparent manner
- Expand the adoption of bioenergy in Sabah energy mix[20]
- Optimise hydropower potential to be included within Sabah energy mix[21]
- Explore the implementation of Supply Agreement with Renewable Energy (SARE) to boost utilisation of renewables by non-residential consumers

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)

Relevant Stakeholders

- Sabah State Government
- Sabah Electricity Sdn Bhd (SESB)
- Ministry of Natural Resources, Environment & Climate Change (NRECC)

Implementation timeline	Initiative Type
2023 Onwards	New Initiative

Note: [20] Initiative will be further elaborated in Strategy C2 – Expand Use of Bio-energy
[21] Initiative will be further elaborated in Strategy B5 – Optimise Hydropower Potential

Strategy C2: Expand Use of Bio-energy

C2	Expand Use of Bio-energy

Key Objective

- Establish an appropriate State Policy to boost utilisation of oil palm biomass as source of renewable energy
- Coordinate with government agencies and industry players to develop, plan and implement Sabah Biomass Industry Development Plan
- Facilitate last-mile inter-connectivity for potential bioenergy plants with the nearest grid points
- Explore Sabah's solid waste-to-energy (WTE) combustion potential as additional fuel source for power generation

Description of Initiative

- Develop State Policy to mandate minimum requirement for empty fruit bunch (EFB) to be made available for bioenergy power generation
- Coordinate cooperation between government agencies and industry players to develop Sabah Green Grid (SGG) for interconnectivity to Sabah Electricity Grid to improve viability of biomass and biogas power projects
- Conduct knowledge-sharing and capacity building to advance knowledge and understanding of green technology opportunities across the Sabah Development Corridor (SDC)
- Coordinate with government agencies and industry players to develop efficient planning and approval mechanisms that will facilitate implementation pathways on all matters relating to promotion of the biomass industry
- Promote biomass investment opportunities in Sabah through appropriate financial incentives to attract domestic and international firms to invest in oil palm biomass processing and downstream product development

Stakeholders

Lead Entity

- Energy Commission of Sabah (ECoS)

Relevant Stakeholders

- Sabah State Government
- Sabah Economic Development Investment Authority (SEDIA)
- Ministry of Science, Technology and Innovation (KSTI)
- Malaysian Palm Oil Board (MPOB)

Implementation timeline	Initiative Type
2023 Onwards	Continuous

Strategy C3: Establish Sabah Energy Efficiency Action Plan (SEEAP)

C3	Establish Sabah Energy Efficiency Action Plan (SEEAP)	
Key Objective • Implement Sabah Energy Efficiency Action Plan (SEEAP) focusing on government policy and regulatory enablers to enhance Energy Efficiency (EE) implementation by public and private buildings, EE appliances and to promote co-generation **Description of Initiative** • Develop a framework that integrates components of the National Energy Efficiency Action Plan (NEEAP), with considerations made to apply to Sabah's unique circumstances and energy sector, within a Sabah Energy Efficiency Action Plan (SEEAP) • Develop initiatives to promote energy audits, management and energy efficient labelling for buildings; green mobility, encourage 5-star rated appliances, promotion of energy efficient lighting, minimum energy performance standards; and promote cogeneration • Monitor and evaluate the progress of programmes under Sabah Energy Efficiency Action Plan (SEEAP)	**Stakeholders** **Lead Entity** • Energy Commission of Sabah (ECoS) **Relevant Stakeholders** • Sabah State Government • Sustainable Energy Development Authority (SEDA) • Sabah Local Authorities • Sabah Electricity Sdn Bhd (SESB)	
	Implementation timeline	**Initiative Type**
	2023 Onwards	New Initiative

Strategy C4: Transition Sabah towards a Carbon Neutral State

C4	Transition Sabah towards a Carbon Neutral State

Key Objective

- Develop implementation plan for energy transition from fossil fuels to renewable energy towards carbon neutrality in 2050
- Leverage on the national drive towards achieving Sustainable Development Goals (SDG) and Climate Change Committee (at state and national level)
- Leverage on Sabah's renewable energy potentials for carbon market participation
- Explore carbon taxation implications and recommendations
- Introduce green mobility (electric vehicles, hydrogen, biofuel etc)

Description of Initiative

- Develop a roadmap with identified milestones commencing from 2023 to 2050
- Implement a robust carbon and greenhouse gas (GHG) inventory to determine the State's baseline and enable the tracking and monitoring of its carbon reduction initiatives
- Develop gas flaring management framework to bolster Malaysia's efforts to commit to zero continuous flaring and venting emissions
- Explore carbon capture, utilisation and storage (CCUS) concept for long-term implementation in Sabah
- Establish policies to ensure that carbon emitted within Sabah's borders comply to Verified Carbon Standard (Verra) or other recognised standards
- Comply with the standards to ensure that carbon credits are eligible for carbon trading
- Trade carbon credits in Sabah to interested purchasers through the Voluntary Carbon Market (VCM) as well as the international carbon market
- Promote the preparation for Sabah to be ready for the Carbon Border Adjustment Mechanism (CBAM)
- Explore the adoption of Virtual Power Purchase Agreement (VPPA) to expand access to renewable energy and Energy Attribute Certificates (EACs) from solar IPPs

Stakeholders

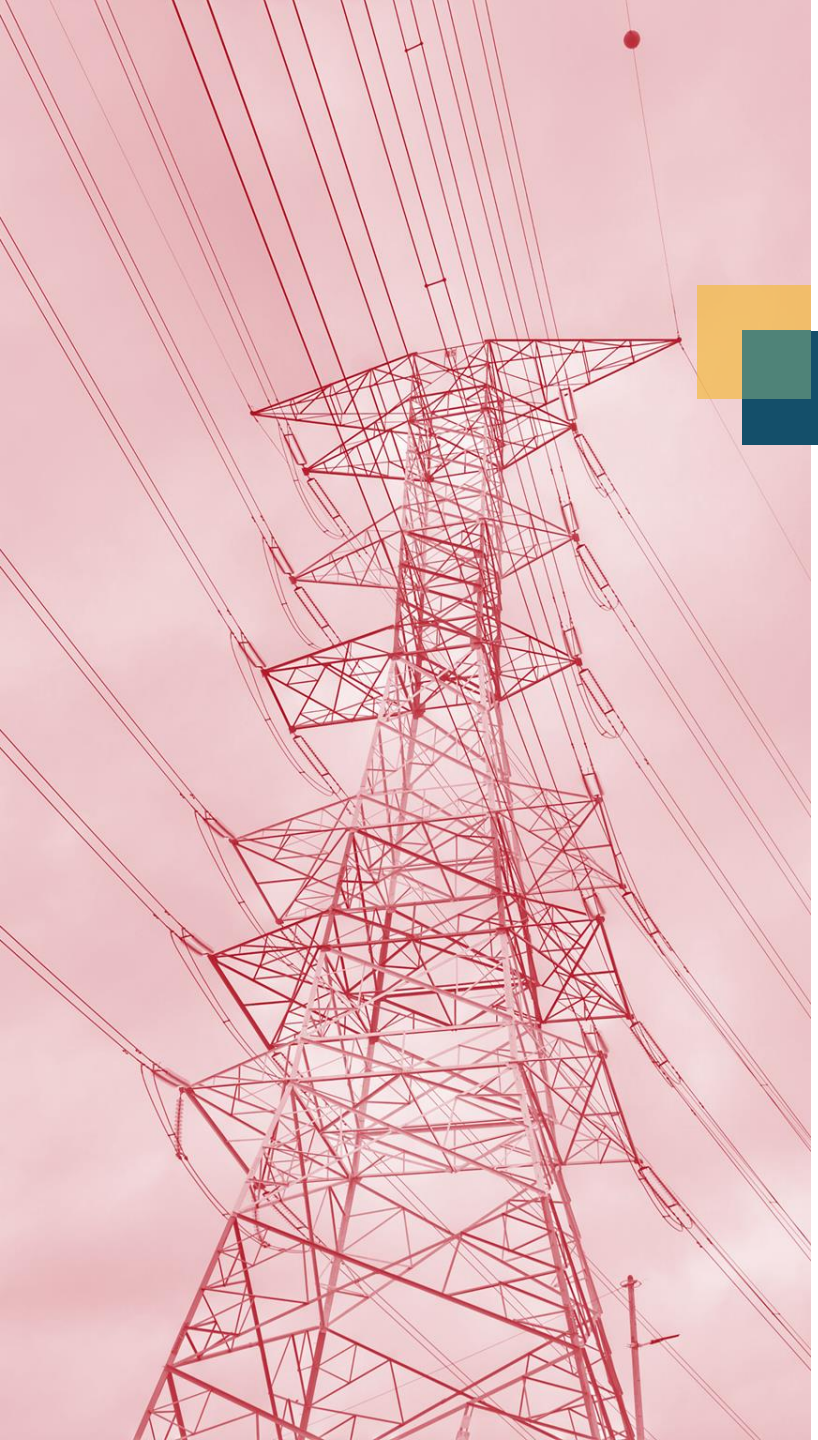
Lead Entity

- Energy Commission of Sabah (ECoS)
- Sabah Forestry Department

Relevant Stakeholders

- Sabah State Government
- Sabah Economic Development Investment Authority (SEDIA)
- UPEN Sabah
- Ministry of Industrial Development (MID)
- Bursa Malaysia

Implementation timeline	Initiative Type
2024 onwards	Continuous



07

Strategic Thrust 1: Ensuring Energy Security

Strategy A1: Achieve Operational Sustainability

Sabah Electricity Sdn Bhd (SESB) is a utility body that provides generation, transmission and distribution services to Sabah and the Federal Territory of Labuan

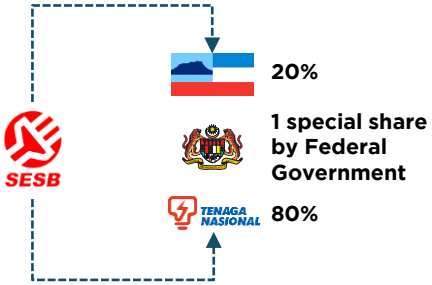
1910 – 1960s

- Up until the 1920's, there were 3 electricity suppliers:
  i. Sandakan Light & Power Co. Ltd
  ii. Jesselton Ice Co. Ltd
  iii. Labuan Rural Board
- **1957**: The North Borneo Electricity Board (NBEB) was formed consolidating the 3 suppliers

- **1963**: NBEB renamed to Sabah Electricity Board, administered under Sabah State Government

1980 – 1990s

- **1984**: Lembaga Letrik Sabah Act 278 passed and Sabah Electricity Board renamed to Lembaga Letrik Sabah (LLS) administered by the Federal Government (to ensure better allocation of funds for infrastructure development)
- **1998**: LLS was privatised and became known as Sabah Electricity Sdn. Bhd. upon its incorporation as part of Malaysia's Privatisation Masterplan



2022

Generation | **Transmission** | **Distribution**

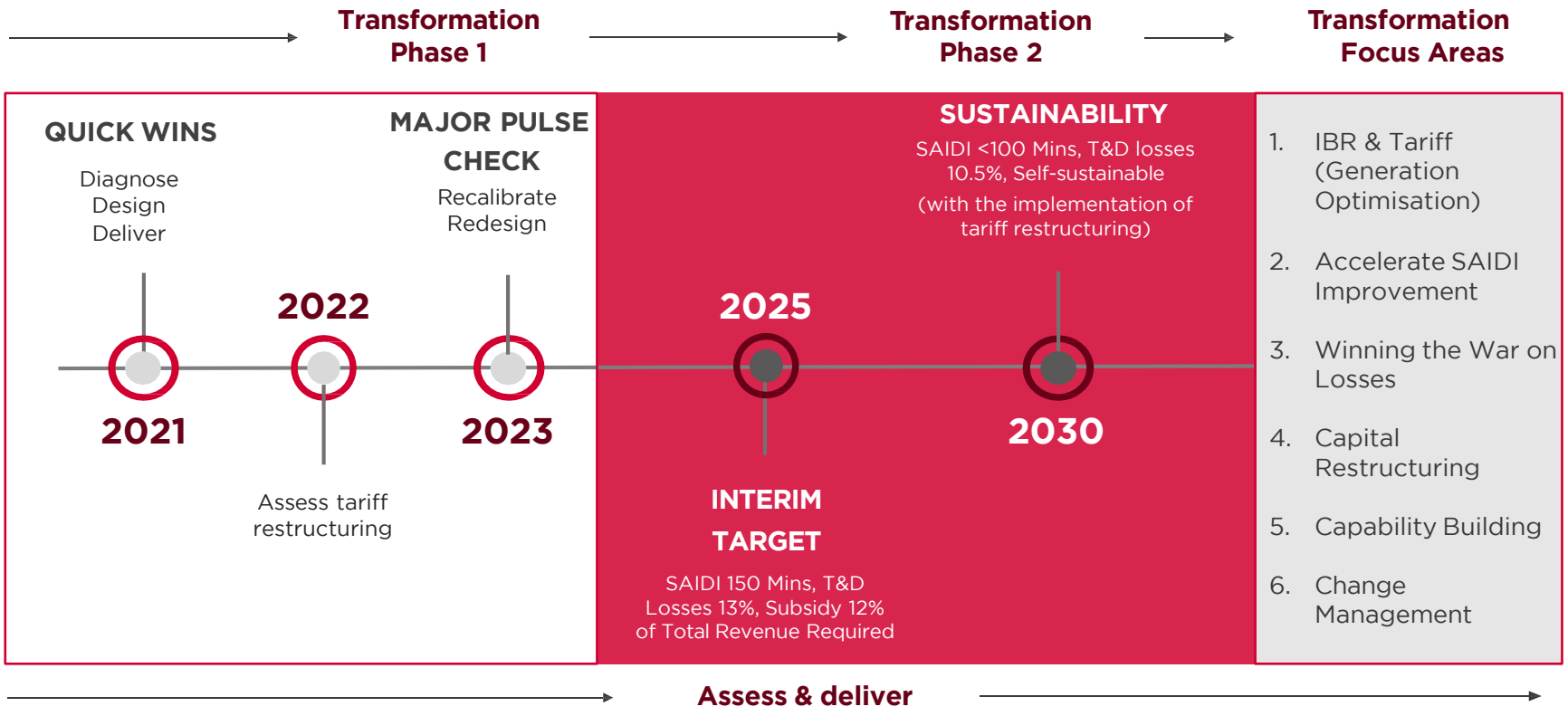
SABAH ELECTRICITY SDN. BHD. (462872-W)

- **2022**: Since the utility body's incorporation in 1998, SESB remains Sabah's only power utility and is committed to developing the electricity infrastructure in the state of Sabah and the Federal Territory of Labuan through generation, transmission and distribution, where the current Sabah main grid is composed of 275kV and 132 kV which links up all major towns in Sabah and Federal Territory in Labuan[22]
- Some remote rural areas and islands in the State, however, are powered by SESB's off-grid stations

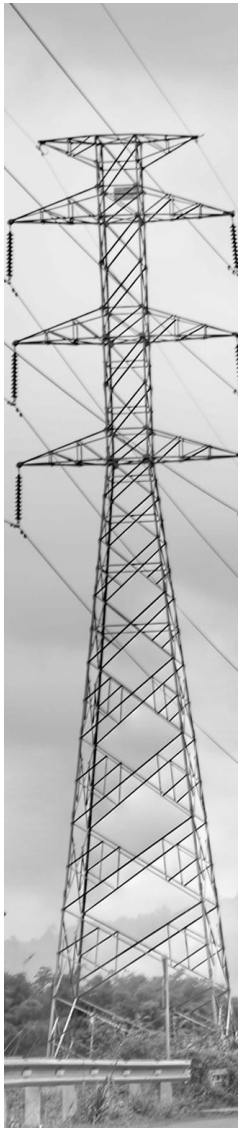
Note: [22] While SESB is the sole utility provider for the State, Sabah also has significant presence of Independent Power Producers (IPPs) for generation of electricity and several Independent Power Distributors (IPDs) that distribute and sell power to consumers within concession areas such as Kota Kinabalu Industrial Park (KKIP)

Source: Sabah Electricity Sdn Bhd (SESB), Sabah Energy Supply Outlook 2019

To improve and accelerate its performance, SESB has embarked on a comprehensive transformation with key indicators to be achieved within 2 main phases



As part of its transformation plan, three of SESB's Strategic Themes are key to realising the operational sustainability, affordability and sustainability of power supply to Sabah



PURPOSE & ASPIRATION

Adequate, affordable and sustainable power supply for Sabah & Federal Territory of Labuan

STRATEGIC THEME

01 Generation Optimisation

- Generation Optimisation focuses on increasing generation capacity with the optimal cost option, refining generation mix to reduce single fuel dependency, and reducing high generation cost by phasing out uneconomical power plants and replacing with lower cost and sustainable generation options, such as hydropower electricity, to ensure adequacy and sustainability in the medium to long term.[23] However, in the short term, SESB will still rely on natural gas as the cheapest option whilst implementing a regimented economical despatch arrangement for grid connected power plants and optimising generation outage schedule
- Additionally in the short-term, SESB is upgrading its main transmission infrastructure to allow higher power transfer of cheaper energy from the West Coast to the East Coast. SESB will also expedite the Ranau and Telupid grid connection to address costly use of diesel in these unitary power stations. In the medium term, initiatives to enhance existing assets by upgrading the capacity of cables, installation of a trash diverter for a key hydropower plant to increase its availability and expedite Southern Link will be the key initiatives

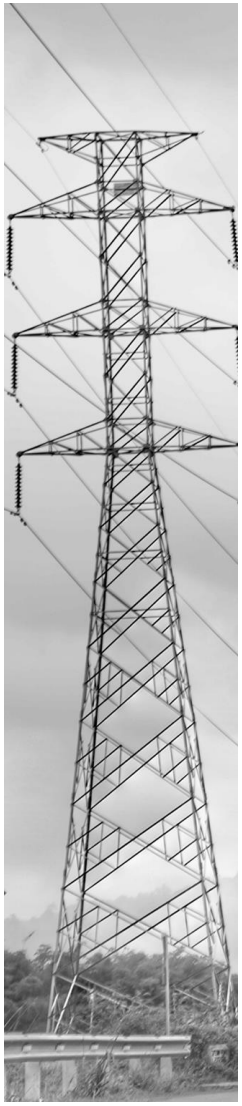
02 Generation, Transmission & Distribution Adequacy & Reliability

- This strategic theme focuses on expediting Game Changing Projects for upstream adequacy, intensifying system improvement projects as well as moving towards operational excellence
- For Generation to meet short term needs, SESB will focus on repowering existing IPPs and SESB's plants while for the longer term, the plant-up in strategic theme 1, Generation Optimisation, will require timely implementation[24]
- For Transmission (275kV & 132 kV), the main initiatives are to complete the 275kV main Sabah Grid backbone to complete the loop (Sipitang – Tawau i.e Southern Link), 132kV networks and PMUs at major towns with complete loop system and to establish N-1 source, transmission network reinforcement in Kota Kinabalu, and cross border interconnection with Sarawak
- For Distribution (33kV & 11kV) upstream adequacy, new PPUs and injection points will be added to cater for load growth
- To greatly improve its 11kV system reliability, SESB will extensively replace AAC with ABC in sections which contribute to interruption incidents, establish ring system for urban and suburban areas and utilise new technology for faster fault detection and restoration of supply
- Operational excellence will focus on asset management best practices in preventive and corrective maintenance of assets, such as condition-based monitoring with use of technology, 'live line' and 'live substation' maintenance, rentice management for distribution networks by embracing technology and digital transformation, as well as building up its technical capabilities

Note: [23, 24] Refer to p. 96 for the Power Development Plan (PDP) 2022

Source: Sabah Electricity Sdn Bhd (SESB) Transformation Plan 2022 – 2030

As part of its transformation plan, three of SESB's Strategic Themes are key to realising the operational sustainability, affordability and sustainability of power supply to Sabah



PURPOSE & ASPIRATION

Adequate, affordable and sustainable power supply for Sabah & Federal Territory of Labuan

STRATEGIC THEME

03 Winning The War On T&D Losses

- Strategic Theme 3 aims to intensify System Loss reduction initiatives through a two-pronged approach. The first is to reduce nontechnical losses which are mainly due to pilferage, tampering of meters or associated equipment, metering and billing accuracy issues. The second is to reduce technical losses which are inherent in the transmission and distribution systems due to configuration of the networks, type of conductors and transformers in the system, which require capital heavy investment to improve and extensive period of implementation
- Initiatives for non-technical system loss reduction focuses on use of remote meter reading (RMR) and Smart Meters for selective customers, provide routine change of obsolete and ageing meters as well as introduce data analytics software for monitoring consumption patterns and to improve data integrity checks. To further support the initiative, close collaboration with PDRM and other authorities to address theft of electricity in squatter areas such as strike force operations, prosecution, and controlled supply by third party through the use of pre-paid meters are also being proposed
- From a technical loss reduction, the on-going replacement of bare conductors (AAC) with aerial bundled cables (ABC) in high SAIDI areas and gradual replacement to other areas will bring added benefits of technical loss reduction. Other initiatives are reconfiguration of the transmission and distribution networks, improve voltage regulation such as installation of static synchronous compensator (STATCOM) at transmission level and VAR compensators at distribution level

Source: Sabah Electricity Sdn Bhd (SESB) Transformation Plan 2022 – 2030

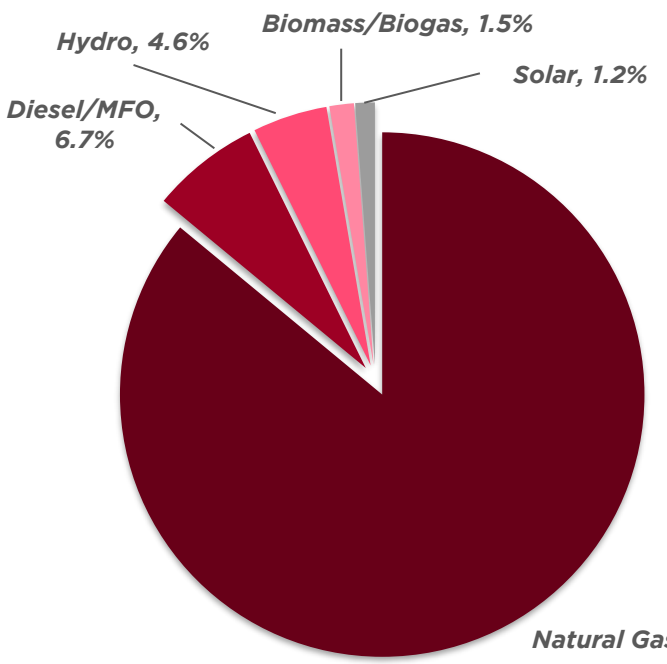
Strategy A2: Establish State Policy for Indigenous Energy Resources

Natural gas represents 86% of Sabah's generation mix in 2021, followed by diesel and MFO, hydro, biomass and biogas, and solar

Sabah Generation Mix, 2021

%

Total Dependable Capacity: 1,179 MW



Key Highlights

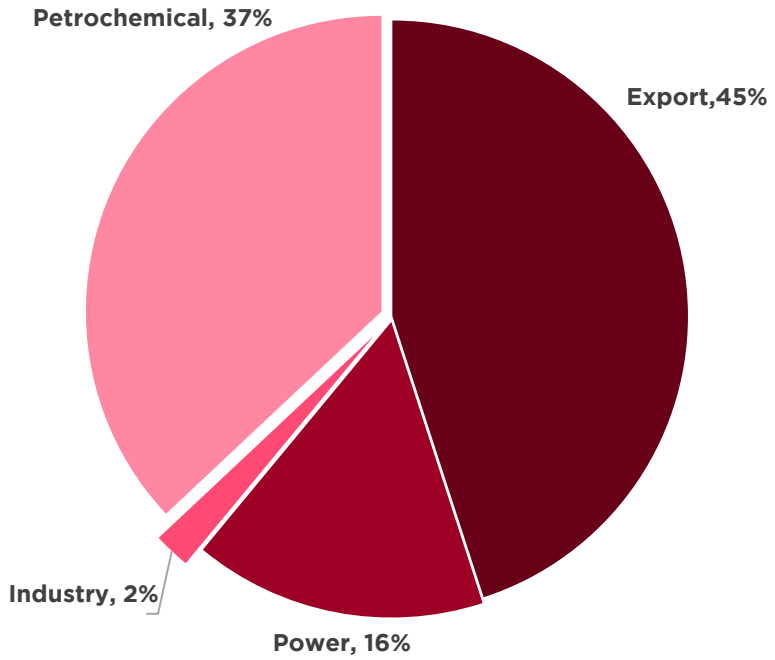
- Sabah is one of the largest gas producing states in Malaysia, contributing approximately 8% of Malaysia's total gas production in 2018
- Based on the trend between 2019 to 2021, Sabah has been heavily reliant on natural gas as its main source of energy for its overall generation mix. In 2021, natural gas makes up the largest share of Sabah's generation mix at 86%. For the past three years, the reliance on natural gas has seen a slight increase from 82.7% in 2019 to 86.2% in 2020 and a slight decline of 0.2% in 2021 to 86%
- As for diesel, the State has seen a slight decrease of its usage in the generation mix from 7.7% in 2019 to 4.9% in 2020. However, in 2021, the share of diesel increased to 6.7%
- Meanwhile, the reliance on renewable energy sources as part of the generation mix has seen a steady decline from 2019 to 2021. In 2019, renewable energy contributed 9.7% to the share of Sabah's generation before declining to 8.8% in 2020 and 7.3% in 2021

Source: Sabah Electricity Sdn Bhd (SESB) Annual Report Card 2019 – 2021, Sabah Gas Masterplan

Only 16% of Sabah's natural gas production is utilised for power generation domestically, whilst most of the gas is used for petrochemical, industry and is exported abroad

Sabah Gas Supply Allocation, 2019
%

Total Supply (2019): 986 MMscfd



Key Highlights

- In Sabah, natural gas is domestically utilised for power generation, feedstock for petrochemicals and fuel gas for industries
- In 2019, the State produced a total of 986 MMscfd of gas through its four main hydrocarbon receiving points namely – Sabah Gas Terminal (SBGAST), Sabah Oil and Gas Terminal (SOGT), Labuan Gas Terminal 1 (LGAST 1) and Labuan Gas Terminal 2 (LGAST 2)
- From this amount, Sabah has committed 45% for exports, 37% for petrochemical manufacturing, 16% for power generation and 2% for other industries
- This presents a challenge for the State to ensure its energy sustainability in the future as the cost of gas production becomes higher. Moving forward, the State aims to utilise its natural gas domestically to drive more vibrant and sustainable economic activities within the state

Source: Sabah Gas Masterplan

Developing fitting natural gas policies for Sabah is imperative to strike a balance between economic returns and long-term benefit to the State

Policy Direction and Consideration for Sustainable Indigenous Resources Production and Utilisation

Guided by SDG 12 (Responsible Consumption and Production) and UN's Sustainable Consumption and Production Policies, Sabah will focus on coordination with the relevant policy makers and stakeholders under the principles of:

- **Decoupling environmental degradation from economic growth.** Focusing on doing more and better with less, which involves increasing net welfare gains from economic activities and reducing resource use, while increasing quality of life
- **Applying sustainable life cycle practice and procurement process.** Focusing on sustainable management of resources and achieving resource efficiency along both production and consumption phases of the lifecycle, including resource extraction, the production of intermediate inputs, distribution, use, disposal and re-use
- **Seizing opportunities for development.** Focusing on greater opportunities such as new markets creation, green and sustainable jobs as well as more efficient, welfare-generating natural resource management. It is an opportunity to "leapfrog" to more resource efficient, environmentally sound and competitive technologies

Development of State Policies for Sustainable Gas Production in Sabah

Potential priorities of the state policies for sustainable indigenous resources production in Sabah:

- Establishing comprehensive analysis of the medium to long term reserve and resource potentials in the state in joint-cooperation with other key stakeholders such as PETRONAS, UPEN Sabah and other government agencies
- Opportunity identification and assessment to achieve the highest sustainable economic growth, employment creation and a higher standard of living, whilst maintaining financial stability of the State and the country
- Long term development planning towards contributing to sound Sabah economic expansion in the process of economic development
- Adopting a sustainable public procurement (SPP) process to optimize the value for money on a whole life-cycle basis in terms of generating benefits to the state economy, rakyat and relevant organizations, whilst significantly reducing negative impacts on the environment

Source: UN Environment Programme's Sustainable consumption and production policies, UN Sustainable Development Goals

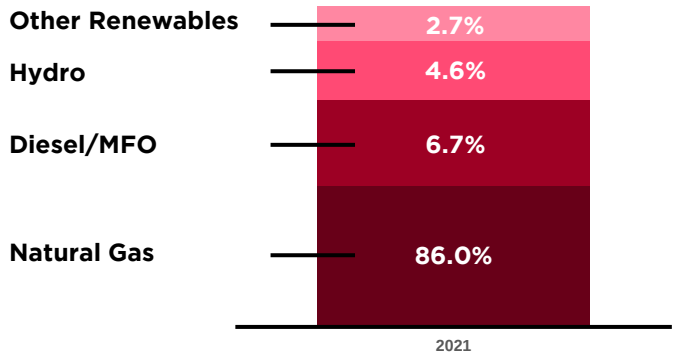
Strategy A3: Improve Generation Energy Mix

Sabah aims to reduce its reliance on natural gas from 86% to 55% and increase the share of renewable energy in its generation mix from 7% to 35% by 2035

Power Generation Mix, 2021

%

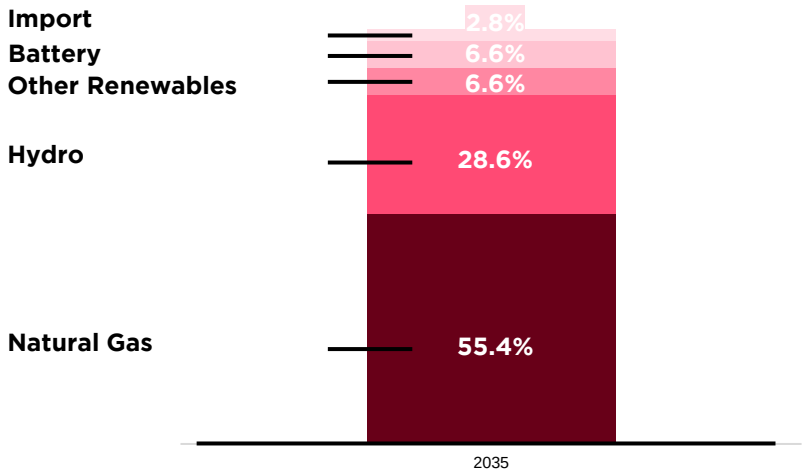
Total Generation Capacity: 1,179MW



Future Generation Mix Target, 2035

%

Total Generation Capacity: 1,805MW[25]



Key Highlights

- As Sabah is bestowed with an abundance of natural gas deposits, the State has been heavily reliant on natural gas as its main source of energy for power generation. Between 2019 to 2021, the reliance on natural gas has consistently been over 80% for the State's overall generation mix. Being a cleaner energy source option compared to other fossil fuels, natural gas is the best fit as a key alternative energy source in bridging towards a sustainable renewable energy transition in Sabah

