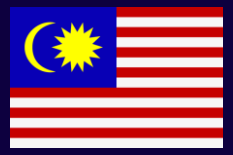
ASEANのエネルギー分野の現状・関連動向に係る調査 – 定点調査業務2023

報告書 - Malaysia



ARTHUR D LITTLE

エネルギー定点調査

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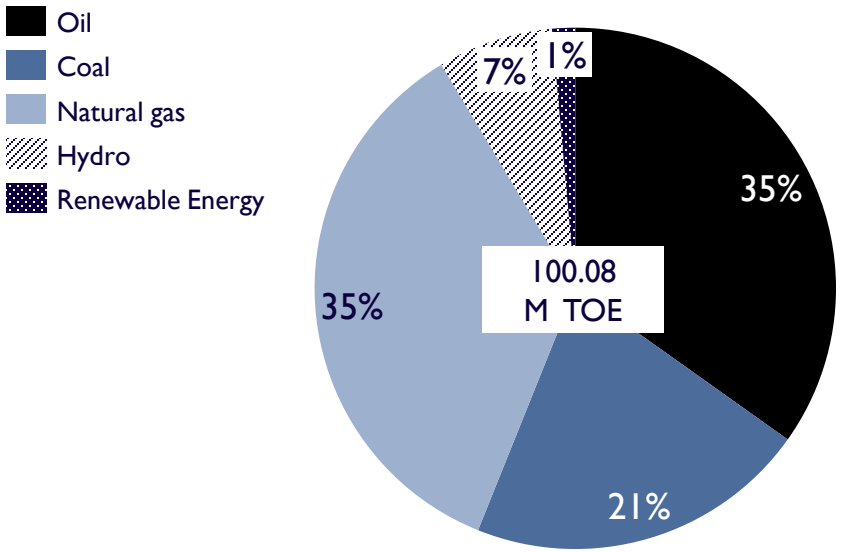
1. 一次エネルギー構成

年々水力/再生可能エネルギーの比率は向上しているが、依然として90%以上は、石油/天然ガス/石炭が占める

Primary Energy Consumption (by Source of Energy at 2021)

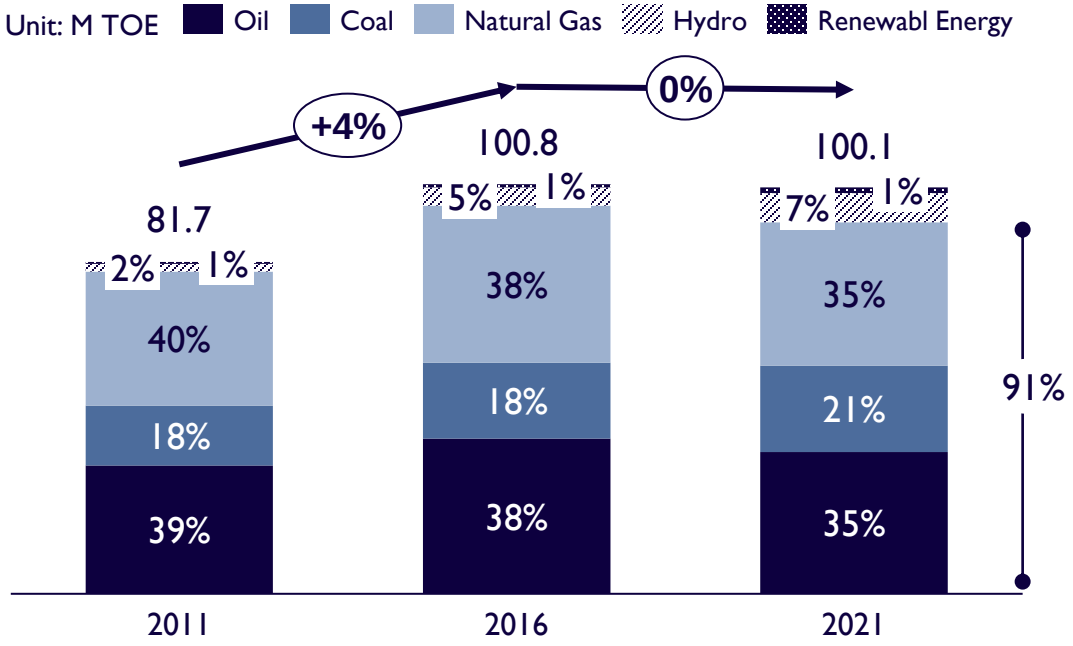
- Malaysia's primary energy demand in 2021 is 4.19 Exajoules, which comes mainly from fossil fuels (91%), especially oil and natural gas

Unit: M TOE



Historical Primary Energy Consumption (by Source of Energy)

- Primary energy demand has no significant growth from 2016 to 2021



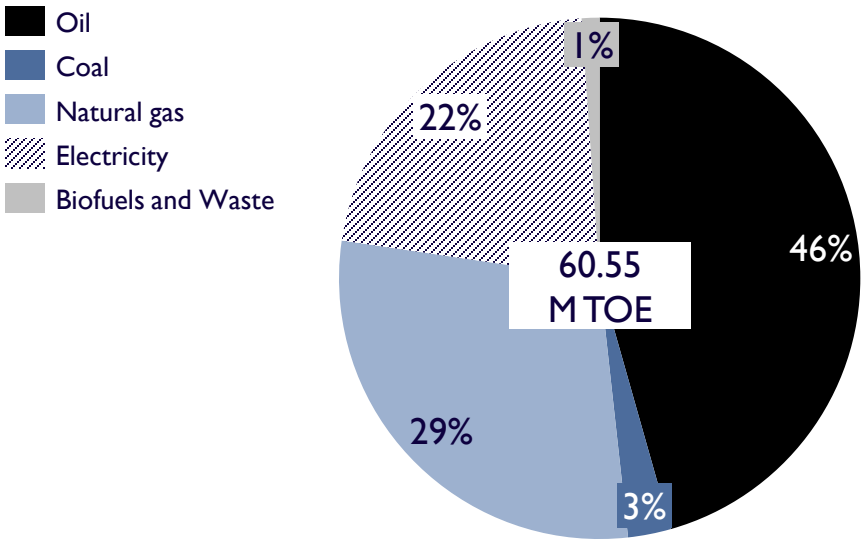
Source：BP Statistical Review of World Energy 2022

最終消費エネルギー量の消費タイプ別では石油が最大シェアで、産業別では交通セクターが最大

Final Energy Consumption(by Source of Energy at 2020)

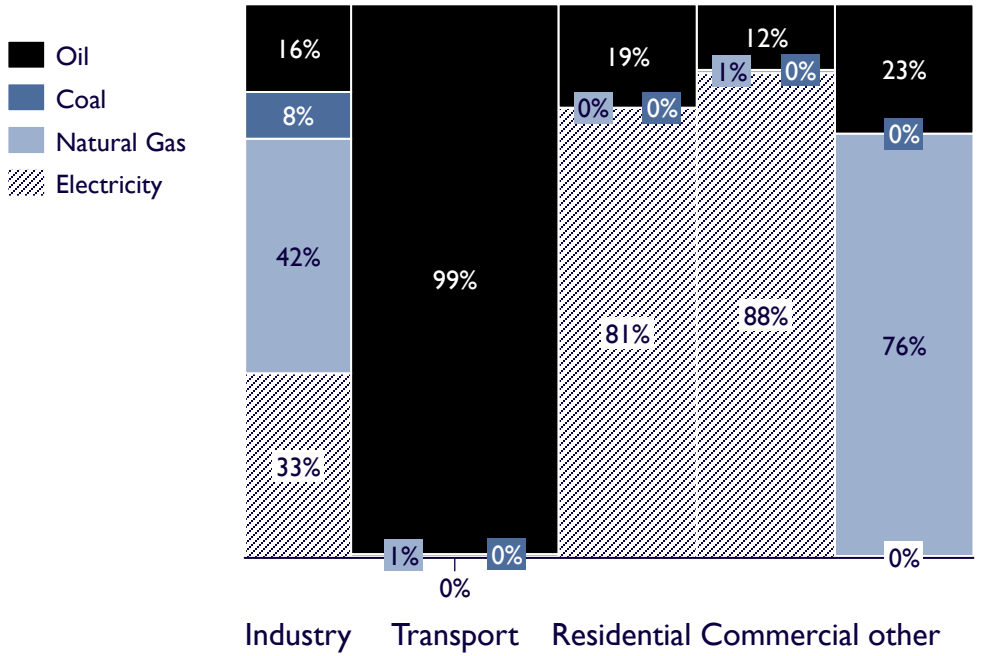
- In 2020, the total final energy consumption was 2.53 million TJ having oil as a primary source of energy, accounting for 46% of the energy mix

Unit: M TOE



Final Energy Consumption(by Sector at 2020)

- The major source of energy in transport sector was mainly from oil, while residential, commercial, and industry sectors heavily relied on electricity.



Source： International Energy Agency statistics

マレーシアは、カーボンニュートラルや電源開発に向けて政策をUpdateしており、昨年国家エネルギー政策を発表

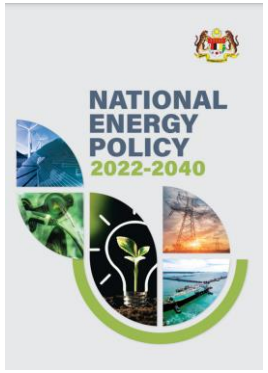
	政策	政策概要
2010	state-runnered policy National Renewable Energy Policy、NREP）。	■ 国の発電電源構成における再エネの貢献度の向上 ■ 再エネ比率に関するターゲット（容量ベース） – 2011：1%、2015：5%、2020：10%、2030：13%、2050：34%
2011	The 10 Timothy grass plan	■ 2015年目標 – 合計332MW の再エネ発電設備容量を達成 – 2015 年時点における電源構成：石炭43%、ガス40%、大規模水力 – 14%、再エネ2%、石油1%
2015	First November Malaysia Project	■ 2020年電源構成目標：**石炭53%、ガス29%、水力15%、その他再エネ3%** – 2018年6月時点で合計490MW の再エネ設備容量を達成 – 2020年までに1,519MW の再エネ導入プロジェクト – 総量500MW のネットエネルギーメータリング（NEM）の導入
2016	The Paris Agreement (1944) (NDC file)	■ 2030年において、 2005年に対するGHG排出削減を下記にように制定 – 無条件でGDP比35%削減 – 援助など条件付きでGDP比45%削減
2017	green technology master plan (GTMP)	■ エネルギーをはじめとする6つの炭素集約的な分野における開発事業に主要な環境技術を導入することが提唱される ■ 再エネ比率に関するターゲット（容量ベース） – 2020年：20%、2025年：23%、2030年：30%
2021	The 12th Malaysia Project	■ Carbon neutrality target by 2050 with several new instruments e.g. carbon pricing and energy trading system (ETS) in addition to GHG emission reduction plan
2021	Peninsular Malaysia Generation Development Plan (2021-2039)	■ Increase renewable energy installed capacity target in power generation to 31% by 2025 with focus on large scale hydro and solar
2022	National Energy Policy	■ Comprehensive national energy policy in response to 12th Malaysia Plan and NDC with concrete policy – To be announced in Q4 2021 or early 2022

関連

Source： Ministry of Environment and Water (KASA) / JETRO etc

第12次マレーシア政策を受けた、エネルギー関連の政策である国家エネルギー政策(DTN)を公表

National Energy Policy 2022-2040(DTN)



Timing		2022 – 2040（2022年9月発行)
Overall		The National Energy Policy (DTN) in Malaysia aims to transition to a low-carbon future by 2040. The DTN focuses on optimizing energy resources, driving economic growth, ensuring environmental sustainability, and maintaining energy security and financial stability. Positioning of the 12th Malaysia Plan in terms of energy
Key Notes	Short Term Focus	Malaysia plans to implement the **Energy Efficiency and Conservation Act (EECA),** which will establish energy performance standards, mandatory energy audits, and penalties for non-compliance. The government also intends to attract investments and foster the development of low-carbon technologies to achieve the goals and targets of the DTN.
	Energy-Related Benefits	The National Energy Policy (DTN) in Malaysia brings significant advantages. Firstly, it reduces reliance on energy imports and promotes fuel diversification, enhancing energy independence. Secondly, it aims to improve energy access in rural areas, ensuring a wider reach of energy services. In terms of environmental sustainability, the DTN contributes to lower CO2 emissions through increased renewable energy (RE) integration into the energy mix.

Source：12th Malaysia Plan, National Energy Policy 2022-2040

DTNの主要目標である「Low Carbon Nation Aspiration 2040」において、石炭比率の引き下げ再エネ設備容量の引き上げなどを掲げた

Low Carbon Nation Aspiration 2040

Selected targets on Low Carbon Nation Aspiration 2040 compared to 2018

Selected Targets		2018	Low Carbon Nation Aspiration 2040
1.	Percentage of urban public transport modal share	20%	50%
2.	Percentage of electric vehicle (EV) share	<1%	38%
3.	Alternative fuel standard for heavy transport	B5	B30
4.	Percentage of Liquefied Natural Gas (LNG) as alternative fuel for marine transport	0%	25%
5.	Percentage of industrial and commercial energy efficiency savings	<1%	11%
6.	Percentage of residential energy efficiency savings	<1%	10%
7.	Total installed capacity of RE	7,597 MW	18,431 MW
8.	Percentage of coal in installed capacity	31.4%	18.6%
9.	Percentage of RE in TPES	7.2%	17%

Legend: Energy security, Energy affordability, Environmental sustainability

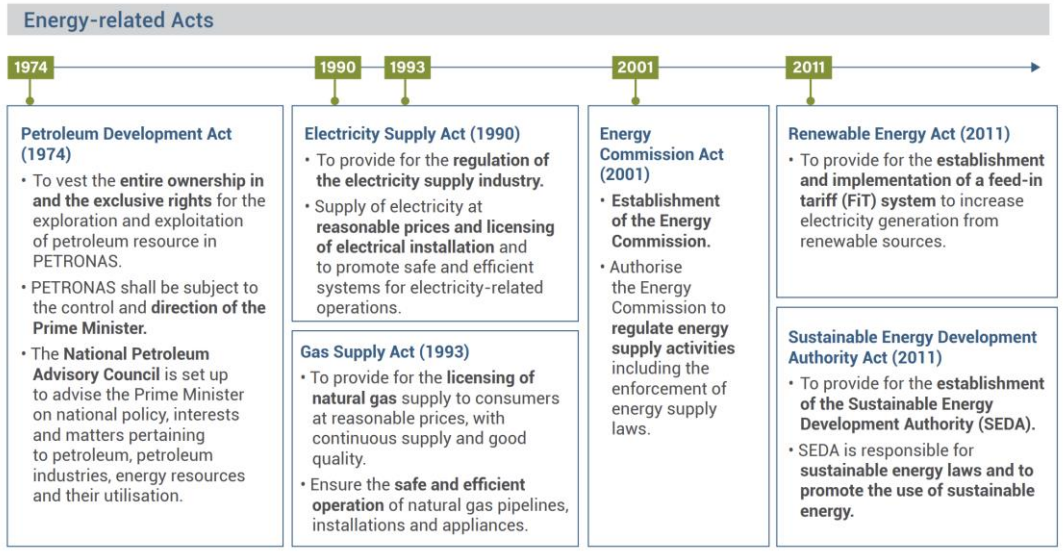
Comment

- It targets a higher level of urban public transport modal share, electric vehicle (EV) penetration, share of alternative lower carbon fuels in heavy vehicles and marine transport and enhanced energy efficiency in industrial and commercial as well as residential sectors.
- **In addition, the Aspiration entails a higher level of RE penetration in the installed capacity and total primary energy supply (TPES), with no new coal power plant.**

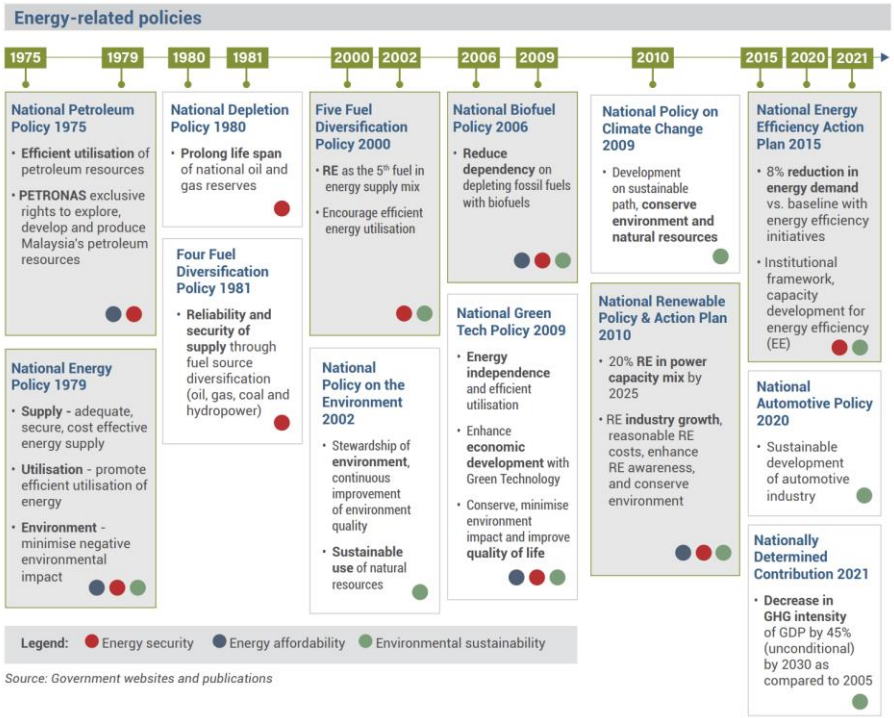
Source：12th Malaysia Plan, National Energy Policy 2022-2040

その他エネルギーに関連するアクションと法案

Energy Related Acts



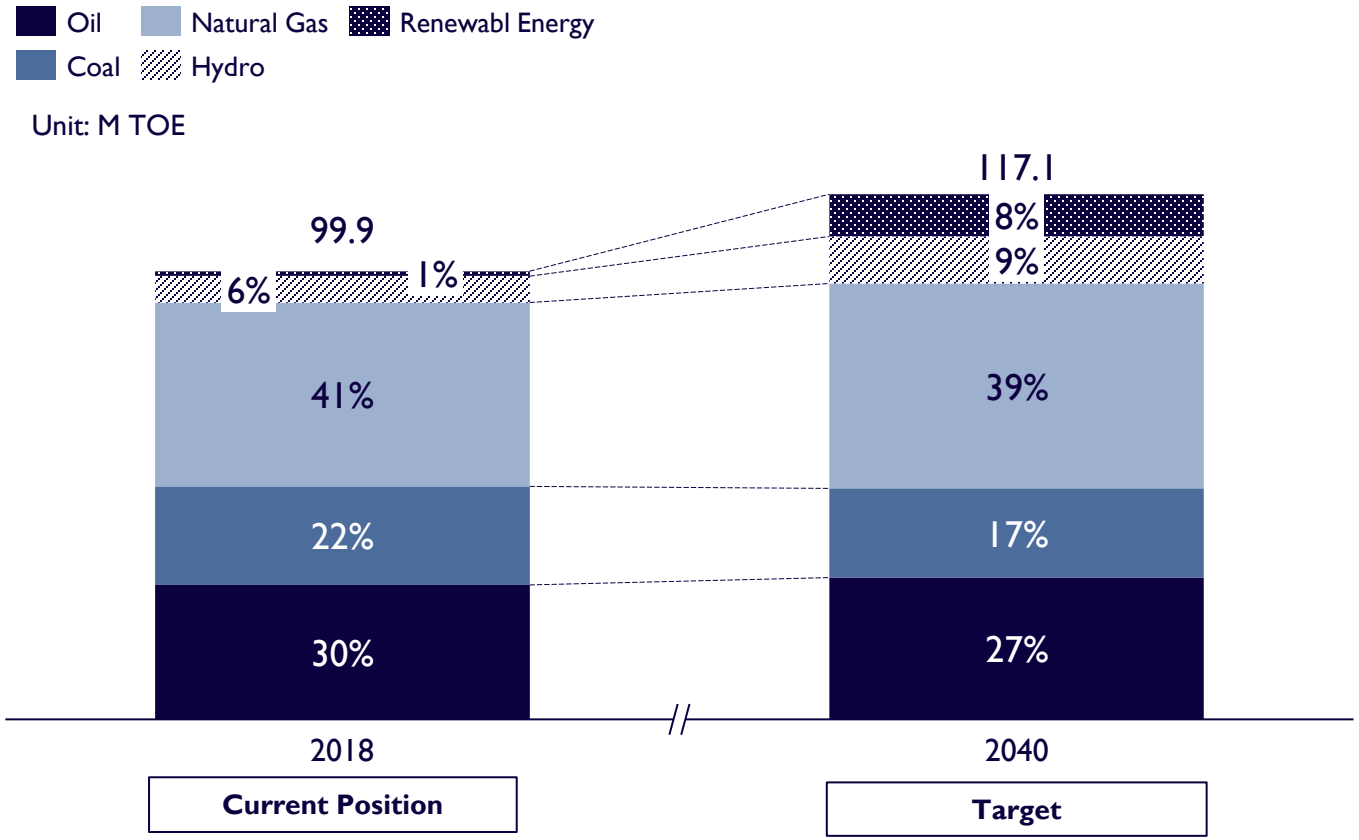
Energy Related Policies



Source：National Energy Policy 2022-2040

国家エネルギー戦略において、2040年までに1次エネルギー構成比率の17%を再エネ(RE 8%+Hydro9%)に転換することを宣言

Primary Energy Mix Target



Source：National Energy Policy (2022-2040)

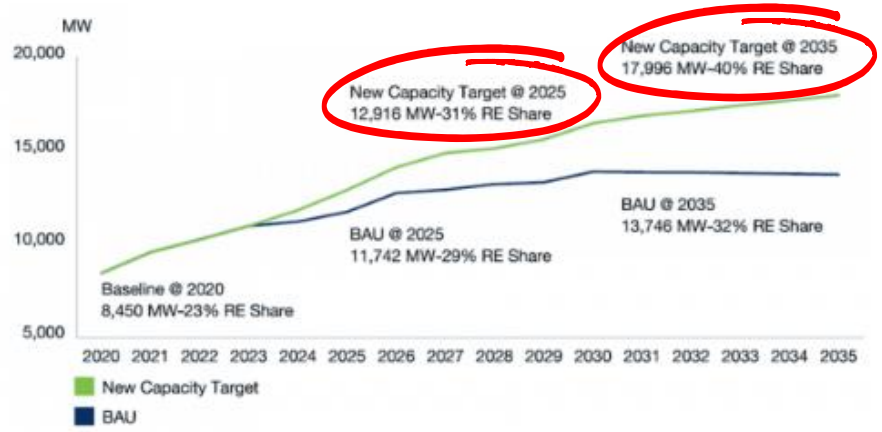
Comments

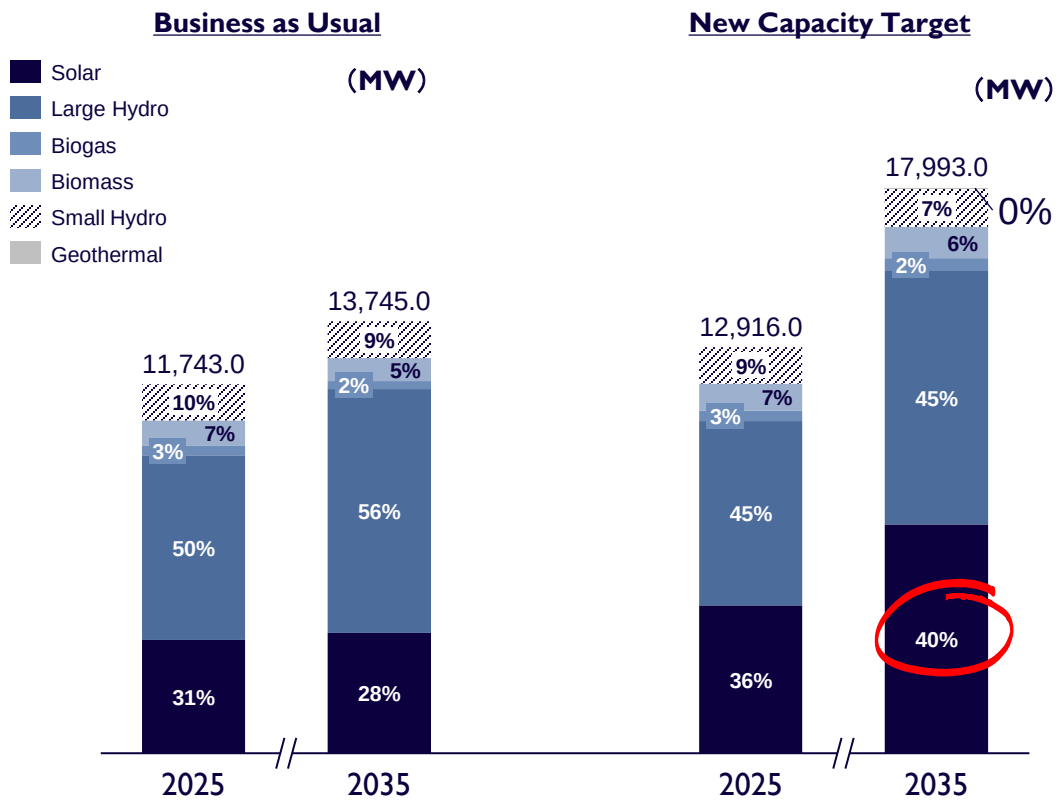
- The **National Energy Policy (2022-2040)** in Malaysia aims to reduce reliance on fossil fuels and promote renewable energy sources. The target is to increase the shares of solar, bioenergy, and hydropower to 4%, 4%, and 9% respectively by 2040, up from 0%, 1%, and 6% in 2018. To achieve this, the government has implemented policies including:
  - Long-term pipeline of large-scale solar (LSS) projects for domestic energy self-sufficiency and environmental sustainability.
  - Improved use of bioenergy for power generation, including biomass and biogas plants, with a focus on waste-to-energy projects to support cost-effective rural electrification.
  - Support for the promotion of electric vehicles (EVs) through investments, financing, and capability building to enhance local EV manufacturing and supply chain ecosystem.