- In 2035, the State aims to achieve approximately 35% renewable energy share in its generation mix, which mainly comes from hydro. Sabah anticipates a significant growth contribution from hydro from 6.6% to 28.6%, supported by its upcoming projects such as Upper Padas Hydroelectric Plant. Other sources of renewables will be drawn from other renewables, which include solar and biomass. However, this share is expected to increase further depending on the reactivation of the geothermal project in Apas Kiri, Tawau as well as new potential renewable energy resources that may be discovered in the State

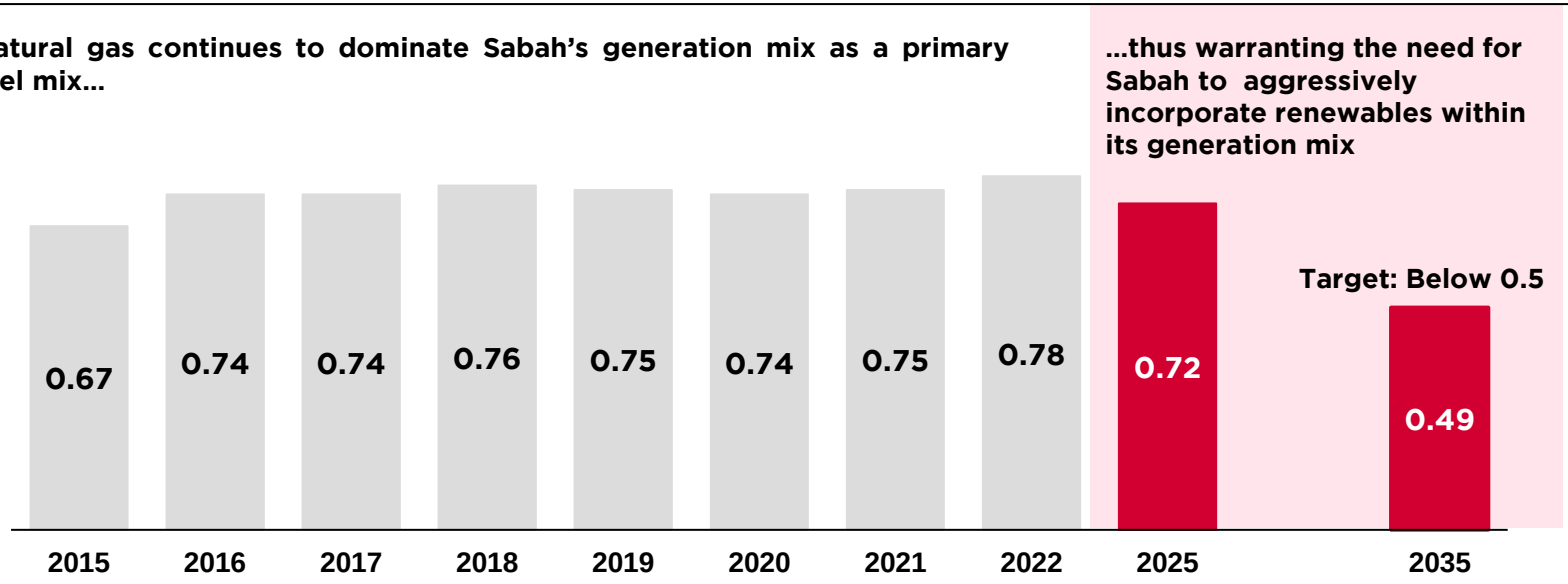
Note: [25] 6.6% of Future Generation Mix Target (2035) is intended to derive from Battery Energy Storage System (BESS) however, future implementation of BESS is to be later determined based on its economic viability

Source: Sabah Electricity Sdn Bhd (SESB)

Thus, in order to achieve its target of below 0.5 HHI by 2035, Sabah will need to aggressively incorporate new source of energy, especially renewables, into its generation mix

Sabah Herfindahl-Hirschman Index (HHI), 2015-2035

Index



Key Highlights

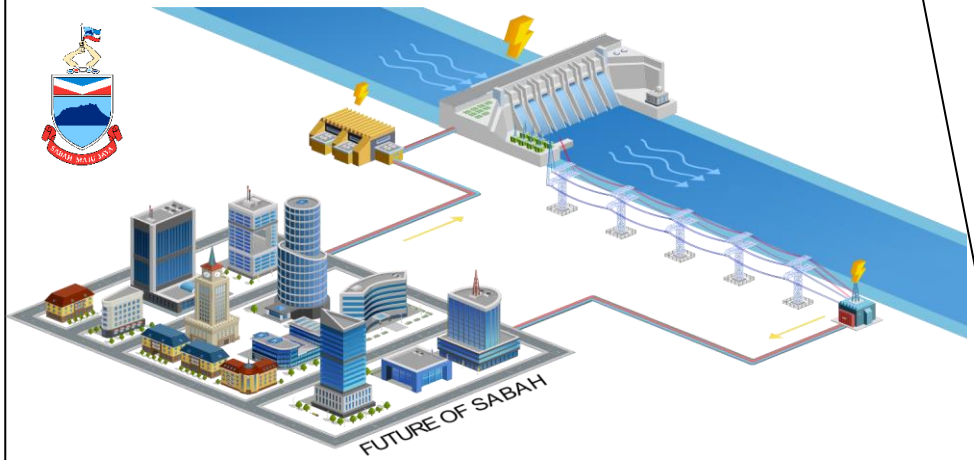
- From 2015 to 2019, Sabah's fuel mix showed an increasing dependence on gas as a primary fuel source and, in a Business-As-Usual (BAU) case, the State's generation mix is expected to see the State's HHI increase from 0.75 in 2021, to 0.78 by 2022 and plateau to 0.72 by 2025
- To mitigate this reliance on natural gas, Sabah will focus on diversifying its energy mix from natural gas dependency towards incorporating new sources of energy, especially more renewables, in order to achieve its HHI target of below 0.5 by 2035

Note: The Herfindhal-Hirschman Index (HHI) score measures the diversity of generation mix by fuel types whereby the lower the score, the higher the fuel diversification and energy security

Source: Suruhanjaya Tenaga, Sabah Electricity Sdn Bhd (SESB)

A key contributor to improving Sabah's generation mix will largely depend on the State's natural renewable energy resource, especially the State's hydropower

Hydropower Project in Sabah



Current Committed Hydropower Projects:

No.	Project	Scheduled Completion
1.	Telekosang 1 & 2 (40MW)	2023[26]
2.	One River Power (5.6MW)	2024
3.	Upper Padas (180MW)	2029
	TOTAL MW: 225.6MW	

Committed projects will boost hydropower contribution to generation mix up to 30% by 2029

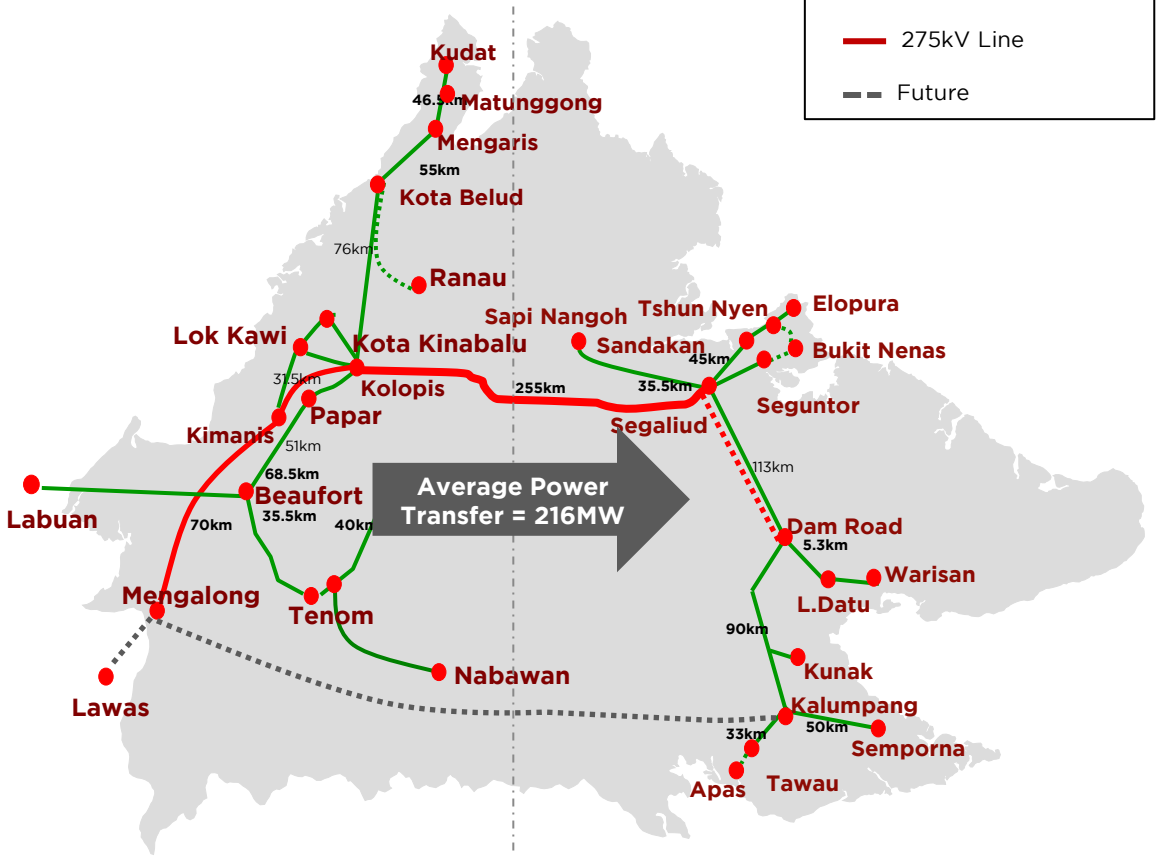
Key Highlights

- In 2019, the Malaysia Renewable Energy Roadmap (MYRER) identified Sabah's total hydro potential at 1,100MW, equating to 14% of Malaysia's total large hydro potential
- As of 2022, Sabah's current available hydro capacity stands at 102MW, contributing to 4% of Sabah's generation mix
- Thus, the Upper Padas Hydroelectric Plant (UPHEP) will kick off leveraging Sabah's hydro potential - a 180 MW power generation facility, associated transmission lines and infrastructure and water reservoir will be constructed
- The project is set up to meet the load forecast where Sabah's electricity demand is expected to increase by 35% from 1,003 MW in 2021 to 1,350MW in 2030
- An additional 170MW hydropower is also expected to contribute to the generation mix in 2027

Note: [26] Completed as of February 2023
Source: Sabah Electricity Sdn Bhd (SESB)

Strategy A4: Improve Generation Reserve Margin

As of 2021, Sabah's generation reserve margin is below industry standard at 16.7% primarily due to absence of new additional generation



Key Highlights

Generation Limitations

- In the East Coast, there are **limited viable fuel options** for its plants
- Addressing peak demand shortages requires **dispatching of ageing local diesel/MFO plants**

Network Constraints

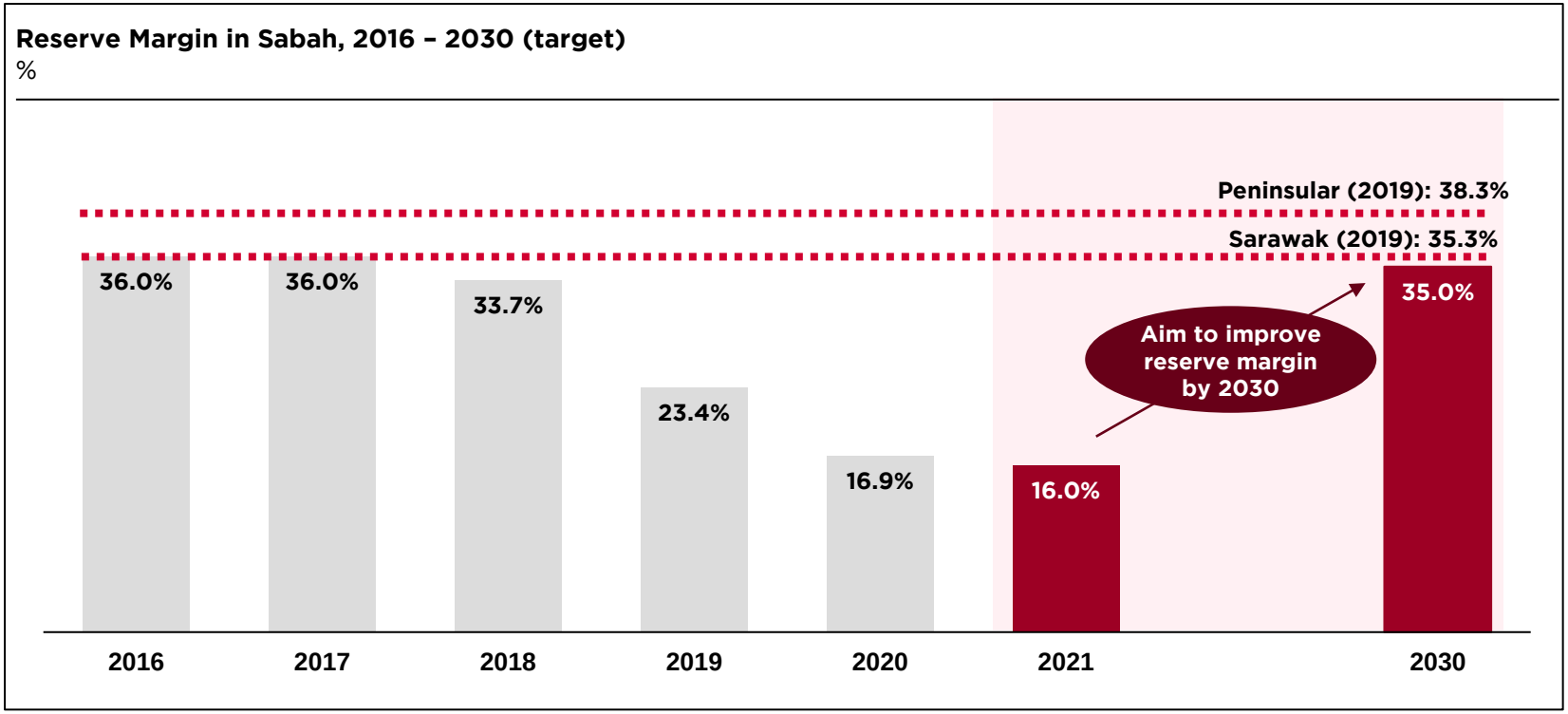
- **High reliance on West-East Link** and **limited transfer capacity** of transmission lines
- Occasional brownouts due to insufficient generation capacity
- Delays in planning and construction of new plant-ups lead to the need for decommissioned plants to be reactivated

Reserve Margin

- **West Coast:** +44%
- **East Coast:** -55%

Source: Sabah Electricity Sdn Bhd (SESB) Generation and Transmission Data Assessment

Sabah aims to improve its generation reserve margin towards industry standards of between 30% to 35% by 2030 to cater for anticipated large demand



Key Highlights

- Due to increasing peak demand and declining capacity over the years, Sabah has seen a significant decline in its reserve margin relative to Sarawak and the Peninsular
- As the State anticipates larger demand for electricity in the future, particularly in achieving the industrial development agenda, Sabah aims to achieve a reserve margin of between 30% to 35% by 2030 to ensure reliability of electricity supply during high demand periods

Source: National Energy Balance 2017 – 2019

To enhance the generation reserve margin, the Power Development Plan 2022 has laid out initiatives to develop the required infrastructure[27]

Year	West Coast	East Coast	Retirement
2023 to 2025	1. Hydro (57MW) 2. Large Scale Solar (23MW) 3. Gas (290MW) 4. Sarawak-Sabah Interconnection (30MW) 5. Biogas (2.4MW)	1. Biogas (6.8MW) 2. Large Scale Solar (40.9MW) 3. New BESS (120MW)[28]	1. Gas Turbine (15MW) 2. Tawau Canopy (8MW) 3. Hydro (2MW) 4. Oil (126.4MW) 5. Gas (90MW)
	1. Enhanced Sabah East-West Grid (SEWG) from West to East 2. Southern Link (275kV Mengalong-Tawau)		
2026 to 2030	1. Hydro (357MW) 2. Sabah-Sarawak Interconnection (+20MW) 3. New Plant (90MW)		1. Oil (63MW) 2. Gas (387.8MW)

Journey towards Optimum Reserve Margin[29]:

2024-2025 28%

2026-2027 29%

2028-2030 31%

Note: [27] The Power Development Plan may be subject to change and does not include other source of energy currently explored including synthesis gas (IGCC), additional Sarawak import, new hydro potential and geothermal; [28] New BESS may also be subject to change based on economic viability of project; [29] Optimum Reserve Margin is based on JPPPET Sept 2022, However, this may be subject to change

Source: Power Development Plan 2022

Strategy A5: Develop Integrated Gas Masterplan

The natural gas industry in Sabah can function as the nucleus to catalyse the development of other sectors and optimise economic returns to the State

Potential Spin-Off Options of Natural Gas

440 MMscf

Potential Spin-offs

LNG

(320 MMscfd)

Petrochemical Derivatives

(Leverage Existing Petrochemical Products)

Commercial & Others

(120 MMscfd)

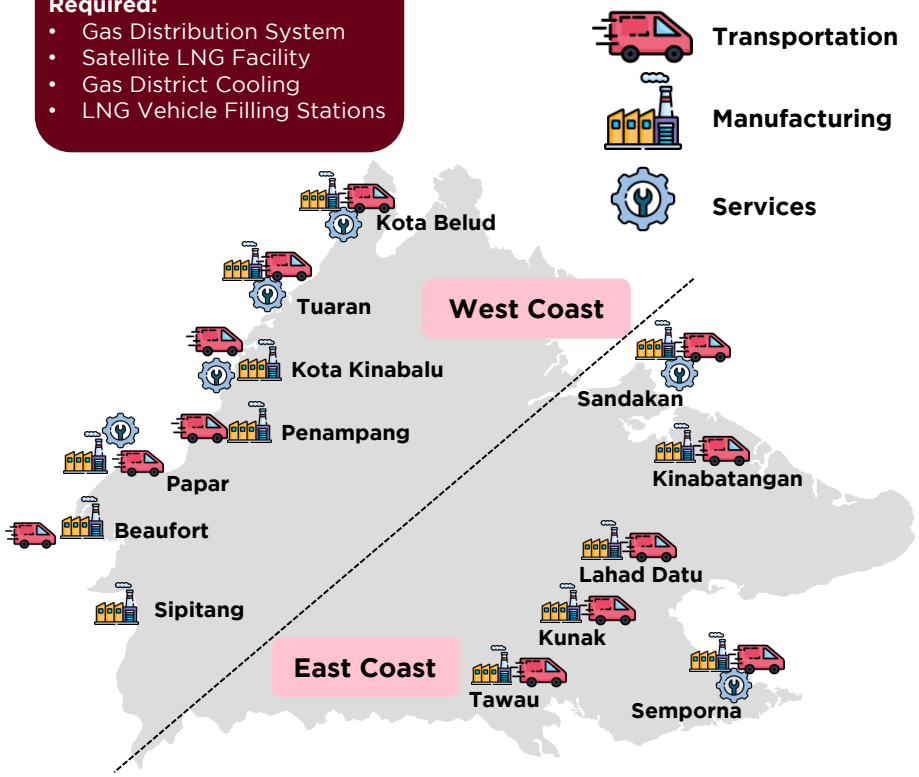
Key Highlights

- With a growing economy and population as well as increasing push for cleaner energy, demand on liquefied natural gas (LNG) from both local and international industry is expected to increase over the long term
- The 2.6 Tscf of gas available in the West Coast identified by PETRONAS can be translated into a sustainable flow of approximately 440 MMscf per day of gas
- Given the huge potential of economic benefits, PETRONAS is open to build, own and operate a 2.0 Million Tonnes Per Annum (MTPA) LNG plant in Sabah with a location selected based on a study performed in 2022
- A 2.0 MTPA LNG plant in Sabah will generate both direct and indirect benefits to the State of Sabah. Directly, the plant itself will create employment opportunities for qualified Sabahans during construction, operation and turnaround of the plant and its ancillary facilities
- On top of the direct benefits, the 2.0 MTPA LNG plant also has the potential to unlock new business opportunities for the State via an LNG Virtual Pipeline System (VPS) which will enable Sabah to extend gas supply to gas users across the State without the need to invest significantly in pipeline infrastructure

Source: Sabah Gas Masterplan

Lack of infrastructure and fragmented customer market in Sabah pose a challenge for the State's gas market

West Coast Infrastructure Required:
- Gas Distribution System
- Satellite LNG Facility
- Gas District Cooling
- LNG Vehicle Filling Stations



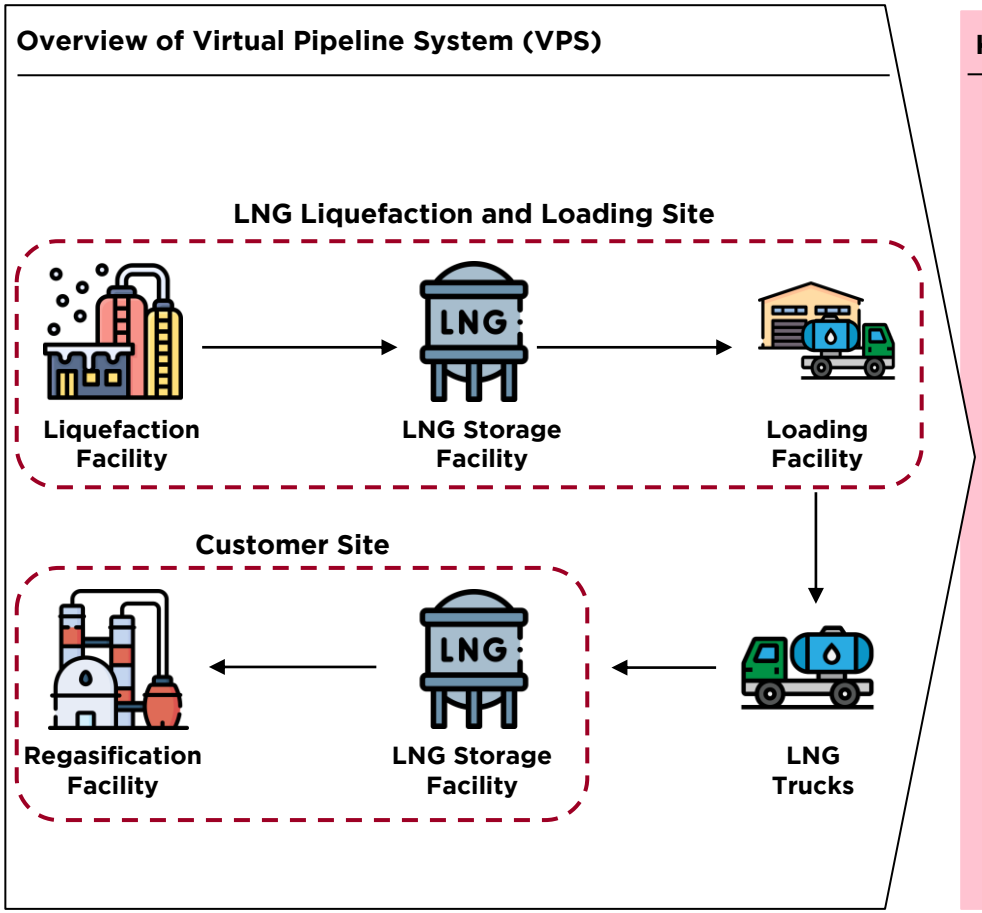
East Coast Infrastructure Required:
- Satellite LNG Facility
- LNG Vehicle Filling Stations

Gas Market in Sabah

- The gas markets in Sabah are divided into two; the West Coast and the East Coast. The West Coast of Sabah is predominantly served via pipelines while the East Coast requires LNG VPS due to both the lack of infrastructure and a fragmented customer market
- While 16% of demand for Sabah's natural gas is for the power sector, there is a growing use of natural gas in the commercial and industrial segments within Sabah. For example, commercial and industrial gas users, such as the manufacturing and tourism and hospitality sectors, utilise natural gas for heating and powering core facilities
- With growing manufacturing, service and transportation sectors in Sabah, the State can expand the LNG VPS. Industries and businesses that benefit from natural gas can spur substantial job creation across Sabah as the new investments targeted are labour intensive
- The 120 MMscfd of natural gas is planned to be monetised through supply to industries and commercial customers via pipeline distribution. Combined with LNG VPS, the State will have a portfolio of gas sources to better meet the needs of industrial and commercial customers across Sabah as a gas marketer

Source: Sabah Gas Masterplan

Developing a Virtual Pipeline System (VPS) serves as a solution for customers that are not connected to conventional gas transmission and distribution network



Key Highlights

- Virtual Pipeline System (VPS) allows supply of gas to customers that are not connected to conventional gas transmission and distribution pipeline network. The system allows compressed or liquefied natural gas to be distributed in purpose-built tanks via trucks and trains
- The system is adopted to extend gas supply to areas not within gas infrastructure vicinity, where gas demand is not sizeable enough to make pipeline construction commercially feasible however, in the long term, upon financial and commercial viability, the State will consider the development of a physical gas pipeline. This enables small volume gas users to utilise energy which is generally more economical than oil.
- The VPS can be developed on a modular concept, which allows scaling up on infrastructure in proportion to demand
- VPS is already being utilised in countries such as Australia, Canada, China, Europe and USA, and is expected to be further adopted in several other countries as the concept gains more traction

Source: Sabah Gas Masterplan

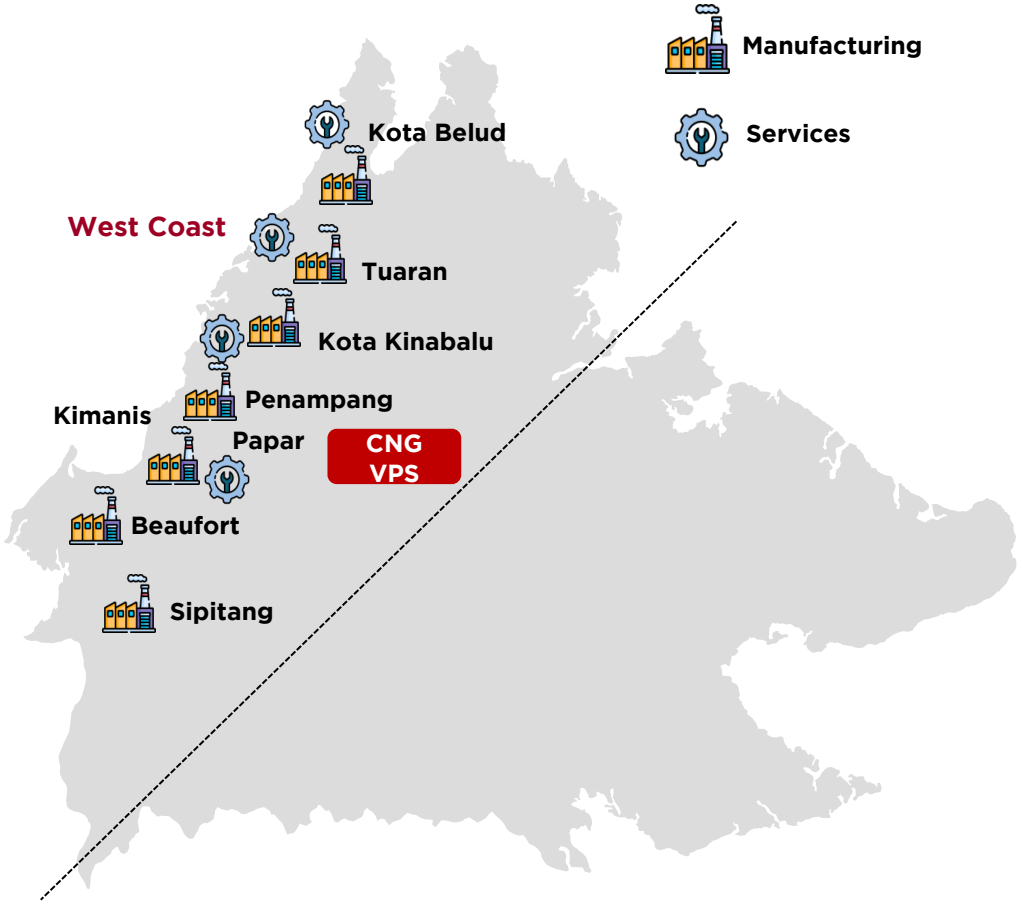
Improving gas infrastructure will provide Sabah with various potential economic benefits

Potential Economic Benefits from Gas Use in West Coast Sabah

- The use of traditional fuel such as diesel and liquefied petroleum gas (LPG) among the industries and business is still prevalent in the West Coast of Sabah. Switching to natural gas from traditional fuel would benefit these industries and businesses as gas is generally cheaper compared to diesel and LPG, thus lowering the cost of doing business in the long run

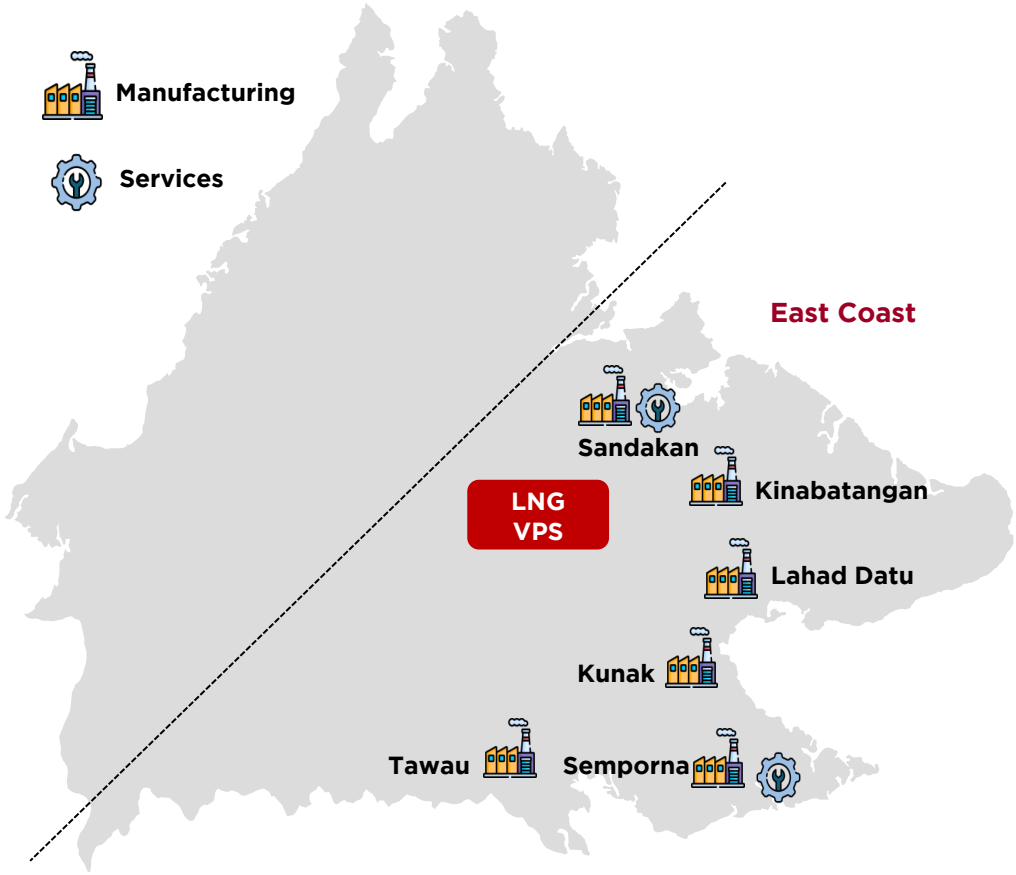
- Sabah can leverage from the use of natural gas to accelerate the growth of manufacturing and service sector in the State. For instance, the West Coast has huge potential to develop a large-scale glass manufacturing operation, utilising silica as raw material and supported by the supply of natural gas of up to 48 MMscfd

- For the service sector, potential new developments in Lok Kawi and Tanjung Aru can be supported by gas supply to hotels, resorts and commercial building facilities. With strengthened gas pipeline investment in these areas, further developments along the gas links to Sabah Oil & Gas Terminal (SOGT) can be expected in the future[30]



Note: [30] In the West Coast of Sabah, gas is supplied via CNG VPS as well as pipeline to five power plants in KKIP and Kimanis totaling 137 MMscfd
Source: Sabah Gas Masterplan

Improving gas infrastructure will provide Sabah with various potential economic benefits



Potential Economic Benefits from Gas Use in East Coast Sabah

- Similar to the West Coast, most industries and businesses operating in the East Coast of Sabah utilise diesel and LPG as fuel for processes and core facilities. Some existing gas users in the East Coast are agriculture-based manufacturing businesses in Sandakan, Kunak, Semporna and Tawau. These businesses rely on diesel for fuel before switching to gas
- Leveraging the use of natural gas can benefit various industries in the East Coast. For instance, the supply of gas can benefit the agriculture-based manufacturing operations in Lahad Datu such as the Palm Oil Industrial Cluster (POIC). Another prospect may be Sandakan, which has been earmarked to become a future furniture manufacturing hub
- Due to the fragmented nature of both existing and potential natural gas users in the East Coast, Sabah should rely on VPS to allow access to gas and keep logistics cost affordable for industries and businesses in the East Coast. Gas will be transported as LNG via VPS to customer sites, where each would have their own regasification facilities, to convert the LNG into its gaseous state for consumption
- Additionally, Sabah needs to continuously explore the potential new sources of gas in the East Coast to ensure continuing feedgas in the area

Note: Gas users in the East Coast are supplied in natural gas as LNG from SEC's micro-LNG facility in KKIP. Liquefaction reduces the volume of gas by a factor of 600 times, hence enabling more gas volume to be transported in a single ISO tank, which makes it more economical

Source: Sabah Gas Masterplan

Construction of 2.0 MTPA LNG Plant in Sabah is key to spark interests of investors to the state and presents multiple opportunities for spin-offs for Sabah

Benefits of 2.0 MTPA LNG Plant

- An LNG plant in Sabah would place the State on the global map as a player in the LNG exporter club
- Immediately create approximately 100-150 jobs for the operations and maintenance of the plant, requiring 70-75 per cent skilled manpower with the remainder requiring semi-skilled manpower
- Job opportunities during construction and plant turnaround will be available, requiring both skilled and semi-skilled manpower
- Beyond that, there will also be spin-off industries close to the plant to meet the needs of the individuals working on-site such as food and beverage, accommodations and others
- If Sabah State were to invest in the plant via equity participation, the LNG plant can potentially generate future income stream for the State through annual dividends

Spin-Off Opportunities for Sabah

Income for Sabah via equity participation
Potential future income stream for Sabah State via dividend payments

Enhances reach of gas supply via Virtual Pipeline System (VPS)
Business opportunity through investment in loading and storage facility

Widely distributed employment creation
Direct jobs created in the long term: Up to 360 across Sabah

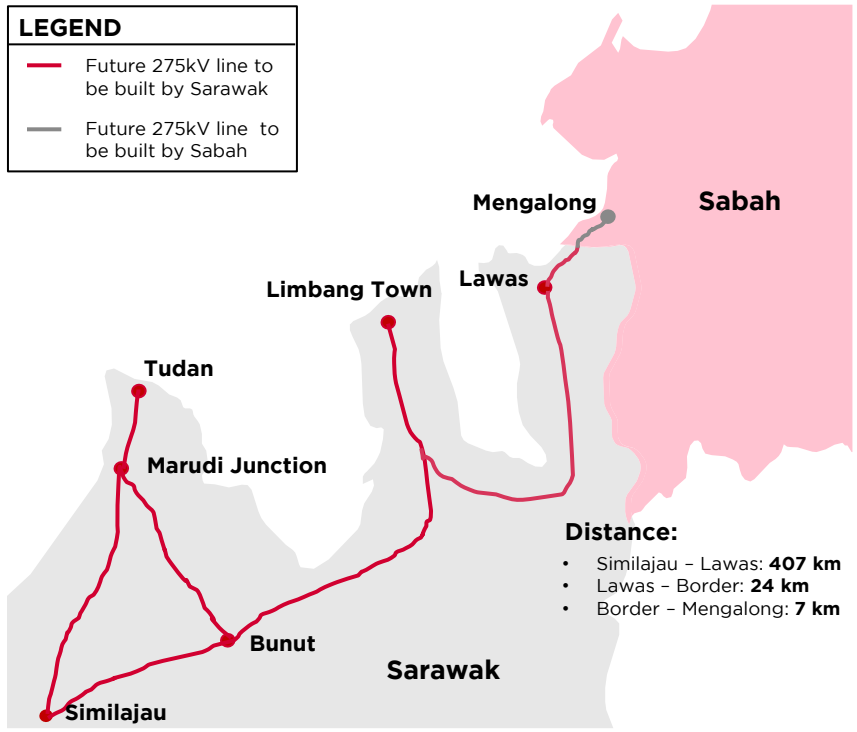
Unlocks potential future businesses
This includes LNG ISO regional distribution and LNG Bunkering

Source: Sabah Gas Masterplan

Strategy A6: Establish Resilient Cross-border Interconnectivity

Sabah will leverage on the State's proximity to Sarawak by implementing an effective cross border interconnectivity to improve system security and supply contingency

Interconnection point from Sarawak to Sabah



SNAPSHOT OF BENEFITS

1. Less frequency dip and this will reduce under frequency load shedding and blackout
2. Greener option for Sabah due to hydro utilised as source

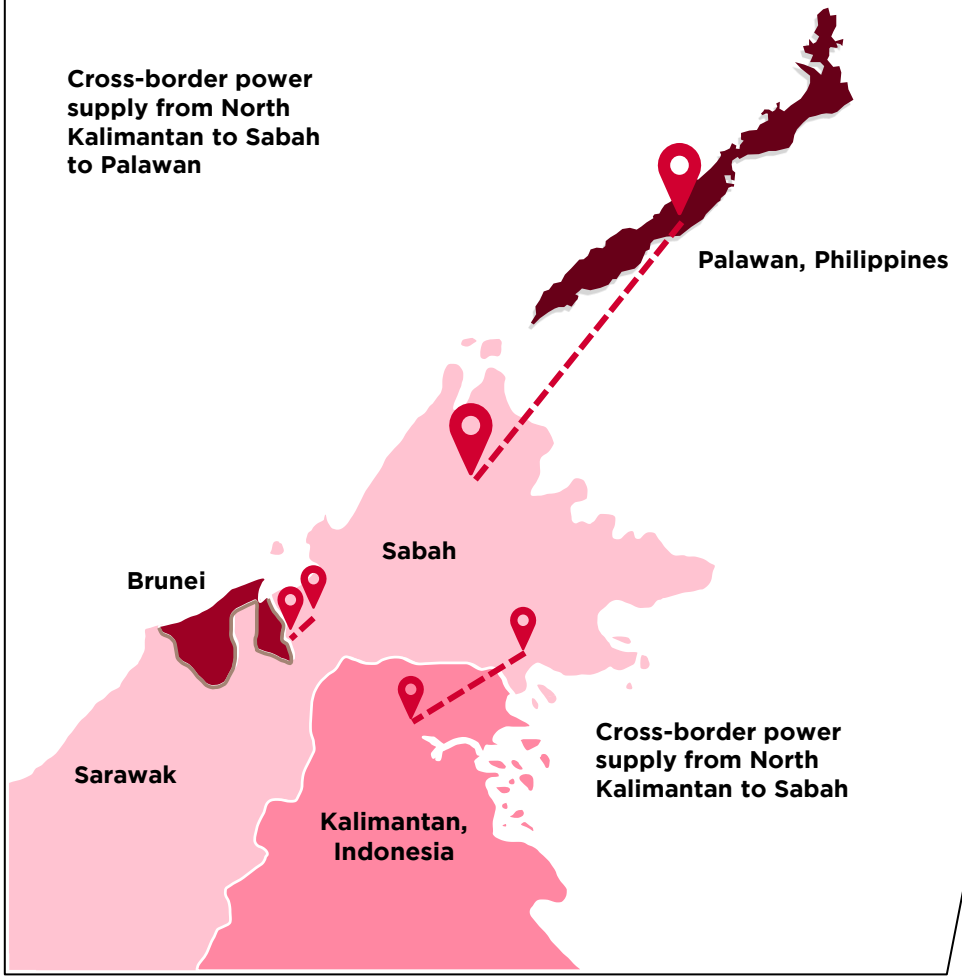
Key Highlights

- The interconnection will connect the future substation in Lawas, Sarawak to the substation in Mengalong, Sabah. This will begin with an initial export of 30 MW and eventually 50MW for a term of 15 years via a 31 km 275 kV double circuit transmission line. The interconnection will diversify Sabah's generation mix and reduce need of generation plant up for peaking.
- The interconnection with Sarawak is a strong and economical option for system security and stability to cater for future demand in Sabah. The interconnection link presents multiple benefits to Sabah especially in improving the State's reserve margin and spinning reserve of generation capacity. The interconnection to a larger system will stabilize Sabah's system, such as from intermittent solar power or sudden power shortage, hence, reinforce Sabah's security of electricity supply.
- By tapping into the Sarawak interconnection, Sabah can expect to benefit from minimised under frequency load shedding, gain larger allowable generator sizes and enjoy lower generation and operational costs of electricity supply.

Source: Sabah Electricity Sdn Bhd (SESB)

Interconnection between Sarawak and Sabah will also empower Sabah to power wheel to the neighbouring regions hence leveraging on the State's position within BIMP-EAGA

Sabah Cross-border Interconnectivity with North Kalimantan, Indonesia and Palawan, Philippines



Key Highlights

- Dubbed the Kayan Cascade project, Indonesia is planning to develop a hydropower plant unit in North Kalimantan with a capacity of 900 MW in 2026
- While West Kalimantan and Sarawak have completed the Trans-Borneo Power Grid Sarawak–West Kalimantan Interconnection Project, North Kalimantan has shown interest to connect with Sabah through a proposal to supply and export electricity to Sabah from the proposed power plant
- Robust grid interconnection with North Kalimantan will open future opportunities for Sabah to leverage its strategic location within the BIMP-EAGA (the Brunei – Indonesia – Malaysia – Philippines East ASEAN Growth Area), to become a regional trading hub for electricity among the ASEAN countries
- Simultaneous to this, Sabah is also currently engaged with Palawan, Philippines to establish grid interconnectivity. In addition, there is potential for interconnectivity to other remote areas in the Philippines, such as Mindanao, Tawi-Tawi and Lanao del Sur, to supply electricity to the areas
- In reference to a study conducted by the Asian Development Bank (ADB), discussions are on-going at the BIMP-EAGA power cluster forum to look into realising the interconnectivity

Sabah's interconnection with regional power grids will strengthen Sabah and the wider ASEAN region's energy security and will support the transition into green energy

Electrifying BIMP-EAGA Through Energy Cooperation and Connectivity

BIMP-EAGA
BRUNEI DARUSSALAM–INDONESIA–MALAYSIA–PHILIPPINES
EAST ASEAN GROWTH AREA

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Hajiji said the recent power trade and interconnection agreements between Syarikat Sesco Bhd, a subsidiary of Sarawak Energy Bhd (SEB), and Sabah Electricity Sdn Bhd (SESB) are key to establishing the Borneo Grid and the ASEAN Power Grid. A 31-kilometer 275-kilovolt transmission line will be used to deliver 30 megawatts of hydroelectric power from Lawas in Sarawak to Mengalong in Sabah.

Key Highlights

- According to the ASEAN Energy Outlook (2017-2040), the ASEAN Power Grid (APG), of which the power wheeling projects between Sabah, Sarawak, the Philippines and North Kalimantan are a part of, is meant to facilitate electricity trading among Member States through strategic interconnections and enhance the integration of their power systems
- The concept includes improvements to both physical infrastructure as well as procedures and mechanisms for power trade where increased power system connectivity through the APG offers several potential benefits including:
    - More efficient use of resources
    - Enhanced grid stability and service in remote areas
    - Improved energy security for the region as electricity demand and end uses grow

Source: BIMP-EAGA 2021, Daily Express 2021, The ASEAN Energy Outlook 2017-2040

Strategy A7: Identify New Energy Sources and Technologies

In the medium to long term, Sabah will explore new emerging technologies and energy alternatives to diversify its energy mix

Battery Energy Storage System (BESS)

Timeline: Short Term

- Battery Energy Storage System (BESS) is a device that enables energy from renewables such as solar and wind to be stored and then discharged at a later time to provide electricity when needed
- As such, BESSs can be used to overcome several challenges related to large-scale integration of renewables by providing better frequency regulation than the traditional spinning reserve from power plants
- Sabah Energy Supply Industry (SESI) is exploring the option to install BESS to provide fast response and to support the intermittent nature of Large Scale Solar (LSS) by providing grid stability
- In the long-term however, the potentiality of utility scale will be further explored should the technology become economically viable to support the transmission of electricity generated in the West Coast to the East Coast of Sabah to help overcome the electricity challenges in the eastern part of the State

Low/Very Low Head Hydropower

Timeline: Medium Term

- With terrain constraints and environmental protection concerns high on Sabah's agenda, conventional hydropower dams may not be suitable in remote areas or rivers with low heads
- Where conventional hydropower turbines are no longer considered profitable, non-conventional low head or very low head technology can be used as they utilise compact propeller turbines
- These require minimum construction logistics, are easy to install and can be retrofitted into existing transverse structures
- In addition to the lower construction logistics, installation and costs, these non-conventional low-head or very low head turbines have lower maintenance and operating costs

Source: Asian Development Bank (ADB)

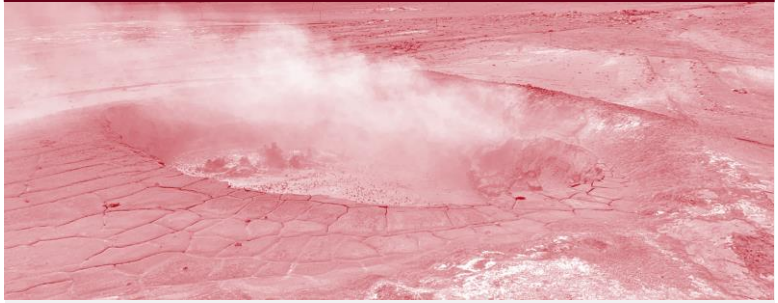
In the medium to long term, Sabah will explore new emerging technologies and energy alternatives to diversify its energy mix

Synthesis Gas

Timeline: Medium Term

- Synthesis gas is produced mainly from natural gas, coal or by-products from refineries. Synthesis gas is usually used directly as fuel source for power generation, transport fuel, as well as feedstock for chemical production
- Due to high carbon emission and issues related to security of energy supply, research and development (R&D) on the production of synthesis gas from coal and biomass have been carried out in the past decade. Though the focus has been mainly on transportation fuel and electricity supply, the conversion of synthesis gas from coal and biomass has high potential for other applicable usage
- Leveraging the potential of synthesis gas in the State, Sabah should explore the possibility of developing synthesis gas production capability as part of its plan to diversify its energy mix. Besides enhancing its energy security, this could also encourage technological development within the renewable energy space in the State

Geothermal



Timeline: Medium Term

- In 2009, a study commissioned by the Minerals and Geoscience Department of Malaysia identified 67 MW of geothermal resource potential in Tawau, Sabah. The reservoir identified covers 12 km^2 with temperature ranging from 190°C to 236°C. Later study by a project proponent had found the potential to be at 100MW
- The project proponent was approved to develop a 30MW geothermal power plant Feed-in-Tariff scheme which was initially scheduled to achieve commercial operation in June 2018
- However, in December 2018, the project was reported to be abandoned. Subsequently, the Feed in approval was revoked by Sustainable Energy Development Authority (SEDA) and the concession to the land was later terminated by the State Government.
- Review process has commenced to revive this proposed geothermal power development as a new and renewable energy source for the State

In the medium to long term, Sabah will explore new emerging technologies and energy alternatives to diversify its energy mix

Wind

Timeline: Medium Term

- Wind is used to produce electricity by converting the kinetic energy of air in motion into electricity. In modern wind turbines, wind rotates the rotor blades, which convert kinetic energy into rotational energy. This rotational energy is transferred by a shaft to the generator, thereby producing electrical energy
- Feasibility of wind generation is dependent on wind speed and cut-in speed of wind turbine. Global case studies show that minimum wind speed requires for profitable wind energy generation is 7 to 8 m/s
- Based on a wind mapping study commissioned by Sustainable Energy Development Authority (SEDA), Sabah has a potential to develop its wind energy sector especially in the northern part of the State where the wind speed is greater than 5m/s at 100 metre height. Despite the slow adoption of wind energy at this point, future technology on wind energy is worth exploring as part of energy alternative for Sabah given its high potential

Hydrogen

Timeline: Long Term

- Green hydrogen is a form of renewable energy produced by splitting water through electrolysis process which leaves zero carbon footprints. Green hydrogen is becoming a key component in bringing about energy transition and ensuring a sustainable future
- Currently, there is an unprecedented high demand for green hydrogen production as a form of clean energy solution globally. According to World Bank, the demand for green hydrogen reaches an estimated 87 million metric tons in 2020 and is expected to grow to 680 million MT by 2050
- Recently, a major breakthrough was discovered in splitting natural seawater without pre-treatment to produce green hydrogen. Though the technology is relatively nascent, Sabah should explore the potential of localising the technology to develop its green hydrogen-based energy sector given the State's large coastal areas and access to seawater supply

In the medium to long term, Sabah will explore new emerging technologies and energy alternatives to diversify its energy mix

Green Ammonia

Timeline: Long Term

- Green ammonia production is 100% renewable and carbon-free. One way of making green ammonia is by using hydrogen from water through electrolysis and nitrogen separated from the air through a separation unit
- There are various potential uses of green ammonia from merely fertilisers and industrial products. These include marine fuel, power generation and energy storage
- As renewable energy is an important component in green ammonia production, Sabah should explore the possibility of developing green ammonia production capability by leveraging its immense renewable energy supply

Tidal

Timeline: Long Term

- Tidal energy is a form of renewable energy that produces power by the surge of ocean waters during the rise and fall of tides
- Currently, tidal energy production is still in its infancy as the high capital cost of developing such power plant and the small amount of power yield impede many countries from exploring the potential of developing the energy. Globally, there are only few sites where tidal energy could be produced at a reasonable price. Innovators are actively working to improve the technology of tidal energy generators to increase the amount of energy produced, to decrease their impact on the environment and to make the cost of building the generators cheaper
- Though Malaysia has not yet seen any tidal energy development, tidal energy can be an alternative for the State of Sabah to explore as a form of new energy in the future. Leveraging the State's coastal areas, the State should explore the potential of developing the energy in the long term

In the medium to long term, Sabah will explore new emerging technologies and energy alternatives to diversify its energy mix

Small Modular Reactor (SMR)

Timeline: Long Term

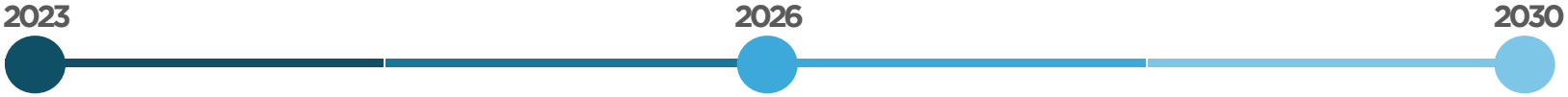
- Small Modular Reactors (SMRs) are advanced nuclear reactors that can generate clean energy with smaller fraction of power capacity compared to the traditional nuclear power reactors
- Many benefits of SMRs are inherently linked to the nature of their design. SMRs are small and can be factory-assembled and transported to a remote location for installation. They also require lower initial capital investment, greater scalability and siting flexibility for locations that are unable to accommodate traditional larger reactors
- Given the unique features of SMRs, it is practical for Sabah to explore the potential of developing SMRs as a new source of energy within the State. This is practical especially in exploring an alternative of a stopgap measure to accommodate the increasing energy demand from the industrial growth in Sabah

08

Strategic Thrust 2: Achieving Equal Accessibility & Affordability

Strategy B1: Implement Generation Optimisation Plan

To enhance Sabah's generation optimisation plan, the Power Development Plan has laid out initiatives to develop key power infrastructures based on load demand forecast[31]

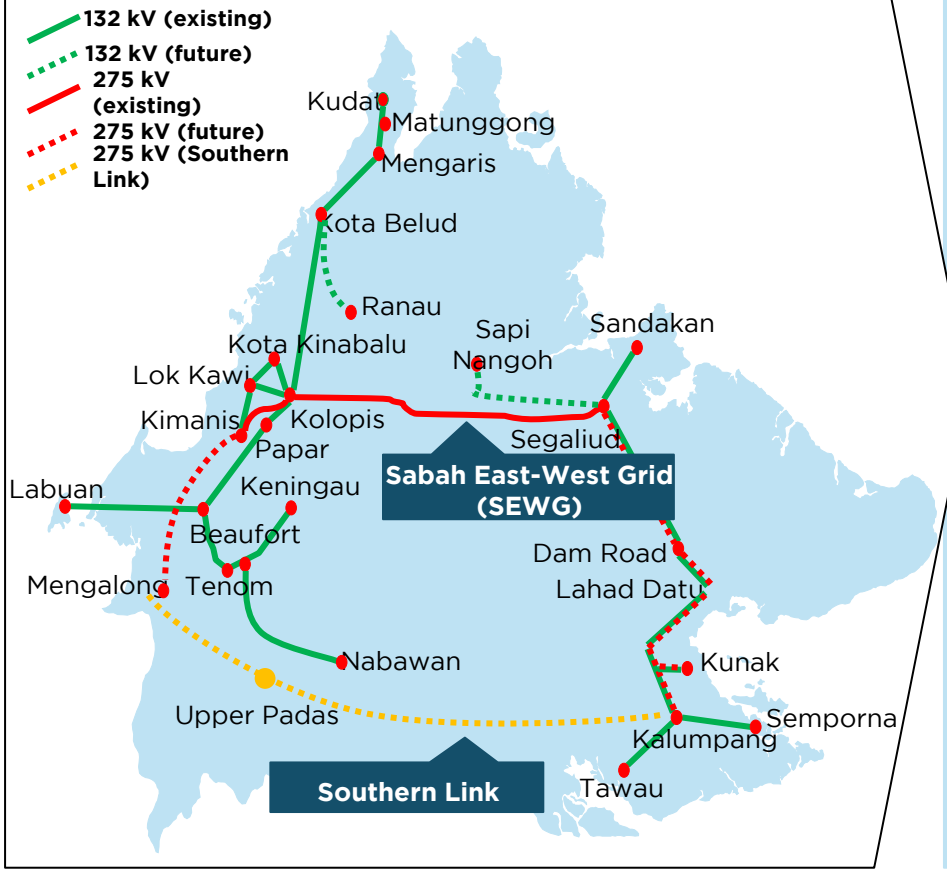


	2023	2026
West Coast	1. Hydro (57MW) 2. Large Scale Solar (23MW) 3. Gas (290MW) 4. Sarawak-Sabah Interconnection (30MW) 5. Biogas (2.4MW)	1. Hydro (357MW) 2. Sabah-Sarawak Interconnection (+20MW) 3. New Plant (90MW)
	Enhanced Sabah East-West Grid (SEWG) from West to East	Southern Link (275kV Mengalong-Tawau)
East Coast	1. Biogas (6.8MW) 2. Large Scale Solar (40.9MW) 3. New BESS (120MW)[32]	

Note: [31] The Power Development Plan may be subject to change and does not include other source of energy currently explored including synthesis gas (IGCC), additional Sarawak import, new hydro potential and geothermal; [32] New BESS may also be subject to change based on economic viability of project; This plan is based on a proposal presented to *Jawatankuasa Perancangan dan Pelaksanaan Pembekalan Elektrik dan Tarif (JPPPET) Sabah* in 2022. However, it is subject to prevailing load demand forecast, which may change based on future load demand forecast

The Southern Link will enable Sabah to complete the grid loop, thus optimising the cost of generation while improving the resilience of the grid

Anticipated Southern Link Location



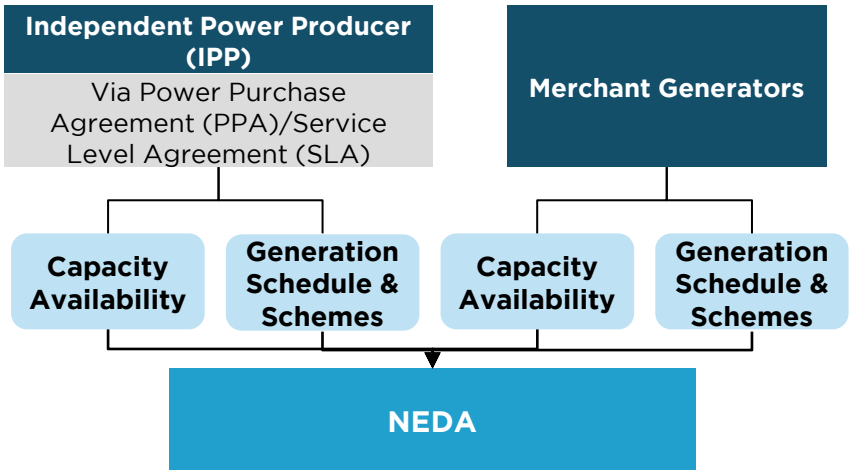
Key Highlights

- The Southern Link project will improve the quantum of power transfer from the West Coast to the East Coast while maintaining a secure and reliable power supply[33]
- Additionally, the Southern Link will serve as a gateway to the Sabah-Sarawak interconnection which is expected to commence in 2023 and provide infrastructure necessary to connect with North Kalimantan
- By 2024, Sabah Electricity Supply Industry (SESI) will implement Phase 1 of the 275kV Transmission Line from Mengalong, Sipitang to Upper Padas with Phase 2 from Upper Padas to PMU Tawau expected to be completed by 2027
- The project will also optimise generation costs by leveraging cheaper generation costs from the West Coast to the East Coast due to cheaper source of energy available in the West Coast such as natural gas, hydro and imports from Sarawak
- The transmission line will ultimately serve as a backbone for Sabah's grid system to complete the loop connecting the East Coast and the West Coast

Note: [33] See Appendix I, p. 145 on diagram illustration of Kolopis to Segaliud 275kV line

Sabah will also explore New Enhanced Dispatch Arrangement (NEDA) to improve cost and energy efficiency as well as enhance business opportunities

Process Flow of New Enhanced Dispatch Arrangement (NEDA)



BENEFITS

1. **Cost Efficiency:** Enhance cost efficiency in generation through short-run competition
2. **Energy Efficiency:** Enable energy efficient options, particularly the use of efficient technology such as Co-generation to participate in the electricity market
3. **Business Opportunities:** Provide opportunities for non-PPA/SLA Generators, such as Co-generation plant, Small Renewable Plant, Franchise Utilities, Part PPA/SLA Generators, and Expired PPA/SLA Generators to operate as Merchant Generators to sell energy to Single Buyer

Key Highlights

- The New Enhanced Dispatch Arrangement (NEDA) was initially launched in June 2017 for Peninsular Malaysia by Energy Commission to enhance short run competition and cost efficiency of the Malaysian electricity supply industry by allowing non-Power Purchase Agreements (non-PPAs) or Service-Level Agreement (SLA) Generators such as co-generators, renewable energy generators/producers, embedded generators and expired PPA/SLA Generators to operate as Merchant Generators to sell energy to the Single Buyer
- This is because NEDA enables these power generators to bid their variable costs (fuel cost and operation and maintenance cost) than those stated in the PPAs and SLAs
- By exploring NEDA for Sabah, SESI will be able to improve **cost efficiency in generation through short-run competition,** enable **energy-efficient options, particularly in the use of efficient technology**, such as co-generation in the market and allow for the **Single Buyer to enhance their business options by maximizing the use of their facilities in a cost-efficient manner for the benefit of the electricity supply industry and the consumers**

Source: Tenaga Nasional Berhad (TNB), Single Buyer

Through the implementation of NEDA, the Single Buyer will be able to develop Dispatch Schedules based on a Least Cost Dispatch Scheduling Methodology

Functions of Single Buyer and Dispatch Schedules

- To ensure that energy demand in Sabah is met at least cost, Sabah has developed a Single Buyer – an entity authorised by the Minister to govern the operation of the Single Buyer Market and conduct of Participants within the Market. The Single Buyer Market application in Peninsular has demonstrated benefits that can be applied to electricity industry in Sabah
- Under the Single Buyer Market, Single Buyers are responsible to procure electricity from Independent Power Producers (IPP) alongside Sabah Electricity Supply Industry (SESI) to meet demand at least cost. Single Buyers carry out this role by planning and managing generator agreements to ensure supply to the electricity industry is secure, reliable and affordable
- Simultaneously, Single Buyers will develop the Dispatch Schedules based on a Least Cost Dispatch Scheduling Methodology such that the lowest marginal cost Generating Unit is forecast to be dispatched first to meet demand followed by the next lowest marginal cost Generating Unit until all demand is met

Least Cost Dispatch Scheduling Methodology

- The Least Cost Dispatch Scheduling Methodology allows for the Single Buyer to prepare the Day Ahead Dispatch Schedule, the Week Ahead Dispatch Schedule and the Three Month Ahead Dispatch Schedule (collectively referred to as Dispatch Schedules) and the requirements of the Dispatch Scheduling Model
- Least Cost Dispatch Scheduling Methodology such that the lowest marginal cost Generating Unit is forecast to be dispatched first to meet demand followed by the next lowest marginal cost Generating Unit until all demand is met

Source: Guidelines for Single Buyer Market (Peninsular Malaysia), Suruhanjaya Tenaga

Strategy B2: Progress towards Effective Energy Tariff

The recently introduced Incentive Based Regulation (IBR) framework will improve Sabah's electricity supply system by promoting transparency and certainty in tariff setting

Before IBR Implementation	After IBR Implementation
1 Tariff based on historical costs	1 Tariff based on forecasted cost with regulated revenue requirement model
2 No specific period of reviewing the tariff	2 Tariff is reviewed every regulatory period of three (3) years
3 Uncertainty to address generation cost fluctuations	3 ICPT mechanism to address variation in generation costs every six (6) months
4 Tariff was a single figure (without component breakdown)	4 Tariff components for regulated entities are transparent to the regulator and customers

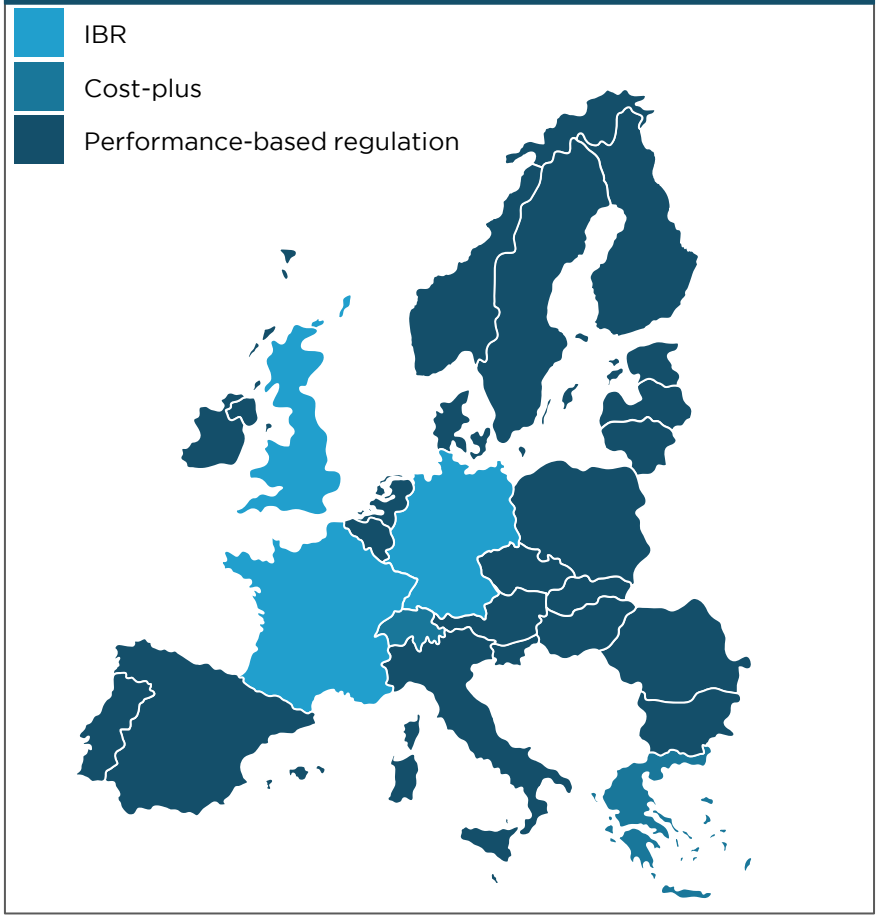
Key Highlights

- IBR is a form of economic regulation where regulatory intervention is provided to ensure that power utilities are operating efficiently. Malaysia's first introduction to the IBR framework was during its implementation in Peninsular Malaysia in 2014 where the framework was recognised as a breakthrough electricity tariff framework for the local energy industry
- The framework seeks to incentivise efficiency, enhance service levels, improve efficiency and help electricity suppliers develop predetermined budgets thereby allowing for electricity suppliers to be more transparent in their dealings
- IBR was implemented for Sabah in January 2022 for First Regulatory Period (2022-2024)

Source: Sabah Electricity Sdn Bhd (SESB)

IBR has been widely adopted in Europe and is being introduced in Southeast Asia

IBR has long been adopted in Germany, the United Kingdom and France...