再エネの容量目標は2025年で31%、2035年で40%まで引き上げられ、当初計画に対して特に太陽光を伸ばす想定

MALAYSIA RENEWABLE ENERGY ROADMAP (MYPER)：Capacity Base

- SEDA[1)] has announced its renewable energy policy for the period up to 2035 and has set the share of installed power generation capacity at 31% in 2025 and 40% in 2035.

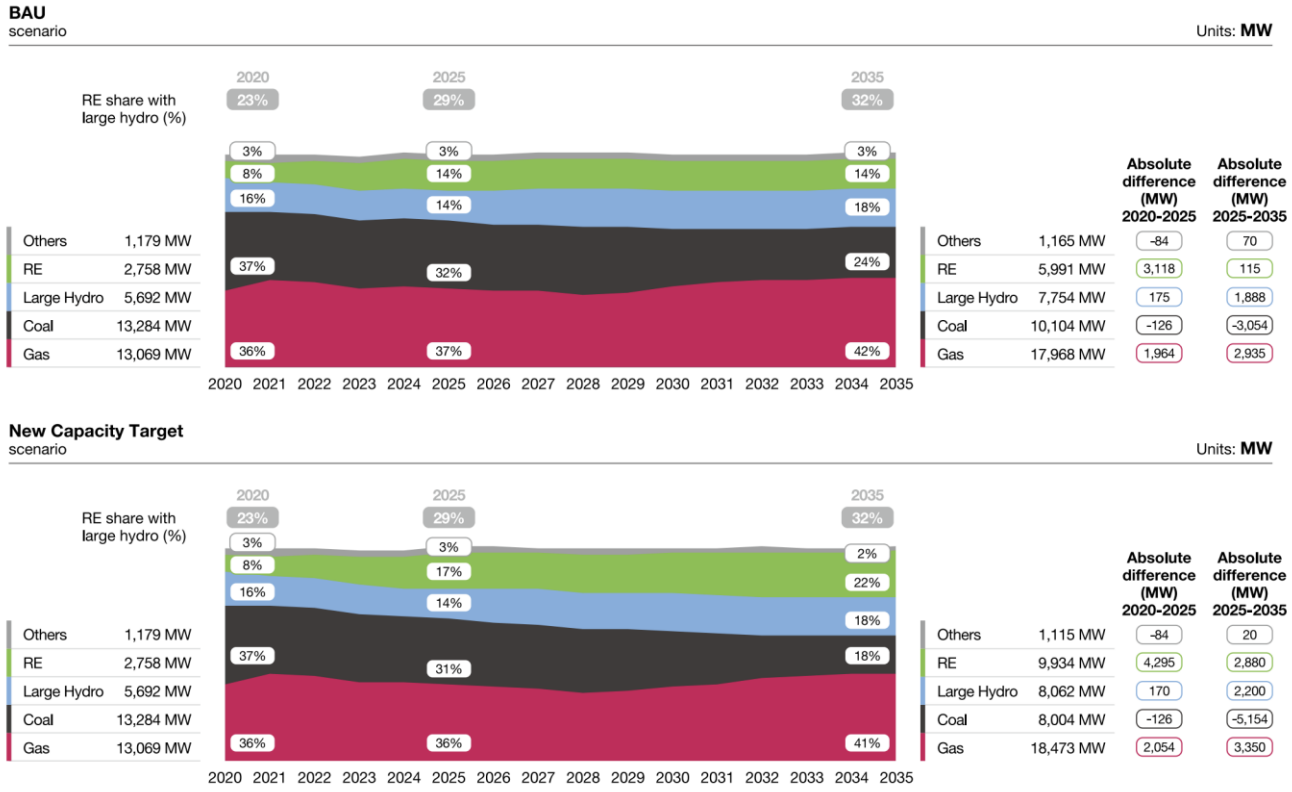




Source：SEDA=Sustainable Energy Development Authority / MyRER – Renewable Energy Malaysia (seda.gov.my)

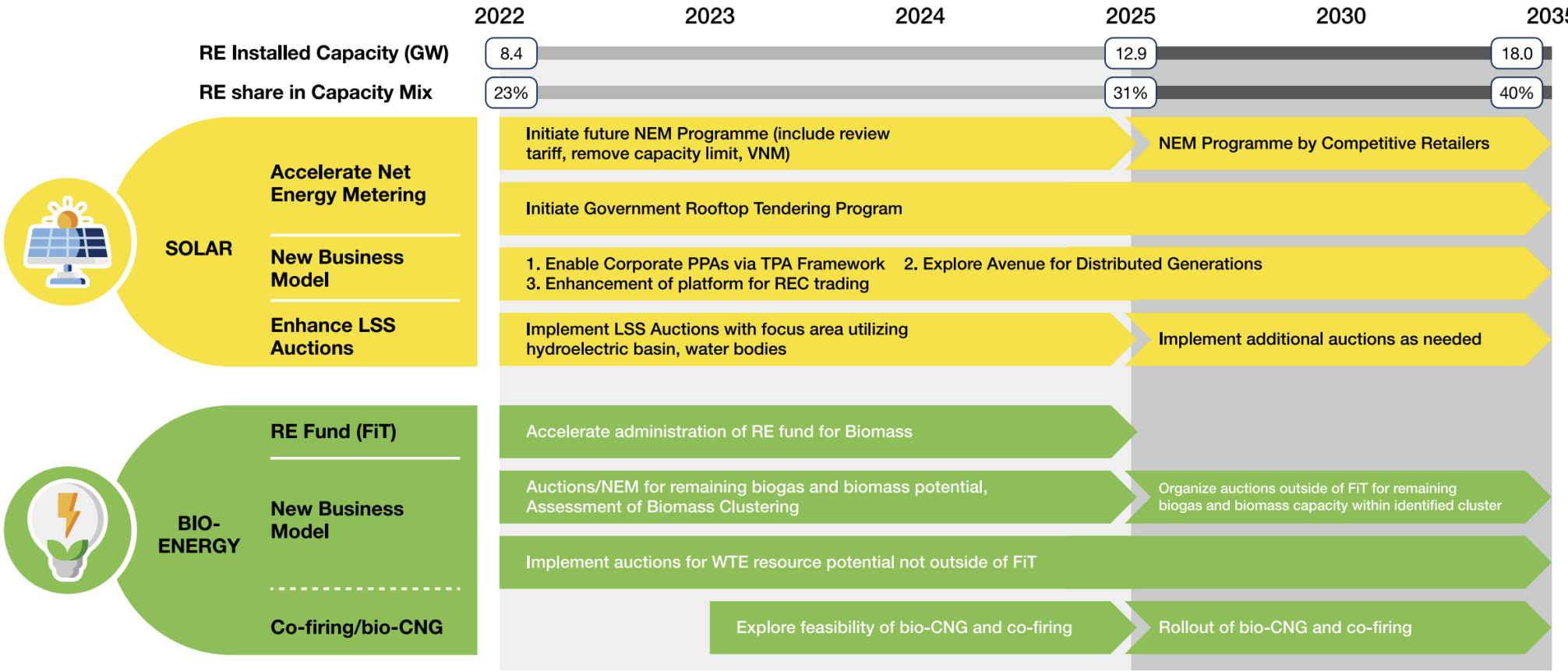
再エネの容量目標は2025年で31%、2035年で40%まで引き上げられ、当初計画に対して特に太陽光を伸ばす想定

MALAYSIA RENEWABLE ENERGY ROADMAP (MYPER)：Capacity Base



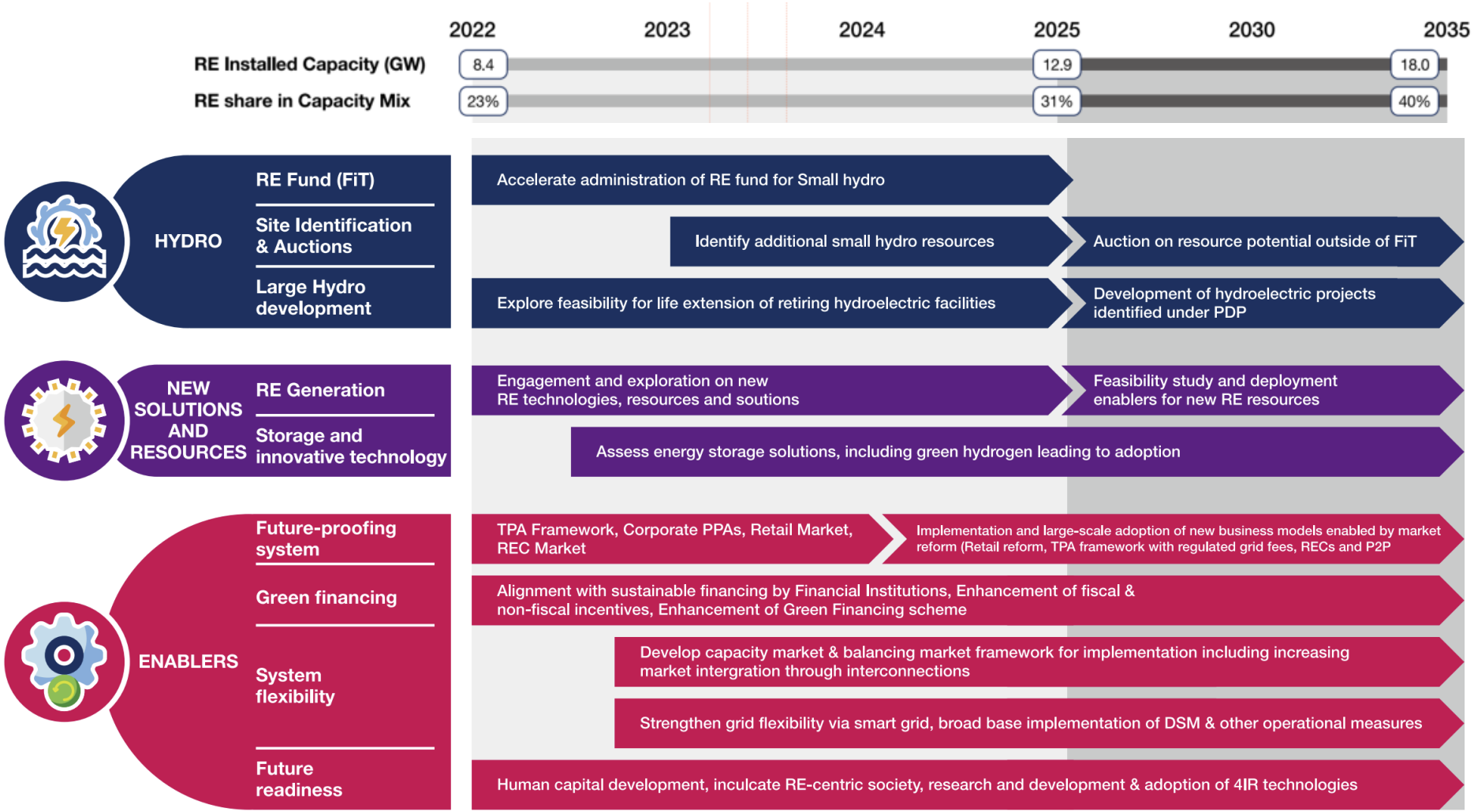
Source：SEDA=Sustainable Energy Development Authority / MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

例えばソーラーでは、NEM[1]やPPA[2]の促進、LSS[3]の展開などにより普及を目指す



1) Net Energy Metering 2) Power purchase agreement 3) Large scale solar
Source：SEDA=Sustainable Energy Development Authority / MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

水力は、小水力には、Fitプログラムを適用

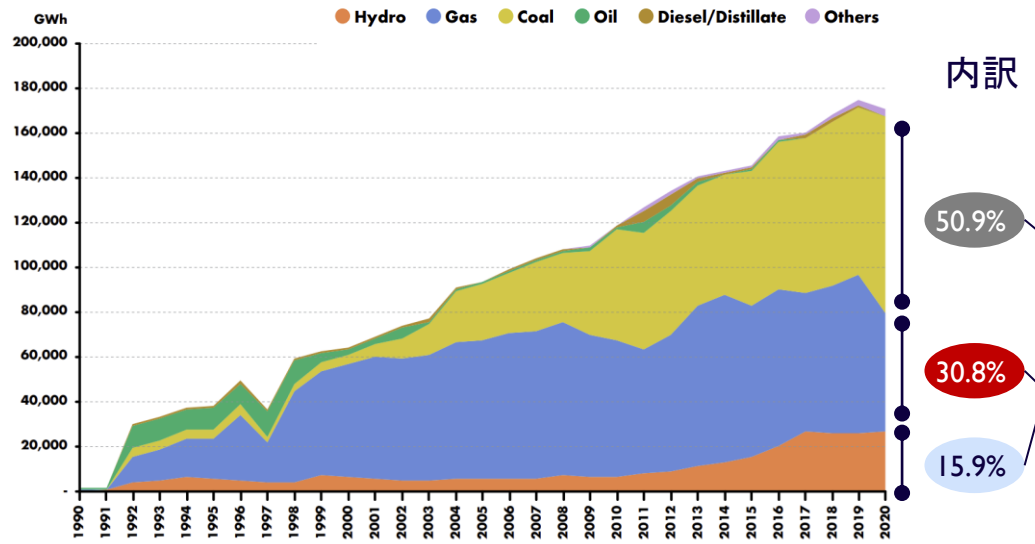


Source：SEDA=Sustainable Energy Development Authority / MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

2000年に入り発電は主に石炭に依存。しかし、今後は石炭発電から再生可能エネルギーへの転換を図り、エネルギーミックスで2035年に約28%になる見込み

Historical Power Generation Mix

- In the 2000s, coal-fired power generation increased rapidly, Water power generation has been increasing since the 2010s. On the other hand, natural gas power generation peaked in 2014 and has remained flat.



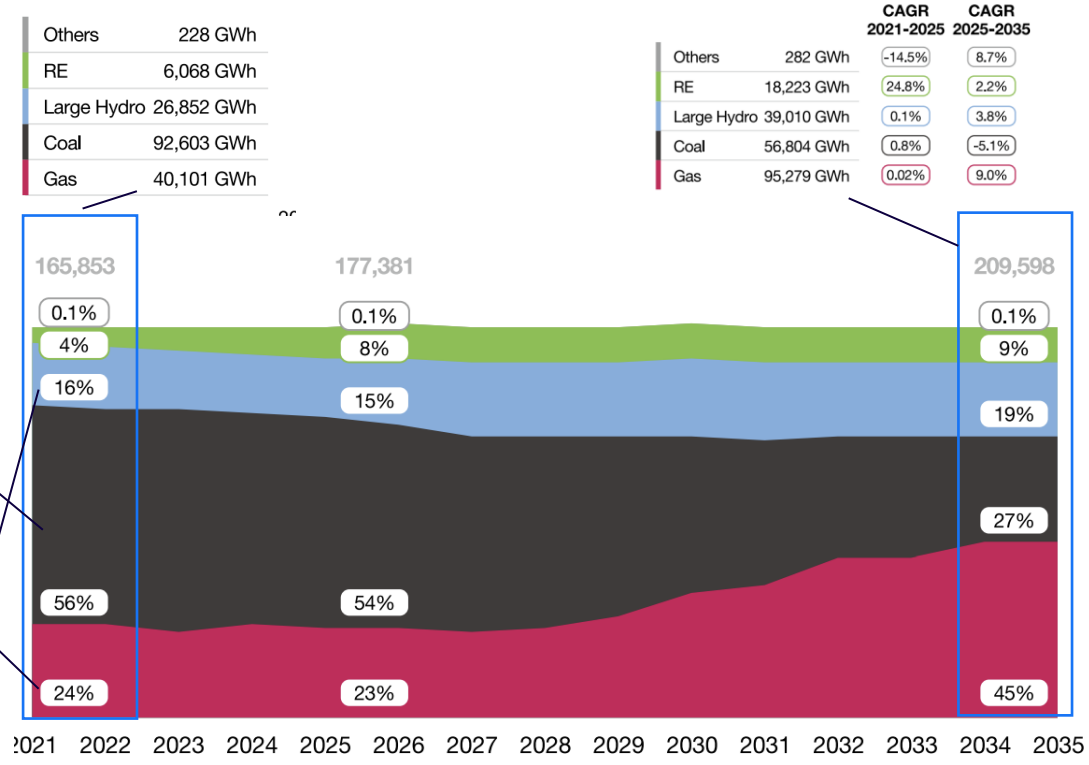
内訳

50.9%

30.8%

15.9%

Forecast Power Generation Mix



Source：Malaysia National Energy Handbook2021 , Fitch Solutions - Malaysia Power Forecast Scenario 2023、MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

List of Renewable policies in force (highlighted are key policies)

Policy for RE

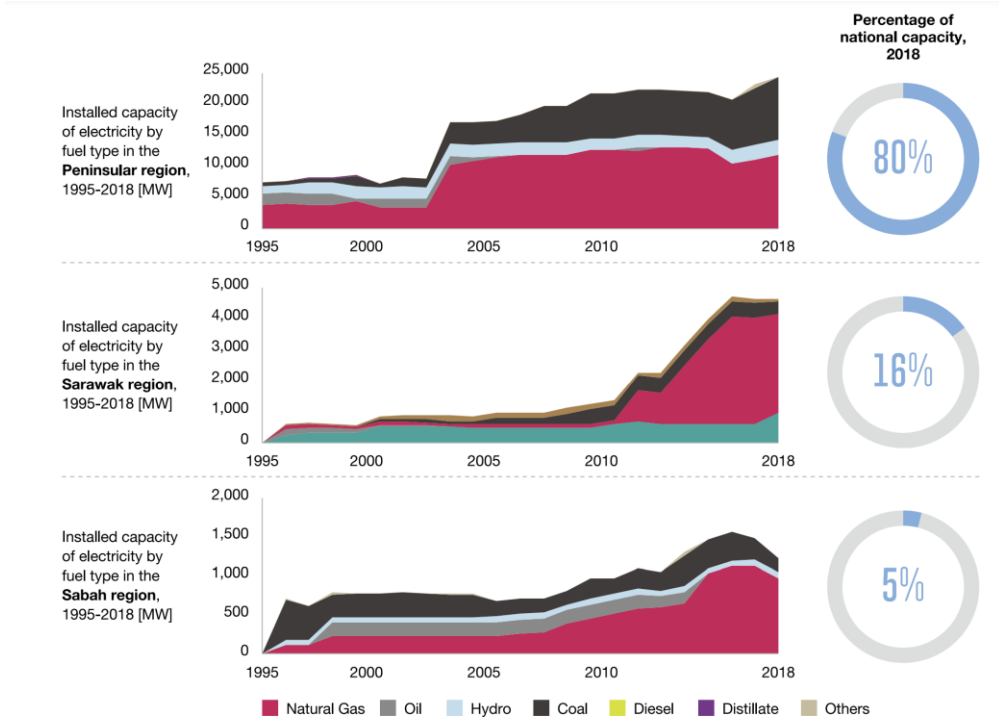
#	TITLE	YEAR	STATUS	TYPE OF POLICY				POLICY TARGET
				Strategic Planning	Regulatory Instruments	Fiscal/Financial incentives	Education, R&D	
1	Renewable Energy Act establishing feed-in tariff (FIT) system	2011 (last upda	In force			x		Energy Utilities (Renewables)
2	Renewable Energy Policy and Action Plan	2010	In force	x			x	Multi-Sectoral Policy
3	Green Technology Financing Scheme (GTFS)	2010	In force			x		Multi-Sectoral Policy Energy Utilities (Renewables)
4	Malaysian Biofuel Industry Act 2007	2008 (Nov 1st)	In force		x			
5	National Biofuel Policy of Malaysia (NBP 2006)	2006 (March)	In force	x	x			

Source： Organisation for Economic Co-operation and Development/International Energy Agency (www.iea.org) and International Renewable Energy Agency (www.irena.org)

マレー半島が発電量において最大規模となり（消費量も最大）、８割を占める

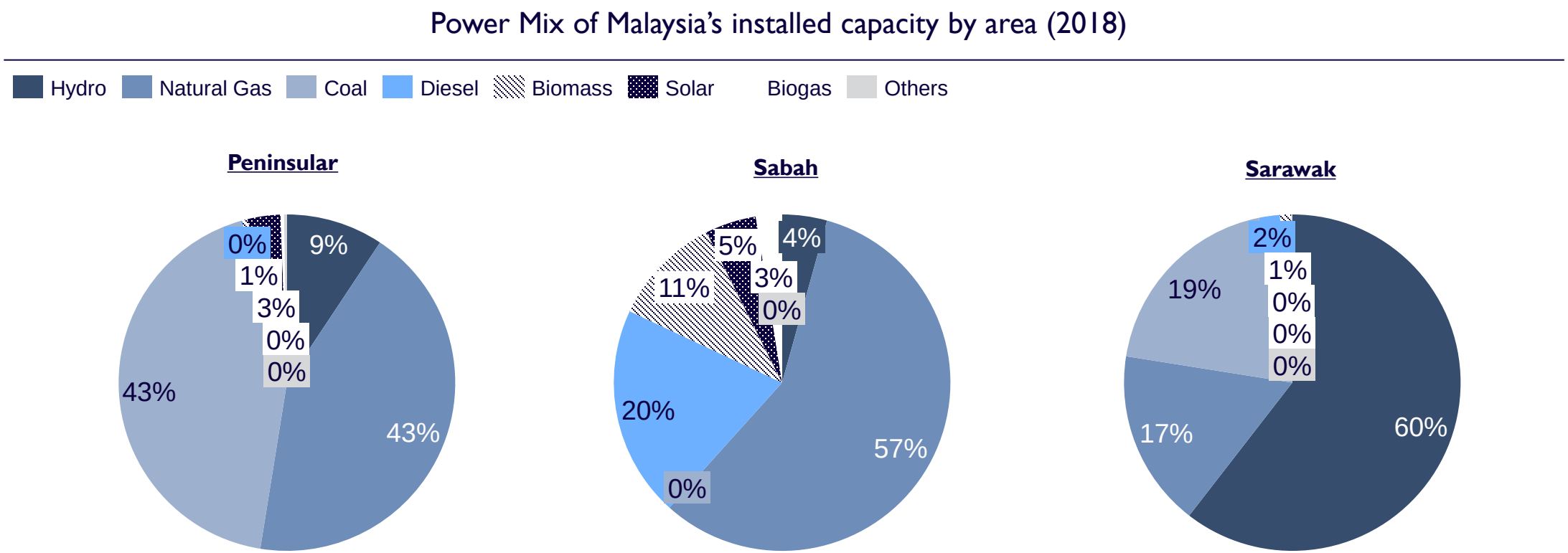
Malaysia's Electricity Gross Generation, Consumption, Available Capacity, Peak Demand and Reserve Margin (2019) by area

REGION	ELECTRICITY GROSS GENERATION		ELECTRICITY CONSUMPTION		AVAILABLE CAPACITY	PEAK DEMAND	RESERVE MARGIN
	GWh	%	GWh	%	MW	MW	%
PENINSULAR MALAYSIA	139,779	78.3	125,238	79.0	25,675	18,566	38.3
SARAWAK	31,351	17.6	27,386	17.3	5,109	3,777	35.3
SABAH	7,363	4.1	5,979	3.8	1,235	1,001	23.4
TOTAL	178,492	100.0	158,603	100.0	32,019		



Note: Total capacity = Peak demand + Idle capacity
Source: National Energy Balance 2019, MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

発電MIXについては地域によって異なり、マレー半島とサバ州は天然ガスが最大だが、サラワク州は水力発電が最大



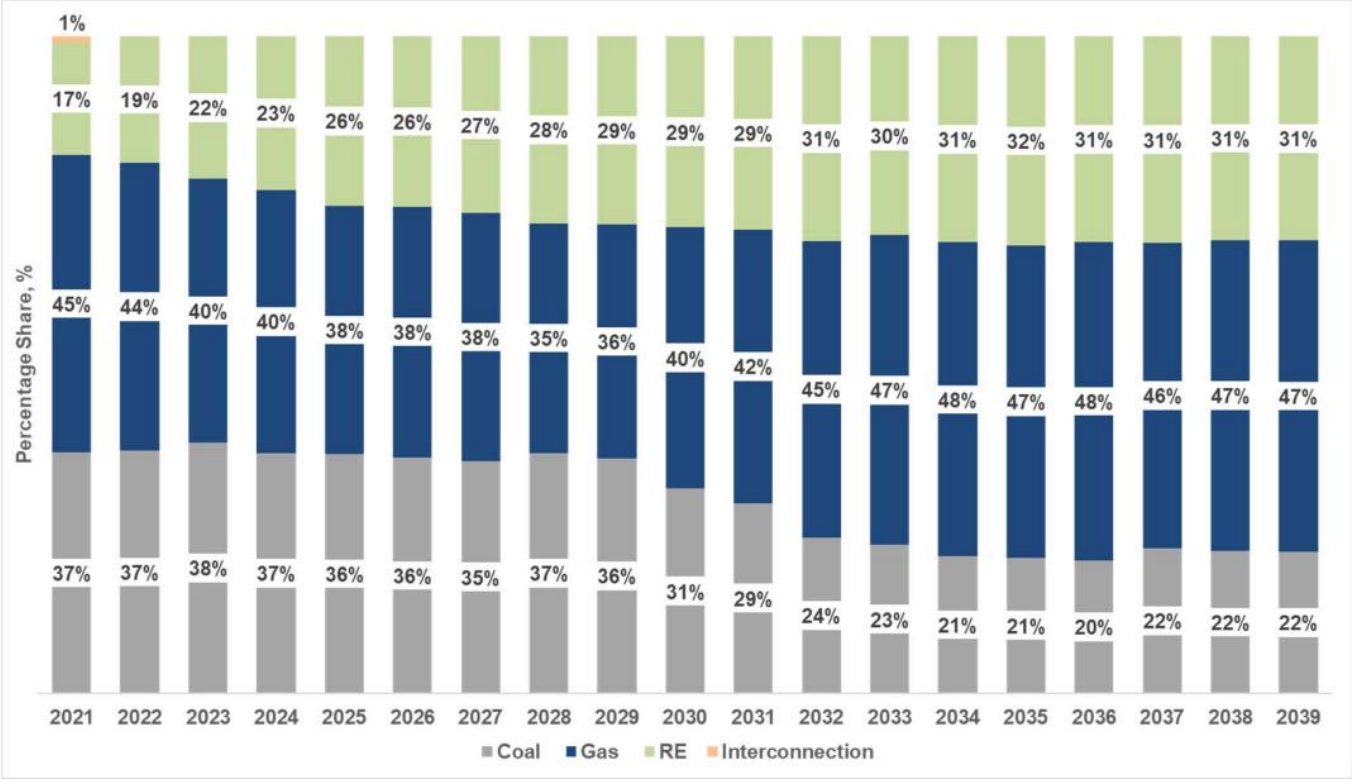
The fuel mix indicates that the generation sector in Peninsula and Sabah area is still highly dependent on natural gas while Sarawak relies heavily on hydropower for power generation.