...while the Philippines and Malaysia are the only countries in Asia to have embraced the framework

- Through IBR, electricity transmission and distribution networks are a natural monopoly and is an improvement over the cost plus model as it enables tracking of efficiencies and improves costs

Source: Suruhanjaya Tenaga

The IBR framework also wields benefits for key stakeholders in the industry

1 Regulator

- Set performance goals
- Establish incentives and penalties structure
- Ensure financially robust and sustainable Sabah Electricity Supply Industry (SESI)

2 Utility

- Efficient
- Reliable
- Encourages innovation among industry operators
- Ensures that industry operators (including electricity suppliers) meet performance goals
- Establishment of incentive and penalties mechanism for performance

3 Consumers

- Competitive and reasonable cost of service
- Reliable service
- Customer satisfaction
- Shared cost of savings

Key Highlights

- As a form of economic regulation, the IBR framework ensures that customers are protected, and price charges are based on efficient costs and quality of service. This improves the relationship between the regulator, utility and consumers as the framework ensures that set targets are met by industry operators and dealings with the industry regulator is kept transparent for consumers
- The framework also benefits both consumers and utility alike by ensuring that quality of service and performance of utility company assets are maintained, thus improving reliability of the electricity system
- Utilities are also provided the proper incentives to improve its performance and to sustainably increase investments

Source: Sabah Electricity Sdn Bhd (SESB)

Imbalanced Cost Pass-Through (ICPT) is embedded as a key element within the IBR framework that is implemented in Sabah

Regulatory Implementation for ICPT

Imbalanced Cost Pass-Through (ICPT)

Fuel Cost Pass-Through (FCPT)

- **Adjustment in the following 6 months period**
- **Changes in volume of generation mix (forecast vs actual)**

Generation Specific Cost Pass-Through (GSPT)

- **Adjustment in the following 6 months period**
- **Formula: Actual revenue based on Generation Specific Cost = Actual cost of generation**

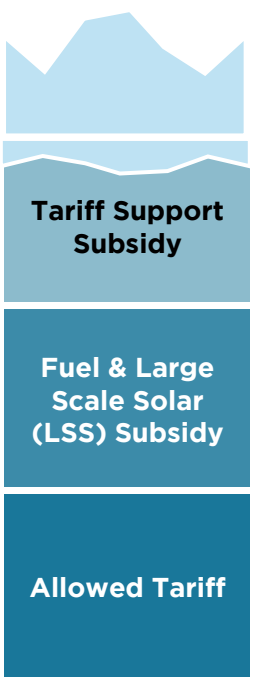
Changes in fuel cost

- To cater for changes in fuel cost due to actual fuel price and volume compared to the projected cost

Changes In other related generation cost

- All costs incurred by Single Buyer under the power procurement agreements i.e. Power Purchasing Agreements (PPAs), Service Level Agreements (SLAs) and fuel procurement agreements i.e. Gas Framework Agreements (GFAs) and Gas Supply Agreements (GSAs) etc
- Renewable energy FiT displaced cost

Composition of tariff with subsidies and ICPT

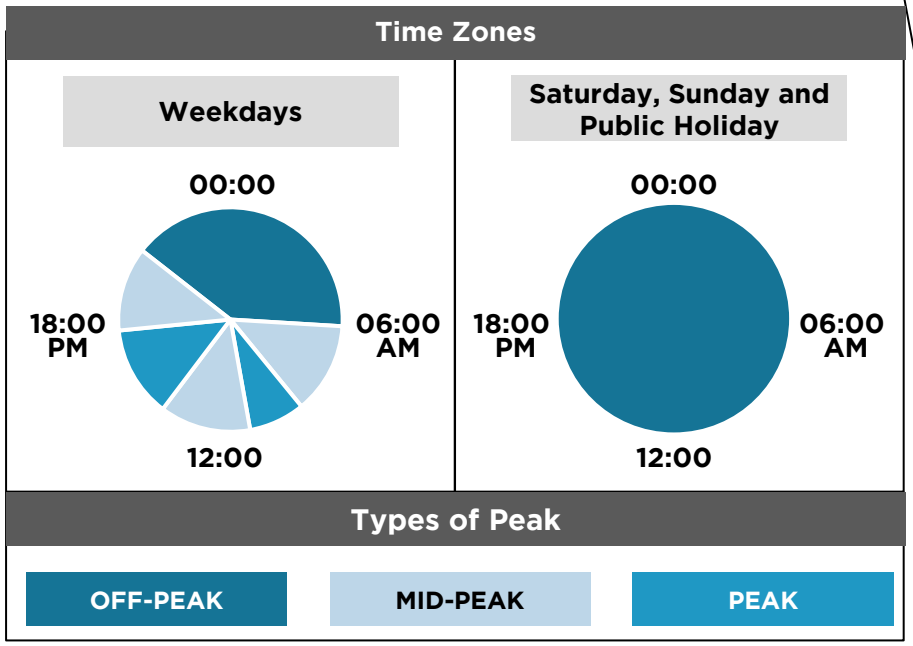


- **ICPT 6-monthly (+/-) adjustment to cater for fuel costs, generation specific costs variation after fuel subsidy**
- **The Tariff Support Subsidy would be claimed from the Government based on actual Unit Sold on monthly basis**
- **Subsidies for fuel and LSS would be based on actual monthly claims**
- **The allowed tariff to be charged to the consumer**

Source: Sabah Electricity Sdn Bhd (SESB)

Sabah will also explore the use of Enhanced Time of Use (ETOU) to reduce energy usage and cost during peak demand

Enhanced Time of Use (ETOU) Time Zones



Quick Brief

- ETOU is a self-regulating tool for customers to control their electricity usage and bill
- Customers will enjoy the reduction in monthly bill by shifting their consumption to Mid-Peak and Off-Peak hours, when the rates are lower

Key Highlights

- Sabah will be able to further incentivise industry players to shift production away from peak demand times by introducing additional off-peak schemes to complement off-peak schemes currently observed in Sabah, namely, the Off-Peak Tariff Rider (OPTR) Scheme and the Sunday Tariff Rider (STR) Scheme
- One of the two additional off-peak tariff schemes observed in Malaysia, to be explored in Sabah, is the Enhanced Time of Use (ETOU) – a tariff scheme that encourages Demand Side Management where there will be three (3) time zones namely Peak, Mid-Peak and Off-Peak
- Maximum Demand charge, on the other hand, will have two (2) time zones with Peak and Mid-peak rates
- ETOU is an extension to TOU a tariff scheme that is currently utilised in Sabah and offers different tariff rates at different times of the day

Source: Tenaga Nasional Berhad (TNB)

Strategy B3: Implement Energy Subsidies Rationalisation Plan

To ensure fiscal stability in the long term, Sabah needs to implement gradual subsidy rationalisation plan through energy pricing towards market parity with cost optimisation

Why we shouldn't continue subsidies?

For many years, electricity tariff rates have been kept artificially low through government subsidies. The current rates are not reflective of the actual cost of electricity supply. While subsidies may provide a short-term relief to consumers, continuous subsidies are considered ineffective and may hamper the development of energy sector in the long run.

How does maintaining subsidies hamper the development of energy sector?

1 Incurring significant fiscal burden to the government

Subsidies are costly to maintain and can divert limited government resources away from other important investments. For example, these subsidies could alternatively be used to finance and develop rural areas that have little to no supply of electricity

2 Reducing incentives for investment in renewable energy

Continuous subsidies can result in over-reliance on depleting resources such as natural gas for electricity generation. The efforts to invest in energy efficiency and renewable energy will be affected if electricity prices are kept artificially low through government subsidies

3 Creating inefficiencies in electricity usage

Electricity subsidies may encourage overconsumption, misuse and moral hazard problems among the consumers. As electricity prices are kept artificially low, consumers would not have the incentive to reduce their energy consumption and practice efficient energy usage

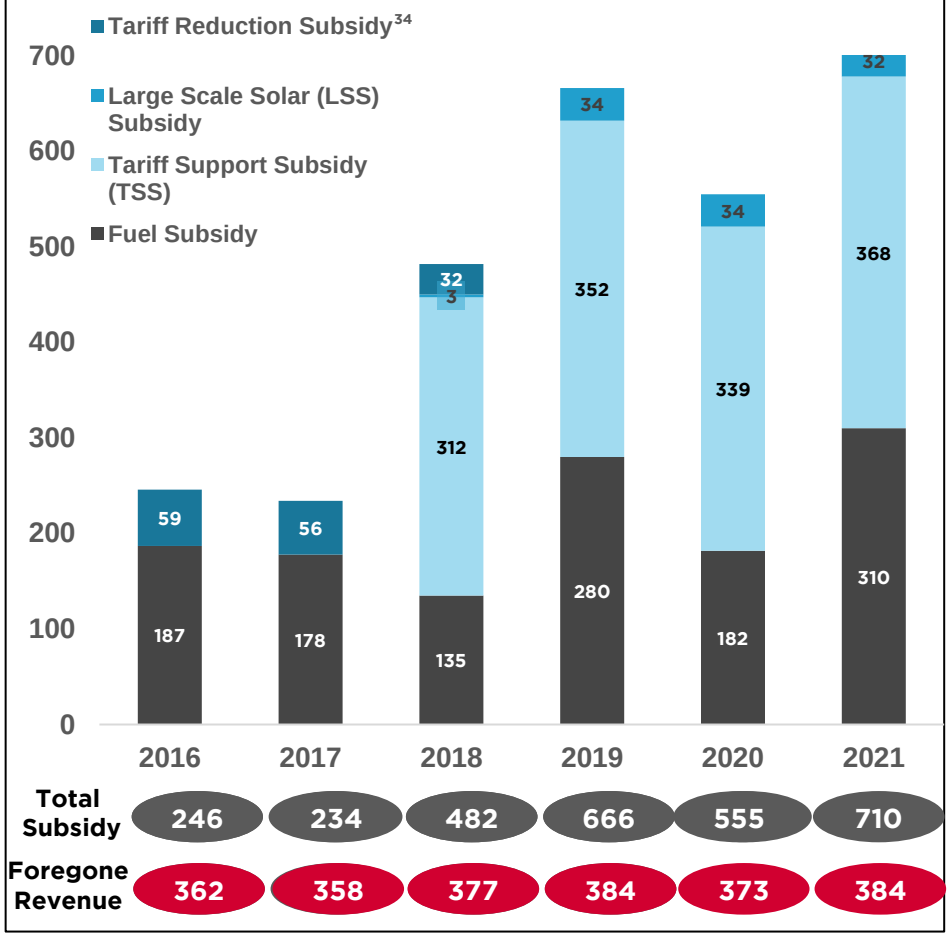
4 Developing risk of unsustainable industry

Subsidies may create an unequal playing field for different energy sources which can lead to an imbalance in the development of the energy industry. For instance, subsidies for fossil fuels may make it difficult for renewable energy sources to compete in the market, even if they are more environmentally friendly or efficient

Source: Suruhanjaya Tenaga

Between 2016 to 2021, Sabah Electricity Supply Industry (SESI) received substantial financial support from the Federal Government amounting to RM 2.89 billion

Annual Subsidy Support and Foregone Revenue, 2016-2021
RM Million



Key highlights

- At average tariff of 34.52 cent/kWh, SESI is unable to sustain the cost of electricity supply (revenue required) which stands at 43.83 cent/kWh. Due to the gap, SESI has been reliant on government financial assistance, summed to over RM 2.89 billion between 2016 to 2021. The types of subsidies and assistance are as follows:

  1. **Fuel Subsidy (MFO & Diesel)**: Diesel and Medium Fuel Oil are subsidised at RM0.495/liter and RM0.42/liter respectively

  2. **Large Scale Solar (LSS) Subsidy**: Large Scale Solar is subsidised at displaced cost of 21 sen/kWh and spinning reserve cost of 3.5 sen/kWh. First LSS commenced operation in Sabah was in 2018

  3. **Tariff Support Subsidy (TSS):** TSS is provisioned to cover the remaining shortfall between the cost of electricity supply (revenue required) and tariff revenue, fuel subsidy and LSS subsidy. This subsidy was first given in 2018 based on IBR revenue requirement calculation in lieu of tariff increase, although IBR was only fully implemented in 2022

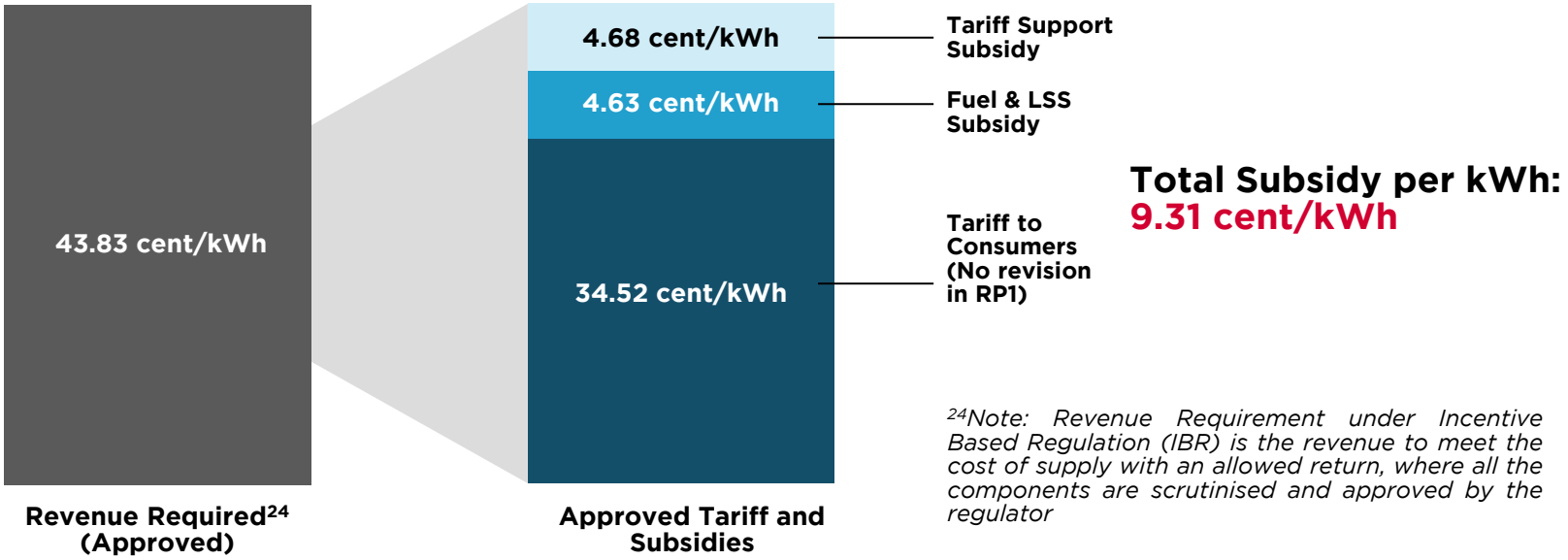
- Current tariff rates are not cost reflective of SESI's true cost of supply, hence, requiring subsidies in order to cover the cost differential. The last tariff revision with average tariff of 34.52 cent/kWh was done in 2014

- On top of the subsidy support, the gas supplied for power in Sabah is also subsidised at RM6.40/MMBTU, resulting in foregone revenue to the gas supplier[35]

Note: [34] Tariff Reduction Subsidy: Tariff rebate of 1.20 sen/kWh for domestic consumers with monthly usage <300kWh was provided up to June 2018; [35] Figure is based on assumed market price for Sabah at RM15/MMBTU
Source: Sabah Electricity Sdn Bhd (SESB) Financial Records

Without tariff revision, SESI continues to be reliant on financial support from the Federal Government to manage the gap between the cost of supply and tariff revenue

Sabah Tariff Support Subsidy Breakdown, 2022 – 2024



[24]Note: Revenue Requirement under Incentive Based Regulation (IBR) is the revenue to meet the cost of supply with an allowed return, where all the components are scrutinised and approved by the regulator

Key Highlights

- The government implements Incentive Based Regulation (IBR) in Sabah with approved revenue requirement at 43.83 cent/kWh for regulatory period 1 (2022 – 2024). This is without tariff revision to consumers, who receive an estimated average selling price of 34.52 cent/kWh. The approved Tariff Support Subsidy is set at 4.68 cent/kWh while Fuel and Large-Scale Solar (LSS) Subsidy is set at 4.63 cent/kWh which translates to RM884 million and RM876 million respectively. This comes to a total of RM1,760 million
- While the journey for tariff revision towards market parity is a continuous measure, it is important to note that subsidies cannot last forever. There is an urgent need for subsidies to be targeted to allow for more efficient spending by the government

Source: Sabah Electricity Sdn Bhd (SESB)

As the government is gradually phasing out electricity subsidy, Sabah needs to explore the introduction of targeted subsidy programme for lower income groups

What are targeted subsidies?

Targeted subsidies are one of the most important economic policies and a means of support for governments in order to distribute income and wealth more appropriately among different individuals within the society. Implementing targeted subsidies on electricity will optimise the government's financial resources as the savings obtained can be redistributed for other priorities. However, the implementation of targeted subsidy programme will need to be effectively coordinated to mitigate the potential impacts of subsidy rationalisation especially on the lower income groups

Why a targeted subsidy mechanism important?

1 Protecting the Vulnerable Groups

- Rationalising electricity subsidy will lead to higher electricity prices which may result in inflation as the cost of production becomes higher
- Higher inflation would financially affect the lower income groups as they are more vulnerable to the shifts in prices compared to the higher income groups
- Implementing targeted subsidy programme will allow the government to channel the larger portion of the subsidy to the vulnerable groups
- For example, the recent RM40 Electricity Bill Rebate Programme by the government has helped the hard core poor to endure the rising living costs

2 Optimising the Government's Financial Resources

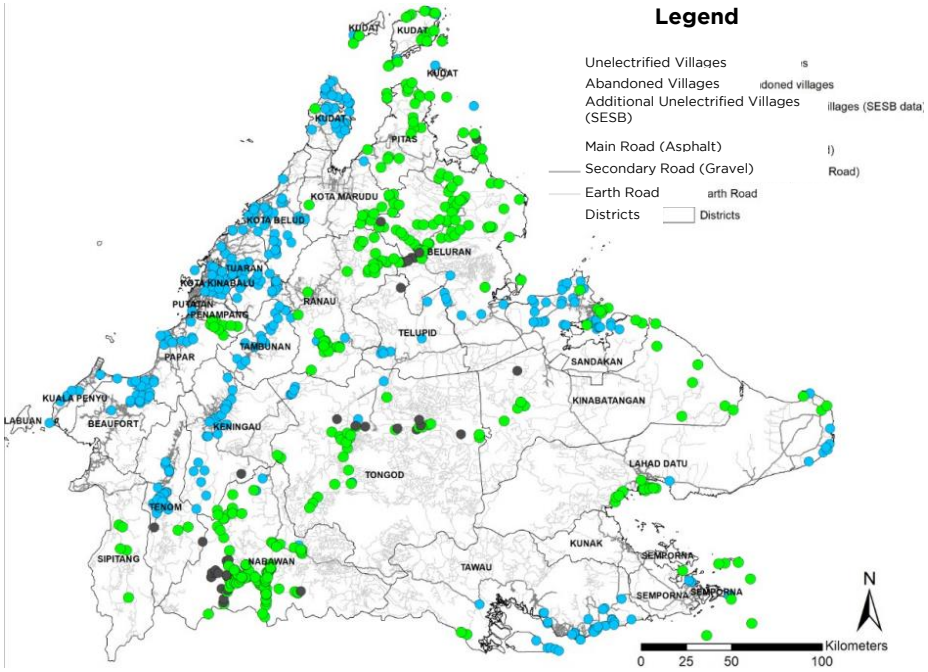
- Subsidies are intended to protect consumers by keeping prices low, but they may come at a high cost
- Sticking to blanket subsidy programme is detrimental to the economy as it creates inefficiency in utilising the government's financial resource
- As announced by Ministry of Energy and Natural Resources (KeTSA, now NRECC), the government spent RM 14.91 billion to maintain the current electricity tariff. However, with the upcoming targeted subsidy scheme in 2023, the government would be able to save RM 4.16 billion in subsidy allocation

Source: Suruhanjaya Tenaga, The Edge Markets

Strategy B4: Achieve 100% Rural Electrification

Sabah aims for 100% rural electrification through either grid connection methods or alternative methods such as hybrid solar and micro hydro by 2030

Heat map of locations requiring power



STATISTICS

Rural electrification in Sabah as of 2021:
98.3%

Target:
Achieve 100% electrification in rural areas by 2030

Key Highlights

- The Rural Electricity Supply Program (BELB) aims to provide 24-hour electricity supply to houses and longhouses located in rural areas throughout Malaysia
- Its activities include assessing grid connection methods, exploring alternative methods such as hybrid solar and micro hydro for the supply of electricity to ensure the availability of sufficient, secure and reliable electricity supply to residents, especially in rural areas as well as the installation of *Lampu Jalan Kampung* (LJK) (or Village Street Lights)
- In addition to BELB, a Sabah NGO collective has also developed new toolkits that enable the consortium to plan and design micro-hydro, solar or solar/hydro hybrid mini-grids at scale based on the technical feasibility of the system to the community
- The toolkits also feature the feasibility of mini and micro-hydro projects given its cost effectiveness and suitability to the forests and healthy streams in Sabah thus enabling the consortium to provide hydropower mini-grids to rural areas that lack access to reliable electricity supply

Source: KPLB 2020, Sabah RE2 Roadmap

Kementerian Pembangunan Luar Bandar (KPLB) and NGOs will collaborate to electrify rural areas by identifying suitable methods of electricity supply

Program Bekalan Elektrik Luar Bandar (BELB)

- In their efforts to achieve 100% rural electrification by 2030, the State and Federal Governments have taken the initiative to ensure a comprehensive BELB plan is operational in Sabah with priority provided to Sabahan communities that have yet to receive 24-hour electricity supply
- The programme provides two types of electricity supply: extension of distribution lines and alternative renewable energy generation systems for rural areas where the extension of distribution line is not economically viable
- The type of electricity supply provided to the villages is based on the information obtained through village profiles which are consistently updated through the district office and submitted to Sabah Electricity Sdn Bhd (SESB)[36]
- This information obtained is utilised by SESB to make plans for a period of ten years from 2021 to 2030 by targeting the percentage of electricity supply coverage to reach 100 per cent by the end of 2030

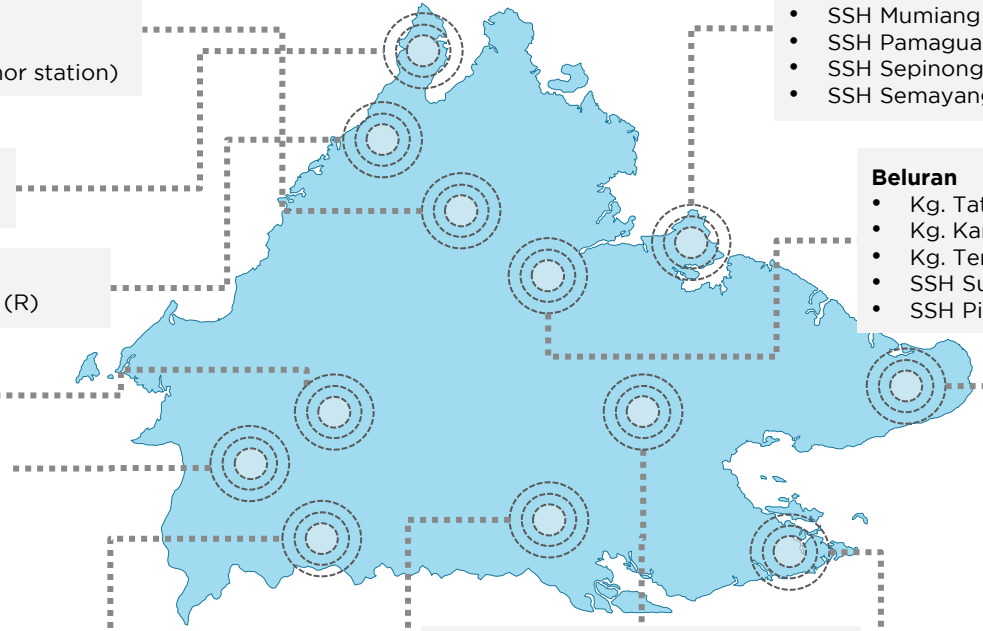
Renewable Energy Rural Electrification Projects supported by NGOs

- Sabah NGOs such as TONIBUNG, PACOS Trust, Forever Sabah and Green Empowerment that have collectively developed toolkits to guide the planning and implementation of renewable energy mini-grids for a target of 200 remote villages across Sabah that are far from the current and planned electricity grid
- Part of their toolkit includes an energy demand map of Sabah which tracks in real time the electricity demand in rural areas throughout the State and a method that allows the collective to determine, plan and design next generation mini-grids at scales crafted to suit and meet the needs of each village in Sabah
- The Renewable Energy Rural Electrification Projects (RE2) fills the gap in circumstances where BELB may face certain difficulties in providing electricity supply to unelectrified villages thus expediting the process towards 100% rural electrification in Sabah[37]

Note: [36] See Appendix I, p. 146 on prioritisation and methodology utilised to obtain information; [37] See Appendix I, p. 147 for further information on the issues that SESB often encounters in the provision of electricity supply

Source: KPLB 2020, Sabah RE2 Roadmap, NST 2022

There are 48 off-grid stations across Sabah (33 SSH, 11 Rural, 2 minor station, 2 MH)



Ranau
- MH Naradau
- MH Carabau
- SJ Ranau (Minor station)

Kudat
- SSH Pulau Banggi

Kota Belud
- Kg. Pulau Mantanani (R)

Nabawan
- Kg. Pensiangan (R)

Sipitang
- SSH Maligan 1 & 2

Keningau
- SSH Pergalungan

Tawau
- SSH Kalabakan

Sandakan
- Kg. Tanjung Aru (R)
- SSH Mumiang
- SSH Pamaguan
- SSH Sepinong
- SSH Semayang
- SSH Lubukan
- SSH Tg. Batu
- SSH Tundun Bohangin

Beluran
- Kg. Tatabuan (R)
- Kg. Kaniogan (R)
- Kg. Terusan Sugut (R)
- SSH Sukang Telidusan
- SSH Pinangkau
- SSH Tangkarason
- SSH Kabuluh
- SSH Pantai Boring
- SSH Sungai-Sungai
- SSH Tampat

Lahad Datu
- SSH Tg. Labian
- SSH Tidong
- SSH Tambisan
- SSH Sg. Merah

Telupid / Kinabatangan
- SJ Balat (R)
- SJ Lintang (R)
- Kg. Tenaga Baru (R)
- Kg. Kanang-Kanangan (R)
- Kg. Karamuak Dalam (R)
- SSH Kuamut Besar
- SSH Kuamut Seberang
- SJ Telupid (Minor Station)

Semporna
- SSH Pebabag
- SSH Bait 1
- SSH Bait 2
- SSH Larapan
- SSH Omadal
- SSH Selakan
- SSH Denawan
- SSH Sumander
- SSH Menampilik

Legend:
SSH – Solar Hybrid
(R) – Rural
MH – Mini Hydro

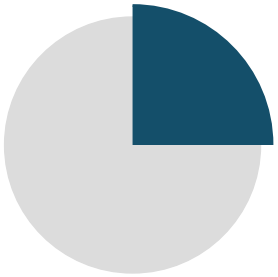
Kementerian Pembangunan Luar Bandar

The Bekalan Elektrik Luar Bandar (BELB) programme by Kementerian Pembangunan Luar Bandar (KPLB) includes a grid connection method, alternative methods such as hybrid solar and hydro micro and installation of streetlights in the village to ensure the readiness of sufficiency and reliability in electricity supply to rural areas

Strategy B5: Optimise Hydropower Potential

Hydropower is one of the world's largest source of renewable electricity generation due to its affordability and reliability

Share of Global Electricity Generation, 2019
%



27.3% RENEWABLE ENERGY

72.7% NON-RENEWABLE ENERGY

15.9% **HYDROPOWER**

5.9% WIND POWER

2.8% SOLAR POWER

2.2% BIOPOWER

0.4% OTHER RENEWABLES

Worldwide hydropower installed capacity in 2017-2022...

1,247GW *2017* | **1,308**GW *2019*

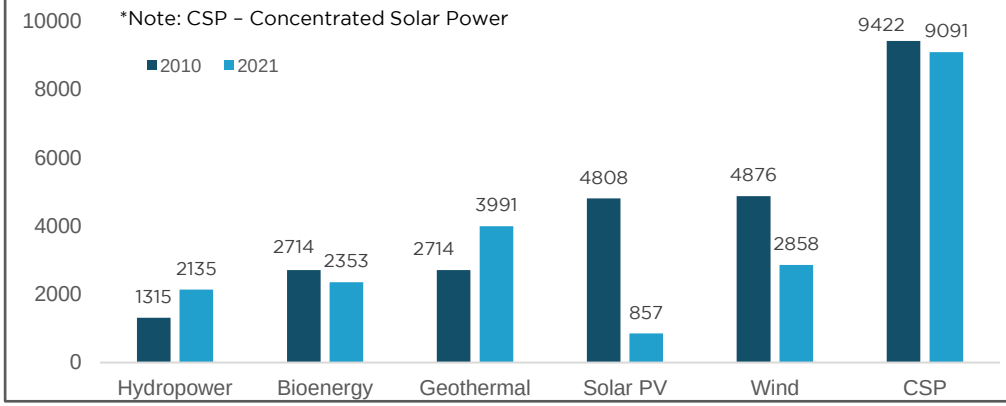
Benefits of Hydro Power Generation

- Clean, affordable and reliable source of energy
- Reliable energy from hydropower enables other types of renewables
- Improved infrastructure and waterways for the state of Sabah
- Responsibly managed sources of freshwater
- Avoiding emission of hazardous gas to the environment

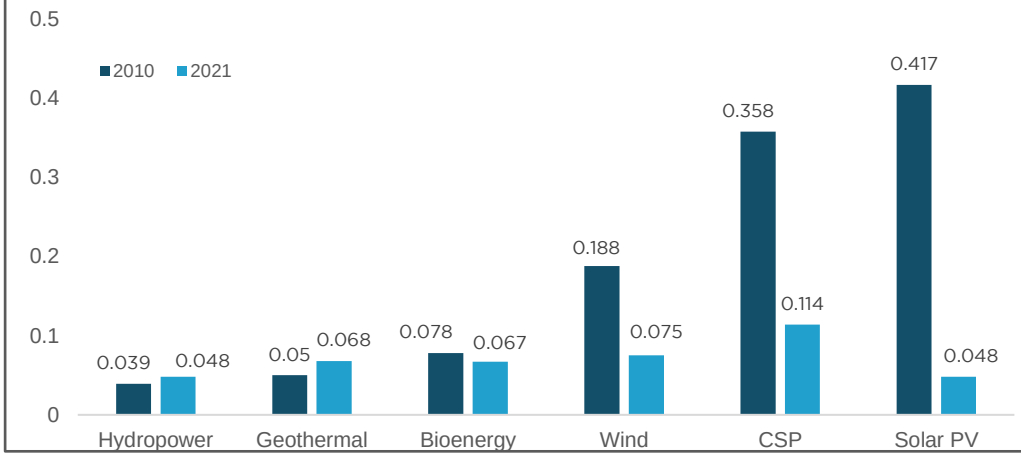
Source: Our World in Data, International Energy Agency (IEA)

According to the IRENA report on renewable power generation costs, hydropower remains one of the most cost effective sources of electricity globally

Total Installed Costs
USD/kW



Levelised Cost of Electricity (LCOE)
USD/kWh



Key Highlights

- Hydropower remains one of the lowest-cost sources of electricity worldwide after solar PV
- Based on the report, an average total installed cost of hydropower project is USD 2,135/kW in 2021, the second lowest after the solar PV at USD 857/kW
- Despite an approximately 62% increase in total installed costs over the past 10 years, hydropower remains one of the cheapest options
- Additionally, hydropower also recorded the lowest LCOE compared to other sources of energy. LCOE represents the price at which the generated electricity should be sold for the system to break even at the end of its lifetime
- At USD 0.048/kWh, the cost of electricity generation through hydropower is cheaper compared to newly commissioned fossil fuel fired capacity that ranges between USD 0.054/kWh to USD 0.167/kWh

Source: International Renewable Energy Agency (IRENA) Renewable Power Generation Costs 2021

The Hydropower Development Master Plan will be established to unlock the full potential of Sabah's hydropower

Key components	Analysis
1 Main Objectives	• To review and update previous studies on the potential for hydropower in Sabah • To institute a holistic consolidation and coordination of other related studies and state documents on hydropower potentials, technologies and potential impacts on Sabah's economy, social and environment • To incorporate and explore the potential and prospect of new technologies, with latest and innovative approach in hydropower projects
2 Key Principles	• Long-term sustainability and efficiency in utilising the hydropower potentials • Considerations of other important aspects of the river system i.e. irrigation, water supply, navigation, flood control in the context of sustainable hydropower and multipurpose development • Align with social and environment protection requirements • Align with overall economic/social development plan in the project area • Align with power development plan
3 Fundamental Approach	• Establish integrated energy modelling and forecast for the next 20 years based on the expected energy yield of hydropower generation assets, accounting for any potential losses and time of use, providing the insights needed to support investment and financing decisions • Establish energy system feasibility, modelling optimisation and simulation by meeting the demands and constraints of energy market participants, system planners, investors and the regulators. • Energy generation and scheme design optimisation that incorporates simulation of different operating scenarios from various design schemes, reservoir operation, peaking generation, pumped storage and other factors • Explore viable technical and financial options to unlock the hydropower potential in Sabah, based on social, economical and environmental value creation principles • Syndicate for input and feedback from stakeholders in the hydropower and energy industry for robust mitigation action plan against any risks and implementation challenges

The Hydropower Development Master Plan will incorporate the fundamental elements under 4 main study phases

Hydropower data gathering & mapping

- Proposed to develop up to 6 regional models across Sabah
- Administer long record of reliable hydrological and metrological data
- Establish record and topographical data
- Conduct calibration and cross-checking of available data
- Assess environmental and social impact
- Conduct geological and geotechnical assessment
- Establish mapping of hydropower potential

Scheme identification

- Identify potential schemes together with detailed concept
- Select preferred scheme layout based on engineering assessment, local topographical, geological and hydrological conditions; and social environmental impact
- Conduct layout optimisation for prefeasibility study stage with site-specific information and conditions
- Conduct cost benefit analysis

Plant configuration

- Select the most promising sites and define illustrative plant configuration, grouped by similar site characteristics.
- Prioritisation and deprioritisation of sites based on positive and negative social and environment impact
- Establish optimized sequence of development
- Identify relevant stakeholder for engagement and consultation

Policy and regulatory framework

- Recommendation of policies, regulatory framework, best practices for bidding exercise, etc. to facilitate sustainable hydropower development in Sabah
- Establish any potential framework for public-private collaboration
- Identify enablers for access to project finance and funding
- Capacity building for key stakeholders

09

Strategic Thrust 3: Safeguarding Environmental Sustainability

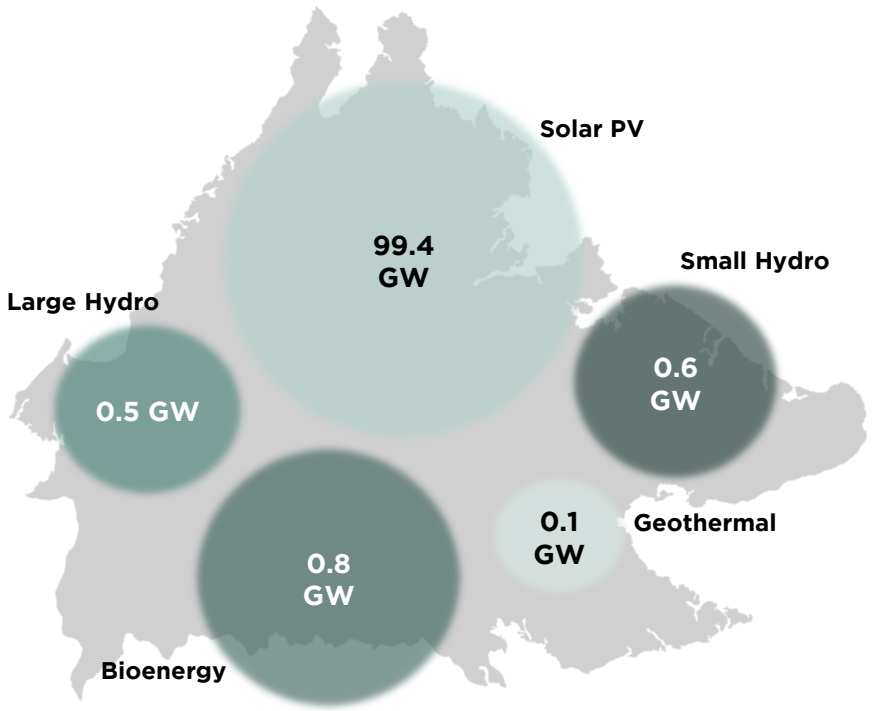
Strategy C1: Increase Renewable Contribution to Sabah Generation Mix

Sabah has abundant renewable energy resources with over 101 GW potential capacity readily exploitable for power generation

Sabah Renewable Energy Resource Potentials by Locations

GW,MW

Total RE Resource Potential : 101 GW



Key Highlights

- Sabah is blessed with abundant renewable energy resources readily exploitable for power generation. The Malaysian Renewable Energy Roadmap (MYRER) has provided detailed strategic framework and initiatives on how Sabah can maximise its RE potential subject to technical feasibility and commercial viability of each project
- Sabah receives the highest solar radiance of 1,861 kWh/m2 compared to other states in Malaysia. As solar radiance is relatively high, solar PV is considered a viable RE option for the State. Based on a study by Sustainable Energy Development Authority (SEDA), Sabah has 99.4 GW potential capacity to be generated via solar PV
- Sabah also has high potential in harnessing its bioenergy from the abundant waste by-products especially from oil palm activities. According to SEDA, biomass constitutes the largest resource of bioenergy in Sabah with approximately 561 MW potential capacity from over 26.2 million tons of biomass supply from the oil palm plantations
- Given the numerous river basins in Sabah, the State can also leverage its potential to harness both small and large hydro energy with a total of 1.1 GW potential capacity. For geothermal, a study commissioned by Minerals and Geoscience Department has identified an estimated 100 MW of geothermal resource potential in Tawau, Sabah

Note: The assessment of resource availability does not consider economic feasibility and adoption barriers such as grid connectivity
Source: Malaysia Renewable Energy Roadmap (MYRER), Department of Minerals and Geoscience

To kickstart the transition towards increasing the share of renewables into the generation mix, Sabah aims to complete several projects in 2023-2024

	Existing Total Capacity:	Under Development Total Capacity:
Large Scale Solar	50.0 MW	63.9 MW
Solar PV	41.0 MW	NIL
Hydro	89.5 MW	45.6 MW
Biogas	8.5 MW	9.2 MW
Biomass	18.0 MW	NIL

Note: Grid connected SESI
Source: Sabah Electricity Sdn Bhd (SESB)

Exploring Large Scale Solar (LSS) scheme will help Sabah in promoting the growth of renewables within the State

Large Scale Solar (LSS) Scheme

BENEFITS OF LSS

1. LSS can help increase the clean energy supply and consumption of renewable energy power
2. LSS can also help increase the share of solar contribution to the State's generation mix

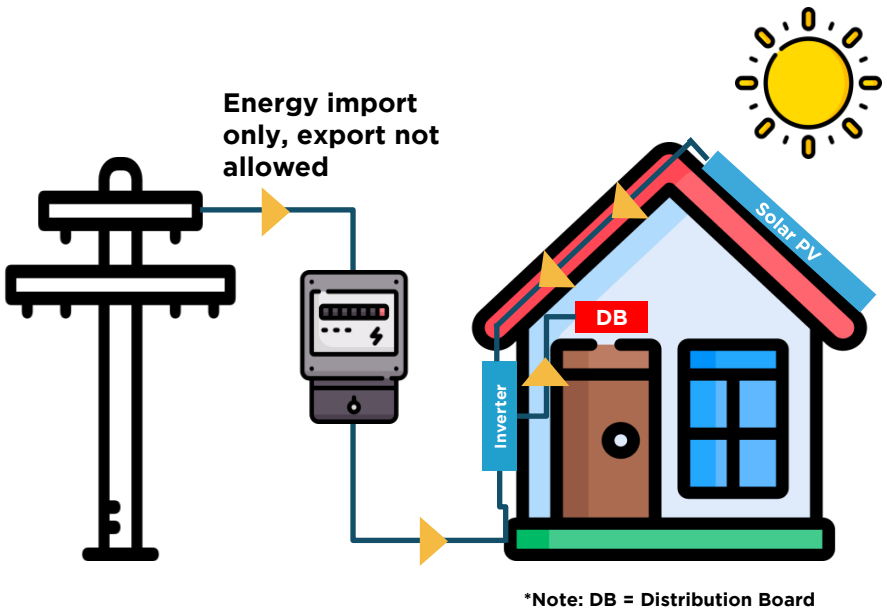
Key Highlights

- Large Scale Solar (LSS) utilises solar PV farm to harness solar energy from the sun in a large-scale manner.
- LSS in Malaysia is administered by the regulator for the selection of potential developers through competitive bidding. However, a technical study must be conducted before submission to the relevant authority. As of 2022, a total of 113.9 MW LSS capacity has been awarded to Sabah with 50 MW capacity already in operation. The remaining 63.9 MW capacity is still in progress and will be developed in the near future.
- Comparing resource potential with other states, Sabah ranks the highest in ground-mounted solar PV resource potential at 97.2GW compared to Peninsular Malaysia (94.9GW) and Sarawak (18.2GW). Sabah also has a higher ratio of unused suitable land corresponding to 2.6% of Sabah's total land of 1,887km^2 contributing to the State's suitability for ground-mounted solar PV. In comparison, Peninsular Malaysia has 1,843km^2 of unused suitable land (1.4%) while Sarawak has the lowest ratio of 0.3%.
- Despite the high potential for Sabah to increase its solar share in installed capacity, the State will continue to maintain and limit the threshold of 20-22% solar penetration of peak demand to ensure system stability. Solar penetration at 20% of peak demand is optimum for Sabah's system.

Source: Suruhanjaya Tenaga, Malaysia Renewable Energy Roadmap (MYRER)

Expanding Self-Consumption (SelCo) programme to all consumers in Sabah would also drive the renewables contribution to the State's generation mix

Self-Consumption (SelCo) Concept and Process Flow



*Note: DB = Distribution Board

The SelCo programme will focus on solar PV system before expanding into other forms of renewable energy in the long term

BENEFITS OF SELCO

1. Consume the electricity generated with a solar PV system without relying on SESI
2. Hedge against SESI tariff hikes and increasing electricity pricing
3. Potential Demand Side Management to reduce system peak, thus slowing the need to plant up generation capacity

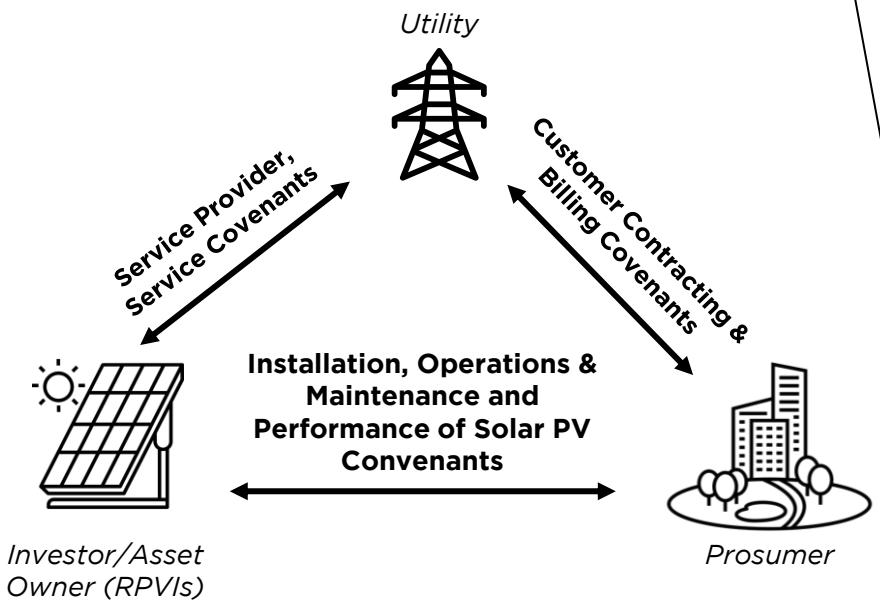
Key Highlights

- Self-consumption (SelCo) is a mechanism where eligible consumers install solar PV system to generate electricity entirely for their own use. In the event of excess generation, the energy would not be able to be exported into the utility network. However, during periods where solar PV is unable to generate solar power, users may import power from the grid
- SelCo offers a great alternative option for consumers to generate electricity from their own solar PV system to offset or to reduce their electricity bills. The consumers can opt to install the solar PV systems on their available rooftops or car porches within their premises. The interested users would be required to present the power flow study of the proposed connection of their generating plants/sources to the utility company to be eligible under the programme
- Currently only individuals and small commercial consumers are encouraged to participate in this scheme due to the potential impact of SelCo programme on grid stability and cost to SESI
- The State aims to expand SelCo to all consumers subject to further studies on suitable penetration level and potential benefit of Demand Side Management to reduce system peak. In addition, this will enable consumers to soften the impact of tariff revisions

Source: Suruhanjaya Tenaga

Explore implementation of Supply Agreement with Renewable Energy (SARE) in Sabah to boost utilisation of renewables by non-residential consumers

Supply Agreement with Renewable Energy (SARE) Project Concept



BENEFITS OF SARE

1. No initial upfront cost borne onto prosumer and RPVIs are protected in the event non-payment
2. SARE will encourage the continued uptake of RE by commercial and industrial prosumers in addition to the Solar Power Purchase Agreements (PPA)

Key Highlights

- The Supply Agreement with Renewable Energy (SARE) is a tripartite agreement between the Utility (such as SESB), Registered Solar Photovoltaic Investors (RPVIs) and the prosumer for the billing,[38] invoicing, as well as revenue management of the Solar PV System and Solar Energy Meter (the 'Service')
- SARE stipulates the tenure of the contract, the tariff rate for the purchase of the solar energy as well as legal obligations of the parties. The agreement also comprises these key concepts:
  - The solar PV system installed at the prosumer's premise is owned and operated by the RVPIs;
  - The prosumer shall purchase all solar energy generated by the system provided by the RVPIs at the agreed PPA Tariff;
  - Billing of the solar energy purchased by the Prosumer from the Investor will be prepared by the Utility on behalf of the Investor to the Prosumer, and the payment is to be made by the Prosumer to the Utility directly on a monthly basis;
  - The Utility will re-pay the sum collected from the Prosumer to the RVPIs;
  - The Utility may disconnect the electricity supply to the premise of the prosumer in the event of non-payment of charges due
- SARE was first introduced in Peninsular Malaysia in 2019 for commercial and industrial prosumers and will be explored for Sabah in the long-term

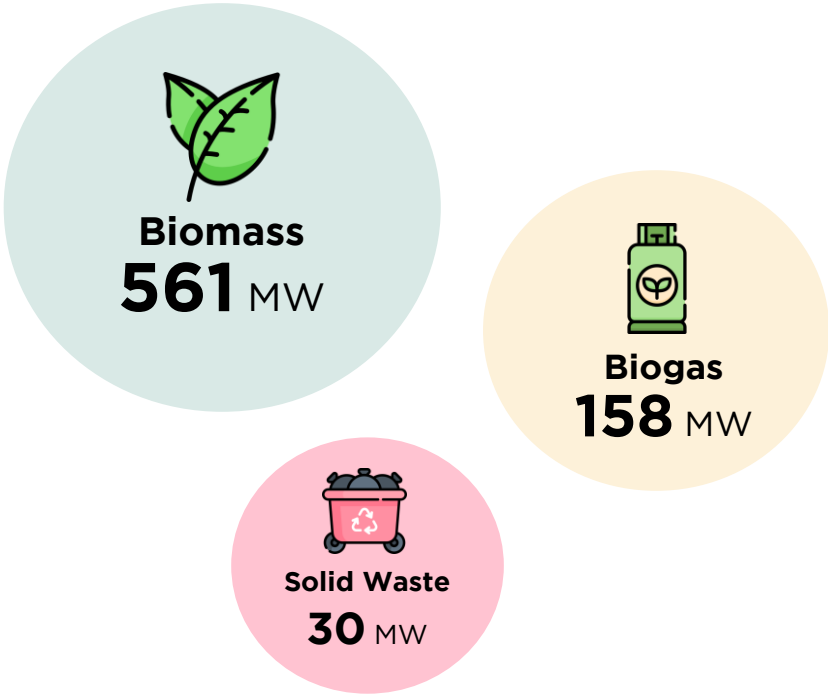
Note: [38] Prosumers (within the context of SARE) refers to consumers who own the premise(s) where the solar photovoltaic system(s) will be planted on and produce energy
Source: Suruhanjaya Tenaga, Malaysia Renewable Energy Roadmap (MYRER)

Strategy C2: Expand Use of Bio-energy

Due to its large agricultural activities and steady population growth, Sabah has an abundance of waste by-products that could potentially be used for electricity generation

Overview of Bioenergy Resource Availability in Sabah

Total Bioenergy Resource Potential : 749 MW



Key Highlights

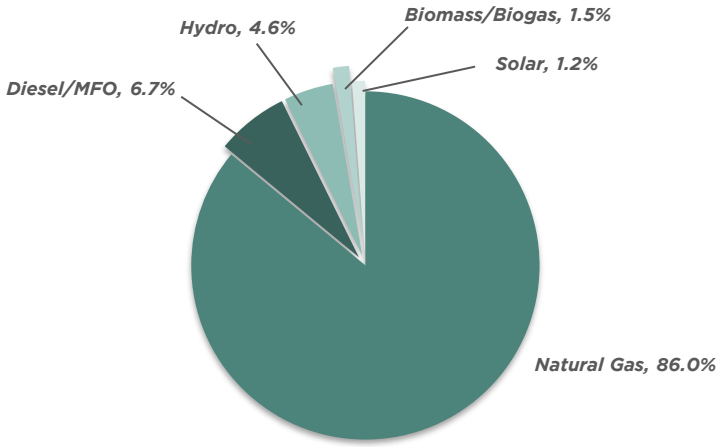
- Sabah has approximately 750 MW worth of total bioenergy resource potential within the State. Due to its massive agricultural activities and steady population growth, the State has an abundance of waste by-products that could potentially be used for power generation
- Biomass constitutes the largest resource with approximately 561 MW of potential in Sabah. According to Malaysian Palm Oil Board (MPOB), the State has the second largest palm oil planted area as of 2021 with over 1.5 million hectares of land. This represents almost 27% of Malaysia's total palm oil planted area across the country
- Besides biomass, Sabah also has immense supply of biogas with approximately 158 MW of potential supply. This represents almost 22% of the country's biogas potential. The source of biogas includes palm oil mill effluent (POME) and landfill gas (LFG)
- With total population of almost 3.9 million and average growth rate of 1% each year, Sabah also has the potential to exploit its solid waste. Solid waste for waste to energy (WTE) combustion constitutes 30 MW worth of potential in bioenergy resource in Sabah

Source: Malaysia Renewable Energy Roadmap 2020–2040, Malaysian Palm Oil Board (MPOB), Department of Statistics Malaysia (DOSM)

Palm oil biomass is a largely untapped industry that presents an opportunity for Sabah to expand its renewable energy contribution to the State's generation mix

Energy Generation Mix of Sabah, 2021
%

Total Dependable Capacity: 1,179 MW



Potential Capacity from Palm Oil Biomass, 2021

Current capacity from palm oil biomass:

5% utilisation of palm oil biomass → ***1.2 million tonnes*** → ***17.7 MW***

Estimated potential capacity from palm oil biomass based on current capacity:

100% utilisation of palm oil biomass (best-case scenario) → ***24.7 million tonnes*** → ***364 MW***

Key Highlights

- As of 2021, biomass/biogas energy only constitutes 1.5% of Sabah's energy generation mix. Given the vast amount of oil palm planted across the State, there is a huge opportunity in the use of oil palm biomass as a source of renewable energy.
- Whilst oil only makes up 10% of the oil palm, the other 90% comprises of empty fruit bunches (EFB), mesocarp fibres (MF), palm kernel shells (PKS), oil palm fronds (OPF), and the oil palm trunk (OPT) which are a great source of biomass energy for power generation. Sabah produces approximately 24.7 million tonnes of biomass supply which is mainly derived from oil palm plantation. However, only 5% of the oil palm biomass is currently used for energy generation whilst the majority is discarded.
- As Sabah recognises the challenges surrounding its biomass industry, the State aims to explore various strategic initiatives to encourage and support the development of the biomass industry as a priority for the State going forward.

Source: Sabah Electricity Sdn Bhd (SESB), Sabah Development Corridor (SDC) Blueprint 2.0 2020-2030

Despite its benefits, bioenergy feedstock is currently underutilised for power generation due to the presence of several barriers for developers

Barriers	Key Highlights
1 Remote Locality and Limitation of Distribution Grid (33kV and 11kV)	• Oil palm plantations and palm oil mills are typically located in remote areas, ranging between 30 to 90km from the grid system • A 33kV line is typically used in Sabah to connect bioenergy power stations with a substation. However, the 33kV network supply area that stems from each substations are currently limited to a 30km radius as voltage will begin to drop beyond the 30km radial limit • A 132kV line would be required to connect palm oil mills located beyond the 30km radius to substations. However, capital cost to construct a 132kV line is estimated to be six times more than a 33kV line
2 High Capital Contribution of Infrastructure Development	• Developers are required to shoulder the high construction cost of transmission infrastructure from palm oil mills to the nearest substation of the grid system • Additionally, developers may only cover their capital cost through the tariff which are set on a fixed period of 18 years where, more often than not, breakeven for developers tend to occur nine years after electricity is sold to the grid
3 Competition from other biomass usage and collection	• Palm oil plantation developers tend to export biomass byproducts to other, non-energy related industries such as the European feedstock due to the higher profit margin and are therefore, less incentivised to utilise oil palm biomass supply for electricity generation • Collection and transportation of biomass to bioenergy facilities is challenging due to the remote location and distance of some plantations to bioenergy power stations, further disincentivizing the use of oil palm biomass for electricity generation

Source: Sustainable Energy Development Authority (SEDA) Malaysia

Sabah State Government aims to develop an appropriate State policy that promotes the utilisation of oil palm biomass as a source of renewable energy

Introducing Potential Policy to Promote Sabah's Biomass Permeability

POLICY OVERVIEW

Sabah State Government will explore the introduction of State policy that will mandate a minimum requirement for empty fruit bunch (EFB) to be made available for biomass power generation

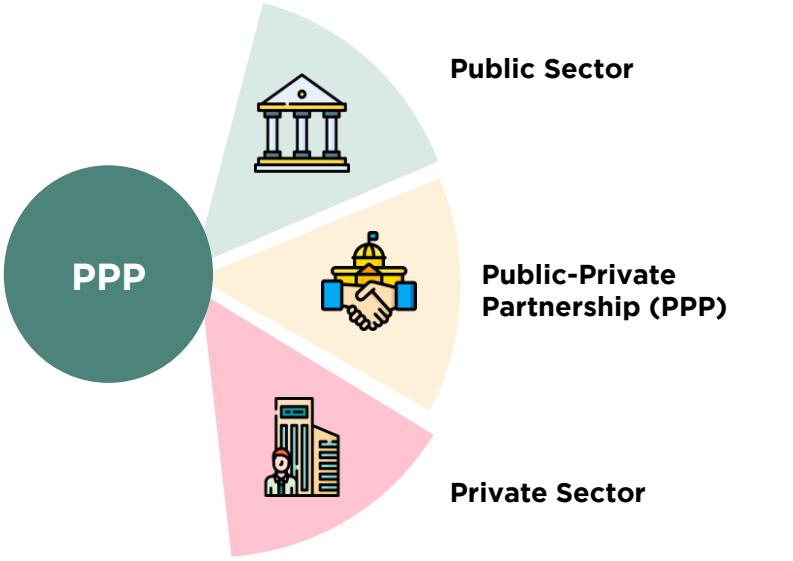
Key Highlights

- Sabah has a huge opportunity to capitalise on its oil palm biomass as a source of renewable energy, given the vast amount of oil palm planted across the State
- In efforts to expand the utilisation of biomass as part of Sabah's generation mix, there is a need for the State Government to explore a policy to address the issue of underutilised oil palm biomass supply available within the State
- State level policy plays a critical role in encouraging the development of biomass industry in Sabah. Through a well-planned and methodical policy, Sabah can unlock the full potential of its biomass industry especially from the oil palm given the immense availability of supply across the State
- As such, Sabah aims to develop a State policy that will mandate a minimum requirement for empty fruit bunch (EFB) to be made available for biomass power generation. This will allow the State to optimally utilise the availability of EFB from the oil palm industry which helps to promote the development of biomass industry for power generation across Sabah. Such policy will also help the biomass industry to form a more reliable collection system that enables efficient collection and distribution of biomass supply

Source: Sabah Electricity Sdn Bhd (SESB), Sabah Development Corridor (SDC) Blueprint 2.0 2020-2030

Additionally, Sabah will capitalise on its biomass potential by encouraging government-industry cooperation to promote biomass investment opportunities for greener energy

Public-Private Partnership (PPP) to Promote Biomass Industry Development



QUICK SNAPSHOT

1 **Potential Investment Opportunities: RM 13.5 billion**

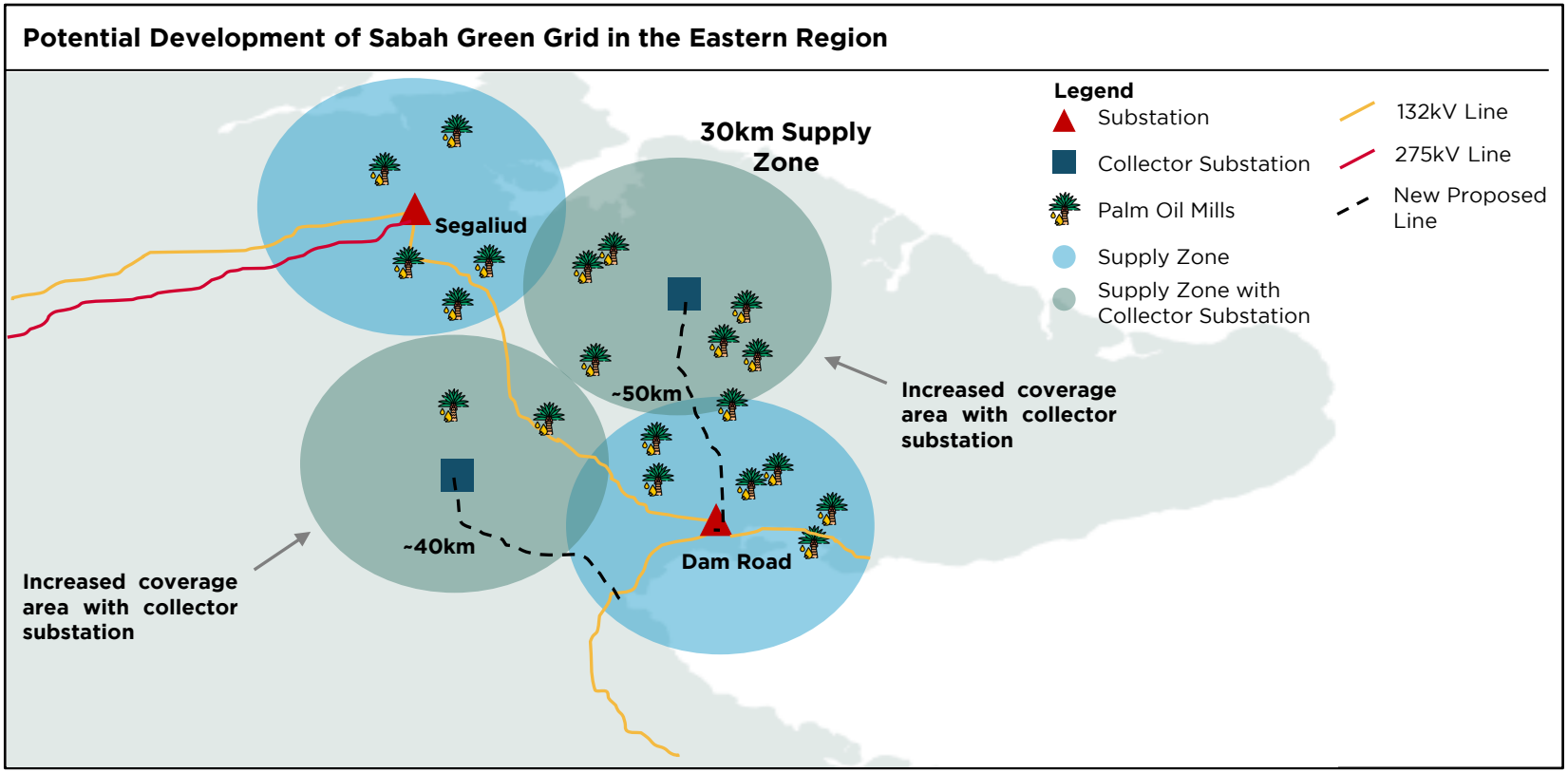
2 **Potential Employment Opportunities: ~25,000**

Key Highlights

- Sabah contributes over a quarter of Malaysia's palm oil production with more than 1.55 million hectares of oil palm planted area. The State generates approximately 26.2 million of biomass supply from the oil palm plantations through 124 identified palm oil mills which are mainly located in the East Coast of Sabah
- Sabah's biomass potential has been greatly underutilised. The State needs to look into developing an integrated biomass industry development plan that expounds the practical initiatives in promoting the development of biomass industry in the State
- The State Government should play a role in coordinating and initiating the cooperation between relevant government agencies and private industry players to develop efficient planning that would result in practical pathways for implementation
- This includes promoting biomass investment opportunities in Sabah through appropriate financial incentives to attract domestic and foreign firms to invest in oil palm biomass processing and downstream product development
- This coordination and collaboration will have a positive spillover effect on increasing biomass for power generation

Source: Sabah Electricity Sdn Bhd (SESB), Sabah Development Corridor (SDC) Blueprint 2.0 2020-2030

To overcome the challenge on limited network supply area, Sabah will explore the development of Sabah Green Grid (SGG) by establishing collector substations in strategic locations



What is Sabah Green Grid (SGG)?