Source: Malaysia Energy Statistic Handbook 2021

マレー半島の発電ミックスは以下。2039年で31%を目指す

Peninsular Malaysia Generation Mix (2016-2026)

- There is an increasing trend in renewable energy generation, while there is a slightly reduce in the shares of fossil fuels energy generation since 2018.
- The shares of gas will increase from 2030 onwards and becoming a dominant energy source.



Source : Report on Peninsular Malaysia Generation Development Plan 2020 (2021-2039)

マレー半島の電源開発計画は以下

Revised Generation Development Plan

Year	Generation Capacity (31% RE Capacity Mix for Malaysia)	Retiring Plants
2021	Edra Energy (CCGT) (3x747 MW) RE (860 MW)	YTL Power (CCGT) (585 MW)
2022	RE (652 MW)	TNB Pasir Gudang (CCGT) (275 MW) GB3 (CCGT) (640 MW)
2023	RE (663 MW)	Panglima (CCGT) (720 MW)
2024	TADMAX (CCGT) (2x600 MW) RE (855 MW)	SKS Prai CCGT (341 MW) TTPC (CCGT) (650 MW) TNB Gelugor (CCGT) (310 MW)
2025	RE (818 MW)	TNB Putrajaya GT4 & GT5 (OCGT) (249 MW)
2026	THB (CCGT) (2x600 MW) RE (117 MW)	KLPP (CCGT) (675 MW)

Year	Generation Capacity (31% RE Capacity Mix for Malaysia)	Retiring Plants
2027	Nenggiri (Hydro) (300 MW) RE (184 MW)	Segari Energy Ventures (CCGT) (1,303 MW)
2028	RE (192 MW)	TNB Tuanku Jaafar PD1 (CCGT) (703 MW)
2029	CCGT (1x700 MW) CCGT (1x500 MW) RE (199 MW)	KEV Gas U1 & U2 (Thermal Gas) (578 MW) KEV Coal U3-U6 (Coal) (1,474 MW)
2030	CCGT (4x700 MW) RE (207 MW) BESS (1X100MW)	TNB Tuanku Jaafar PD2 (CCGT) (708 MW) TNB Janamanjung (Coal) (2,070 MW)

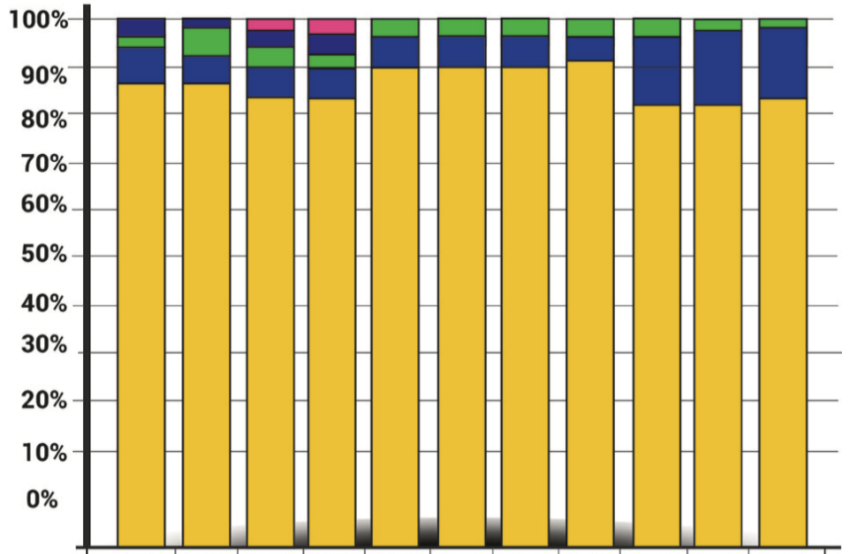
Year	Generation Capacity (31% RE Capacity Mix for Malaysia)	Retiring Plants
2031	CCGT (1x700 MW) Coal (2x700 MW) BESS (1x100 MW) RE (215 MW)	Tanjung Bin Power (Coal) (2,100 MW)
2032	CCGT (1x700 MW) BESS (1x100 MW) RE (224 MW)	
2033	CCGT (2x700 MW) BESS (1x100 MW) RE (232 MW)	Jimah Energy Venture (Coal) (1,400 MW)
2034	Coal (1x700 MW) BESS (1x100 MW) RE (242 MW)	
2035	RE (278 MW)	

Year	Generation Capacity (31% RE Capacity Mix for Malaysia)	Retiring Plants
2036	CCGT (1x700 MW) RE (80 MW)	
2037	CCGT (1x700 MW) Coal (1x700 MW) OCGT (1x100 MW) RE (77 MW)	TNB Prai (CCGT) (1,071 MW) TNB CBPS (CCGT) (375 MW)
2038	CCGT (1x700 MW) RE (76 MW)	Pengerang Power (Co-Gen) (600 MW)
2039	CCGT (1x700 MW)	

Source:Report on Peninsular Malaysia Generation Development Plan 2020（2021-2039)

サバ州の発電量はいまだ天然ガスへの依存度が高く、今後10年間は大きく変わらない

Sabah Generation Mix Projection (2015 – 2025) and comments



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Diesel	1%	1%	2%	3%	1%	0%	0%	0%	0%	0%	0%
MFO	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%
RE	3%	5%	5%	5%	3%	3%	3%	3%	3%	2%	2%
Hydro	7%	7%	7%	6%	6%	6%	6%	5%	14%	115%	14%
Gas	86%	85%	83%	82%	89%	91%	92%	92%	83%	83%	84%

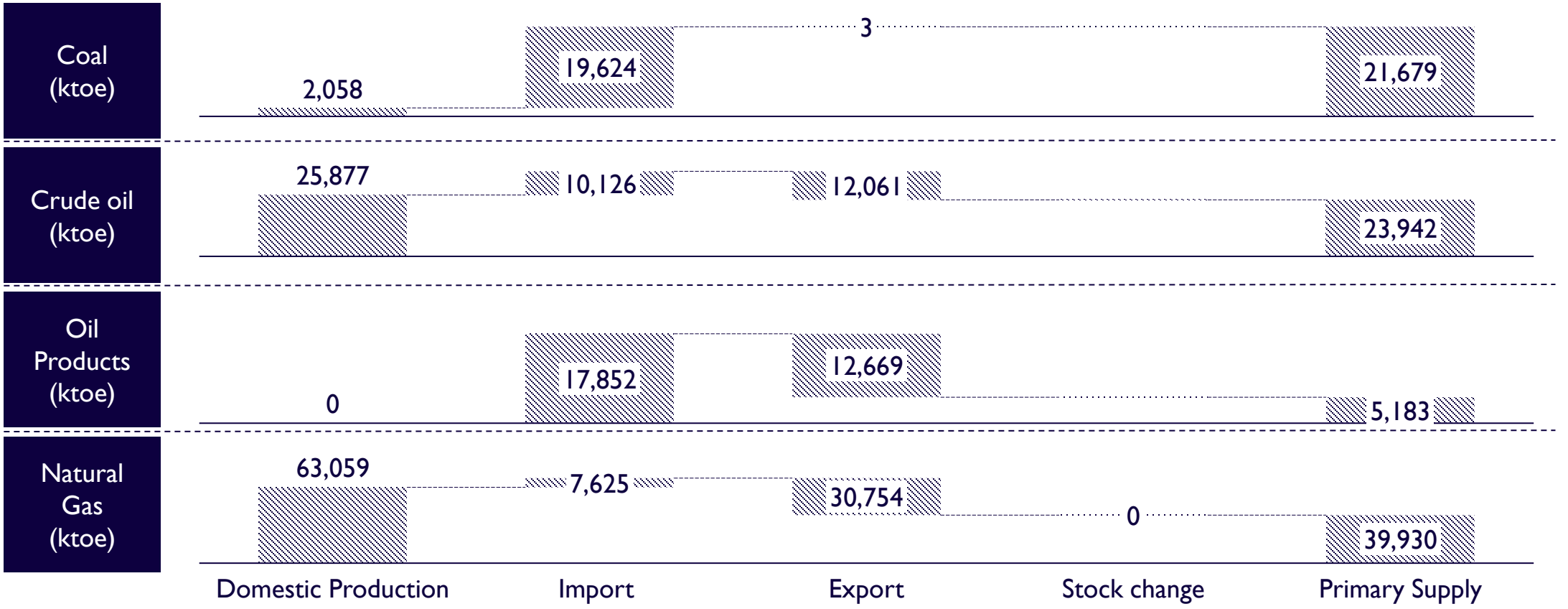
- Hydro contribution in overall generation mix is projected to increase from 7% in 2015 to 14% in 2025.
- To increase the share of RE, The Planning and Implementation Committee for Electricity Supply and Tariff agreed to the implementation of the Utility Solar Scale (USS) with a targeted 50 MW annually for a period of four years.
- Several power plant projects such as the 180MW Upper Padas hydro-electricity project and the new 390MW diesel/gas plants in Lahad Datu and POIC Sandakan have been planned to increase capacity for East Coast area.
- After one year of implementation, FiT mechanism increased RE share towards the total generation mix to up to 5% during the short to medium term window, significantly contributed by successful commissioning of new biomass and biogas plants.

Source: Energy Commission Annual Report 2015

2 化石エネルギー

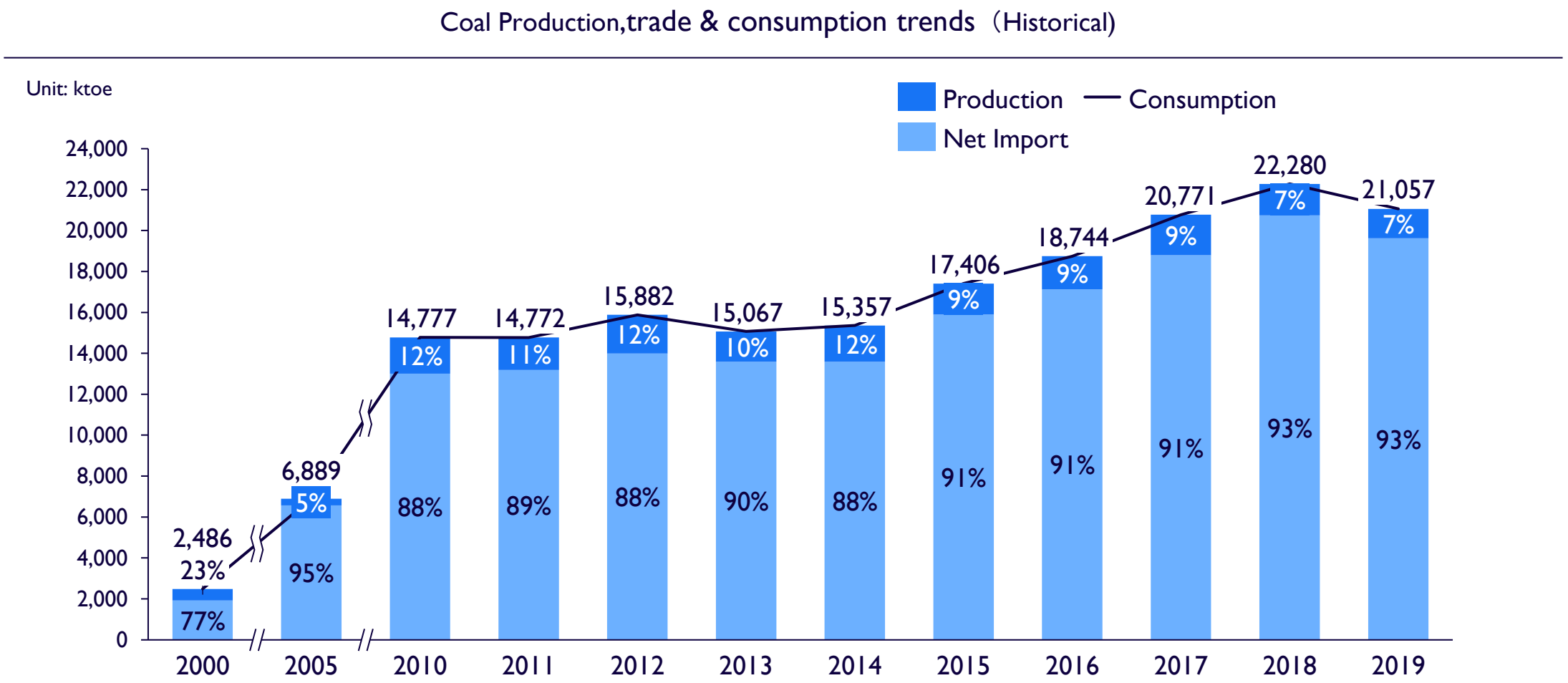
マレーシアは東南アジア諸国において2番目に大きい石油・天然ガス生産国。LNGの輸出は、マレーシアにとって重要な位置付け

Rate of domestic production and import/export of fossil fuel energy (2020)



Note: Net domestic consume may not necessarily add up due to statistical adjustment and rounding
Source :IEA Malaysia

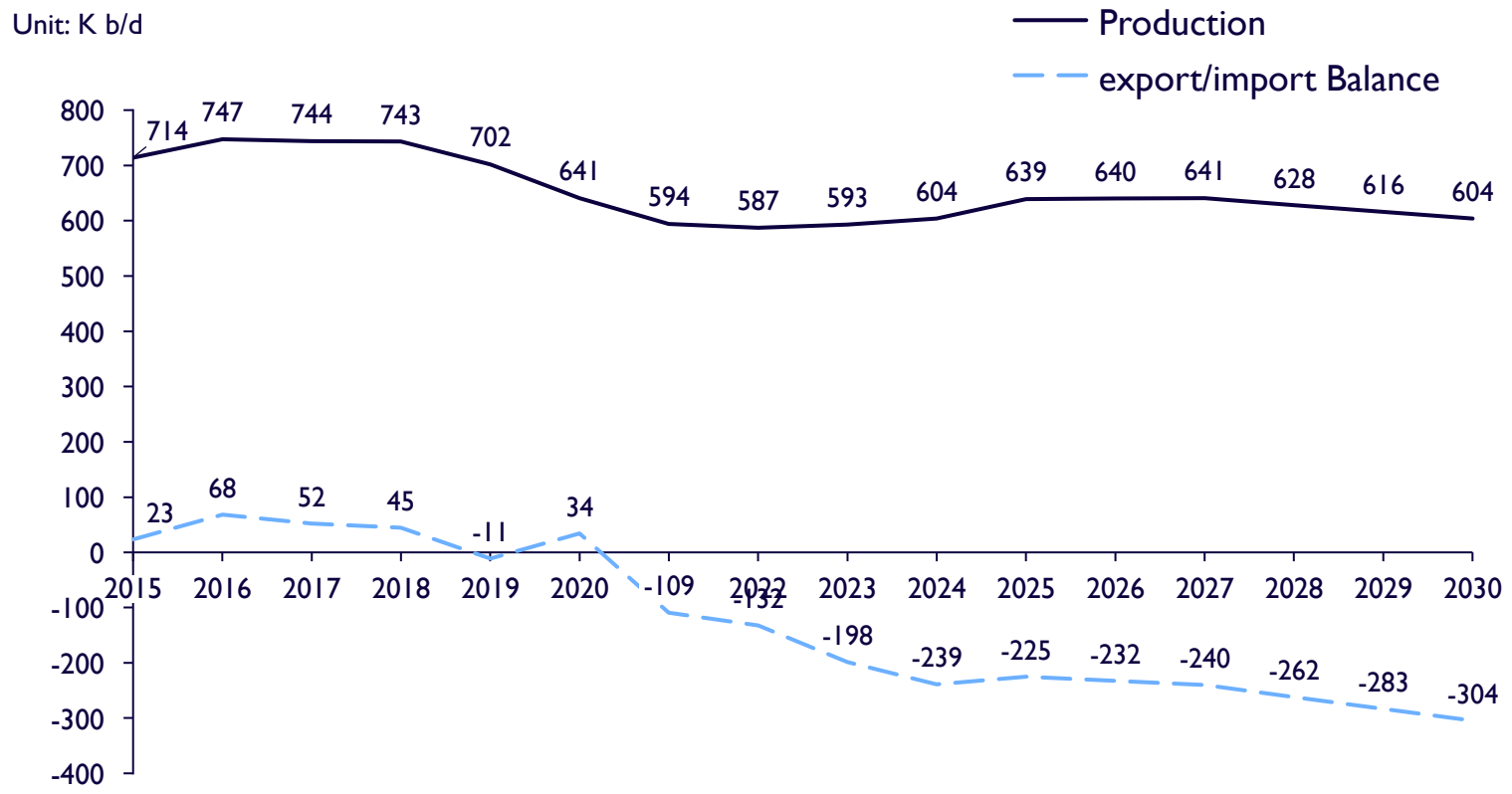
マレーシアは石炭の多くを輸入に頼っている



Source：National Energy Balance 2019よりADL作成

マレーシアは原油生産量が年々低下しており、将来的には純輸入国になるものと考えられる

Crude oil &Other liquids Production,trade & consumption trends



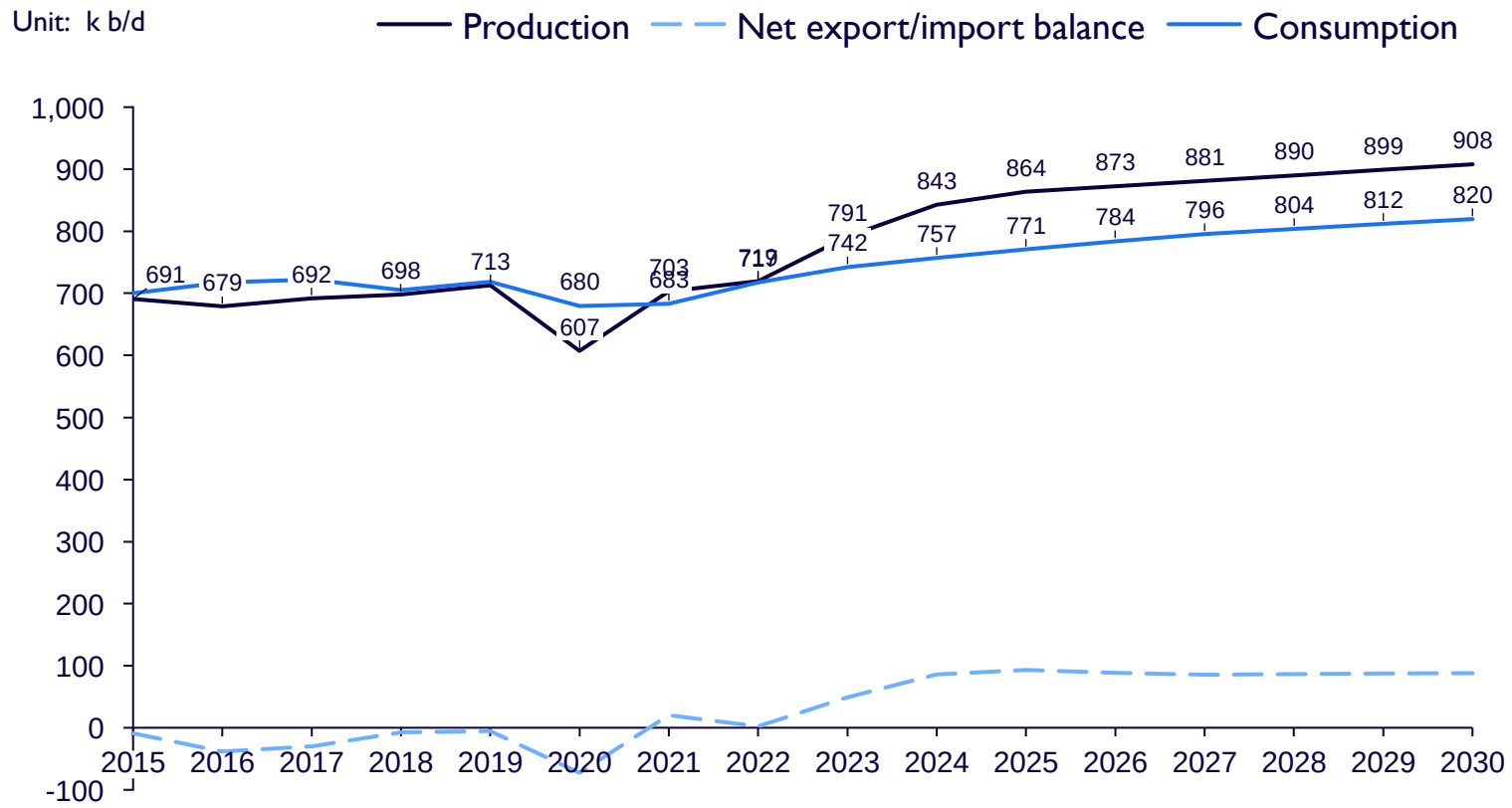
Comments

- Malaysia is Southeast Asia's second-largest oil producer behind Indonesia. Petroleum and other liquids production (including crude oil, lease condensates, natural gas liquids, biofuels, and refinery processing gains)
- The country's oil production has experienced overall decline as a result of maturing fields, particularly larger fields in the shallow waters offshore Peninsular Malaysia. Some recent drilling efforts in the area such as Lundin Petroleum's Bertam oilfield in the Penyu Basin are expected to offset some production declines from mature fields.
- Malaysia's domestic oil consumption has risen while production has fallen over the past decade, leaving smaller volumes of oil available for exports

Note: The negative net export refers to import greater than export
Source：Fitch solutions 2023年6月時点

精油所の容量拡大し、輸出を拡大

Refined petroleum Products production, trade & consumption trends



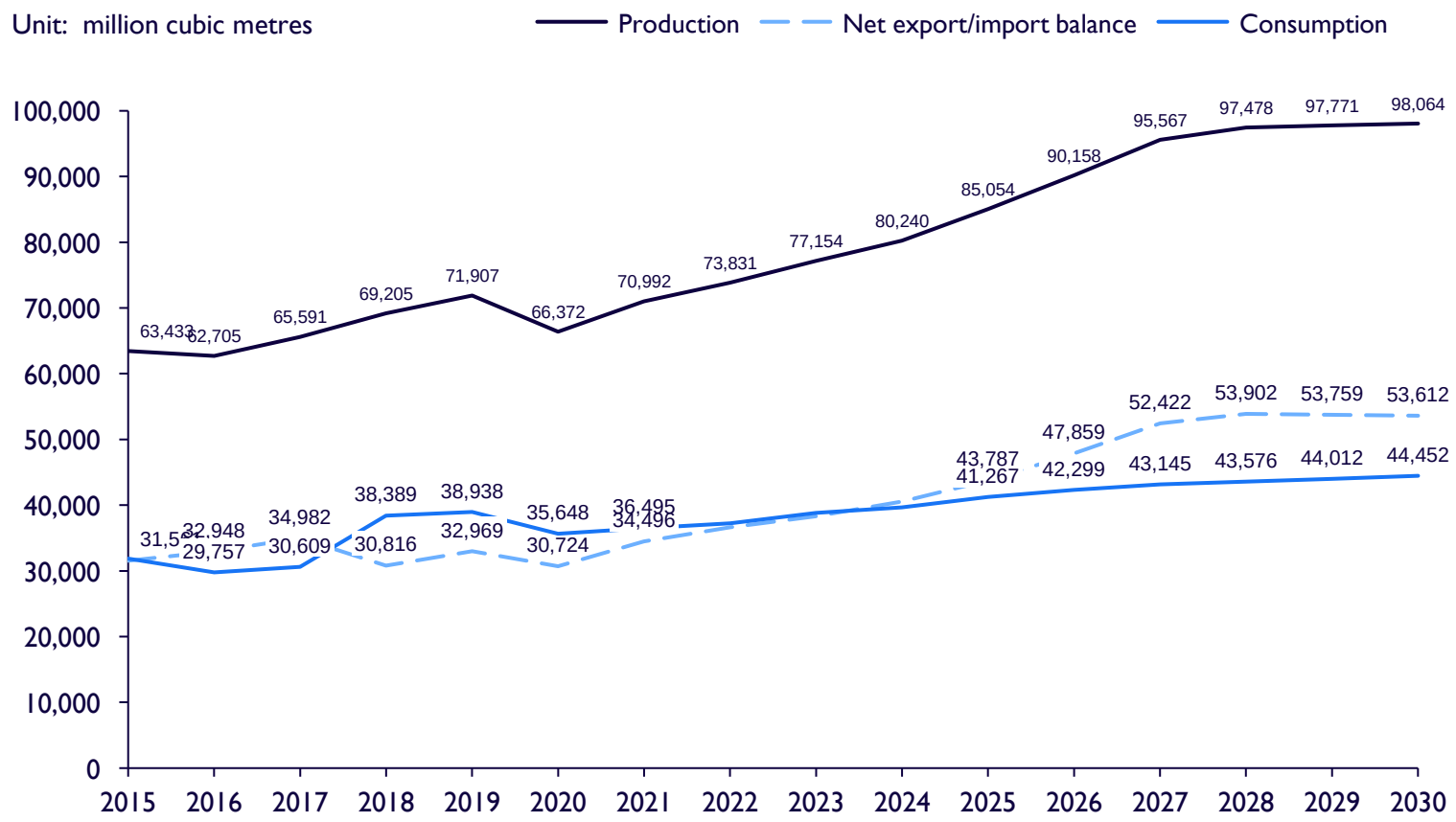
Note: The negative net export refers to import greater than export
Source：Fitch solutions　2023年6月時点

Comments

- According to FGE, Malaysia has 591,000 barrels per day (bbl/d) of refining capacity at six facilities. Malaysia invested heavily in refining activities during the past two decades and is now able to meet most of its demand for petroleum products domestically, after relying on refineries in Singapore for many years.
- Malaysia is expanding its oil terminal and storage capacity as the need for more oil storage and trading grows within Asia and as its neighbor, Singapore, lacks the space to continue increasing its massive storage capacity.

マレーシアは天然ガスの純輸出国となっており、これには外資によるサラワク州への投資が影響している

Dry natural gas production,trade＆consumption trends



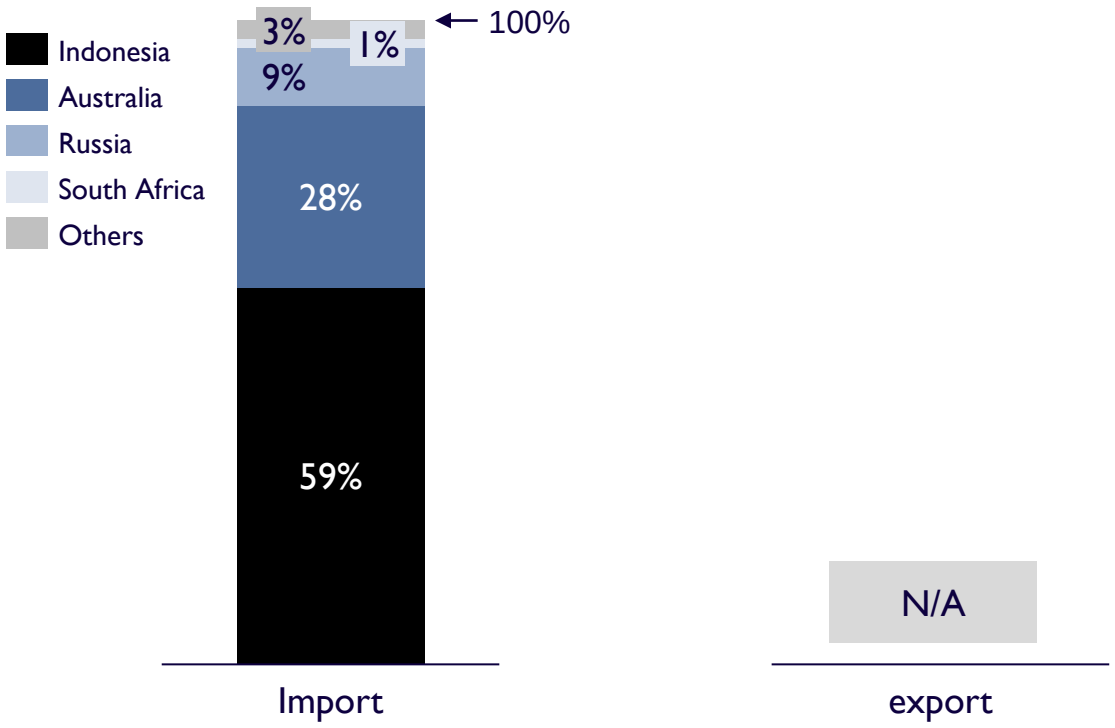
Note: The negative net export refers to import greater than export
Source：Fitch solutions　2023年6月時点

Comments

- Malaysia's natural gas production has risen over the past two decades to serve the growing domestic demand and export contracts. Recent foreign investment in deepwater and technically challenging fields, primarily in the Sarawak and Sabah states, provides impetus to maintain natural gas production levels over the next few years.
- Although Malaysia's dry natural gas production has risen steadily over the past two decades, reaching an estimated 2.3 Tcf in 2012, growth slowed somewhat since 2007. Meanwhile domestic natural gas consumption has increased, reaching 1.1 Tcf in 2013, and it accounted for about 50% of production.

石炭の純輸入国でありインドネシアやオーストラリアからの輸入に頼っている

Coal import & Export Partners (at 2020)



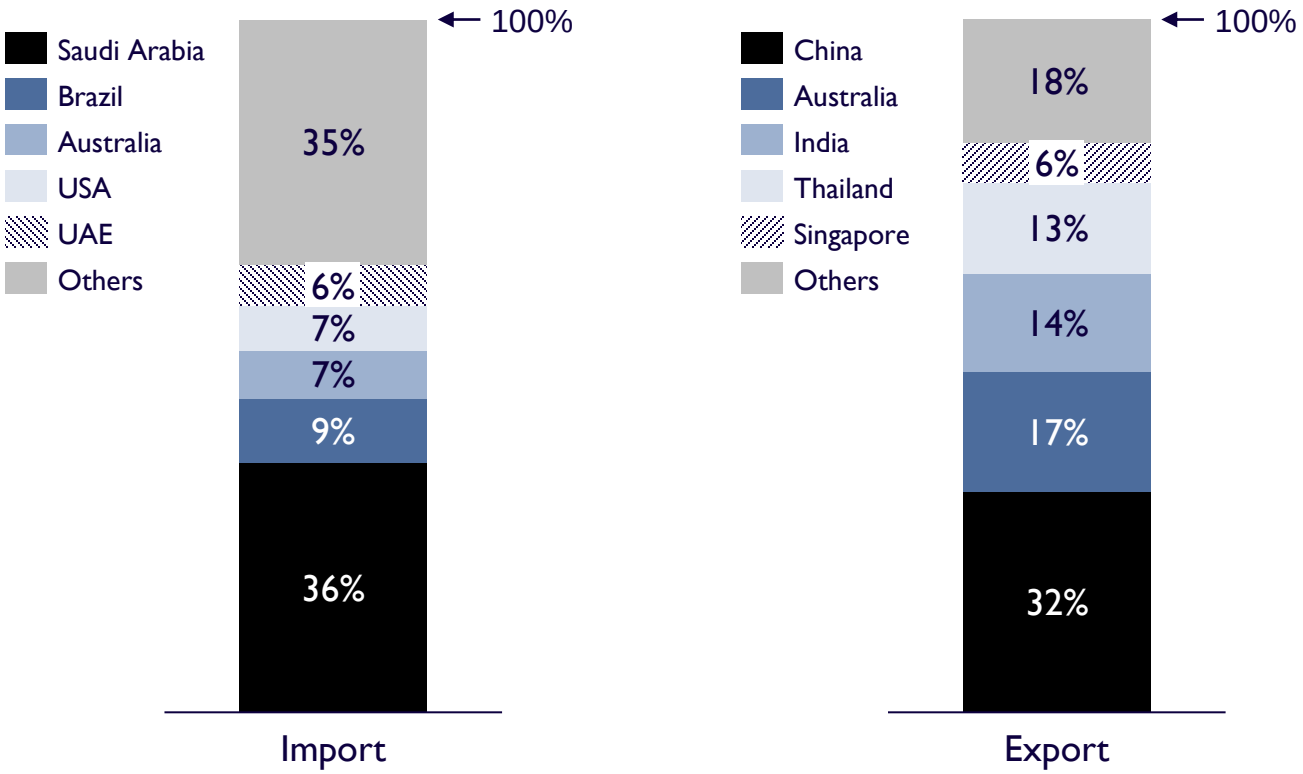
Source：Atlas of economic complexity (HS code: 2701 Coal)

Comments

- **Coal imports from Indonesia accounted for 59% of the total imports**, followed by Australia, 28%; Russia, 9%; South Africa, 1%; and others, 3% accumulating with the total of 2.20 billion USD.
- All imported coal is bituminuous coal. Coal consumption was expected to increase during the next several years because the demand for electricity was expected to increase.

マレーシアは原油を中国・オーストラリア・インド等に輸出している。一方で、重油は中東から輸入して国内需要(主に発電需要)に活用

Crude Oil import & Export Partners (at 2020)



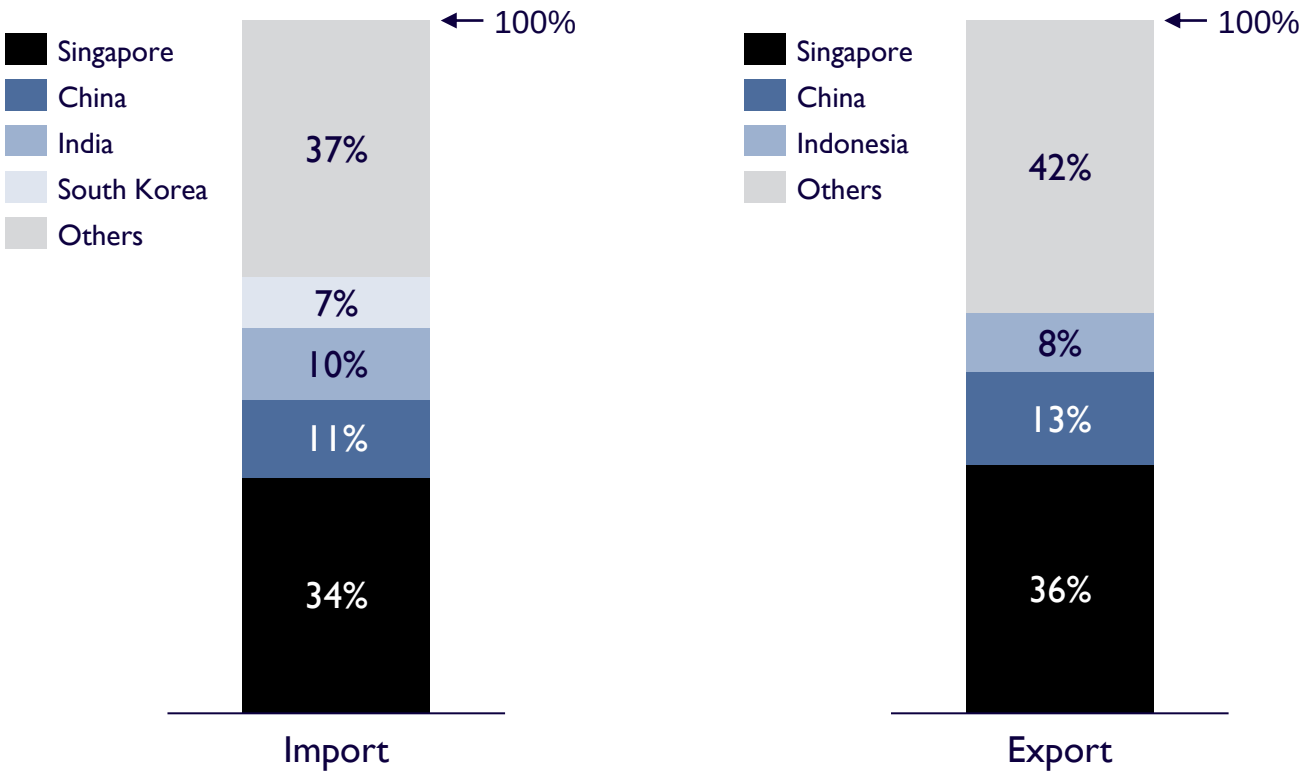
Source： Atlas of economic complexity (HS code: 2709 Petroleum Oils, Crude)

Comments

- Rapid economic growth in recent years has raised domestic energy demand and consumption of crude oil. Coupled with declining output, this has resulted in a reduction of crude oil exports.
- Malaysia exports sweet crude, which commands a premium, and imports heavier crude oils from the Middle East and other locations for refining and domestic consumption
- Primary export destinations are China, Australia, India, and Thailand.

マレーシアにとって石油精製の貿易で最も重要な国はシンガポール

Refined petroleum products import & Export Partners (at 2020)



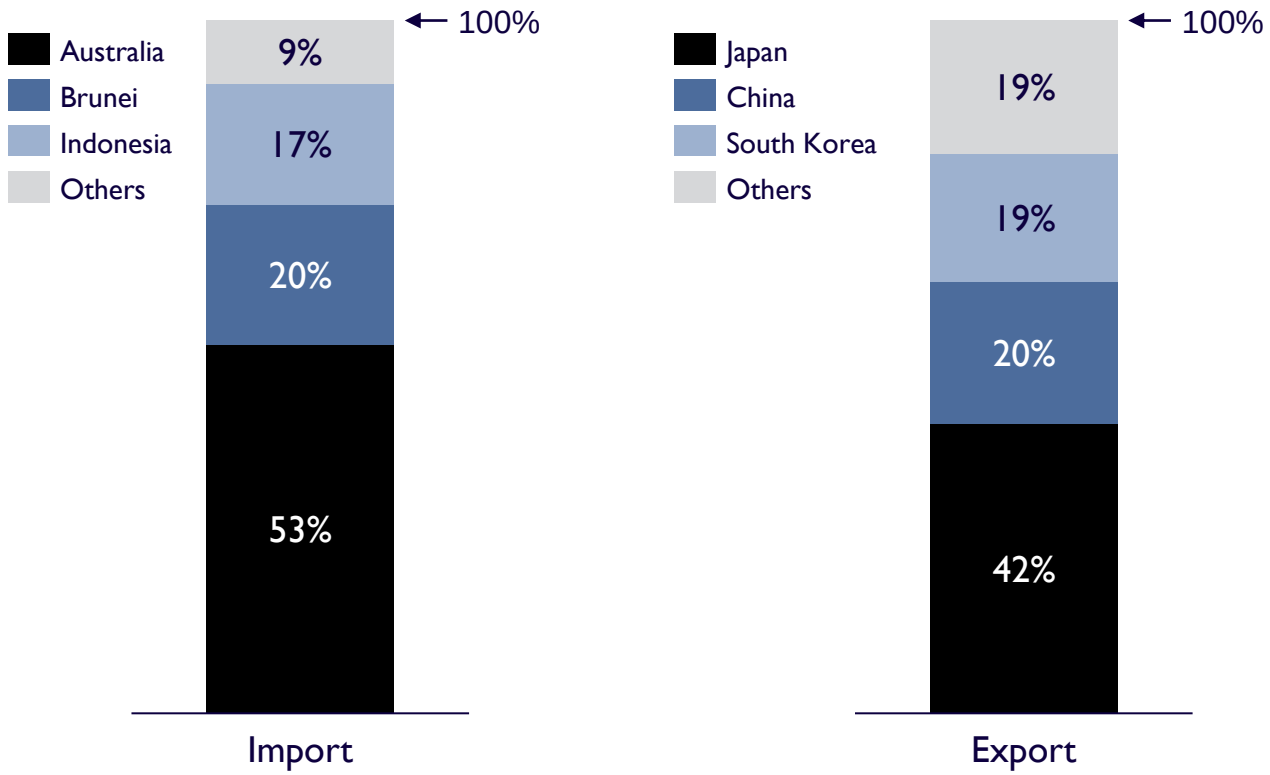
Source： Atlas of economic complexity (HS code: 2710 Petroleum Oils)

Comments

- As part of Malaysia's goal to compete with the oil refining and storage hub in Singapore, Petronas plans to build a $16 billion refining and petrochemicals integrated development project (RAPID) in Johor state at the southern tip of Peninsular Malaysia. This project includes a 300,000 bbl/d refinery, which industry expects will turn Malaysia from a net oil product importer to a net oil product exporter once it is operational.
- Additionally, the RAPID Pengerang project refinery is designed to produce gasoline and diesel that meet Euro 4 and Euro 5 fuel specifications. As a result, exports of low-sulfur fuels from the RAPID are expected to rise since the refinery is capable of producing large quantities of Euro-4 and Euro-5 fuel grades that meet stringent specifications in both domestic and international markets.

マレーシアは天然ガス輸出のうち42 %を日本に輸出している。一方でオーストラリア等から輸入もしている。

Natural Gas import & Export Partners (at 2020)



Source： Atlas of economic complexity (HS code: 2711 Petroleum Gases)

Comments

- Malaysia has historically been a **major supplier of LNG for Japan, South Korea, and Taiwan**. Malaysia LNG has had over 30 years of experience as an established and reliable supplier in delivering LNG to these major markets.
- Japan continues to be the main buyer of natural gas from Malaysia, accounting for 42% of natural gas export in 2020, followed by China (20%), South Korea (19%) while the balance of 19% is exported to other countries accumulating

Major oil & gas projects currently producing in Malaysia (1/2)

	Name	Field Name	Companies	Completion Date	Est.Peak Oil/Liquids Range (b/d)	Est.Peak Gas Output (bcm)	Type of Project	Onshore/ Offshore
1	Block K & G	Siakap North-Petai (SNP)	Murphy Oil (32%), Royal Dutch Shell (21%), Petronas (26%), ConocoPhillips (21%)	2014	35000		Oil	Offshore
2	Block SK10	Helang	JX Nippon Oil & Energy Corporation (75%), Petronas (25%)	2003	10000	2.5	Oil, Gas & Condensate	Offshore
3	Block PM307	Bertam	Lundin Petroleum (75%), Petronas (25%)	2015	75000		Oil	Offshore
4	Block PM303	Damar	ExxonMobil (50%), Petronas (50%)	2014		2	Natural Gas	Offshore
5	Telok	Telok	ExxonMobil (50%), Petronas (50%)	2013		4.5	Natural Gas	Offshore
6	Balai Cluster Risk Service Contract (RSC)	Bentara	Petronas (20%), Dialog Group Berhad (32%), Roc Oil (48%)	2014	3000		Oil & Gas	Offshore
7	North Malay Basin Project (PM302)	Kamelia	Hess Corporation (50%), Petronas (50%)	2013	360	0.4	Gas & Condensate	Offshore
8	Block K	Kikeh	Murphy Oil (56%)	2007	120000		Oil & Gas	Offshore
9	Block A-18	Cakerawala	Carigali-PTTEPI Operating Company (100%)	2005			Gas & Condensate	Offshore
10	Block SK309/SK311	Golok, Merapuh, Serampang, Belum & Pemanis	Murphy Oil (59.5%)	2009	18500	1.1	Gas & Condensate	Offshore
11	Bintang	Bintang	ExxonMobil (50%), Petronas (50%)	2003		3.6	Natural gas	Offshore
12	Block SK 309	West Patricia	Murphy Oil (59.5%)	2003	20000		Oil	Offshore
13	Block PM 304	Cendor	Kuwait Foreign Petroleum Exploration Company (KUFPEC) (25%), Petrovietnam Exploration Production Corporation (PVEP) (15%), Petrofac, Petronas (30%)	2006	30000		Oil	Offshore
14	Block PM 304	West Desaru	Kuwait Foreign Petroleum Exploration Company (KUFPEC) (25%), Petrovietnam Exploration Production Corporation (PVEP) (15%), Petrofac, Petronas (30%)	2013	20000		Oil	Offshore
15	Block SK-305	D30	PetroVietnam (30%), Petronas (40%), Pertamina (30%)	2010			Oil & Gas	Offshore
16	Block SK-305	Dana	PetroVietnam (30%), Petronas (40%), Pertamina (30%)	2011			Oil & Gas	Offshore
17	Tembikai	Tembikai	Petronas	2015	2000		Oil & Gas	Offshore
18	KBM Cluster, Block PM 316	Kapal, Banang, Meranti	Petronas	2013			Oil	Offshore
19	KBM Cluster, Block PM 316	Kapal	Petronas	2013	13000		Oil	Offshore

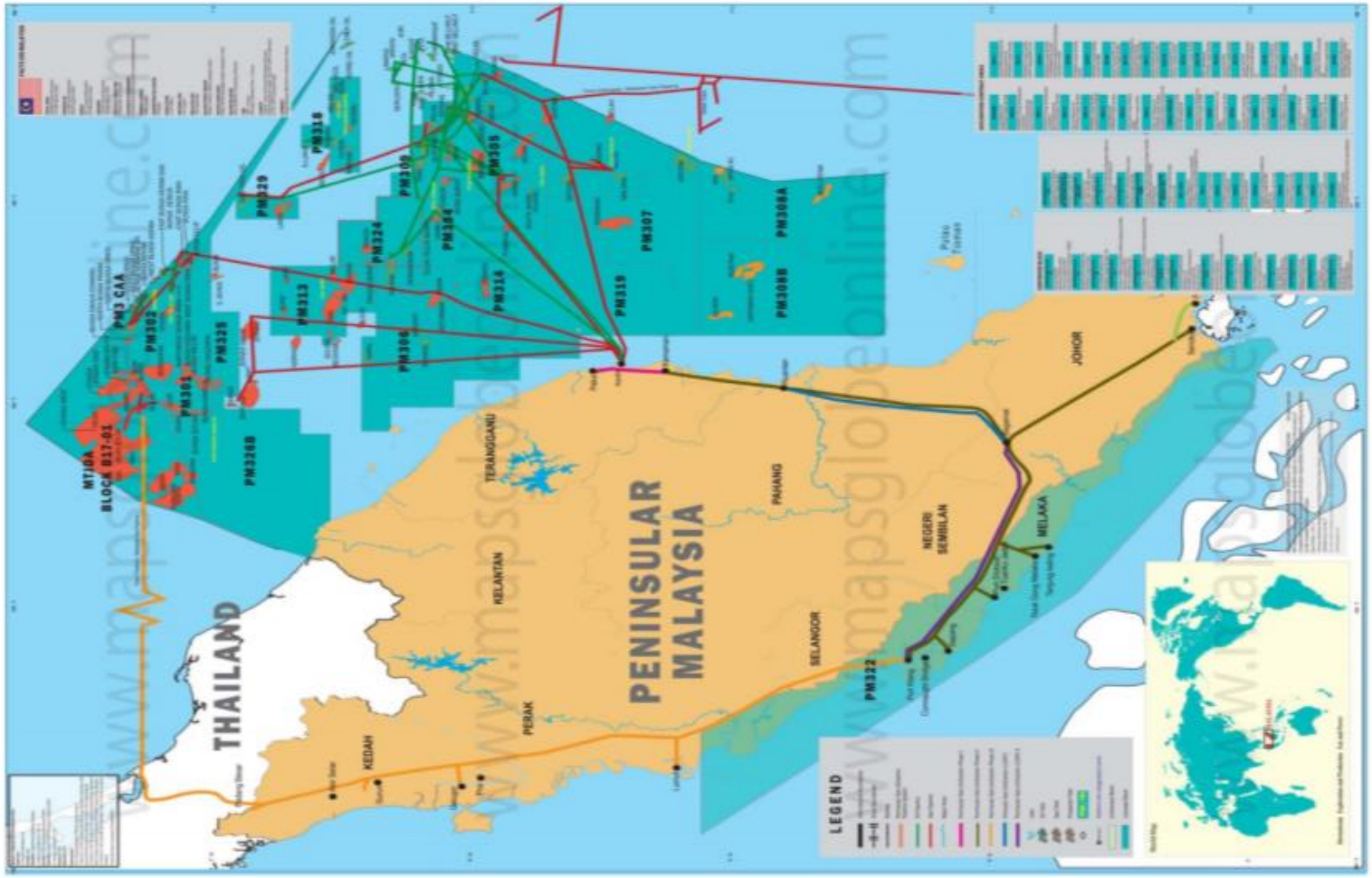
Source：Fitch Solutions - Malaysia Oil & Gas Report 2023