- SGG is a transmission network specially developed to pick up renewable generation particularly biomass in Sabah by establishing collector substations (CSS)
- The CSS are located strategically such that the distance from the renewable energy producers and the palm oil mills is reduced. The CSS would be connected to the existing grid network at transmission level via the 275kV or 132kV lines

Source: Sustainable Energy Development Authority (SEDA) Malaysia

Strategy C3: Establish Sabah Energy Efficiency Action Plan (SEEAP)

To encourage energy efficiency, Sabah will develop a Sabah Energy Efficiency Action Plan (SEEAP)

AIM
Achieve 8% energy savings against BAU scenario

4 Strategic Thrusts

- **Implementation of Energy Efficiency Action Plan**
- **Strengthen Institutional Framework, Capacity Development and Training**
- **Establishment of Sustainable Funding Mechanisms to Implement Energy Efficiency Initiatives**
- **Promotion of Private Sector Investment in Energy Efficiency Initiatives**

5 Key Initiatives

1. **Promotion of 5-Star Rated Appliances**
   - 5-Star Appliance Campaign
2. **Minimum Energy Performance Standards (MEPS)**
   - Energy Efficient Lighting Campaign
   - High Efficiency Motors
3. **Promotion of Co-Generation**
   - Cogeneration in Industries and Commercial Buildings
4. **Energy Audits and Energy Management in Buildings and Industries**
   - Energy Audit and Management in Commercial, Industrial and Government Buildings and Facilities
5. **Energy Efficient Building**
   - Energy Efficiency Labelling in Existing and New Buildings

Note: Development of framework is guided by National Energy Efficiency Action Plan (NEEAP)

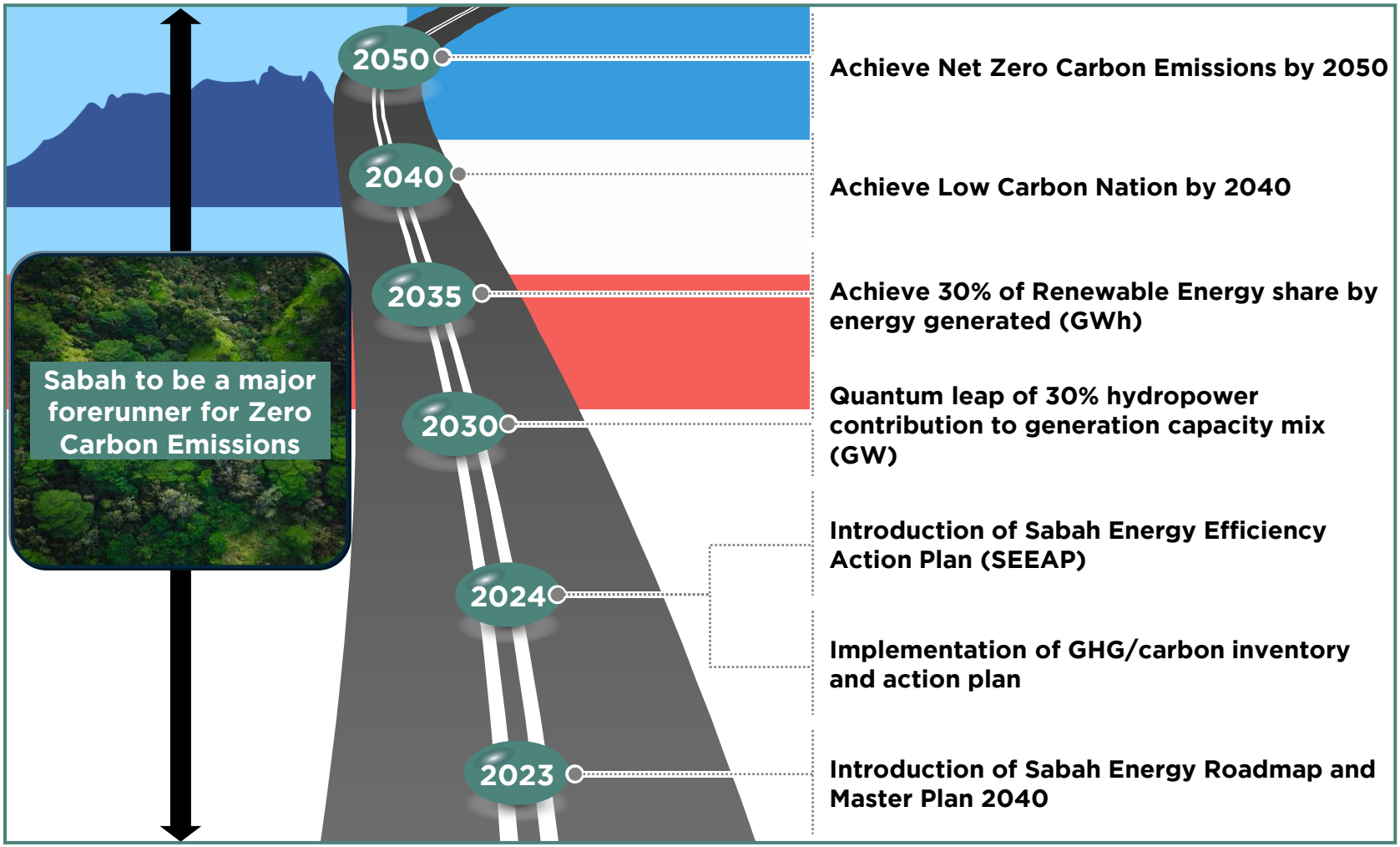
The action plans to drive energy efficiency will incorporate programmes under 5 main prioritised initiatives

	Key Initiatives	Description of Programmes
1	**Promotion of 5-Star Rated Applications**	• Promotion of 5-star energy rated and labelled appliances to transform market into more efficient models • Introduction of mandatory energy labels for qualifying appliances, where 5-star rated appliances are at least 25% more efficient than conventional models
2	**Minimum Energy Performance Standards (MEPS)**	• Promotion of energy efficient lighting such as LED through awareness enhancement programmes, the enforcement of Minimum Energy Performance Standards (MEPS) and labelling, and the enhancement of awareness on the benefit of using smart meters • Introduction of mandatory minimum energy performance standard for motors based on the CEMEP/IEC standard that will define the minimum performance for motors
3	**Promotion of Cogeneration**	• Reduction of barriers that disincentivise the uptake of cogeneration such as possible lack of incentives, technical hurdles, connection to the grid and a lack of awareness of cogeneration, with the intention of promoting cogeneration in industries and buildings
4	**Energy Audits and Energy Management in Buildings and Industries**	• Create awareness on benefits of audit programmes to facilities and promote energy audit programmes • Enforce mandatory energy audits on large and medium commercial and industrial consumers as well as increase the number of certified energy managers (EM) and energy service companies (ESCO) in Sabah
5	**Energy Efficient Building Labelling**	• Joint-cooperation with the Ministry of Local Government & Housing Sabah (KKTP) and local council authorities for the enforcement of the Code of Practice MS1525:2019 on energy efficiency and use of renewable energy for non-residential buildings to ensure that newly constructed buildings in Sabah are designed and built with energy efficiency set as a priority, where buildings must also be provided with an Energy Management System (EMS) to monitor energy use • Coordination and promotion of building energy audits

Source: National Energy Efficiency Action Plan, Green Technology Masterplan Malaysia 2017-2030

Strategy C4: Transition Sabah Towards a Carbon Neutral State

Sabah's road to carbon neutrality by 2050 will include several milestones



In supporting the call for action towards affordable, sustainable & clean energy under SDGs and RMK12, Sabah will transition its energy industry towards carbon neutrality

Sabah is known to have a rich and diverse natural environment, including forests, wetlands, and other ecosystems, which are likely to play an important role in absorbing carbon dioxide and other greenhouse gases from the atmosphere. These ecosystems are also likely to be important sources of livelihoods and biodiversity, making their protection and conservation a key priority.

More accurate and detailed estimates of Sabah's carbon-absorption potential, for example the establishment of a carbon inventory, will be useful for informing policy and management decisions, as well as for tracking progress towards reducing emissions and mitigating climate change. Further research and monitoring may be needed to more accurately quantify the carbon-absorption potential of Sabah's ecosystems and to assess how it is changing over time.

Carbon Sink Potential

Forest Reserve Classification	Approximate Area (Ha) (2020)
Protection Forest	1,421,717.25
Commercial Forest	1,655,482.95
Domestic Forest	4,634.00
Amenity Forest	11,402.77
Mangrove Forest	234,680.27
Virgin Jungle Forest	107,047.91
Wildlife Reserves	139,502.85
Total	**3,574,468.00**

Forest Reserves as carbon sinks: With almost **3.6m hectares**, representing 48.6% of Sabah's land mass, **gazetted as Forest Reserves, this represents a high carbon sink potential** to bolster Sabah's push towards achieving the Low Carbon Aspiration 2040 and Carbon Neutral Aspiration 2050.

Low-Carbon, Clean and Resilient Development

Up to **45%**

RMK12

Reduction in Greenhouse Gas (GHG) emissions intensity to GDP by 2030, based on emissions intensity in 2005

National Aspirations

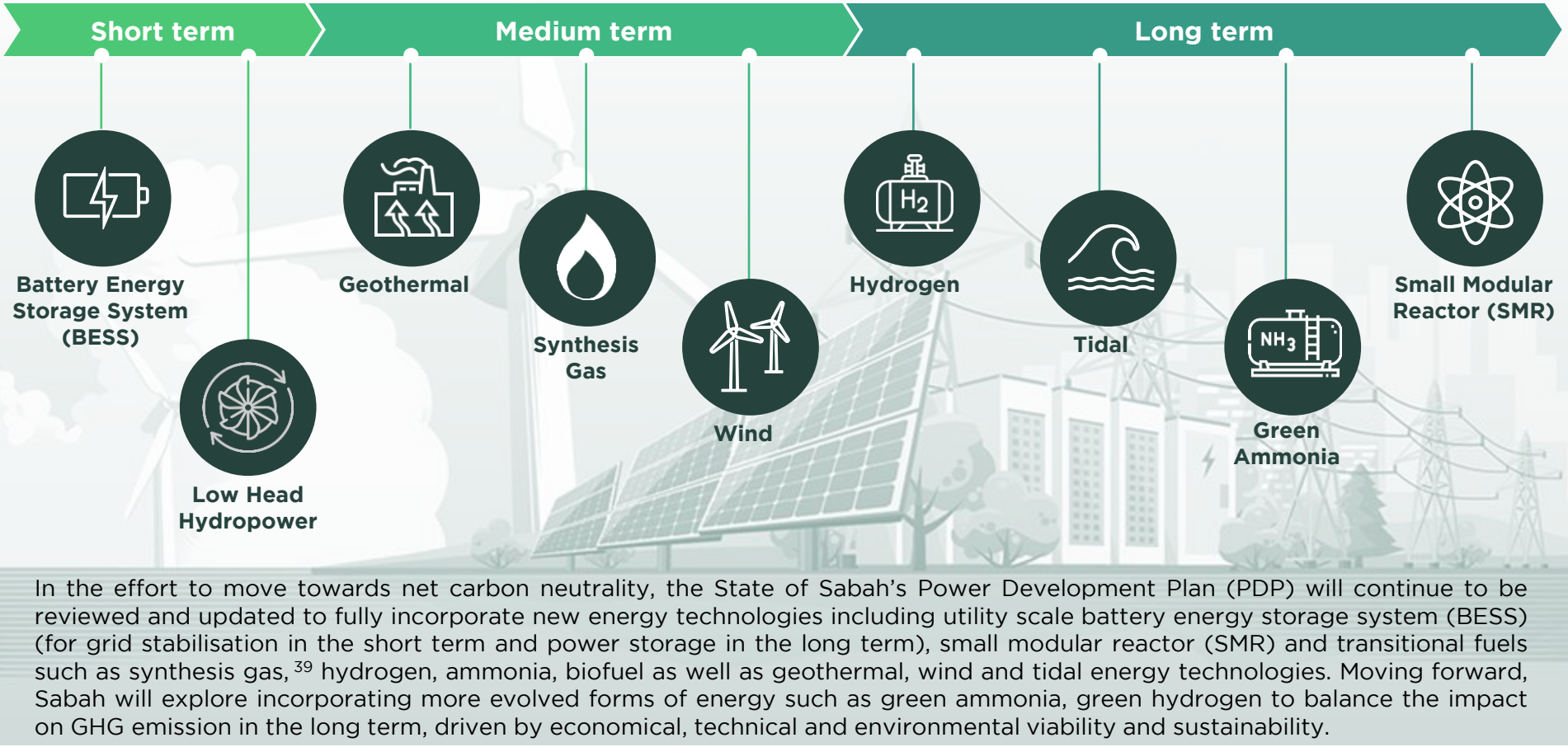
2040 Low Carbon Nation

2050 Carbon Neutrality

National Aspirations for Sabah to contribute to by 2040 and 2050

Source: Sabah Forestry Department, 12th Malaysia Plan

In transitioning towards carbon neutrality, the Power Development Plan (PDP) of Sabah will incorporate new technologies and alternative energy sources, based on economic viability to the supply system within the short, medium and long term strategies



In the effort to move towards net carbon neutrality, the State of Sabah's Power Development Plan (PDP) will continue to be reviewed and updated to fully incorporate new energy technologies including utility scale battery energy storage system (BESS) (for grid stabilisation in the short term and power storage in the long term), small modular reactor (SMR) and transitional fuels such as synthesis gas,[39] hydrogen, ammonia, biofuel as well as geothermal, wind and tidal energy technologies. Moving forward, Sabah will explore incorporating more evolved forms of energy such as green ammonia, green hydrogen to balance the impact on GHG emission in the long term, driven by economical, technical and environmental viability and sustainability.

Note: [39] IGCC has potential of zero GHG emission by incorporating carbon capture, utilisation and storage (CCUS) as elaborated on p. 140

Sabah will need to prepare for Carbon Border Adjustment Mechanism (CBAM)

Carbon Border Adjustment Mechanism (CBAM)

- In 2021, the EU announced the implementation of the Carbon Border Adjustment Mechanism (CBAM) where a Carbon tax will be imposed on imported goods
- CBAM will begin its transition towards implementation by 2023 where EU importers will have to report emissions embedded in their goods without paying a financial adjustment in a transitional phase starting in 2023 and finishing at the end of 2025, giving time for the final system to be put in place
- This transitional phase, combined with the gradual phasing in of CBAM over time, will allow for a careful, predictable and proportionate transition for EU and non-EU businesses as well as authorities
- Once the definitive system becomes fully operational in 2026, EU importers will be required to declare annually the quantity of goods and the amount of embedded emissions in the total goods they imported into the EU in the preceding year, and surrender the corresponding amount of CBAM certificates
- Apart from the EU, it is likely that other markets will also launch CBAM
- Thus, for Sabah manufacturers to remain competitive, low or zero carbon industrial production will be required

Imposed Risk for Sabah Manufacturers

- While Sabah demonstrates the lowest carbon footprint of all Malaysian states, Sabah still has some ways to go in ensuring that its exports remain competitive in the global market

Remain Competitive

- Manufacturers in Sabah that are intending to export to the EU, especially for aluminium, fertilisers, cement, iron and steel will need to consider ways on delivering low or zero carbon energy products by incorporating combination of energy efficient production, low carbon energy and renewable energy

Source: European Commission, IEN Consultants

Sabah will develop a GHG/carbon inventory to ascertain the baseline data of greenhouse gas, towards formalising a carbon management plan and setting a long term target for the State

A greenhouse gas (GHG) inventory is a list of emission sources and the associated emissions quantified using standardised methods

GHG inventory for Sabah will be aligned to the national decarbonisation agenda, as well as enable a robust carbon management plan that includes:

- Managing GHG risks and identifying reduction opportunities
- Participating in voluntary or mandatory GHG programs
- Participating in GHG markets
- Achieving recognition for early voluntary action

GHG Inventory Development Process

- Review GHG accounting standards and methods for national/ international reporting
- Determine operational boundaries

- Identify data requirements and methods for data collection
- Develop data collection procedures, tools, and guidance tools
- Compile and review facility data (e.g., electricity, gas)
- Estimate missing data to fill gaps
- Choose emissions factors and quantify emissions

- Formalize data collection procedures
- Document process in Inventory Management Plan

- Finalize GHG data
- Incorporate third-party verification, if required
- Report data as needed
- Set a publicly reported GHG target and track progress

Source: United States Environmental Protection Agency (EPA)

Simultaneously, Sabah will participate in the 'Voluntary Carbon Market (VCM)' where companies can make voluntary purchases to compensate for their emissions

Voluntary Carbon Market Process Flow

Emission mitigation project

1

- A developer sets up a project
- Developer obtains validation and registers on a certification standard
- Developer operates and monitors results
- 3rd party verifies results

Project verified by standards and credit insurance

2

- A carbon credit is 'issued' i.e. a certificate is issued and a unique serial number on the registry is created for each ton of CO_2e
- The fist credit issuance can be made 2-3 years after the start of the project

Trading and carbon market

3

- Issued credit belongs to the developers
- These can be bought and sold and their ownership on the registry charges until a buyer "redeems" (retires), at which point the credit ceases to exist (it is marked as "retired" in the registry)

Credits retired toward company targets

4

- The carbon credits are "retired", by companies, to fulfill either voluntary emissions reduction targets or to create "carbon neutral" products for their customers

Source: Bursa Malaysia

Sabah will also incorporate policies and guidelines towards driving green mobility

Development of State Policies and Guidelines for Green Mobility

Prospect of policy direction for green mobility

- Short term focus on the collaborative promotion on green mobility encompassing a drive towards improved public transport modal share, shared mobility, promotion of nonmotorized transport and other low emission vehicles
- Collaborative urban and town planning to incorporate comprehensive mobility and transport corridors with residential & commercial developments
- Potential longer-term coordination on enabling infrastructure development for electric vehicles charging stations and ecosystem to unblock the full potential of green mobility in the State

Key Highlights

Potential priorities towards enabling green mobility

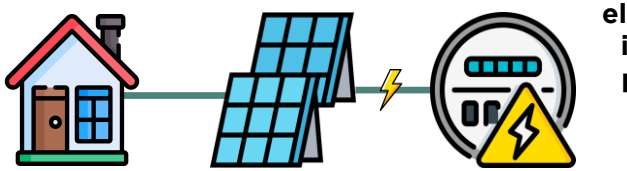
- Implement initiatives to encourage the public to shift from private vehicle to public transport via proactive public-private collaborations on public transport
- Support charging infrastructure build out and other relevant physical enablers to accommodate the entrance and penetration of energy efficient vehicle (EEV) such as electric vehicles or hydrogen vehicles
- Establish or adopting national enabling regulations to support EEV adoption such as regulation on vehicle, battery and infrastructure attributes
- Usage of electric vehicles (EV) which reduces air pollution and potentially contributes towards GHG emission reduction as a preferred mode of transport would be promoted
- The private sector would be encouraged to invest in advancing next-generation vehicles, technologies and supporting infrastructures, such as energy-efficient, hydrogen-powered and electric vehicles and their charging stations as well as for marine transport. The private sector will also be encouraged to uptake recognised green labelling for next-generation vehicles and technologies
- Encourage the adoption of fuel economy standards to increase fuel efficiency for new vehicles which includes the expansion of B20 (or higher) biofuel programme that contains 20% palm methyl ester and alternative fuel sources, such as compressed natural gas, hydrogen energy and fuel cell

Source: Inputs from the Kota Kinabalu Green City Action Plan and Strategy, National Energy Efficiency Action Plan

Sabah will explore Green Electricity Tariff (GET) to provide consumers the opportunity to purchase low carbon electricity supply without renewable energy installations

Green Electricity Tariff (GET)

1



GET Programme users will purchase electricity from RE installations not present on their premise

2

Consumers will receive an internationally recognised Renewable Energy Certificate (REC)

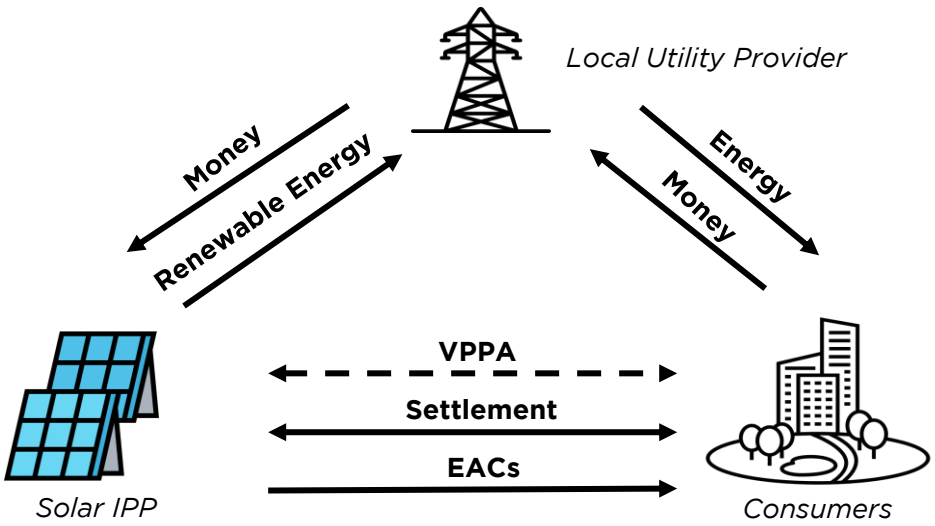
Key Highlights

- GET Programme will present consumers the option to purchase low carbon electricity supply without having to install their own solar rooftop or other renewable energy installations, thus allowing for consumers to reduce their carbon footprint in electricity consumption
- By enrolling into GET Programme, consumers will receive an internationally recognised Renewable Energy Certificate (REC) after the end of calendar year
- The renewable energy resources for GET Programme will be generated by solar power plants under the Large-Scale Solar (LSS) Programme and SESB's and/or its subsidiary's hydropower stations and any other renewable energy plants which may be approved by the Commission from time to time
- Consumers who opt for get subscriptions will pay:
  - Normal tariff as per the Tariff Schedule; and
  - GET for the blocks of Green Energy they have subscribed at a separate rate

Source: Tenaga Nasional Berhad (TNB)

Sabah will also explore Virtual Power Purchase Agreement (VPPA) to expand access to renewable energy and EACs from solar IPPs

Process Flow of Virtual Power Purchase Agreement (VPPA)



BENEFITS

1. **Renewable Energy market growth:** Supply of solar power is done virtually between IPP and consumers, with consumers continuing to receive power from the Local Utility Provider, opening the market to new investors
2. **Financial Hedging:** Consumer and IPP agree on a 'strike price' arrangement, where any difference in market price of electricity is borne by either party through an agreed settlement
3. **EACs for consumers:** Consumers can receive Energy Attribute Certificates (EAC) to certify green origin of power

Key Highlights

- The Virtual Power Purchase Agreement (VPPA) was announced in August 2022 and is anticipated to **expand the solar energy program, with a national quota of 600MW**
- As the supply is done virtually, **solar IPPs can expand their market reach** to other consumers beyond the immediate vicinity, **opening the market to new investors,** and **expand the growth of renewable energy in Sabah**. The Solar IPP will enter into a New Enhanced Dispatch Agreement (NEDA) with the Single Buyer to supply energy to the grid, with the single buyer purchasing energy based on the System Marginal Price
- The solar IPP and consumer agree to a **'strike price,'** which then forms the basis of a **settlement mechanism**. If the **market price is above the strike price, solar IPP pays the consumer the difference**. If the market price is **below the strike price, the consumer pays the IPP the difference**
- In addition, consumers in the VPPA will receive Energy Attribute Certificates (EACs) from the IPP to certify the green origin of electricity supplied

Source: Tenaga Nasional Berhad (TNB)

Additionally, Sabah will consider implementing a flaring management framework in the long term to bolster its efforts to commit to zero continuous flaring and venting emissions

Key elements in Establishing a State-Level Framework for Gas Flaring

Process Elements

Project origination
- Potential for commercializing flared gas
- Flare gas market study
- Identification of project structures
- Private sector participation framework

Definition of specific projects

Third-party funding
- Private equity funds
- Global infrastructure facility
- Climate and concessional funds

Key Structural Elements

Institutional Set-Up:
- Stakeholder mapping
- Organisational structure
- Capacity Building

Data Management:
- Gas production
- Flaring

Regulatory Framework:
- Policies
- Institutional arrangements
- Regulations
- Monitoring and enforcement
- Lessons learned

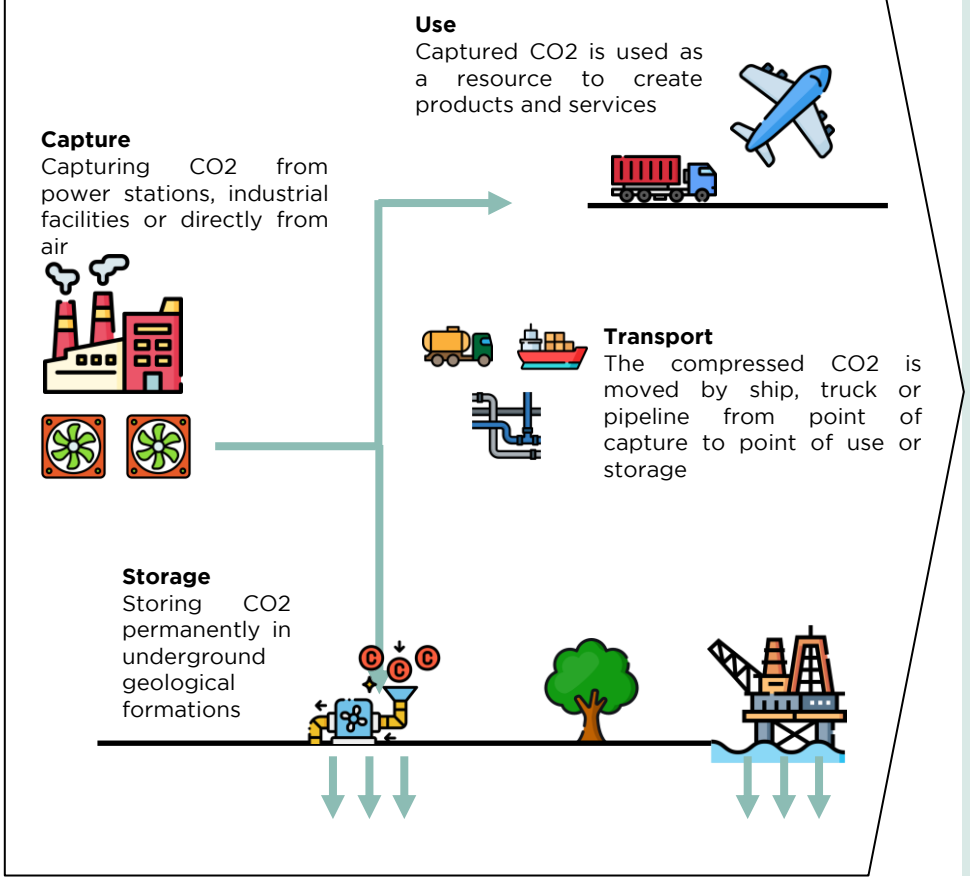
Key Highlights

- Sabah currently has guidelines that describe the safety protocols and procedures for gas flaring in the State. Moving forward, Sabah will consider implementing a flaring management framework to support Malaysia's efforts to commit zero flaring and venting emissions
- In its document, '*Flaring Management Guidance*', the World Bank's Global Gas Flaring Reduction Partnership provides a framework for national governments to address routine flaring of associated gas by structuring laws, programs and incentives to eliminate its use when new 'greenfield' hydrocarbon development projects are sanctioned
- The framework covers the following elements:
  - **Institutional Set-Up:** An organisational structure with an agreed mandate and sufficient resources is essential to achieve a sustainable flaring reduction program.
  - **Regulations and Guidelines:** Rules are needed to define the transactional and commercial structure and are supported by implementation guidelines.
  - **Flaring and Production Data Management System:** Actions by government entities, oil and gas operators, value chain partners and investors are driven by well-defined and transparent data.
  - **Flare Gas-to-Market Project Origination:** Real progress on reducing flaring relies on a host of actors that come together to effectively execute in-field gas utilisation projects