Major oil & gas projects currently producing in Malaysia (2/2)

	Name	Field Name	Companies	Completion Date	Est.Peak Oil/Liquids Range (b/d)	Est.Peak Gas Output (bcm)	Type of Project	Onshore/ Offshore
20	KBM Cluster, Block PM 316	Banang	Petronas	2014	6000		Oil	Offshore
21	Angsi	Angsi	Petronas (50%), ExxonMobil (50%)	2001	65000	4.5	Oil & Gas	Offshore
22	Guntong	Guntong	ExxonMobil (78%), Petronas (22%)				Oil & Gas	Offshore
23	Block PM6	Dulang	Petronas (100%)	1991			Oil & Gas	Offshore
24	Bokor	Bokor	Petronas		140000		Oil & Gas	Offshore
25	Block SK309 and SK311	Patricia, Permas, Serendah & South Acis	Murphy Oil (59.5%)	2013			Oil & Gas	Offshore
26	Block PM 309	Berantai	Petronas	2012	10000	1.5	Gas	Offshore
27	D18	D18	Petronas	1986	5300		Oil	Offshore
28	Block PM302, PM325, PM326B	Kamelia, Bergading, Zetung, Melati, Anggerik, Kezumba	Hess Corporation (50%), Petronas (50%)	2013			Gas & Condensate	Offshore
29	Block K & J	Gumusut-Kakap	Royal Dutch Shell (33%), Murphy Oil (14%), ConocoPhillips (33%), Petronas (20%)	2012	135000		Oil	Offshore
30	Block B-17 & B-17-01	Muda, Muda South, Tapi, Jengka, Amarit, Mali, Jengka West, Jengka East, Jengka South	PTT Exploration and Production Public Company Limited - PTTEP (50%), Petronas (50%)	2010			Oil & Natural Gas	Offshore
31	Block SK10	Layang	JX Nippon Oil & Energy Corporation (75%), Petronas (25%)		12,000		Oil, Gas & Condensate	Offshore
32	Block PM305	Ophir	Scomi Group Bhd (30%), Petronas (20%), Octanex (50%)				Oil	Offshore
33	Block G	Malikai	Royal Dutch Shell (35%), ConocoPhillips (35%), Petronas (30%)		60,000	0.5	Oil & Gas	Offshore
34	Kumang Cluster Phase-II, Block SK306	A3, F11, F22, F27, F12, Selar Marine, Bunga Pelaga	Petronas (100%)				Gas	Offshore
35	Block SK 310	B15, B14 and B17	Sapura Energy Berhad (30%), Petronas (40%), Mitsubishi Corporation (30%)			1	Gas	Offshore
36	SK320	Pegaga Gas Field	Royal Dutch Shell (20%), Petronas (25%), Mubadala Investment (55%)			5.4	Gas & Condensate	Offshore

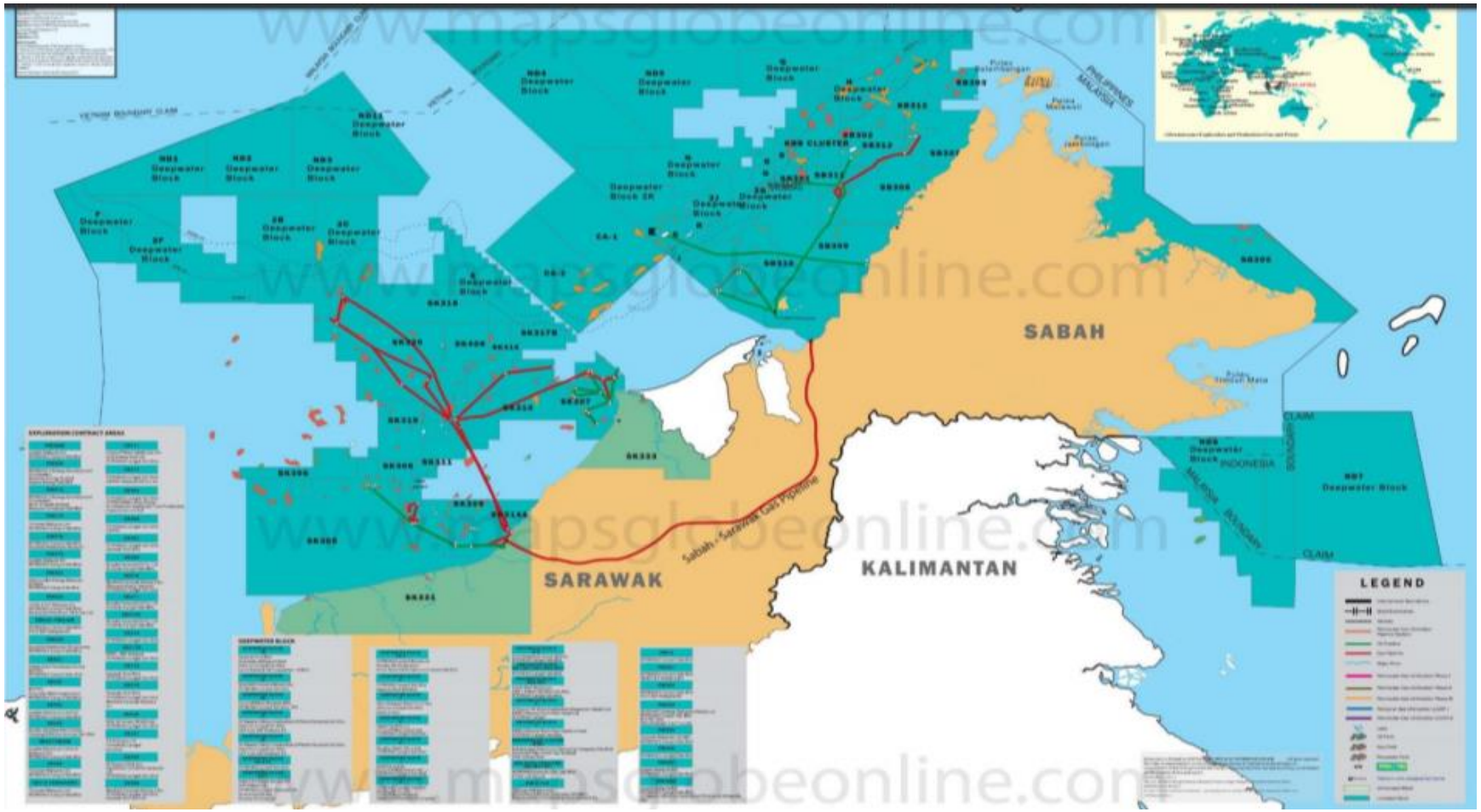
Source： Fitch Solutions - Malaysia Oil & Gas Report 2023

(Ref)Map of oil & gas fields in Malaysia – West Malaysia area



Source： Gas Malaysia annual report 2014

(Ref)Map of oil & gas fields in Malaysia – Sabah & Sarawak area



Source： Gas Malaysia annual report 2014

Major oil & gas projects in the future upstream Malaysia (1/3)

#	Name	Field Name	Companies	Completion Date	Status Select	Type of Project	Onshore/ Offshore
1	Block H	Rotan	Murphy Oil (60%), Petronas (40%)	2018	Final Investment Decision	Gas	Offshore
2	Block SK 314A	Block SK 314A	Murphy Oil (59.5%)		Exploration	Oil & Gas	Offshore
3	Block PM311	Kenarong, Kenarong North, Pertang	Murphy Oil (75%), Petronas (25%)	2016	Appraisal	Gas	Offshore
4	Block P	Block P	Petronas (40%), Murphy Oil (60%)		Exploration	Oil & Gas	Offshore
5	Block SK 408	Gorek, Larak and Bakong	SapuraKencana Petroleum (40%), Petronas (30%), Royal Dutch Shell (30%)		Development	Gas	Offshore
6	Block SK318	Timi Gas Field	Royal Dutch Shell (75%), Petronas (15%),Brunei Energy Exploration (10%)		Development	Gas	Offshore
7	Block S, Sabah Basin	Block S	INPEX Corporation (50%), Petronas (25%), Santos Limited (25%)		Exploration	Oil & Gas	Offshore
8	PM328	PM328	E&P Malaysia Venture (10%), Petronas (40%), Lundin Petroleum		Exploration	Oil & Gas	Offshore
9	North Malay Basin Project (PM302, PM325, PM326B)	Bergading	Hess Corporation (50%), Petronas (50%)	2017	Development	Gas	Offshore
10	North Malay Basin Project (PM302, PM325, PM326B)	Zetung	Hess Corporation (50%), Petronas (50%)	2017	Development	Gas	Offshore
11	North Malay Basin Project (PM302, PM325, PM326B)	Melati	Hess Corporation (50%), Petronas (50%)	2017	Development	Gas	Offshore
12	North Malay Basin Project (PM302, PM325, PM326B)	Anggerik	Hess Corporation (50%), Petronas (50%)	2017	Development	Gas	Offshore
13	North Malay Basin Project (PM302, PM325, PM326B)	Kezumba	Hess Corporation (50%), Petronas (50%)	2017	Development	Gas	Offshore
14	Tapis	Tapis	Petronas (50%), ExxonMobil (50%)	1979	Upgrade/EOR	Extra Light Oil	Offshore

Source： Fitch Solutions - Malaysia Oil & Gas Report 2023

Major oil & gas projects in the future upstream Malaysia (2/3)

#	Name	Field Name	Companies	Completion Date	Status Select	Type of Project	Onshore/ Offshore
15	Block SK308	E6	Royal Dutch Shell, Petronas (50%)		Development	Oil & Gas	Offshore
16	Block DW2B, Sarawak basin	Block DW2B	Korea National Oil Corporation (KNOC) (15%), Royal Dutch Shell (50%), Petronas (15%), Mubadala Petroleum (20%)		Exploration	Oil & Gas	Offshore
17	Block SB312	Block SB312	Kuwait Foreign Petroleum Exploration Company (KUFPEC) (40%), Petronas (60%)		Expansion	Oil & Gas	Offshore
18	Block R	Block R	JX Nippon Oil & Energy Corporation (27.5%), INPEX Corporation (27.5%), Santos Limited (20%), Petronas (25%)		Appraisal	Natural Gas	Offshore
19	Kumang Cluster Phase-I, Block SK306	F9, Kumang, Kanowit	Petronas		Development	Gas	Offshore
20	Block SK306	Kumang	Petronas	2015	Development	Gas	Offshore
21	K5	K5	Petronas	2018	Development	Sour Gas	Offshore
22	Block SK306	Kanowit	Petronas	2016	Development	Gas	Offshore
23	Block SK317B	Block SK317B	Petronas (15%), Total (85%)		Discovery	Oil & Gas	Offshore
24	Chenang	Chenang	Petronas	2015	Development	Oil & Gas	Offshore
25	KBM Cluster, Block PM 316	Meranti	Petronas	2019	Development	Oil	Offshore
26	Block SB331	Block SB331	M3nergy, SapuraKencana Petroleum (70%)		Exploration	Oil & Gas	Onshore
27	Block SB332	Block SB332	SapuraKencana Petroleum (70%), M3nergy		Exploration	Oil & Gas	Onshore
28	North Sabah PSC	St. Joseph	Royal Dutch Shell (50%), Petronas (50%)	1981	Upgrade/EOR	Oil	Offshore
29	North Sabah PSC	South Furious	Royal Dutch Shell (50%), Petronas (50%)		Upgrade/EOR	Oil	Offshore
30	North Sabah PSC	SF30	Petronas (50%), Royal Dutch Shell (50%)	2001	Upgrade/EOR	Oil	Offshore
31	North Sabah PSC	Barton	Royal Dutch Shell (50%), Petronas (50%)		Upgrade/EOR	Oil	Offshore
32	Baram Delta PSC	Bakau	Petronas (60%), Royal Dutch Shell (40%)		Upgrade/EOR	Oil	Offshore
33	Baram Delta PSC	Baram	Petronas (60%), Royal Dutch Shell (40%)		Upgrade/EOR	Oil	Offshore

Source： Fitch Solutions - Malaysia Oil & Gas Report 2023

Major oil & gas projects the future upstream Malaysia (3/3)

#	Name	Field Name	Companies	Completion Date	Status Select	Type of Project	Onshore/Offshore
34	Baram Delta PSC	Baronia	Royal Dutch Shell (40%), Petronas (60%)		Upgrade/EOR	Oil	Offshore
35	Baram Delta PSC	Betty	Royal Dutch Shell (40%), Petronas (60%)		Upgrade/EOR	Oil	Offshore
36	Baram Delta PSC	Fairley Baram	Petronas (60%), Royal Dutch Shell (40%)		Upgrade/EOR	Oil	Offshore
37	Baram Delta PSC	Siwa	Royal Dutch Shell (40%), Petronas (60%)		Upgrade/EOR	Oil	Offshore
38	Baram Delta PSC, Block SK307	Tukau Timur	Petronas (50%), Royal Dutch Shell (50%)		Discovery	Gas	Offshore
39	Baram Delta PSC	West Lutong	Royal Dutch Shell (40%), Petronas (60%)		Upgrade/EOR	Oil	Offshore
40	Block SK316	Kasawari Gas Field	Petronas		Development	Gas	Offshore
41	Block PM-322	Port Klang	Petronas (15%), Ophir Energy (85%)		Exploration	Oil	Offshore
42	Block PM308A	Block PM308A	Petronas (25%), Lundin Petroleum (75%)		Exploration	Oil & Gas	Offshore
43	Block CA1	Block CA1	Murphy Oil (5%), Total (54%), BHP Billiton (22.5%), Hess Corporation (13.5%), Petronas (5%)		Discovery	Oil & Gas	Offshore
44	Block CA2	Kelidang, Keratau, Kempas, Keratau SW	ConocoPhillips (6.25%), Royal Dutch Shell (12.5%), Murphy Oil (30%), Mitsubishi Corporation (6.25%), Petronas (45%)		Appraisal	Oil & Gas	Offshore
45	Block SB331	Block SB331	Sapura Energy Berhad (70%), Petronas (20%), M3nergy (10%)		Exploration	Oil & Gas	Onshore
46	D18	D18	Petronas (100%)		Upgrade/ EOR	Oil	Offshore
47	PM3 Commercial Arrangement Area (CAA), PM-305, PM-314	West Bunga Kekwa, East Bunga Kekwa-Cai Nuoc, East Bunga Raya, West Bunga Raya, NW Bunga Raya and Bunga Seroja, Bunga Orkid	PetroVietnam (30%), Petronas (35%), Repsol (35%)		Upgrade/ EOR	Oil & Gas	Offshore
48	Block SK10	Beryl	Petronas (25%), JX Nippon Oil & Energy Corporation (75%)		Development	Gas & Condensate	Offshore

Source： Fitch Solutions - Malaysia Oil & Gas Report 2023

石炭発電における脱炭素に向けて、GTCCやアンモニア混焼等に関して日系企業-地場大手企業で協業がスタート

Status of introduction of coal-fired power generation

三菱重工-TNB

- (MHI) and TNB Power Generation Sdn. Bhd. (TNB Genco), a subsidiary of Tenaga Nasional Berhad, Malaysia's largest power generation company, signed a Memorandum of Understanding (MOU) to conduct research and exchange information on clean energy technologies. Memorandum of Understanding (MOU) signed with TNB Power Generation Sdn.
- The collaboration will begin with a technical feasibility study of TNB Genco's plans to install a high-efficiency gas turbine combined cycle (GTCC) with hydrogen-ready technology in Malaysia.

(2023)

IHI-PETRONAS-TNB

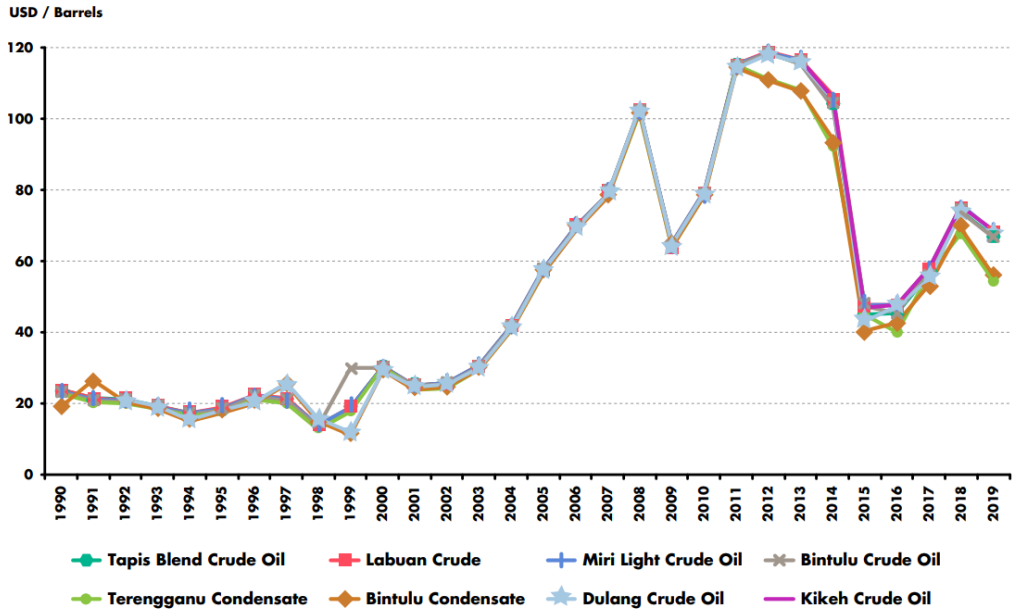
- IHI, in collaboration with PETRONAS Gas & New Energy Sdn. Bhd. and TNB Power Generation Sdn Bhd. The feasibility study project was launched to evaluate the technology and economics of the entire supply chain, including the production of green ammonia derived from renewable energy and blue ammonia derived from natural gas, with the aim of reducing CO_2 emissions.
- IHI has been promoting the development of combustion technology using ammonia as fuel, and has been working on the advancement of combustion technology, including the development of an ammonia co-firing burner for coal-fired power plants that can both suppress nitrogen oxide (NOx) formation and achieve stable combustion. We are now working on the development of the world‘s first demonstration of 20% ammonia co-firing at a commercial coal-fired power plant in Japan. （2021）

Source：S&P Global, Prime minister’s department

原油価格は2014年から世界原油価格の下落を背景に減少。ガソリン価格は近年価格上昇傾向

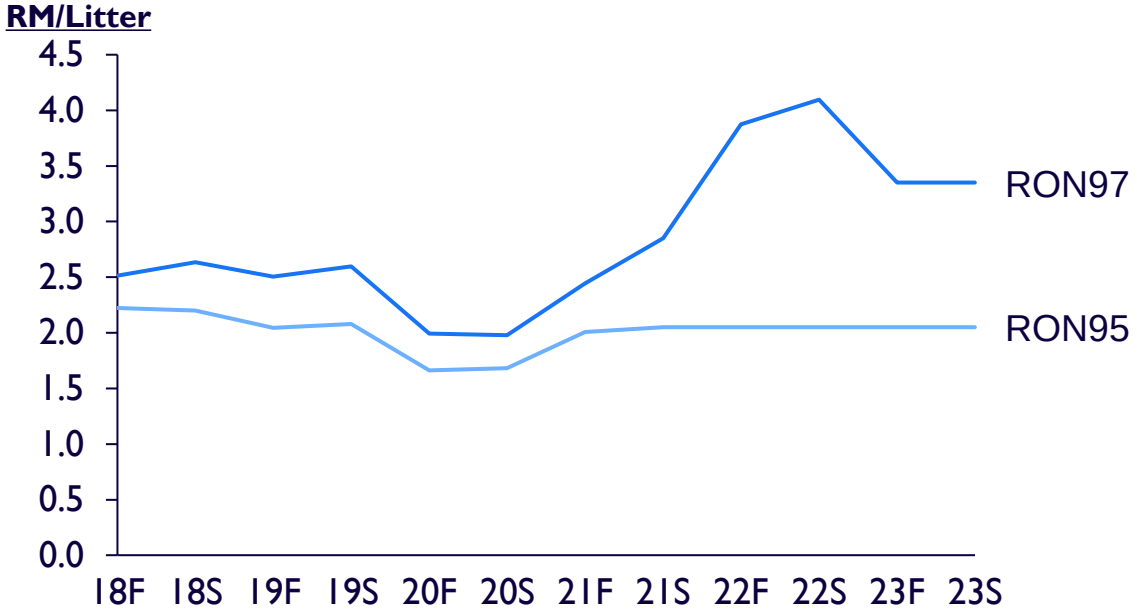
Official selling price of Crude Oil

- Malaysian crude oil prices have been rising year by year, but have been on a downward trend since 2014 due to the drop in world crude oil prices before recovering since 2015.



Official selling price of Retail Petrol Prices

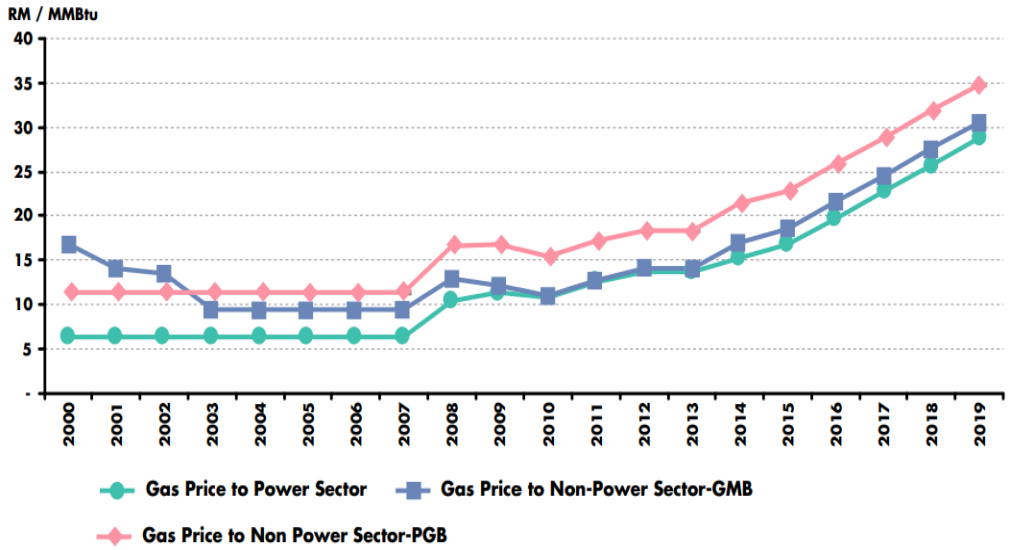
- The petrol prices decrease from 2019 to late 2020 due to the COVID-19 pandemic. After recovering, the petrol demand have been gradually risen resulting in the increase in the petrol price. In addition, political tension situation in the middle east countries also effected the petrol price in Malaysia.



Source：Malaysia Energy Statistics Handbook 2021, Ringgitplus.

国内の天然ガス価格は2007年以降上昇が続く

Official selling price of Natural Gas



- *The natural gas price have been increasing since 2014 due to several factors. One major factor is the rolled-out of **Subsidy Rationalization Program (SRP)** in 2010. As part of the SRP, the government aimed to gradually reduce subsidies on gas prices and align them with market realities. This meant that the prices paid by end-users for natural gas, including both power and non-power sectors, were gradually increased over time to reflect the true cost of supply.*

Source：Malaysia Energy Statistics Handbook 2021, Oxford Institute for Energy Studies 2020

The Economic Planning Unit, KeTSA,KASAがエネルギー関連の中心省庁

Ministry	Department	Role & responsibility
Economic Planning Unit of the Prime Minister's Department	Energy Unit under the Economic Planning Unit	Sets the direction & strategies for energy policy & determines implementation with focus on oil & gas sector and privatization of the electricity supply industry i.e. IPPS. Also sets gas prices.
Ministry of Energy and Natural Resources (KeTSA)	Energy Sector	Responsible for developing electricity supply policies and strategies
	Natural Resources Sector	・Mineral Resource Management ・Marine Resource Management
Energy Commission		・Regulation of the electricial power sector & the piped supply industry (except Sarawak). In Sarawak the state government is the regulator
Sustainable Energy Development Authority (SEDA)		[Re-energy related center] ・Enforcement of the RE Law and other related systems ・Advise government agencies on all matters related to RE ・Implementation, management, and review of FIT programs
Ministry of Environmental and Water （KASA）		・Enacting laws and regulations to protect the environment, ・conducting environmental impact assessments,
Ministry of Rural Development(KPLB)		・Electricity in rural off-grid areas
Ministry of Domestic Trade and Consumer Affairs		・promoting market competition, price control, and consumer protection.（gasoline Subsidy etc)
Ministry of International Trade and Consumer Affairs		・Developing Trade strategy

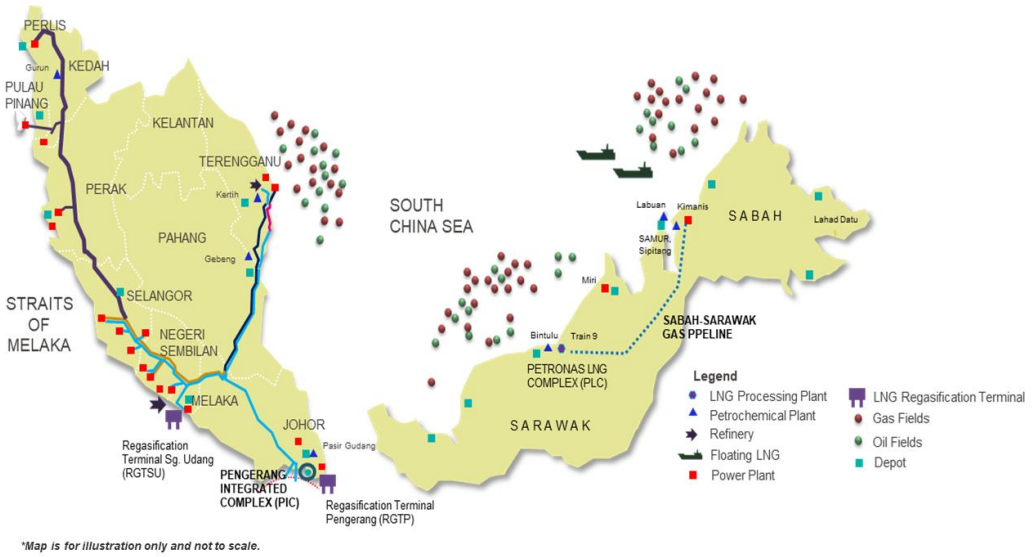
Source：各種二次情報よりADL作成

3 パイプライン（ガス・石油）

マレーシアは相対的に石油のパイプラインは限られており、タンカーやトラック輸送を活用

Oil Pipeline Network

- *Malaysia has a relatively limited crude oil pipeline network and uses crude oil tankers and trucks for onshore distribution. Two major crude oil pipelines in Peninsular Malaysia include:*
  - *Tapis pipeline, which runs from the Tapis field to the refinery in Kerteh.*
  - *Jerneh pipeline, which transports condensate from the Jerneh field to Kerteh.*
- *The crude oil pipeline network for Sabah in Borneo Malaysia connects offshore oil fields with the onshore Labuan oil terminal.*
- *Malaysia also has an oil products pipeline that runs from Indonesia's Dumai refinery to the Melaka refinery in Melaka, Malaysia..*



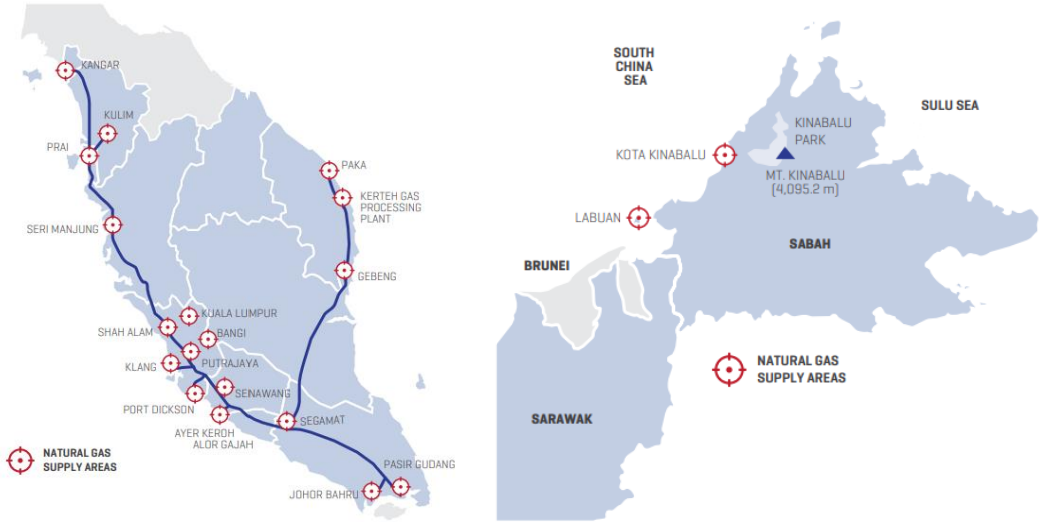
Malaysia Oil & Gas Overview Map

Source： Energy Information Administration (EIA)

PGUプロジェクトは、タイ、インドネシア、シンガポールを結び、天然ガスの輸出（タイ、シンガポールへ）と輸入（インドネシアから）を行う

Gas Pipeline Network/Projects

- *The Peninsular Gas Utilization (PGU) project spans approximately 1,630 miles and has the capacity to transport about 1.28 trillion cubic feet per year of natural gas.28 The PGU system connects with Thailand, Indonesia, and Singapore for natural gas exports (to Thailand and Singapore) and imports (from Indonesia).*
- *The Sabah-Sarawak Integrated Oil and Gas Project has spurred new infrastructure including:*
  - *The SOGT is a storage and processing terminal for natural gas and condensates from offshore fields in Sabah*
  - *The SSGP is a 318-mile onshore pipeline that has the capacity to transport about 270 Bcf per year of natural from SOGT to the Bintulu LNG complex in Sarawak for liquefaction and export.*

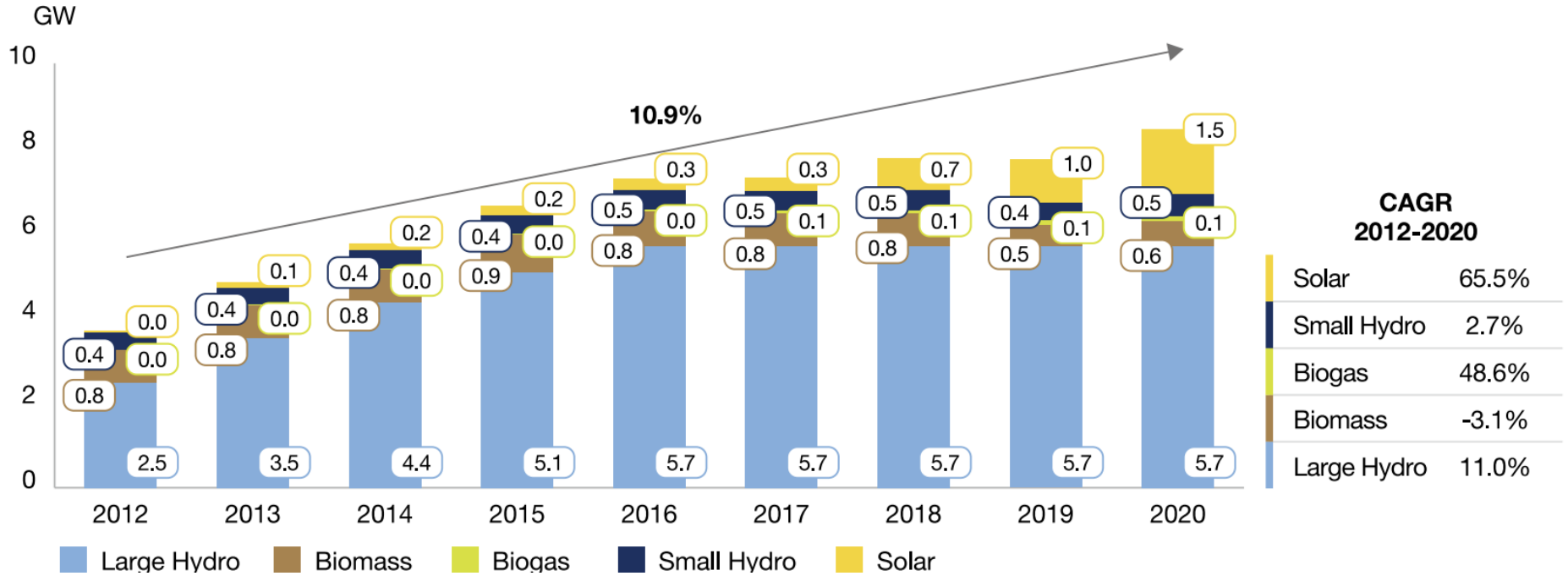


Source： Energy Information Administration (EIA)

4 次世代・再生可能エネルギー

マレーシアの再生可能エネルギーはバイオマス・太陽光・バイオガス・小水力（＋水力)から構成される

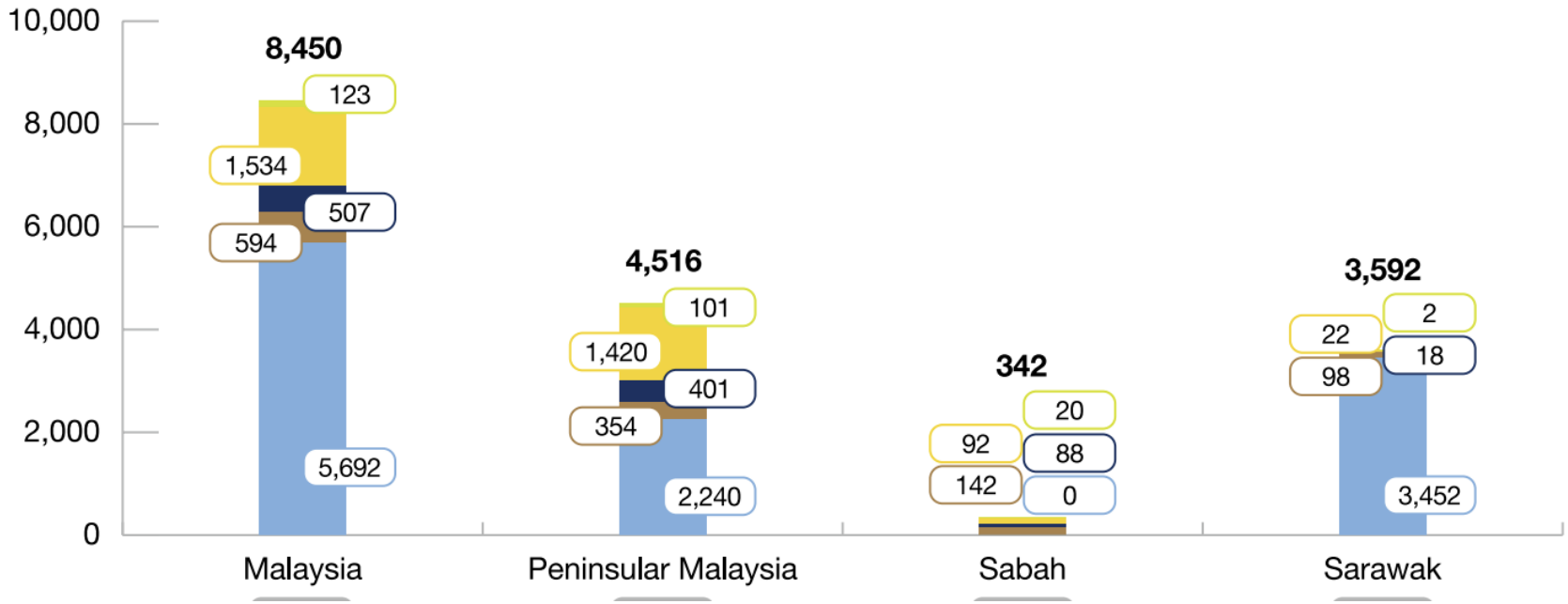
Cumulative RE Capacity for Malaysia 2012-2020



Source： MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

現状ソーラーは本島、水力は本島とサラワクに偏在

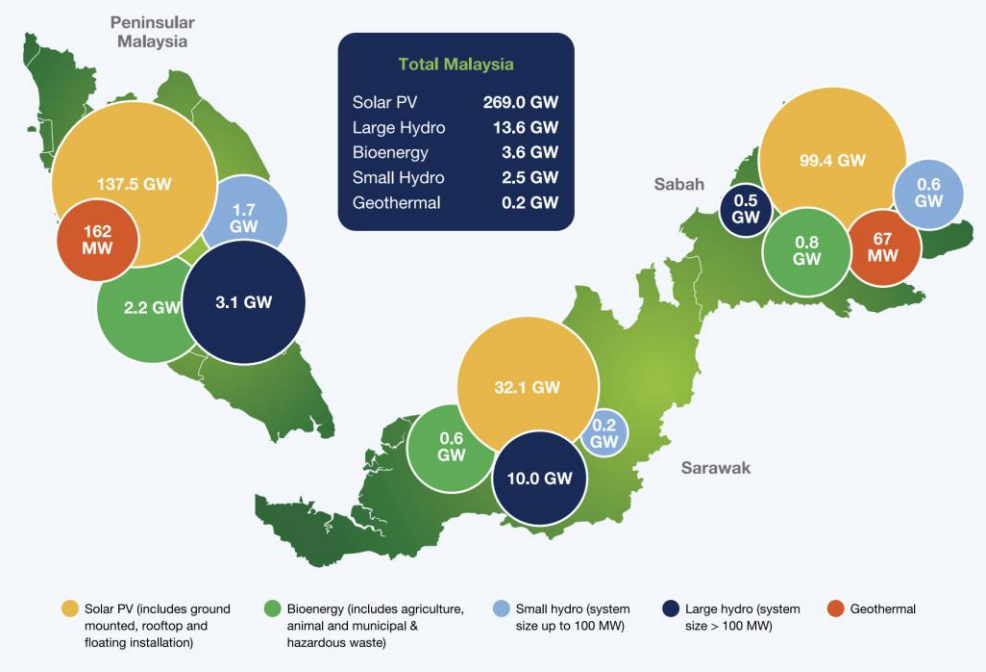
Renewable energy installed capacity



Source： MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

特に太陽光にポテンシャルがあると考えられている

Summary of RE resource potential in Malaysia

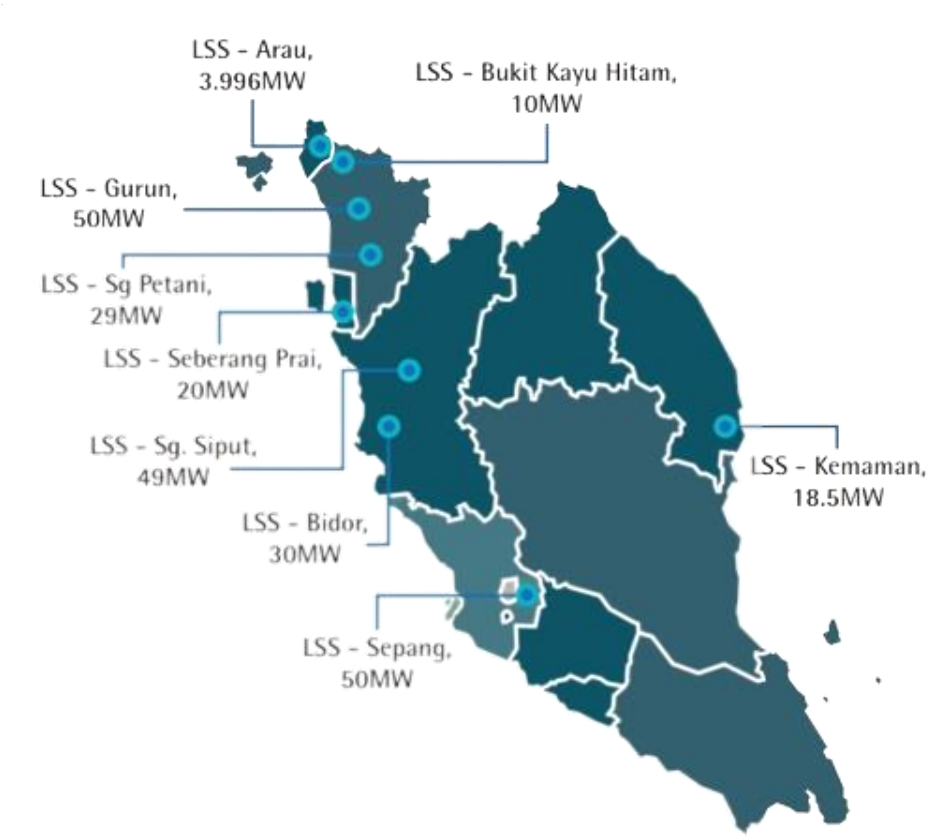


MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

2018年時点、稼働中の大規模太陽光発電は以下

Current Operating Solar Power Plant

Name	Capacity (MW)	Location
IL Solar Sdn Bhd	10	Bukit Kayu Hitam
SBU Power Sdn Bhd	3.996	Arau
Eastern Pacific GD Solar Sdn Bhd	18.5	Teluk Kalong
Gading Kencana Development Sdn Bhd	30	Bidor
Leader Solar Energy Sdn Bhd	29	Kuala Muda
Sinar Kamiri Sdn Bhd	49	Sg. Siput
TNB Sepang Solar Sdn Bhd	50	Sepang
PLB Green Solar Sdn Bhd	20	Ladang Byram
Quantum Solar Park (Kedah) Sdn Bhd	50	Pendang



Source：Peninsular Malaysia Electricity Supply Industry Outlook 2019

また、LSSプロジェクトは2020年までにマレー半島において1000MW規模の発電量になる見込み

Large Scale Solar (LSS) PV Plant Location

- Among RE generation sources, solar photovoltaic commands the highest share against other sources.
- For year 2017 – 2018, a total solar capacity of 434 MW in Peninsula and 16.9 MW in Sabah will be expected to be commissioned with levelised tariff ranging from 39.95 – 44.95 sen/kWh in Peninsula and 45 – 51 sen/kWh in Sabah.

Source： Peninsular Malaysia Electricity Outlook 2017

LSSプロジェクトの入札企業は以下の通り 1/3

(a) LSS1 の結果：パッケージ 3（30MWac - 50MWac）/ Results of LSS1: Package 3 (30MWac - 50MWac)

No.	Company /Consortium	Export capacity (MW_{ac})	Location	Project cost (RM mil.)	Finance source /value (RM mil.)	EPC Contractor	Project site (acres)	Solar panel info.
1.	TNB Sepang Solar Sdn Bhd	50.0	Tg. 12, Sepang, Selangor	N/A	N/A	TNB Engineering Corporation Sdn Bhd.	98	238,000
2.	UiTM Solar Power Sdn Bhd *(UITM Property Management Sdn Bhd, BJ Power Co Ltd and Perwira Al-Syura Consulting Engineers Sdn Bhd.)*	50.0 *RM0.4018 / kWh*	Gambang, Pahang	278	Affin Hwang Investment Bank Berhad / 222 (SRI Green Sukuk)	ET Energy (China) Northwest Electric Power Design Institute (NWEPDI) / China Power Engineering Consulting Group	117	220,000
3.	Mudajaya Corporation Bhd (Sinar Kamiri Sdn Bhd)	49.0	Sungai Siput, Kuala Kangsar, Perak	270	SRI Green Sukuk	Sumec Complete Equipment & Engineering Co Ltd	N/A	N/A
4.	Consortium Malakoff Corporation Bhd /DHES	50.0	Tanjung Malim, Perak	[revoked by EC]				
5.	Gading Kencana Sdn Bhd	30.0	Bidor, Perak	214	Affin Islamic /130.34	Duta Technics Sdn Bhd	98	110,500 Q-CELL
6.	Consortium Synergy Generated Sdn Bhd, SCOMI /LTAT	30.0	Bandar Sungai Petani, Daerah Kuala Muda, Kedah	N/A	N/A	N/A	N/A	N/A
7.	Solar Management (Chembong) Sdn Bhd	50.0	Mukim Pedas, Rembau, Negeri Sembilan	285	MBSB / 247	Mattan Engineering Sdn Bhd + CMEC	~200 acres	N/A

Source：JETRO マレーシアの再生可能エネルギー市場調査:2021年6月

LSSプロジェクトの入札企業は以下の通り 2/3

(b) 選抜 LSS1 プロジェクトの結果：パッケージ 2（6MWac - 29Mwac）/ Results of Selected LSS1 Projects: Package 2 (6MWac - 29MWac)

No.	Company /Consortium	Export capacity (MW_{ac})	Location	Project cost (RM mil.)	Finance source /value (RM mil.)	EPC Contractor	Project site area (acres)
1.	Malakoff Bhd, Consortium Zelleco Engineering Sdn Bhd.	29.0	Kota Tinggi, Johor.	N/A	N/A	Teknik Janakuasa Sdn Bhd (O&M)	N/A
2.	HNG Capital Sdn Bhd / Leader Solar Energy Sdn Bhd	29.0	Kuala Muda, Kedah.	180	HSBC Bank and Alliance Bank	N/A	121

(c) LSS2 の結果：パッケージ 3（10MWac - 30MWac）/ Results of LSS2: Package 3 (10MWac - 30MWac)

No.	Company /Consortium	Export capacity (MW_{ac})	Location	Project cost (RM mil.)	Finance source /value (RM mil.)	EPC Contractor	Project site area (acres)	Solar panel info
1.	BGMC Corporation Sdn Bhd and Bras Venture Bhd	30.0	Kuala Muda, Kedah	190 (incl. land)	N/A	Atlantic Blue Sdn Bhd, BGMC BRAS Power Sdn. Bhd. (SPV)	100	N/A
2.	Redsol Sdn Bhd, SPV of Fumase (Malaysia) Sdn Bhd and Scatec Solar Malaysia B.V.	30.0	Kerian, Perak	USD 47mil.	USD 47mil. / BNP Paribas (73%)	Scatec Solar	N/A	47 MWp(dc)
3.	Gaya Dunia Sdn Bhd, Enertra Sdn Bhd and Ambang Fiesta Sdn Bhd	30.0	Sik, Kedah	N/A	N/A	Viva Solar Sdn. Bhd. (SPV)	N/A	N/A
4.	Halpro Engineering Sdn Bhd, SPV of Majulia Sdn Bhd and Greencells Gmbh	30.0	Pekan, Pahang	N/A	N/A	N/A	N/A	N/A
5.	Hasilwan (M) Sdn Bhd and Idiqa Holding Sdn Bhd	30.0	Machang, Kelantan	N/A	N/A	TopRank Solar Sdn Bhd & Idiwan Solar Sdn. Bhd. (SPV)	N/A	N/A
6.	Kenyir Solar Park Sdn Bhd and Gunkul Engineering Public Co Ltd	29.9	Dungun, Terengganu	N/A	N/A	Kenyir Gunkul Solar Sdn. Bhd. MSR Projects	N/A	N/A
7.	Konsortium Bestari Jaya Sdn Bhd and Hanwha Energy Corporation Singapore Pte Ltd	30.0	Chuping, Perlis	RM250mil.	Hanwha invest USD 10mil. OCBC loan: USD 50mil.	KBJ Hecmy	N/A	N/A

Source：JETRO マレーシアの再生可能エネルギー市場調査:2021年6月

LSSプロジェクトの入札企業は以下の通り 3/3

(c) LSS2 の結果：パッケージ 3（10MWac - 30MWac）/ Results of LSS2: Package 3 (10MWac - 30MWac)

No.	Company /Consortium	Export capacity (MW_{ac})	Location	Project cost (RM mil.)	Finance source /value (RM mil.)	EPC Contractor	Project site area (acres)	Solar panel info
8.	Leader Energy Sdn Bhd	20.0	Kuala Muda, Kedah	RM180mil.	HSBC, Alliance	N/A	49 hectare	N/A
9.	Nippon Bumijaya Sdn Bhd and B&Z Mechanical and Electrical Sdn Bhd	30.0	Empangan Kelinchi, N. Sembilan	N/A	N/A	Cove Suria Sdn. Bhd. (SPV)	N/A	N/A
10.	Revenue Vantage Sdn Bhd and Cypark Renewable Energy Sdn Bhd	30.0	Empangan Terip, N. Sembilan	N/A	N/A	Cypark Estuary Solar Sdn. Bhd. (SPV)	N/A	N/A
11.	RE Gebeng Sdn Bhd	29.916	Kuantan, Pahang	N/A	N/A	N/A	N/A	N/A
12.	Tenaga Nasional Berhad	30.0	Kuala Muda, Kedah	N/A	MUFG: RM144mil.	TNB Bukit Selambau Solar Sdn Bhd (SPV)	N/A	N/A
13.	UiTM Property Management Sdn Bhd	25.0	Pasir Gudang, Johor	N/A	N/A	JV with Petronas	N/A	N/A

(d) その他の LSS プロジェクト/Other LSS Projects

No.	Company /Consortium	Export capacity (MW_{ac})	Location	Project cost (RM mil.)	Finance source /value (RM mil.)	EPC Contractor	Project site area (acres)	Solar panel info.
1.	Quantum Solar Park Sdn Bhd / Itramas Corporation /	150	Jasin (Melaka), Gurun (Kedah) and Merchang (Terengganu)	1,250	SRI Green Sukuk / 1,000	Scatec Solar Solutions Malaysia Sdn Bhd	600	Trina Solar

Source：JETRO マレーシアの再生可能エネルギー市場調査:2021年6月

今後もマレー半島で再エネのPJが勃興することが見込まれる（太陽光が中心）

Future Development RE Power Plant in Peninsular

Operating Year	Name	RE Capacity
2019	Pengerang (200MW), Jimah East (2x1000MW)	790
2020	SPG (2 x 720MW)	621
2021	Edra Energy (2,242MW)	560
2022	RE	782
2023	RE	782
2024	RE	782
2025	RE	782