Source: World Bank

Exploring Carbon Capture, Utilisation and Storage (CCUS) initiative

Carbon Capture, Utilisation and Storage (CCUS)



Key Highlights

- Carbon capture, utilisation and storage (CCUS) is a vital solution in Sabah's plan to transition to a net zero carbon future that is applicable across the energy value chain
- CCUS involves in capturing the CO2 from large point sources, such as power generation or industrial facilities that use either fossil fuels or biomass as fuel. The CO2 can also be captured directly from the atmosphere. If not being used on-site, the captured CO2 is compressed and transported by pipeline, ship, rail or truck to be used in a range of applications, or injected into deep geological formations
- Main industry players such as PETRONAS are actively exploring CCUS opportunities in efforts towards establishing Malaysia as a leading regional CCUS solutions hub. The national oil company announced that Malaysia's very first offshore CCS project (known as the Kasawari CCS project) will be the largest offshore CCS project in the world by volume of CO2 captured, with ability to capture up to 3.3 million tonnes per annum of CO2
- The project is scheduled to commence operations by the end of 2025

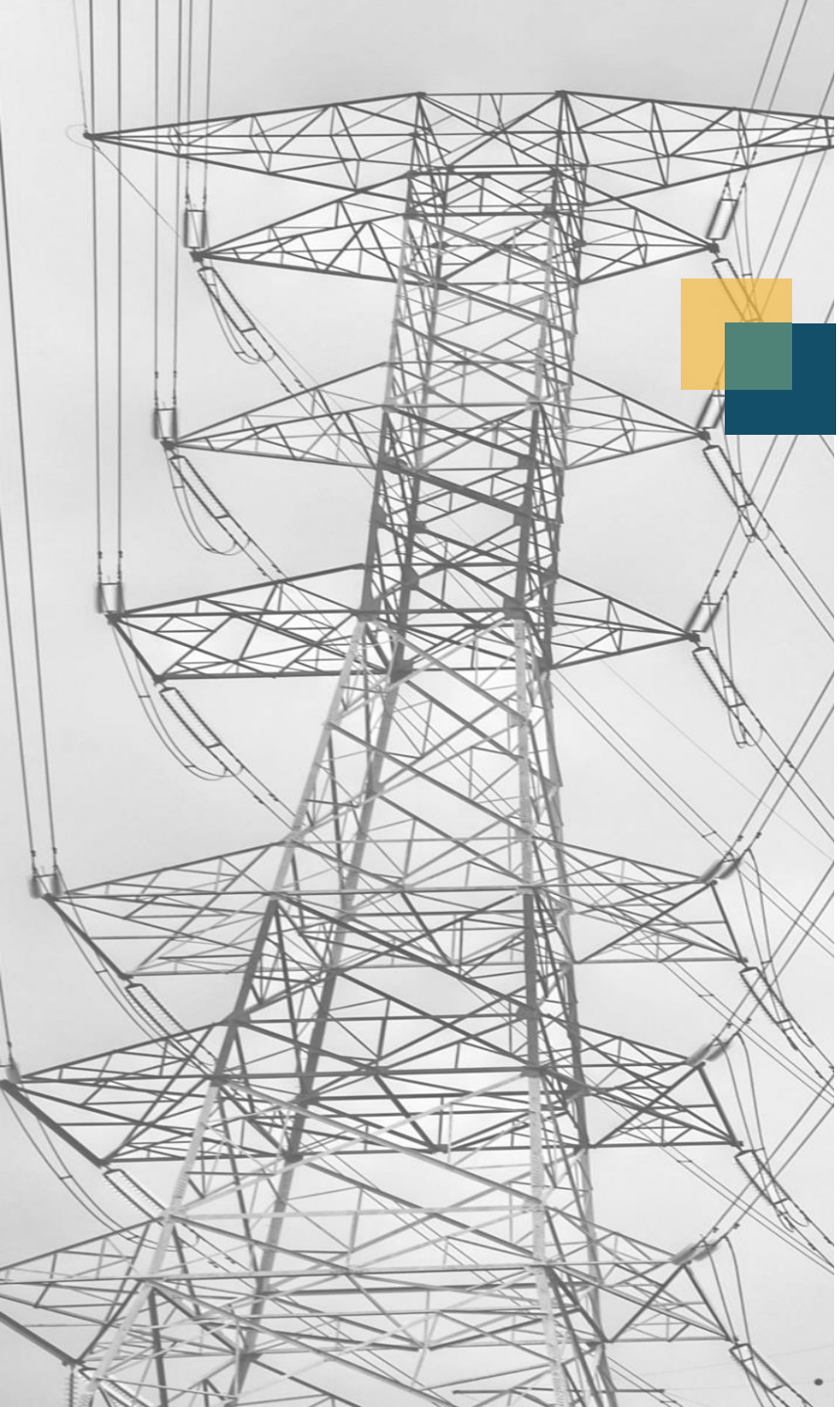
Source: PETRONAS

Good to know: Kasawari Integrated Offshore High Contamination Project

Key Highlights

- The main Kasawari project is an offshore gas field discovered by PETRONAS in November 2011 that is expected to start up by 2023
- The main project is also expected to host more than three trillion cubic feet (tcf) of natural gas resources, making it one of the most significant gas discoveries in Malaysia
- As of Q3 2021 however, PETRONAS has announced efforts to boost carbon capture and storage (CCS) by expanding CCS at the Kasawari gas field, namely Kasawari 2
- Through Kasawari 2, PETRONAS aims to not only reduce the firm's own carbon emissions, but to make Malaysia a hub for CCS due to Malaysia's geography and capacity
- The Kasawari 2 project calls for a fixed platform — with the jacket and topsides weighing between 10,000 and 14,000 tonnes each — that will be installed in a water depth of 108 metres
- This new platform will be bridge-linked to the Kasawari main central processing platform, with a new 138-kilometre 16-inch subsea pipeline delivering the compressed CO^2 for injection at a depleted reservoir at the M1 field
- Kasawari 2, with the related CCS scheme, is expected to be operational by 2024 and is expected to reduce CO^2 volumes emitted via flaring by a total of 76 million tonnes over the expected field life, with an annual average saving of 3.7 million tonnes per annum

Source: The Edge Markets 2022, Offshore Technology 2021, NS Energy Business, n.d.



10

Conclusion

Conclusion

Sabah Energy Roadmap and Master Plan 2040 (Sabah Energy RAMP 2040) sets the overarching blueprint for Sabah to achieve reliable, accessible, affordable and sustainable energy by 2040. The Master Plan has identified 16 key strategies under three pillars of the energy trilemma for the State to balance between strengthening its energy security, maintaining affordability and equity, and realising environmental sustainability within the energy sector for Sabah.

Strategies to achieve operational sustainability of the SESI, sufficient generation reserve margin, diversified fuel mix, and new energy sources and technologies for longer term are key in this Master Plan to achieve energy security. In addition, upstream adequacy for transmission and distribution network which includes Southern Link to ensure grid resilience, and cross border interconnection are also crucial. For the gas sector, an integrated gas master plan is of prime importance to unlock production potential and optimise this resource for the State. Potential policy priorities for the State to consider in its management of natural gas, where long term development of natural gas and its spin-offs must contribute towards Sabah's economic expansion and benefit is also highlighted.

To provide accessibility and affordability, optimised generation plant up, and a Master Plan to optimize hydropower development are of high priority. To ensure that the State's energy sector remains sustainably affordable while becoming increasingly accessible in Sabah, energy pricings need to gradually reach market parity. Recent fluctuations in fuel costs due to market and external forces show SESI is not exempted and this needs to be carefully considered in developing the State's Master Plan to minimise impact to customers as well as to the government.

Through its outline of initiatives that propose alternative energy sources for electricity generation, the Sabah Energy RAMP 2040 focuses on transitional and greener renewable alternatives for the State to set the State's plan towards achieving carbon neutrality by 2050.

Overall, the successful implementation of the identified initiatives will set the State on the trajectory towards ensuring energy security and reliability of gas and electricity supply and distribution in Sabah, the establishment of electricity tariffs that will benefit both consumers and producers, and strengthing the State's generation mix for a greener, reliable, accessible and sustainable energy supply for future Sabahans.

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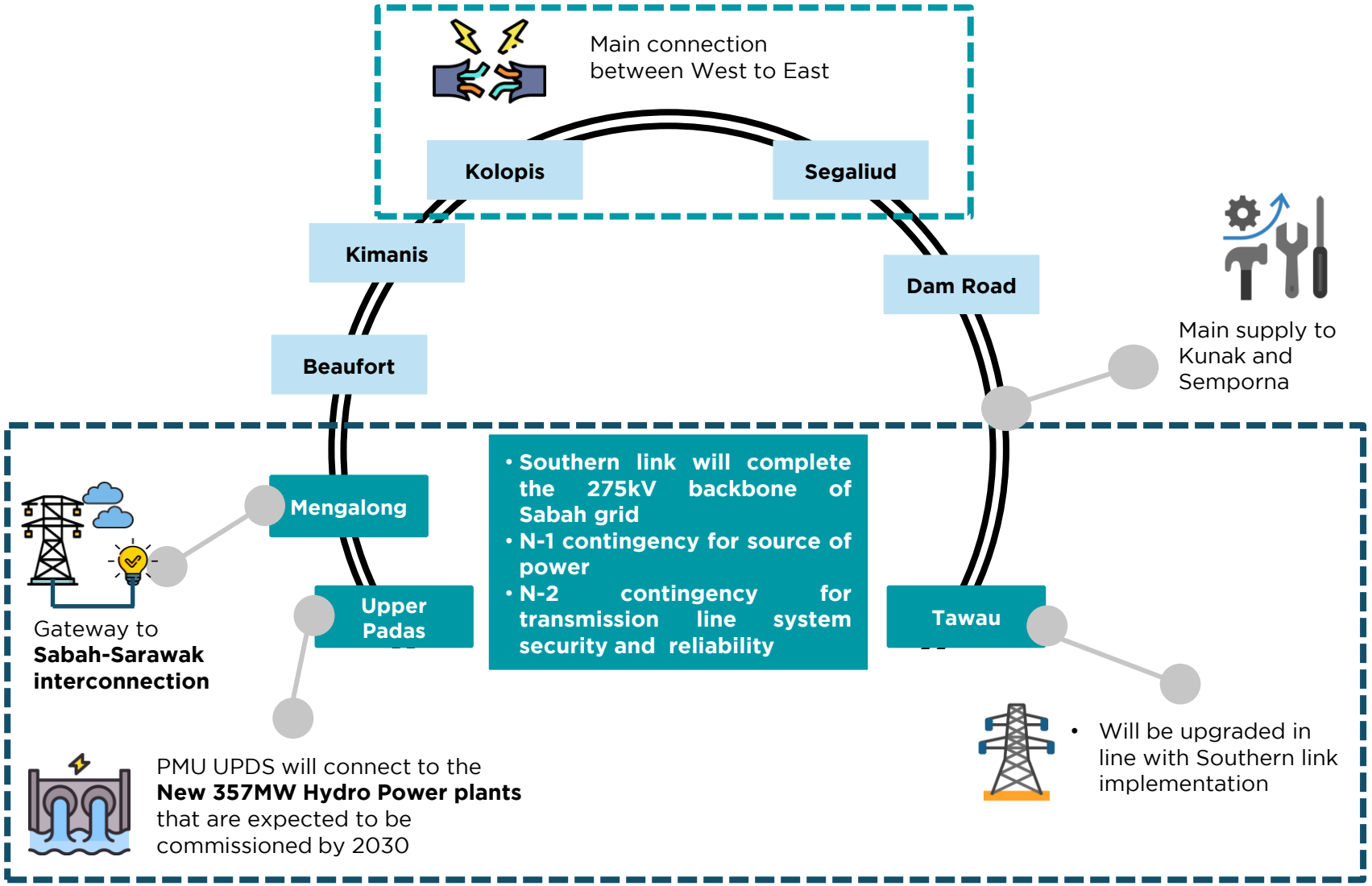
Appendix I: Supplementary Details

Footnote 33. The implementation of the Southern Link will improve Sabah power grid resilience and enable optimisation of generation cost



Source: Sabah Electricity Sdn Bhd (SESB)

Footnote 36. Information on unelectrified rural villages utilises the following three-step methodology

DATA AND METHODOLOGY | PRIORITISATION OF AREAS

STEP 1

- Obtain information on the communities that are living off-grid

Size of the community

- Number of households
- Number of adults and children
- Village land size

Density of the population in the village

STEP 2

- Evaluate the technical aspects of connecting the community to the grid

Distance to the main grid

- Distance of transmission lines required
- Distance of distribution lines required

Complexity of terrain to connect to the main grid

- Mountainous terrain
- Islanded grid
- Deep jungle

STEP 3

- Evaluate the economic value of connecting the village to the main grid

Economic strength

- Economic activities in the village

Cost of connecting to the main grid

- Cost per household ratio of connecting the village to the grid

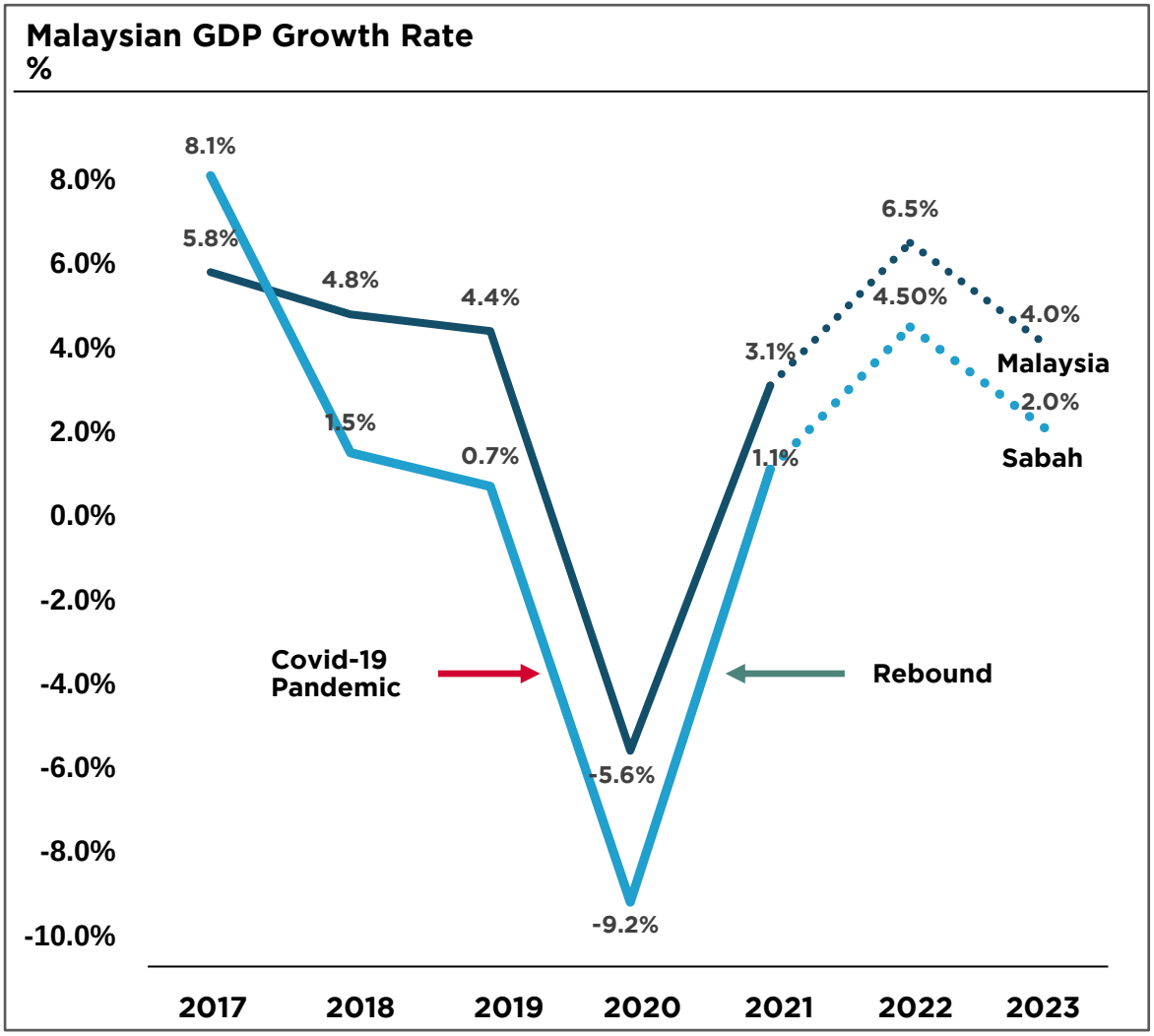
Footnote 37. However, with all the infrastructure in place for rural electrification, there are a few issues that SESB had faced

Key Issues	Brief Description
Battery lifetime for the Solar Hybrid Station (SSH) is short	 • Most of the Original Equipment Manufacturer (OEM) for the battery provider recommended that the effective battery storage lifetime for the Solar Hybrid Stations (SSH) would be approximately five to seven years only
The usage of diesel fuel for SSH had incurred high cost	 • The cost of diesel fuel will increase as the battery storage for the SSH degraded. As of 2018, the fuel consumption for 9 SSH amounting to 1.97mil litres, costing RM4.33mil with an ROI of 2.74 years
Lack of technical support from the Original Equipment Manufacturer (OEM)	 • There is difficulty in getting technical assistance for information and advices to troubleshoot the inverter and renewable energy system installed at the SSH stations
Difficulty in terms of transportation to conduct O&M on the SSH	 • Operational and maintenance workers require to go through a lengthy journey with various logistics difficulties such as the village jetty is far from the SSH stations

12

Appendix II: Global & Regional Trends

Whilst Malaysia and Sabah suffer an economic setback during the pandemic, the economies have witnessed strong rebound in 2021 with moderate yet steady growth projected ahead

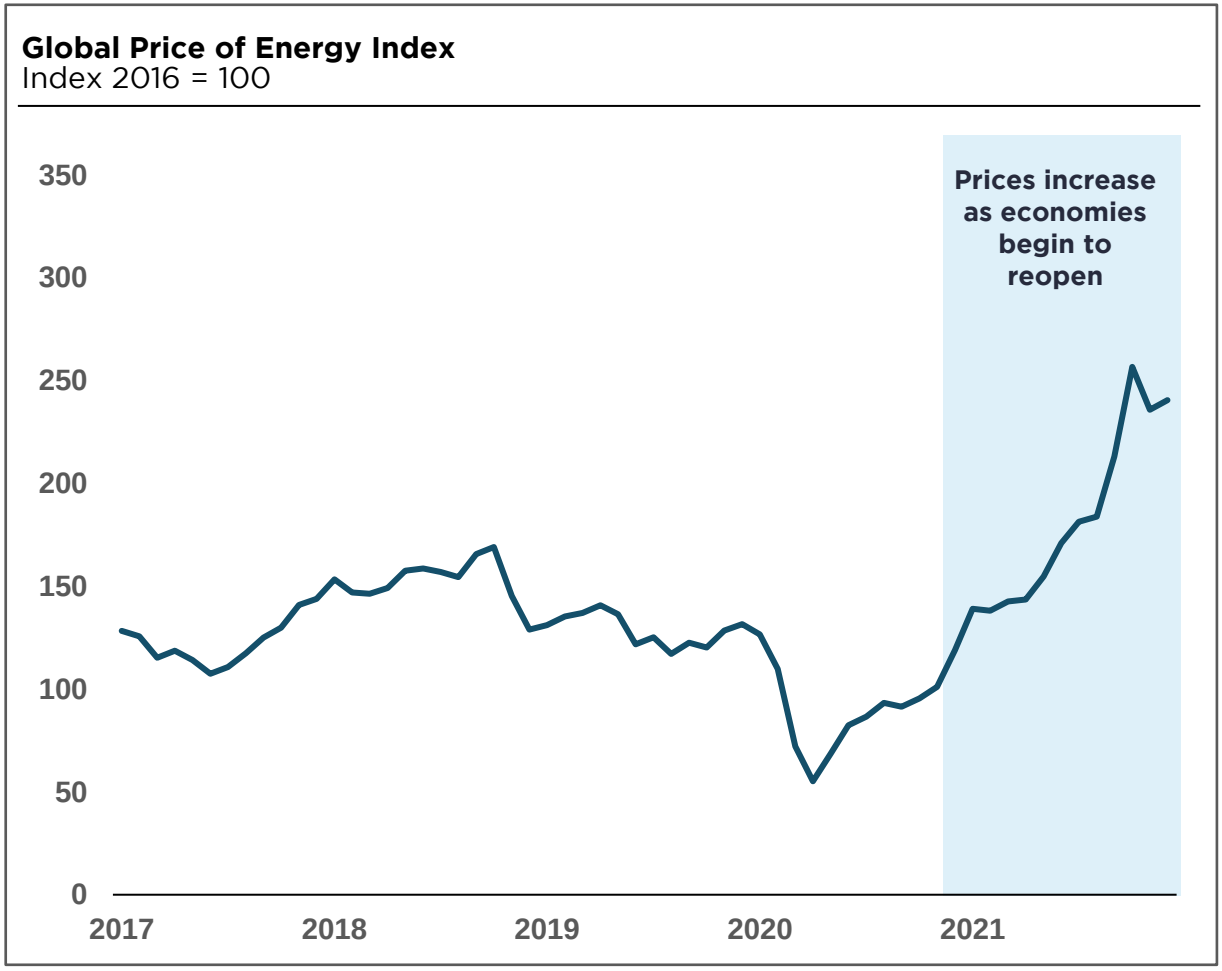


Key Highlights

- Malaysian economy suffered a contraction of 5.6% in 2020 due to Covid-19 pandemic as a result of lockdowns and social restrictions
- As the economy begins to reopen, the country registers a growth of 3.1% in 2021 accompanied by improvement in labour market and increased manufacturing sales
- For 2022, the economy is expected to grow by 6.5% as the recovery continues to gain momentum supported by robust consumption, services and exports. The economy posts a double-digit growth (14.2%) in the third quarter of 2022, the fastest among other economies in ASEAN
- For 2023, the MoF forecasts the economy to grow moderately at 4% against the backdrop of softening overall world economic growth

Source: World Bank, Bank Negara Malaysia, Ministry of Finance (MoF)

The global economic rebound after Covid-19 pandemic has triggered sharp increase in energy prices

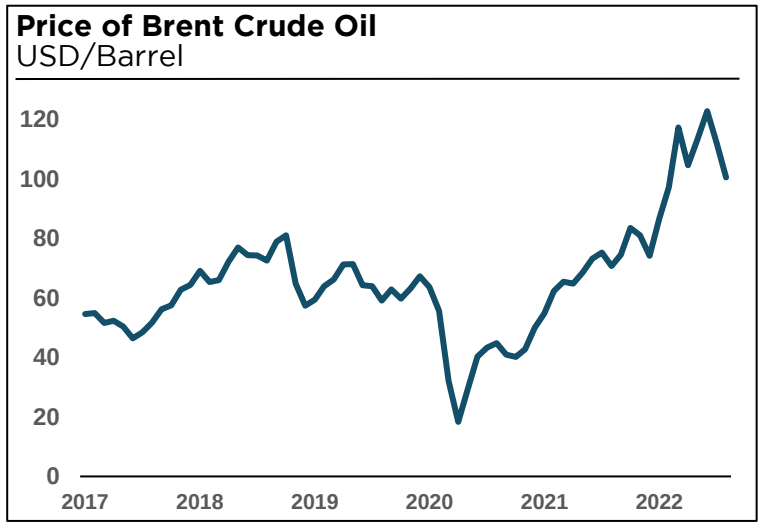


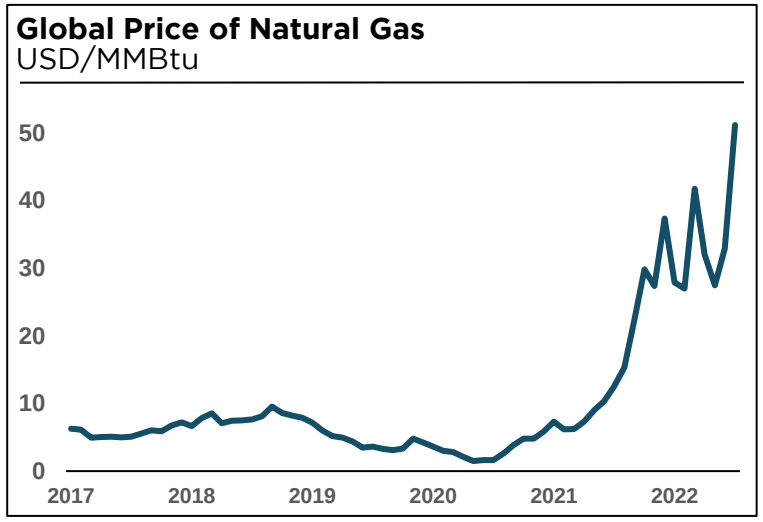
Key Highlights

- Lockdowns and social restrictions due to the pandemic have forced many industries to grind to a halt, resulting a decrease in demand for energy
- Supply production also falls corresponding to the fall in demand
- As restrictions begin to ease, demand soars especially from hospitality and tourism sector that witness strong recovery which contributes to rapid increase in demand
- The rapid surge in demand however cannot be met with sufficient supply which results in soaring global energy prices

 Source: International Monetary Fund (IMF)

Ukraine-Russia conflict has led to spikes in energy prices as concern over supply comes into play



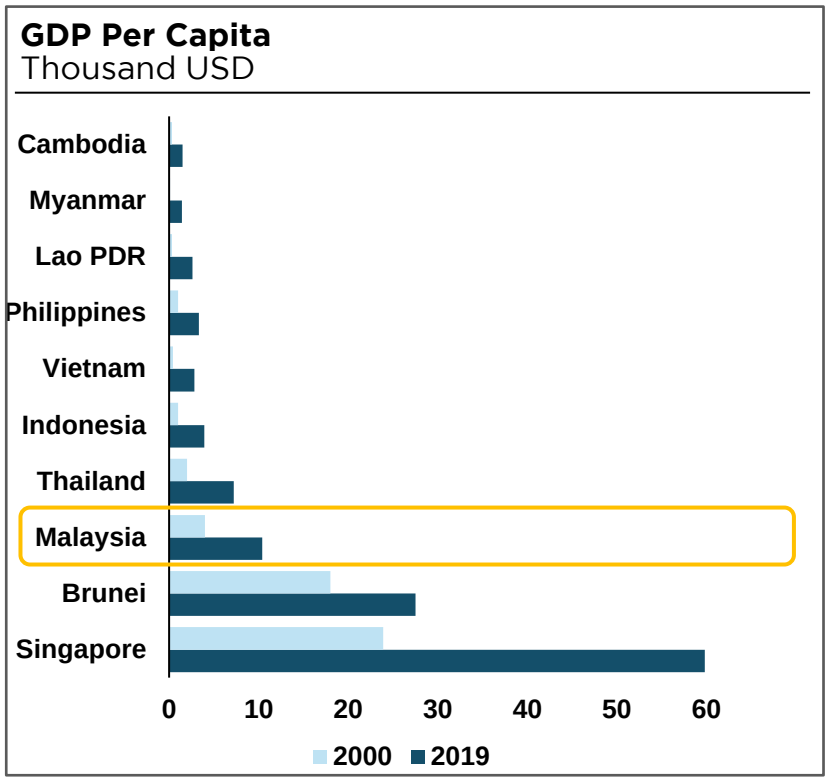


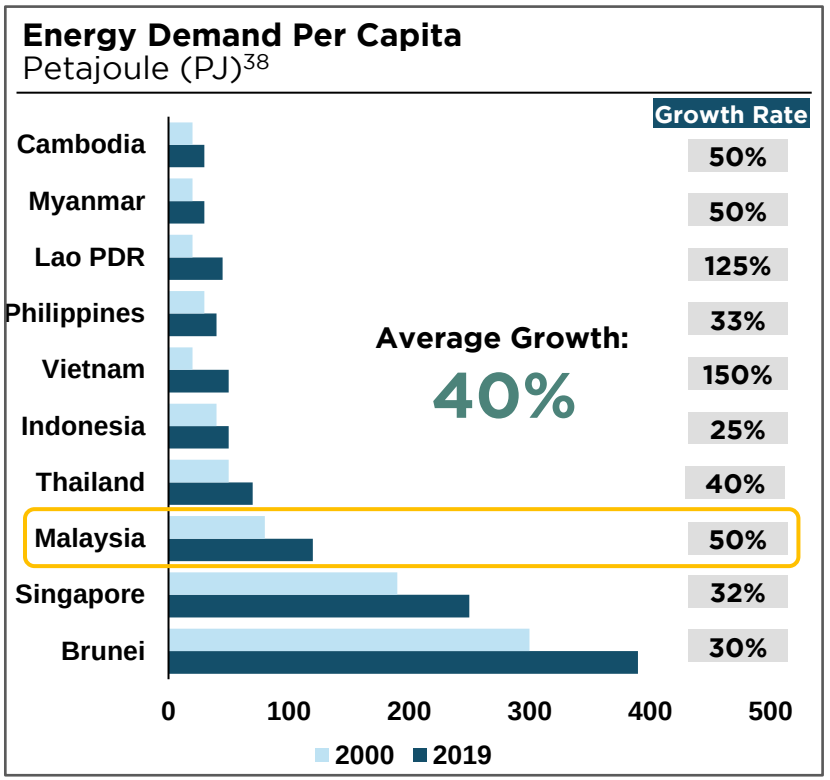
Key Highlights

- Ukraine-Russia conflict has caused global energy prices to soar, especially for oil and natural gas
- Oil price jumps to almost USD 130 a barrel, the highest level in 14 year-period
- The price of natural gas soars by more than double as US and Europe begin to impose sanctions on Russia
- The sanction has put many European countries in a tough spot as Russia is the main natural gas exporter in the region
- Higher oil and gas prices have fueled concerns that the prices for many everyday items from utilities and food, to petrol and heating will increase further

Source: US Federal Reserve Data

In ASEAN, energy demand has increased with an average of 40% over the past two decades with the trend is expected to continue to 2030