Source：Peninsular Malaysia Electricity Supply Industry Outlook 2019

サバの電力発電計画への投資計画は以下の通り（RE以外も含む）

Sabah10 Year Generation Plan (2018-2027)

YEAR	WEST COAST	EAST COAST	RETIREMENT
2018	Tadau LSS (48MW)	-	-
2019	-	GT Melawa (18MW), Tawau Rehab (13MW)	-
2020	One River HEP (30MW)	-	-
2021	Enhanced Kolopis-Segaliud Line (400MW)	-	Tawau (47MW), TSH (10MW)
2022	Sarawak Interconnection (50MW)	-	-
2023	-	-	-
2024	-	New Capacity of 100MW	Diesel Genset (135MW)
2025	-	New Capacity of 100MW	-
2026	-	-	Patau-Patau (103MW)
2027	Upper Padas HEP (192MW)	-	-

Source: Sabah Electricity Supply Industry Outlook 2019

水力発電の所在（マレー半島・サバ)

List of operating Hydroelectric

Peninsular

No.	発電所	事業者	設備容量[MW]
1	Temengor	TNB	348.0
2	Bersia	TNB	72.0
3	Kenering	TNB	120.0
4	Chenderoh	TNB	40.0
5	Sg Piah	TNB	68.6
6	Pergau	TNB	600.0
7	Kenyir	TNB	400.0
8	Sultan Yussuf	TNB	100.0
9	Sultan Idris	TNB	150.0
10	Hulu Terengganu	TNB	250.0
11	Tembat	TNB	15.0
12	Ulu Jelai	TNB	372.0
13	Hidro mini	TNB	21.6
14	Musteg Hydro	Musteg Hydro Sdn. Bhd	20.0
15	Hidro mini	FIT※	43.8

Sabah

No.	発電所	事業者	設備容量[MW]
1	Tenom Pangi	SESB	75.0
2	Hidro mini Merotai	SESB	1.0
3	Hidro mini Bombalai	SESB	1.0
4	Hidro mini Melangkap	SESB	0.0
5	Hidro mini Sayap	SESB	1.0
6	Hidro mini Kiau	SESB	0.0
7	Hidro mini Carabau	SESB	2.0
8	Hidro mini Naradau	SESB	1.8
9	Hidro mini	FIT※	6.5

Source:日本エネ・ユー・エス「令和2年度脱炭素社会実現のための都市間連携事業委託業務」

水力発電の所在と今後の小水力発電の入札者は以下の通り

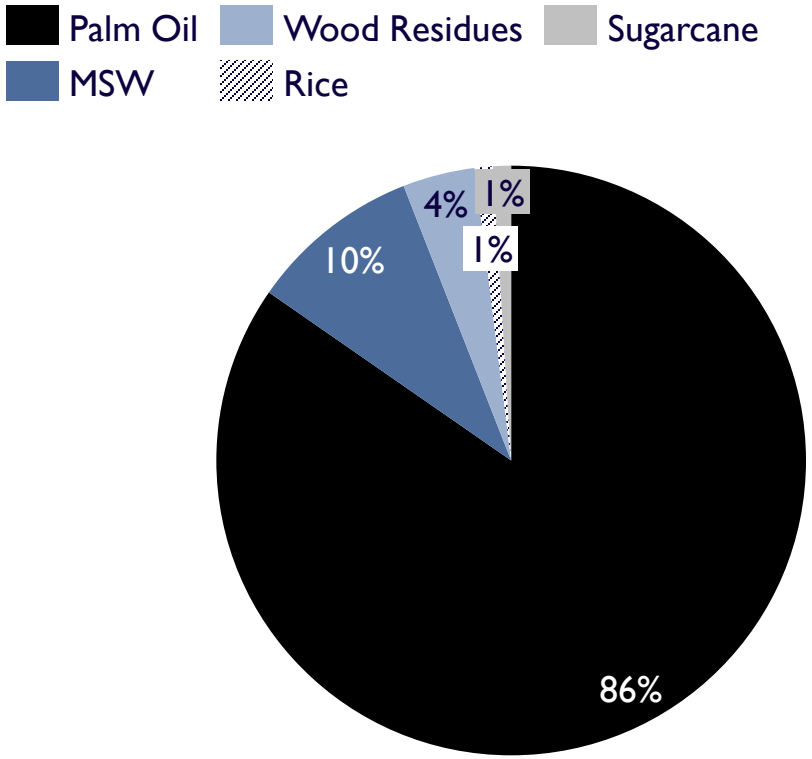
List of successful bidders for small hydropower projects(2019)

No	入札者	設備容量 (MW)	入札価格 (RM/kWh)
1	Kangsar Hidro Sdn Bhd	27.30	0.2300
2	Kangsar Hidro Sdn Bhd	11.53	0.2300
3	Sdf Hydro Sdn.Bhd	9.60	0.2380
4	Kangsar Hidro Sdn Bhd	7.24	0.2400
5	Kangsar Hidro Sdn Bhd	3.00	0.2400
6	Kangsar Hidro Sdn Bhd	3.30	0.2400
7	Kangsar Hidro Sdn Bhd	7.40	0.2400
8	Worldwide Hydro Energy Sdn. Bhd.	2.20	0.2450
9	Banjaran Kinta Hydro Sdn Bhd	2.62	0.2550
10	Topaz Diamond Sdn. Bhd.	3.00	0.2590
11	Cabaran Hijau Sdn. Bhd.	18.70	0.2599
12	Denai Delima Sdn. Bhd.	12.00	0.2599
13	Selat Serasi Sdn. Bhd.	13.90	0.2599
14	Batu Bor Hidro Sdn. Bhd.	30.00	0.2900
15	Lubuk Paku Hidro Sdn. Bhd.	25.00	0.2900

Source: JETRO マレーシアの再生可能エネルギー市場調査:2021年6月

マレーシアは豊富なパーム油資源を背景に第1世代バイオ燃料に注力

Ratio of Resource of Biofuel (2009)



Situation Background

- *Biofuel mandate has been initiated in National Biofuel Policy in 2006 to reduce dependency on fossil fuel and promote environmentally friendly energyStandard blending rate for biodiesel has been set in 2008, with recent goal to yield B20 blend rate by 2021 (delayed from Q1 2020) for transportation usage and B7 (reached in 2019) for manufacturing and industrial sector usageNational Automotive Policy (2020) also restates target blend rate mandate as target national fuel standard, and up to B30 biodiesel in 2025 and beyondPrice subsidy has been utilized to ensure biodiesel commercial viability*

Source： USDA Gain Report - Malaysia Biofuel Annual 2021, Paultan

バイオディーゼルのプラントと、バイオガスプロジェクトの入札者は以下の通り

List of Currently Operating Biodiesel Plant in Malaysia

#	Name	Type of Project
1	Bremfield Sdn. Bhd. Pulau Indah	Selangor
2	Carotino Sdn Bhd Pasir Gudang	Johor
3	FGV Biotechnologies Sdn Bhd	Kuala Lumpur
4	Fima Biodiesel Sdn Bhd Port Klang	Selangor
5	Future Prelude Sdn Bhd Port Klang	Selangor
6	Genting Biodiesel Sdn Bhd	Kuala Lumpur
7	Green Edible Oil Sdn Bhd Sandakan	Sabah
8	Gulf Lubes Malaysia Sdn Bhd Pulau Indah	Selangor
9	KLK Bioenergy Sdn Bhd Shah Alam	Selangor
10	Nexsol (Malaysia) Sdn Bhd Pasir Gudang	Johor
11	PGEO BioProducts Sdn Bhd Pasir Gudang	Johor
12	Sime Darby Oils Biodiesel Sdn Bhd Carey Island	Selangor
13	SOP Green Energy Sdn Bhd Miri	Sarawak
14	SPC Biodiesel Sdn Bhd	Kuala Lumpur
15	Vance Bioenergy Sdn Bhd Pasir Gudang	Johor
16	PGEO BioProducts Sdn Bhd – Pasir Gudang	Johor
17	Excelvite Sdn Bhd	Ipoh Perak
18	Supervitamins Sdn Bhd	Masai Johor
19	Petron Malaysia Refining and Marketing – Sitiawan	Perak

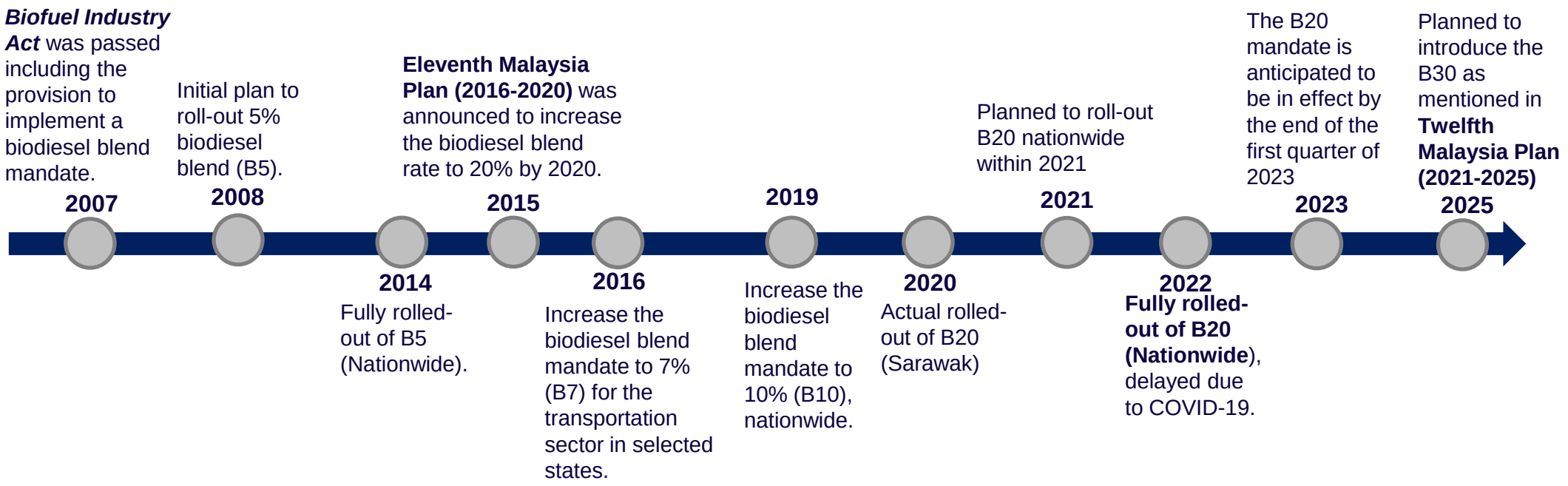
List of successful bidders for BioGas projects(2019)

No	入札者	設備容量 (MW)	入札価格 (基本買取価格 – RM/kWh)
1	Teraju Sepadu Sdn. Bhd.	2.134	0.2345
2	Cenergi Fjp Sdn. Bhd.	1.500	0.2475
3	Cenergi Elphil Sdn. Bhd.	1.200	0.2475
4	Sc Green Solutions Sdn. Bhd.	1.200	0.2478
5	Cenergi Endah Sdn. Bhd.	1.200	0.2500
6	Strategic Euro Resources Sdn. Bhd.	1.200	0.2505
7	Strategic Euro Resources Sdn. Bhd.	6.000	0.2505
8	Bell Cenergi Bp Sdn. Bhd.	1.560	0.2549
9	Fermanagan Biobridge Hall Sdn Bhd	1.600	0.2550
10	Concord Green Biogas Sdn Bhd	2.400	0.2588
11	Southern Biogas Sdn Bhd	2.400	0.2588
12	Reviva Sdn Bhd	1.100	0.2589
13	Glt Lembing Power Sdn Bhd	1.501	0.2596
14	Green Palm Gas Sdn Bhd	2.400	0.2600
15	Glt Lestari Sdn. Bhd.	0.800	0.2613

Source： USDA Gain Report - Malaysia Biofuel Annual 2021/ JETRO マレーシアの再生可能エネルギー市場調査2021年6月

2025年にB30を目指す

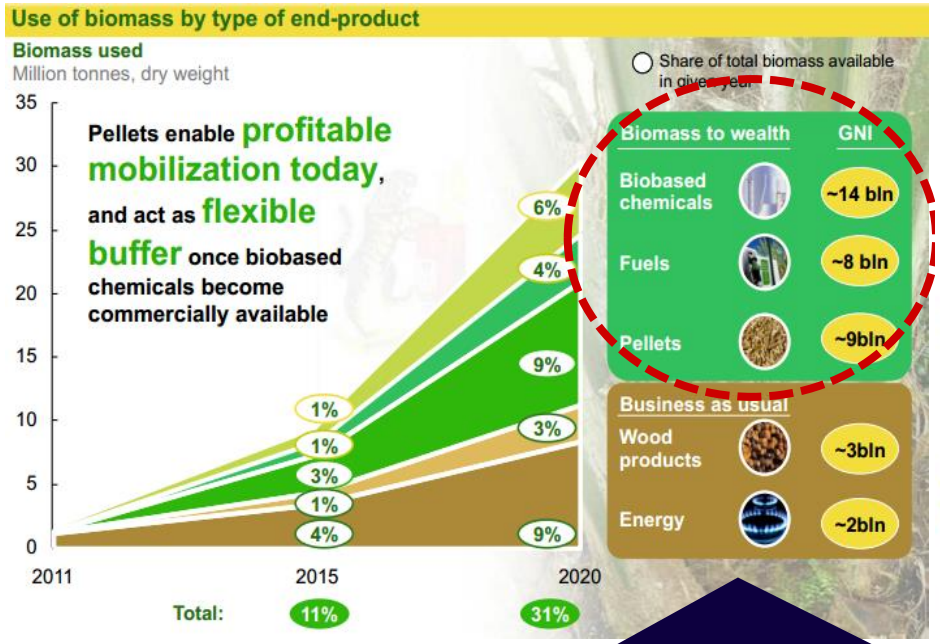
Malaysia Biofuel Policy Development

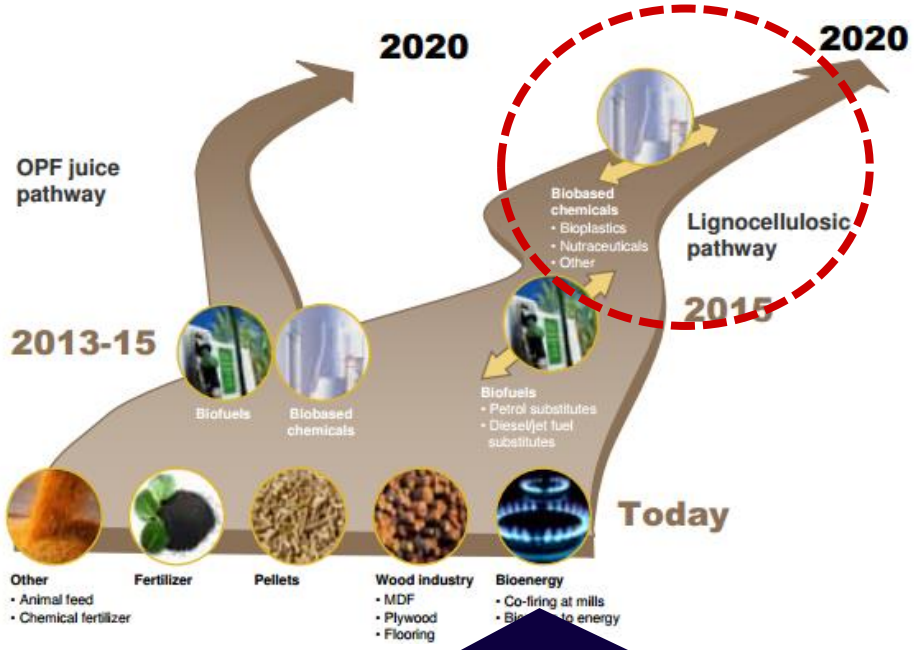


Source： USDA Gain Report - Malaysia Biofuel Annual 2021, Paultan

政府はバイオマス燃料に関する明確なロードマップを作成しており、その中でパーム油などを高付加価値に変えていくことが示唆されている(2023年3QUPDATE予定）

Roadmap of Biofuel





- Conversion of Biomass to Pellets for export purposes is an attractive opportunity
- A medium sized pellet plant of 100,000 tonnes capacity p.a. requires an investment of RM 30–40 million and has a payback period of 3–5 years
- Because of the low capital costs, the biomass need not stay locked into this use and can be channeled to higher value uses once the technology and infrastructure is in place.

An implication of this master plan would be the development of the biogas industry using POME, which will be a potential winner as solid biomass is diverted to higher value uses other than energy generation.

Source： Snippets from National biomass strategy 2020 (Malaysia Innovation Agency

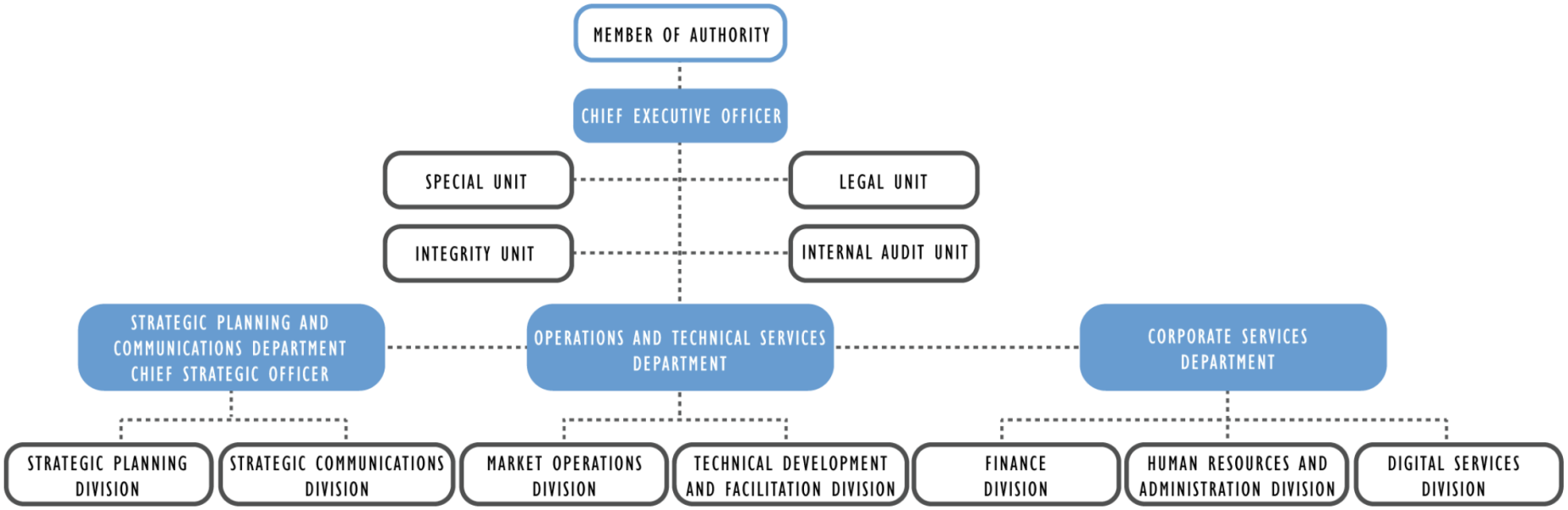
政府はバイオマスエネルギーを推進していく行動計画を策定しており、その中心はパーム油

Malaysia Biofuel Situation

Types of biomass		Market size (TJ 2020)	Background	
			Growth drivers	Bottlenecks
Human	Raw garbage	83,606	• Large amount of waste, especially organic waste produced daily. High organic matter make garbage suitable for biogas production	• Complex and sensitive processing technology • Low tipping fee encourages landfill operations • Strong governmental control
Livestock	Livestock manure	40,539	• (Since it is not viewed as a key industry in Malaysia, there are few expectations for growth and there are no major drivers)	• Scale of plants are small due to lack of resources in an area.
Palm oil	Palm oil frond, trunk etc.	347,653	• Massive palm oil industry producing millions of tons of output per year (18.9 Million in 2011) which yields equally large volume of by products • Within government policy, expectations are also pointed toward the use of palm-based biomass • Since it is a large-scale industry, steady biomass production is can be expected • Also for POME, usage rates are low (currently used in combo with EFB as fertilizer in the majority of cases) but its usages is expected to grow in the future	• Commonly used as fertilizer (last year, declining land fertility became an issue, and some say they do not want to used it for power)
	Palm oil mill effluent	53,028		• Waste consumed internally by giant palm mills • Economically gathering resources from the fields
	Palm oil Fibre and kernel shell	302,786		
	Palm oil empty fruit bunch	147,031		• Require larger than usual capex • In most cases, export to China in mat form, or to Japan & S. Korea as an ingredient for mixed fuel coal-fired power
Coconut	Coconut Husk	4,131	• No current project that utilizes coconut waste for power production • Ashes of burnt waste can be further used as fertilizer or filler in construction	• Complex know how and technology required • Gathering and transportation hurdles • Resource base is shrinking gradually • Coconut shells used to make charcoal briquette
	Coconut Shell	2,052		
Woody waste	Rubber plant wood	44,257	• Mainly derived from palm oil trees and rubber plants after the end of crop cycle • Wood waste are converted to pellets and caters to the export market	• Gathering and transportation of waste products from field to plant • State policies to conserve forest and reduce logging drastically
	Forest waste, Sawmill residue	270,717		

Source : List of Biofuels not exhaustive
Source: Sustainable Energy Development Authority Malaysia, CleanBiz.Asia, UN FAO, News articles, Interviews, ADL analysis

Organizational Chart of SEDA

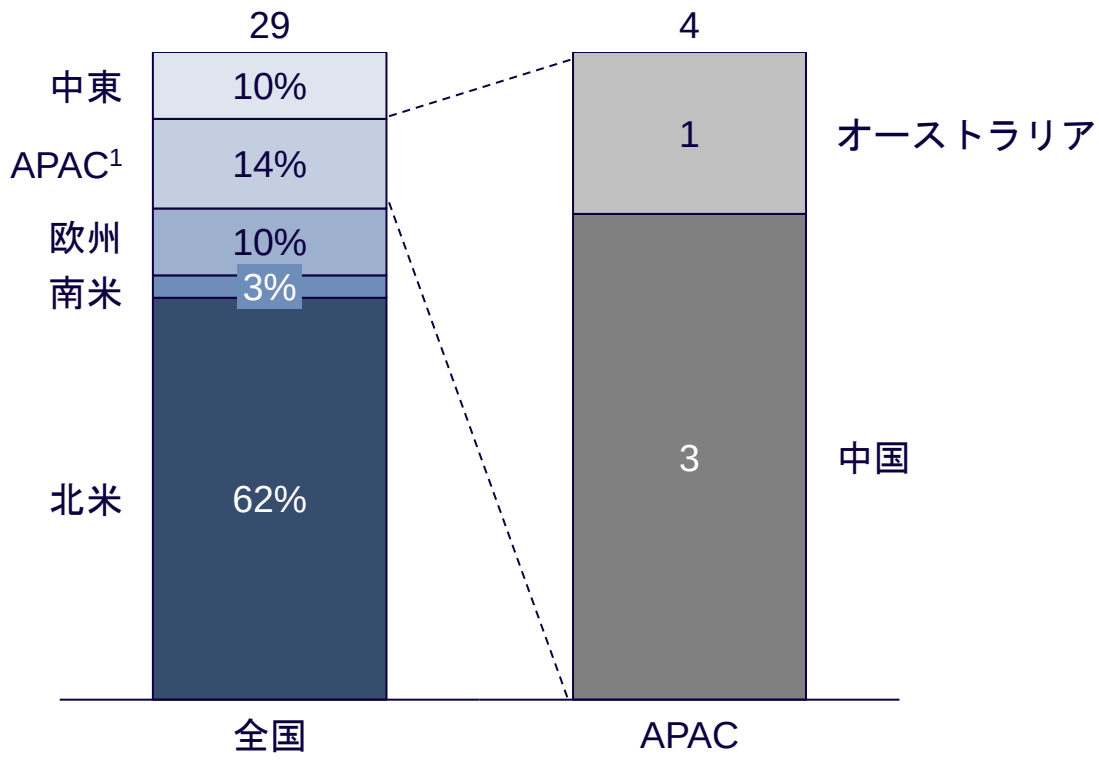


Source : https://www.seda.gov.my/about-seda/organizational-structure/

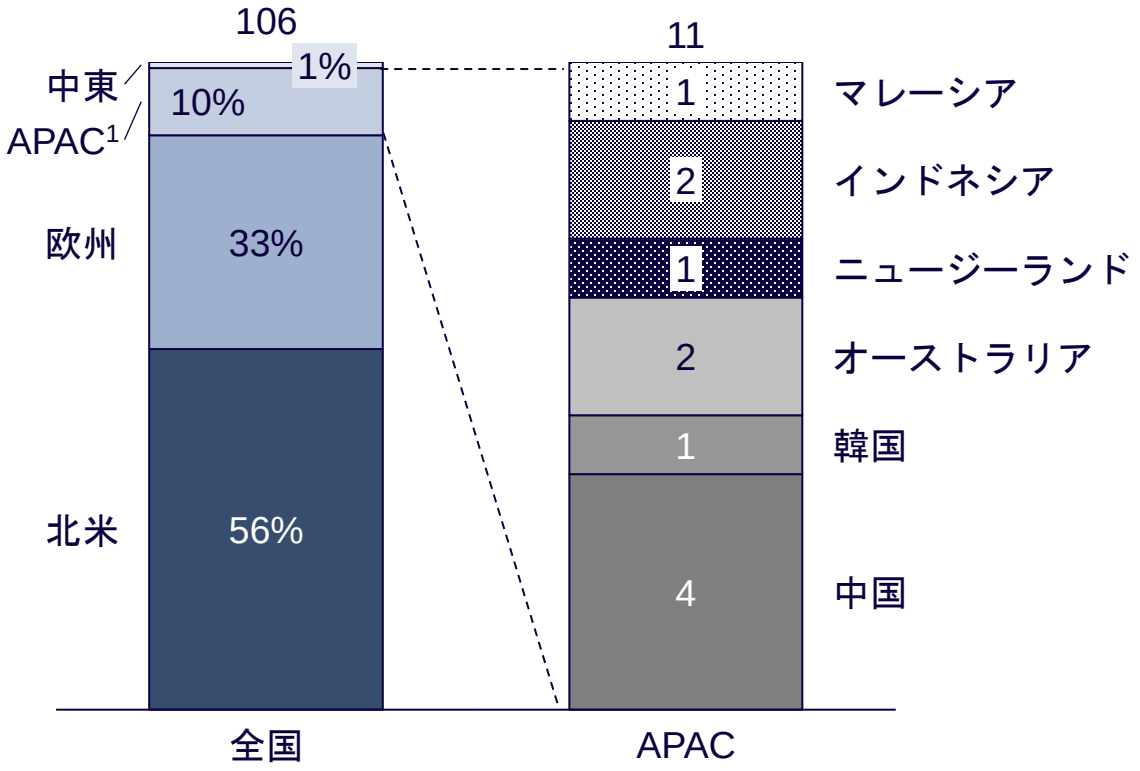
アジア太平洋地域ではこれまで中国を中心にCCSプロジェクトが稼働してきたが、今後は東南アジアやオーストラリアでも複数プロジェクトが稼働開始