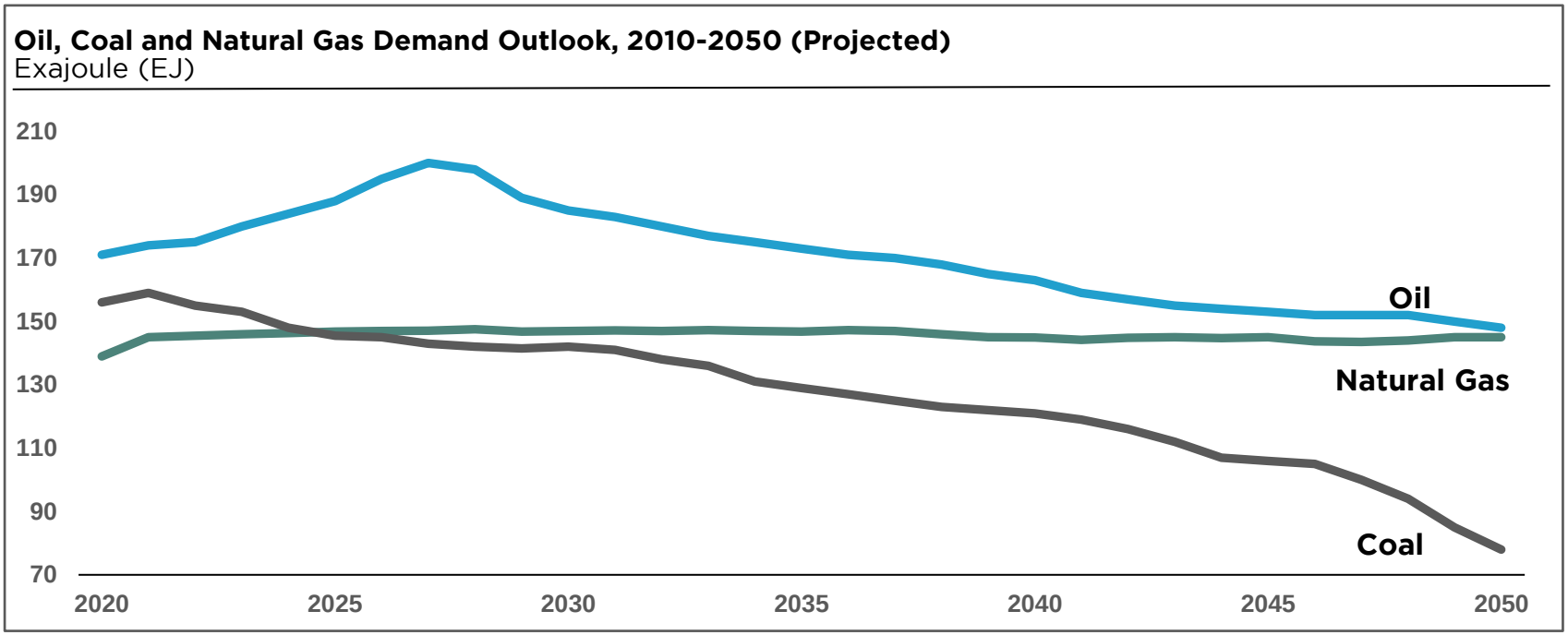


Key Highlights

- ASEAN economies grew by 4.2% on average each year between 2010 and 2019. Today, the region has around 660 million population, expanded by 10% over the past 10 years
- The countries are in different stages of their development, but almost all of their economies have grown more than double in size since 2000

Note: [40] Petajoule equates to 277.8 GWh
Source: World Bank, International Energy Agency – Southeast Asia Energy Outlook 2022

As global demand for energy continues to grow, there is an urgent need for countries to accelerate the transition towards greener energy



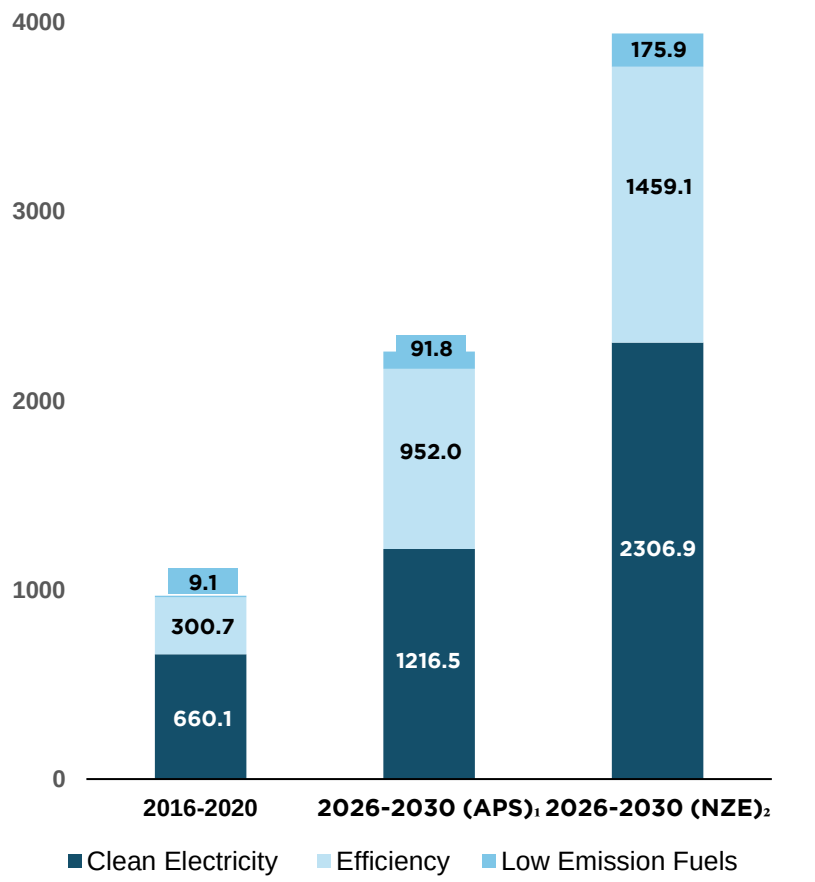
Key Highlights

- The International Energy Agency (IEA) is forecasting a steady decline in aggregate fossil fuels demand from 2030s onwards, with all net growth in energy demand coming from low-emission sources
- While demand for oil and coal is expected to decline, demand for natural gas in industry and power sector is expected to grow moderately as the energy remains the cleanest option of the fossil fuels for power generation
- Policy makers around the world are proactively developing policy settings to accelerate the transition towards renewable energy adoption to substitute the high reliance on oil and coal for power generation

Source: World Energy Outlook 2021

Transition towards sustainable energy system continues to accelerate globally

Annual Average Clean Energy Investment by Technology
Billion USD



Highlight

- Clean energy technology is becoming a major new area for investment and employment
- As major global economies continue to transition into clean energy, the falling costs of key clean energy technologies offer a major opportunity to chart a new, lower emissions path to growth that is centred around clean electrification and efficiency
- Under the APS assumption, the average investment is expected to increase by USD 1.3 trillion between 2026 to 2030. Meanwhile, under NZE assumption, the value is expected to increase by almost USD 3 trillion in the same period

Note

1 **Announced Pledges Scenario (APS)**

APS takes account of all climate commitments made by governments around the world including Nationally Determined Contributions (NDC) and longer-term net zero targets

2 **Net Zero Emissions by 2050 Scenario (NZE)**

NZE sets out a narrow but achievable pathway for the global energy sector to achieve net zero CO_2 emissions by 2050

 Source: World Energy Outlook 2021

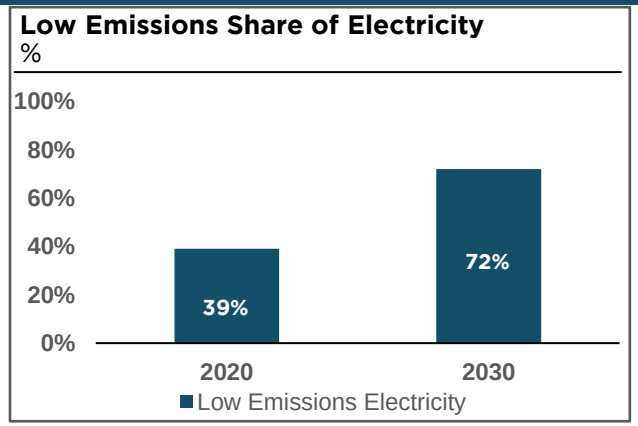
However, today's pledges cover less than 20% of the gap in emissions reduction that needs to be achieved by 2030 to keep 1.5°C path within reach

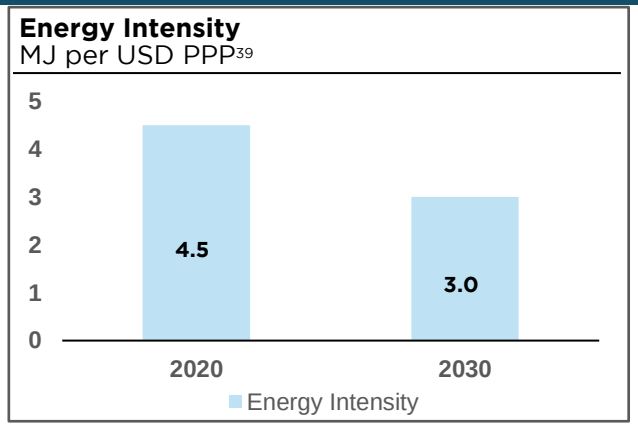
What is 1.5°C pathway?

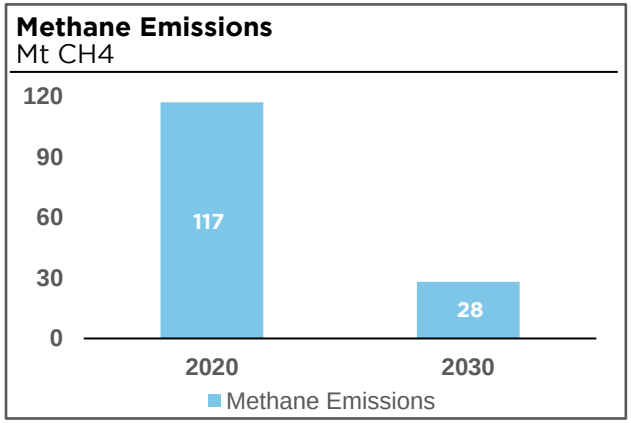
1.5°C pathway was first brought into global attention in the Paris Agreement, which is a legally binding international treaty on climate change. The agreement aims to limit the global temperature increase in this century to well below 2°C above pre-industrial levels whilst pursuing the means to limit the increase to 1.5°C

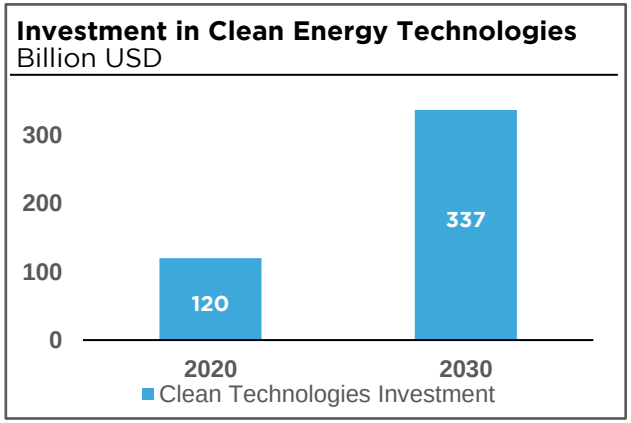
Four key priorities to close the gap between today's pledges and 1.5°C over the next decade:

1. Deliver a surge in clean electrification
2. Realise the full potential of energy efficiency
3. Broad drive to cut methane emissions from fossil fuel operations
4. Boost clean energy innovation



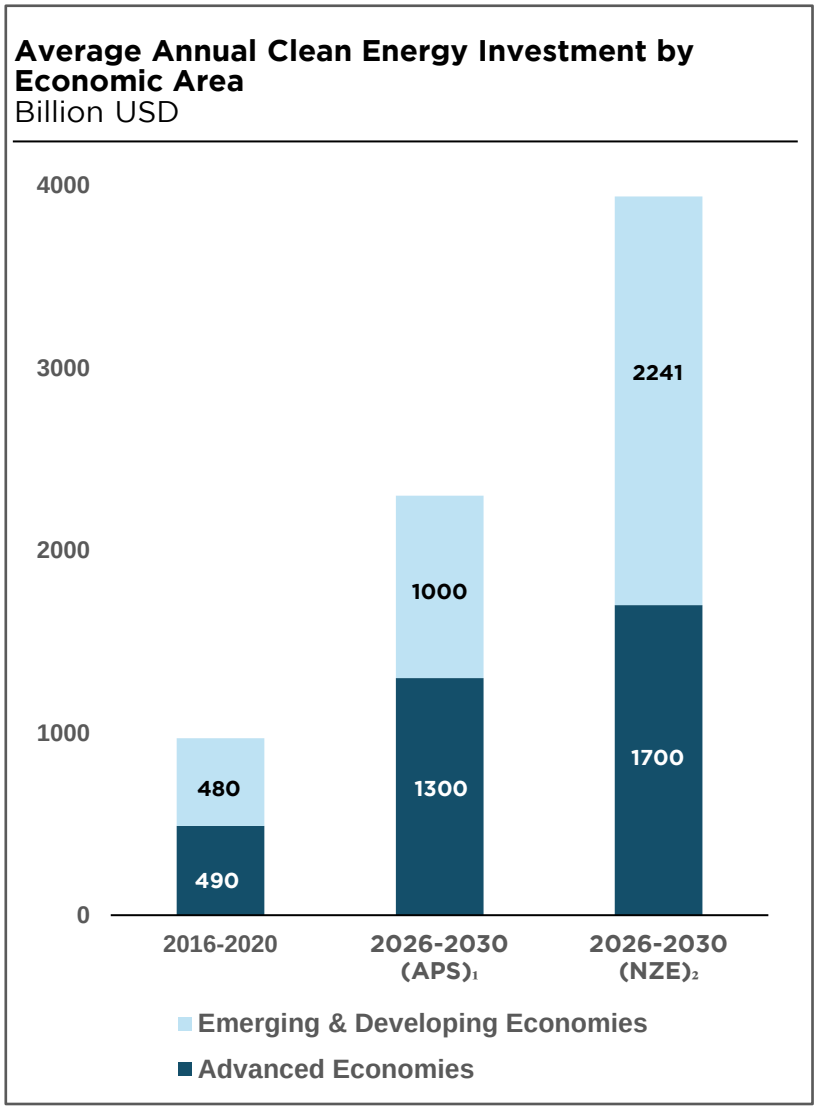






Note: [41] PPP – Power Purchasing Parity
Source: World Energy Outlook 2021

Mobilising investment and finance is key to getting the world on track for 1.5°C pathway



Key Highlights

- Despite the substantial growth in annual clean energy investment projection under the APS assumption, it is still well below the level of investment required to achieve NZE at around USD 4 trillion annually by 2030
- Clean energy investment in NZE is 75% higher than in the APS where the emerging market and developing economies account for around 70% of the extra investment required to bridge the gap between APS and NZE in 2030
- Emerging markets and developing economies need to boost clean energy investment but often have limited fiscal space and constrained access to finance

Mobilising investment and finance in emerging market and developing economies

1 **Public Sector**

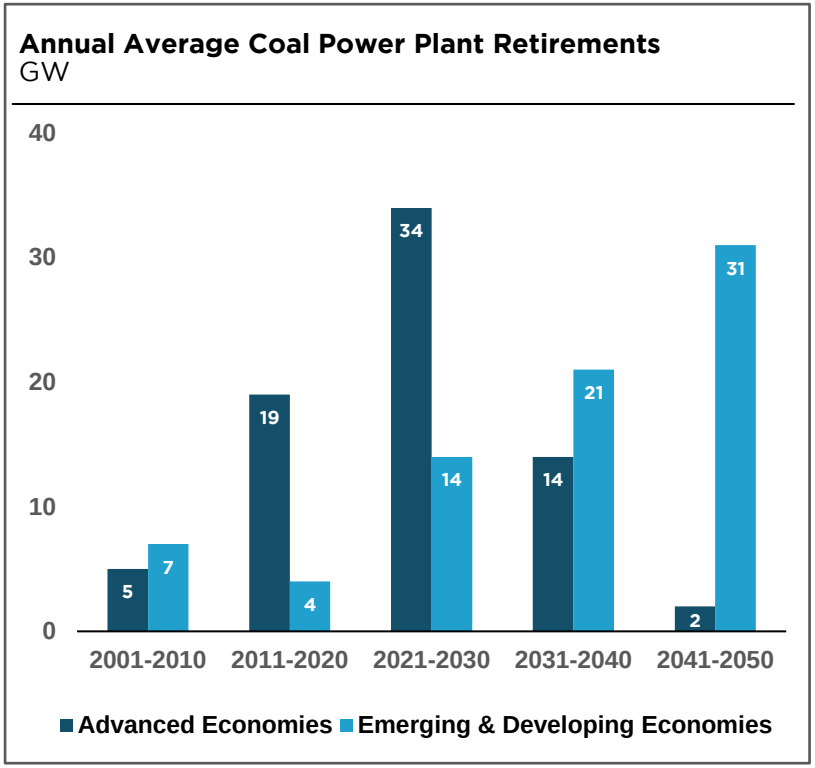
Development of necessary policies to attract investors as well as to address project risks and ensure adequate risk adjusted returns for investors. Expansion of public funding is also essential. State-owned enterprises can play a key role in funding network infrastructure and clean energy transition efforts

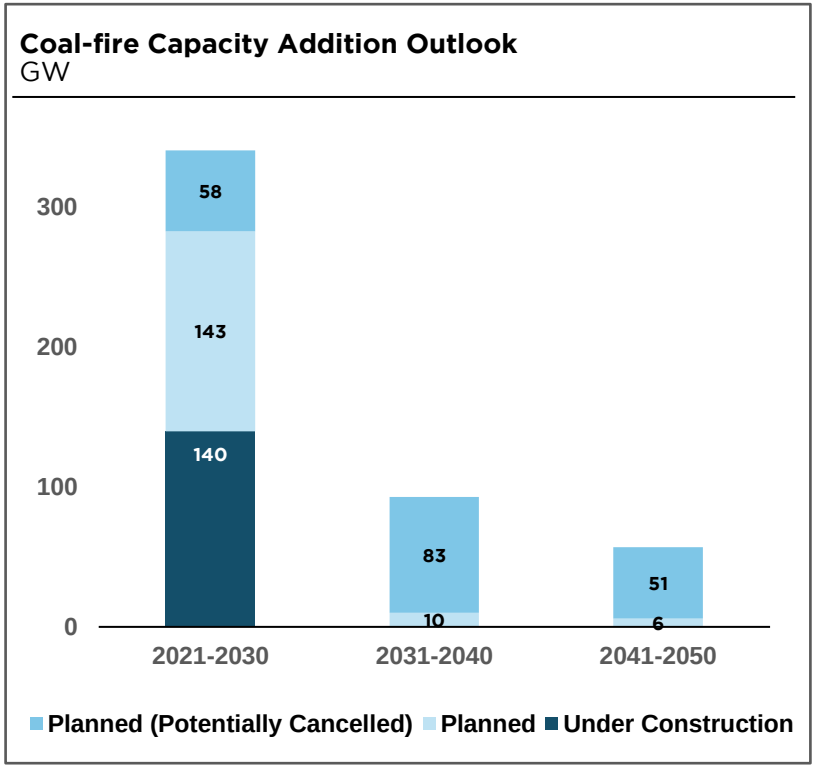
2 **Private Sector**

Around 70% of clean energy investment will need to be carried out by private companies by 2030. An international catalyst is essential to accelerate flows of capital to support energy transitions efforts in developing economies

 Source: World Energy Outlook 2021

Commitment to reducing emissions has gained momentum as more countries have pledged achieving net zero in the coming decades





Key Highlights

- More than 50 countries, as well as the entire European Union, have pledged commitments to meet net zero emissions targets by 2050 which would result in CO_2 emissions to fall by 40% should the pursuit of these pledges succeed
- G7 economies have pledged to end support for building new coal-fired plants whilst China has pledged to end support for building new coal plants abroad. China's announcement is significant as it could lead to cancellation of up to 190 GW of coal projects over the period to 2050
- Major global financial institutions including 40% of the top 40 global banks have also committed to cutting coal investments through introduction of policies restricting coal funding

Source: World Energy Outlook 2021, Reuters, Institute for Energy Economics and Financial Analysis

Well-managed energy transitions will safeguard ASEAN from the impact of volatile international markets

Safeguarding Energy Security

1. Development of necessary policies and measures by governments to meet the rising energy demand and subsequently reduce reliance on fossil fuel imports
2. Introduction of well-designed frameworks that include clear policy targets, independent regulation, least-cost system planning and cost recovery tariffs
3. Improve access to finance by catalysing private funds especially for projects at early stages of development and new technology
4. Targeted investment in energy security throughout energy transition period remains critical

 Source: International Energy Agency – Southeast Asia Energy Outlook 2022

ASEAN countries are making progress on policy and regulation to achieve climate targets

	 Malaysia	 Singapore	 Indonesia	 Thailand	 Philippines
Efficiency	Improve energy efficiency in industry and buildings sectors through standard settings, labelling, energy audits & design	Improve energy intensity by 35% by 2030	Reduce energy intensity by 1% per year to 2025	Reduce energy intensity by 30% per year to 2036	Reduce energy intensity by 40% per year to 2030
Renewables	31% share of renewables installed capacity of 2025	• 2 GW solar PV installed capacity by 2030 • Phase out unabated coal by 2050	Increase share of renewables by 23% by 2025 and 31% by 2050	Increase share of renewables by 30% in total energy consumption by 2037	• 15 GW renewables installed capacity by 2030 • No new coal-fired power plants
Climate Change	• Reduce GHG intensity of GDP by 35% by 2030 • Carbon neutrality by 2050	• Reduce GHG emissions by 16% below BAU level by 2020 • Halve emissions from peak to 33 $MtCO_2e$ by 2050	• Reduce GHG emissions by 41% by 2030 from BAU level • Net zero emissions by 2060 or sooner	• Reduce GHG emissions by 25% by 2030 from BAU level • Carbon neutrality by 2050	Reduce GHG emissions by 70% by 2030 from BAU level

Source: International Energy Agency – Southeast Asia Energy Outlook 2022

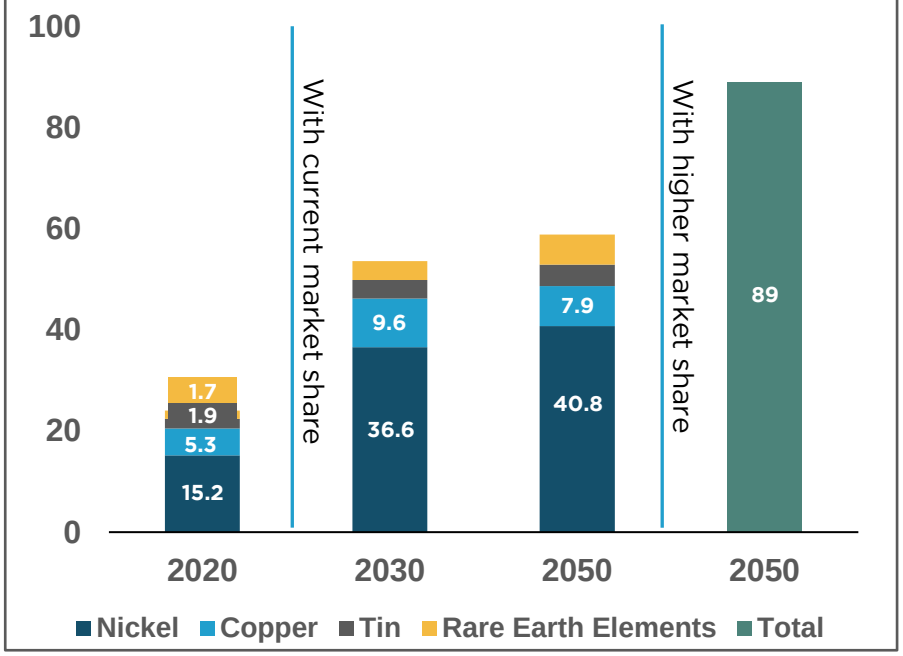
ASEAN countries are making progress on policy and regulation to achieve climate targets

	 Cambodia	 Brunei	 Laos	 Myanmar	 Vietnam
Efficiency	Reduce energy consumption by 20% from BAU level by 2035	Reduce energy consumption by 63% from BAU level by 2035	Reduce energy consumption by 10% from BAU level	Reduce primary energy consumption by 8%	-
Renewables	55% hydro, 6.5% biomass and 3.5% solar PV installed capacity by 2030	30% share of renewables for electricity generation by 2035	30% share of renewables in total primary energy consumption by 2025	20% share of renewables installed capacity by 2025	Renewables share of 15-20% by 2030 and 25-30% by 2050 in total primary energy supply
Climate Change	• Reduce GHG emissions by 27% from 2030 baseline • Carbon neutrality by 2050	• Reduce CO_2 emissions by 40% by 2035 from BAU level • Net zero emissions by 2050	Conditional GHG emissions reduction target to reach net zero by 2050	-	• Reduce GHG emissions by 9% by 2030 • Net zero emissions by 2050

Source: International Energy Agency – Southeast Asia Energy Outlook 2022

Strong growth in clean energy globally provides huge opportunities for ASEAN to capture additional value in supply chains

Potential Revenue from Selected Minerals in ASEAN
Billion USD



Key Highlights:

- Malaysia and Vietnam are the **world's second and third largest** manufacturers of solar PV modules respectively
- Thailand is the **11th largest** vehicle manufacturer in the world and could also become a key hub for EVs manufacturing
- Indonesia and Philippines are the **two largest** nickel producers in the world, and they are developing integrated battery and EV supply chains

Realising full potential in the critical minerals sector

1. Investment in **processing and manufacturing** to develop critical-mineral based industries that can help extracting additional value from ASEAN's natural resources
2. Setting high **environmental, social and governance (ESG)** standards to ensure manufacturers use minerals that are sustainably and responsibly produced
3. **Enhancing capacity building efforts** (i.e. sustainable practices) across the region to ensure sustainable development of mining industries to attract investment

Source: International Energy Agency – Southeast Asia Energy Outlook 2022

13

Glossary

Glossary

ASEAN	Association of Southeast Asian Nations
AAC	All Aluminium Conductor
ABC	Aerial Bundled Cable
ADB	Asian Development Bank
APG	ASEAN Power Grid
BAU	Business As Usual
BELB	Bekalan Elektrik Luar Bandar
BESS	Battery Energy Storage System
BIMP-EAGA	Brunei-Indonesia-Malaysia-Philippines East ASEAN Growth Area
BSCM	Billion Standard Cubic Metres
CAGR	Compound Annual Growth Rate
CBAM	Carbon Border Adjustment Mechanism
CCA	Commercial Collaborative Agreement
CCGT	Combined Cycle Gas Turbine
CCUS	Carbon Capture, Utilisation & Storage
CMCO	Conditional Movement Control Order
CNG	Compressed Natural Gas
CSS	Collector Substation
DTN	Dasar Tenaga Negara
EAC	Energy Attribute Certificate
ECoS	Energy Commission of Sabah
EE	Energy Efficiency
EMS	Energy Management System
ESCO	Energy Service Company
ESDM	Kementerian Energi dan Sumber Daya Mineral
ESG	Environmental, Social & Governance
ETOU	Enhanced Time of Use
EV	Electric Vehicle
FiAH	Feed-in Approval Holder
GDP	Gross Domestic Product

Glossary

GHG	Greenhouse Gas
GLC	Government Linked Company
GT	Gas Terminal
GW	Gigawatt
GWh	Gigawatt Hour
HA	Hectare
HEP	Hydroelectric Power
HHI	Herfindhal-Hirschman Index
IBR	Incentive-Based Regulations
ICPT	Imbalance Cost Pass-Through
IEA	International Energy Agency
IGCC	Integrated Gasification Combined Cycle
IMF	International Monetary Fund
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
ISO	International Organisation for Standardisation
JPPPET	Jawatankuasa Perancangan dan Pelaksanaan Pembekalan Elektrik dan Tarif
KKDW	Kementerian Kemajuan Desa & Wilayah
KKIP	Kota Kinabalu Industrial Park
KKTP	Kementerian Kerajaan Tempatan dan Perumahan
KPI	Key Performance Indicator
KPSB	Kimanis Power Sdn Bhd
LGAST	Labuan Gas Terminal
LLS	Lembaga Letrik Sabah
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LSS	Large Scale Solar
MCO	Movement Control Order
MEPS	Minimum Energy Performance Standards

Glossary

MF	Mesocarp Fibre
MFO	Medium Fuel Oil
MID	Ministry of Industrial Development
MIDA	Malaysian Investment Development Authority
MINDA	Mindanao Development Authority
MMBTU	Metric Million British Thermal Unit
MMSCFD	Million Standard Cubic Feet Per Day
MoF	Ministry of Finance
MRP	Malaysia Reference Price
MSS	Main Switching Substation
MTCO2e	Metric Tons of Carbon Dioxide Equivalent
MW	Megawatt
MWh	Megawatt Hour
MYRER	Malaysia Renewable Energy Roadmap
NBEB	The North Borneo Electricity Board
NEDA	New Enhanced Dispatch Arrangement
NEEAP	National Energy Efficiency Action Plan
NRECC	Ministry of Natural Resources, Environment and Climate Change
OCGT	Open Cycle Gas Turbine
OPF	Oil Palm Frond
OPT	Oil Palm Trunk
PDP	Power Development Plan
PDRM	Polis Diraja Malaysia
PE	Pencawang Elektrik
PJ	Petajoule
PKS	Palm Kernel Shell
PLN	Perusahaan Listrik Negara Indonesia
PMU	Pencawang Masuk Utama
POIC	Palm Oil Industrial Cluster
POME	Palm Oil Mill Effluent

Glossary

PP	Pencawang Pembahagian
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PPU	Pencawang Pembahagian Utama
PV	Photovoltaic
RE	Renewable Energy
REC	Renewable Energy Certificate
RGT	Regasification Terminal
RMR	Remote Meter Reading
RP	Regulatory Period
SAIDI	System Average Interruptions Duration Index
SAPADU	Sabah Special Project Planning and Delivery Unit
SARE	Supply Agreement with Renewable Energy
SBGAST	Sabah Gas Terminal
SBPC	Sepangar Bay Power Corporation
SDC	Sabah Development Corridor
SDG	Sustainable Development Goal
SEB	Sarawak Energy Berhad
SEC	Sabah Energy Corporation
SEDA	Sustainable Energy Development Authority
SEDIA	Sabah Economic Development Investment Authority
SEEAP	Sabah Energy Efficiency Action Plan
SELCO	Self-Consumption
SESI	Sabah Energy Supply Industry
SEWG	Sabah East-West Grid
SGG	Sabah Green Grid
SJ	Stesen Janakuasa
SLA	Service Level Agreement
SMR	Small Modular Reactor

Glossary

SOGDC	Sabah Oil & Gas Development Corporation Sdn Bhd
SOGT	Sabah Oil and Gas Terminal
SPP	Sustainable Public Procurement
SPR	SPR Energy Sdn Bhd
SSGP	Sabah Sarawak Gas Pipeline
STATCOM	Static Synchronous Compensator
TNB	Tenaga Nasional Berhad
TSCF	Trillions of Standard Cubic Feet
TSH	TSH Resources Berhad
TSS	Tariff Support Subsidy
UN	United Nations
VAR	Volt-Amps Reactive
VPPA	Virtual Power Purchase Agreement
VPS	Virtual Pipeline System
WKB	Wawasan Kemakmuran Bersama
WTE	Waste To Energy

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