主要PJの地域別内訳

稼働開始済



今後稼働予定 (2030年迄)



Source：12th Malaysia Plan, National Energy Policy 2022-2040

国営企業であるペトロナスが主体となりCCSが推進されている状況

CCUSの政府動向

CCUS事業の推進に対する動向	• 国営企業であるペトロナスが主体となりCCSを推進 • 規制・補助金は整備されておらず、2023年~2025年に整備が見込まれると想定
各種政策（産業/エネルギー/環境）	• CCSと関連性のないハイテク産業や高付加価値分野を中心とした8つの戦略テーマを中心に産業発展を図る • 再エネ導入を加速させつつも、エネルギーセキュリティや電気コストの観点から天然ガスを中心に火力依存を継続
規制	• 現状無し • (CCS施設（Kasawari PJ）の2025年立ち上げに向けて、2024年~2025年にEUと類似したCCS関連法律の整備が見込まれる)
支援策 補助金	• 現状無し • (クレジット、税額控除に関しては2023年~2024年以降に制度設計が進むか)

Source：各種2次情報よりADL作成

Petronasが政府に対してCCS事業成立に向けた規制・補助金制度を構築するように働きかけている模様

CCS関連プレイヤー

政策意思決定者

政府

President Staff Office

Petronasの意見を踏まえCCSの制度を設計中

- Ministry of Energy and Natural Resources (KeTSA)
- Ministry of Environment and Water (KASA)
- Ministry ofTransport

※CCSの規制は中央政府が規定するものであり、州政府による規制は策定されない方針

民間企業

内資系：PETRONAS

外資系：ExxonMobil

CCSプロジェクトにおけるパワーバランス

概要

Petronasが力を持っており、CCS事業成立に向けた規制・補助金制度を構築するように働きかけている

パワーバランス

マレーシア政府

主導プレイヤー

PETRONAS

- PetronasがCCS事業成立に向けた規制・補助金制度を構築するように働きかけ
- 未整備状況にあったクレジット制度や税額控除に支援を図るように政府に意見を提出

背景

- Petronasはマレー首相府の管轄の国営石油・ガス会社のため首相に直接意見を提出することが認められており、政策決定に強い影響力を持つ

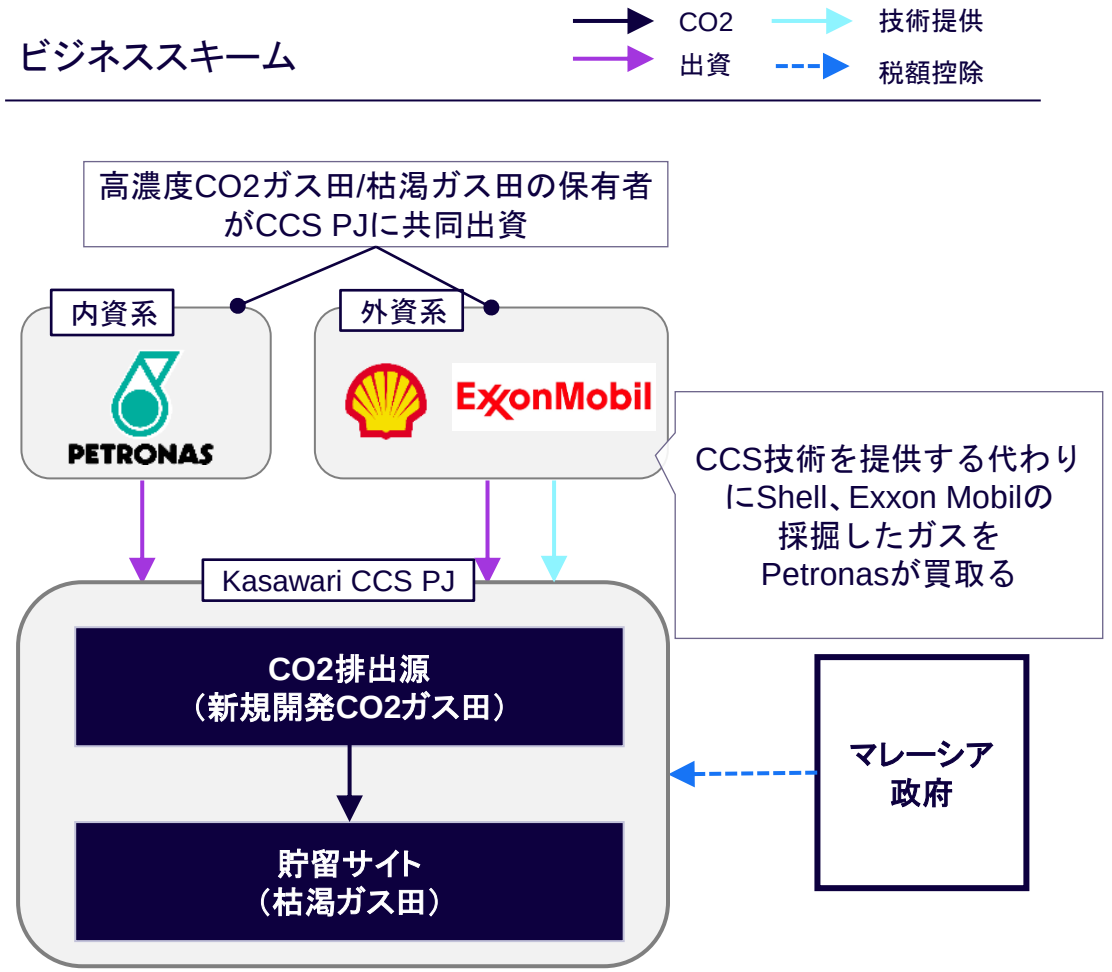
Source： Ministry of Energy HP 等よりADL作成

Kasawari CCSは新規開発のガス田から回収したCO2を枯渇したガス田に貯留。Shell、Exxon MobilがCCS技術を提供する代替として採掘したガスをPetronasが買取る方針

概要

実施主体	• Petronas • Shell • Exxon Mobil
操業開始年	• 2025~2026年
CO2 回収量	• 年間約370万トン
CO2排出源	• 高濃度CO2ガス田 (PETRONAS、Shell、Exxon Mobil社保有)
CO2活用法	• 枯渇ガス田への貯留・EGR
政府による PJへの支援	• 税額控除の適用を検討中 （CCS施設を運営する石油・ガス会社への減税）

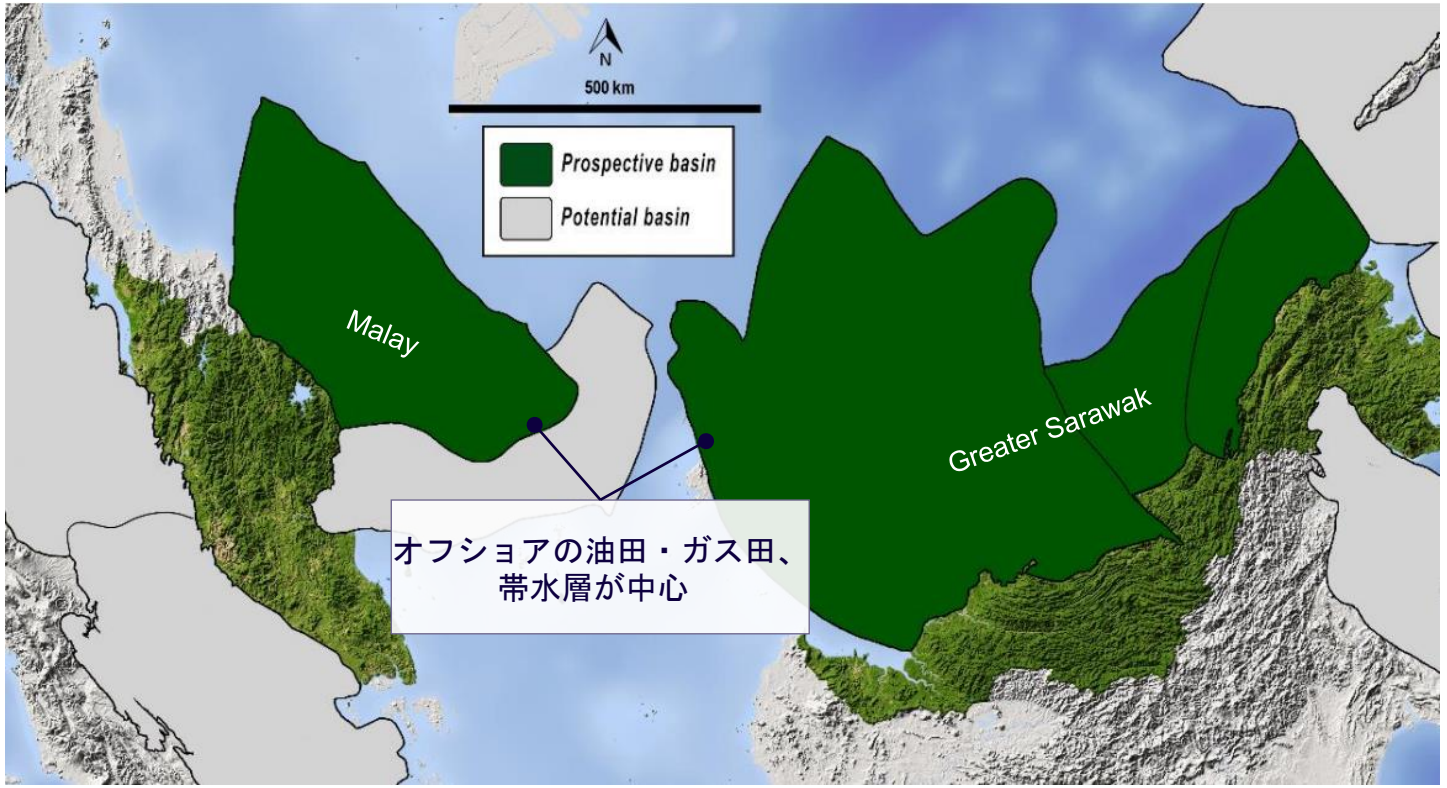
ビジネススキーム



Source： PETRONAS HP、「Petronas awards dual FEED contracts for world's largest offshore CCS project

マレーシアにはオフショアの油田・ガス田、帯水層を中心に約150GtonのCO2貯留ポテンシャルが存在

マレーシアのCCS適地

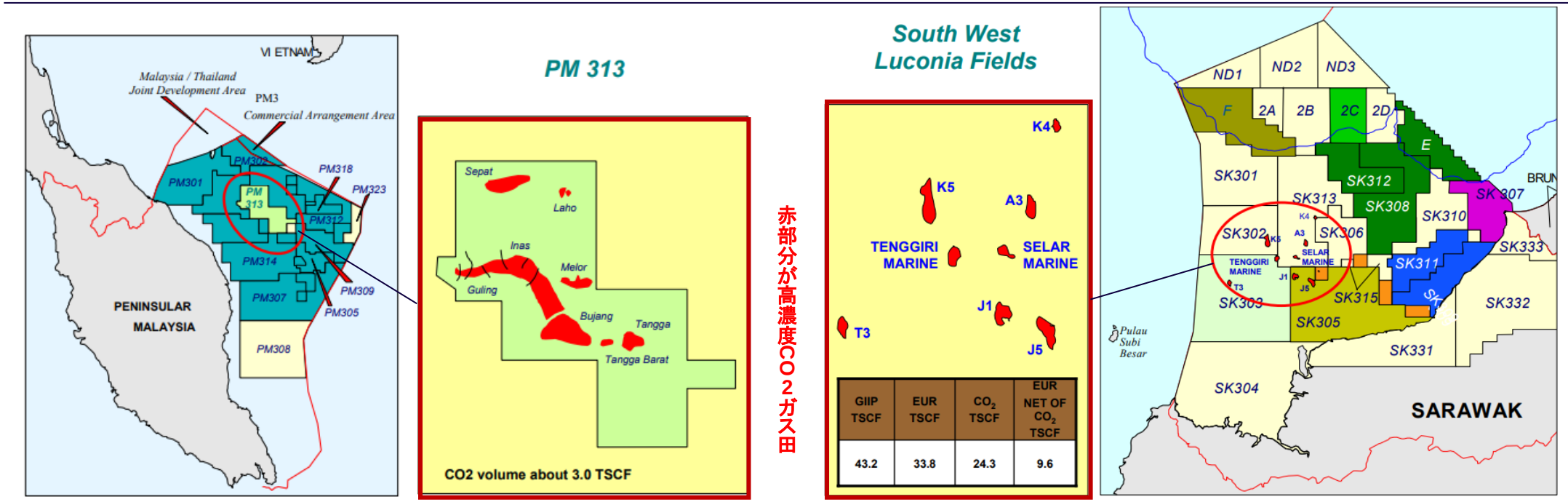


- 150GtonのCO2貯留ポテンシャルが存在
- 貯留可能地域はオフショアの油田・ガス田、帯水層が中心
  【主要なCCS適地の貯留ポテンシャル】
  - ✓ Greater Sarawak：10Gt
  - ✓ Malay ：15Gt

Source： GCCSI “A global assessment of the geological CO2 storage resources potential (2016)

CO2が高濃度のため、発見されても開発に着手できないガス田が存在。高濃度CO2ガス田に対してCO2分離・回収技術を導入したいが技術を内製化できておらず開発できていない状態

マレーシアの高濃度CO2ガス田



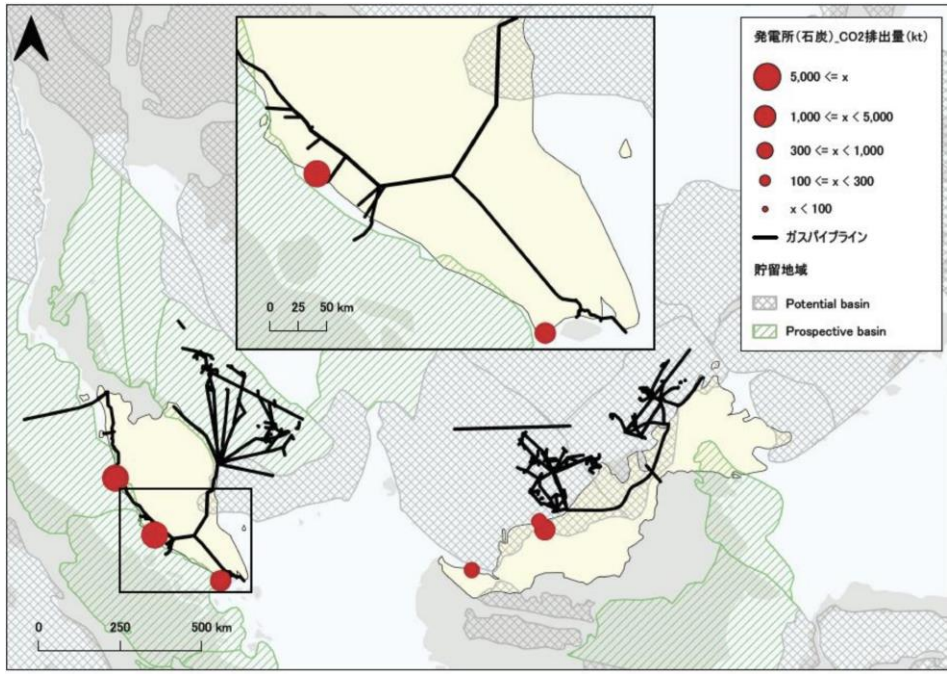
- CO2含有量が60%~70%近く存在するガス田が存在し、PetronasのGHG削減目標を達成するためにはCCS技術なしには稼働することができず、未開発状態にある。
- 採掘したガスからCO2分離・回収技術を導入したいが、技術を内製化できておらず開発できない状態が続いている。

Source： Technical Challenges and Solutions on Natural Gas Development in Malaysia

排出源-石炭火力発電/天然ガス火力発電

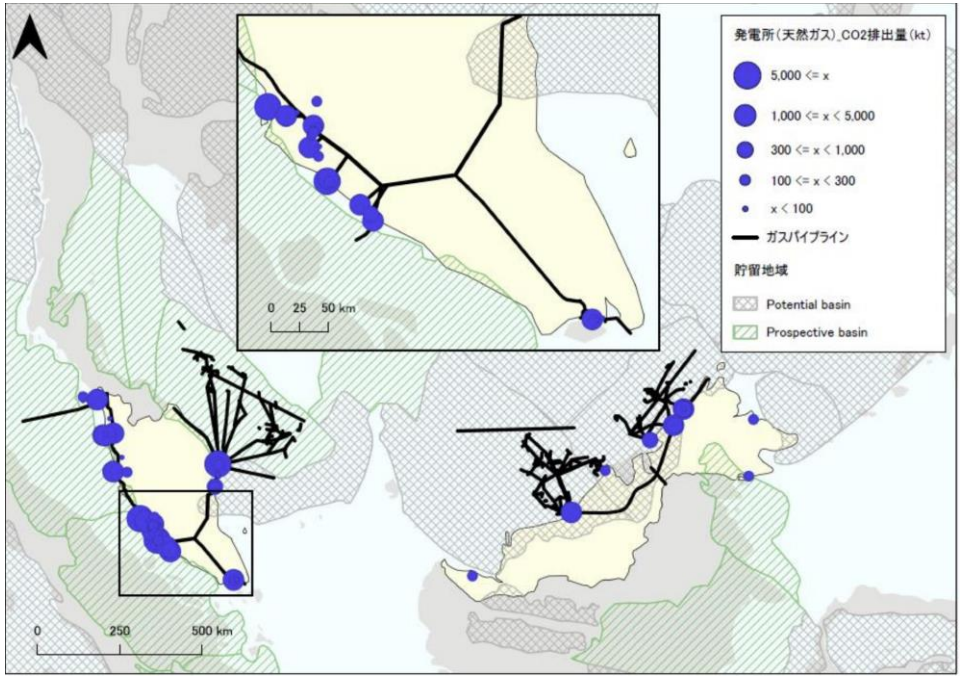
石炭火力発電×貯留地

- 石炭火力発電所は、マレー半島及びボルネオ半島のうちサラワク州に分布し ている。年間 CO2排出量でみると、300kt 程度のものから、5,000kt 以上のものまで、規模は 様々である



天然ガス火力発電×貯留地

- 天然ガス火力発電所はマレー半島にもボルネオ島にも全国的に分布している。年間 CO2 排出量は、100kt 未満から 5,000kt 以上のものまであるが、1,000 ~5,000kt 程度のものが最も多く、57 件中 18 件（約 30%）であった。

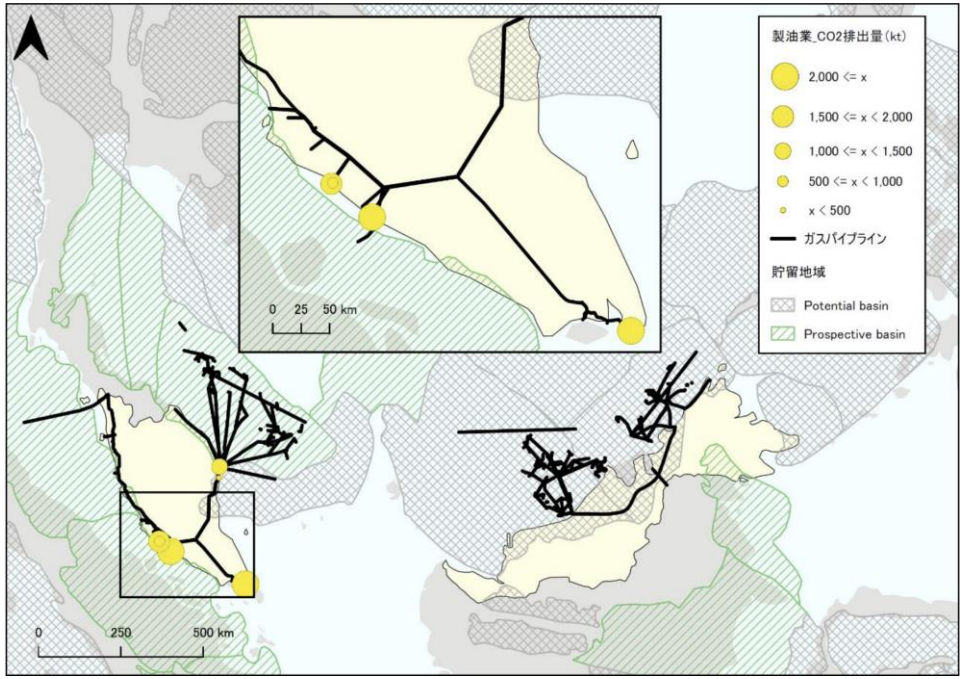


Source：令和２年度二国間クレジット取得等のためのインフ ラ整備調査事業（国際貢献定量化及びＪＣＭ実現可能 性調査（ＣＣＵＳ含む）、人材育成事業支援事務局及 びＣＥＦＩＡ国内事務局業務）報告書

排出源-製油所/製鉄所

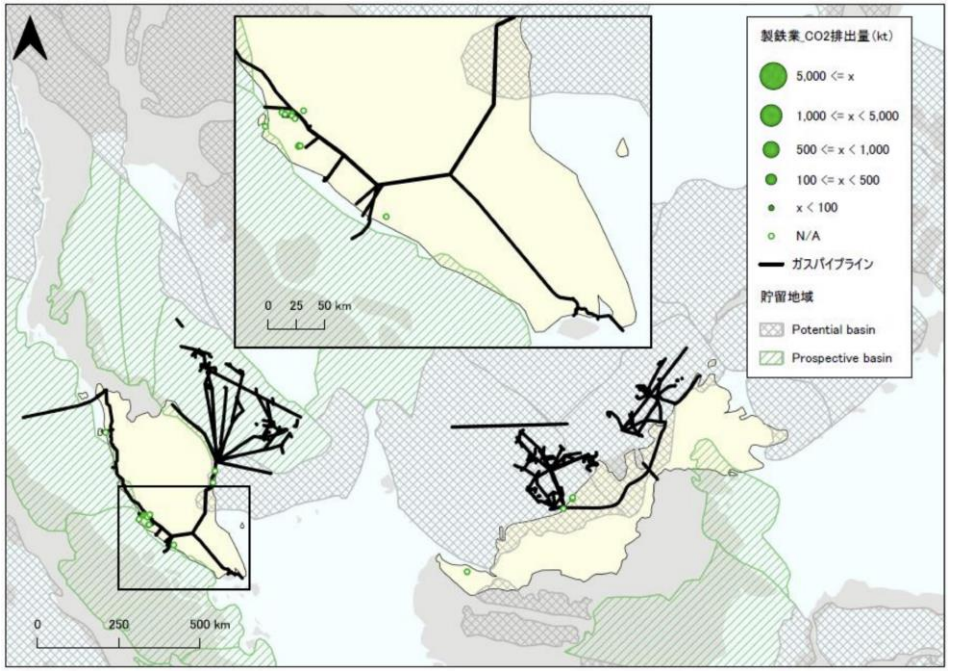
製油所・ガス×貯留地

- 製油所はマレー半島にのみ分布している。製油所の年間 CO2 排出量は 500kt 未満のも のから 2,000kt 以上のものまで、規模は様々



製鉄所×貯留地

- Lion グループがマレーシア国内の生産量の半分以上を占めており、CO2排出量 が多い、高炉では年間約 2,100kt、直接還元では年間 125kt の CO2 を排出

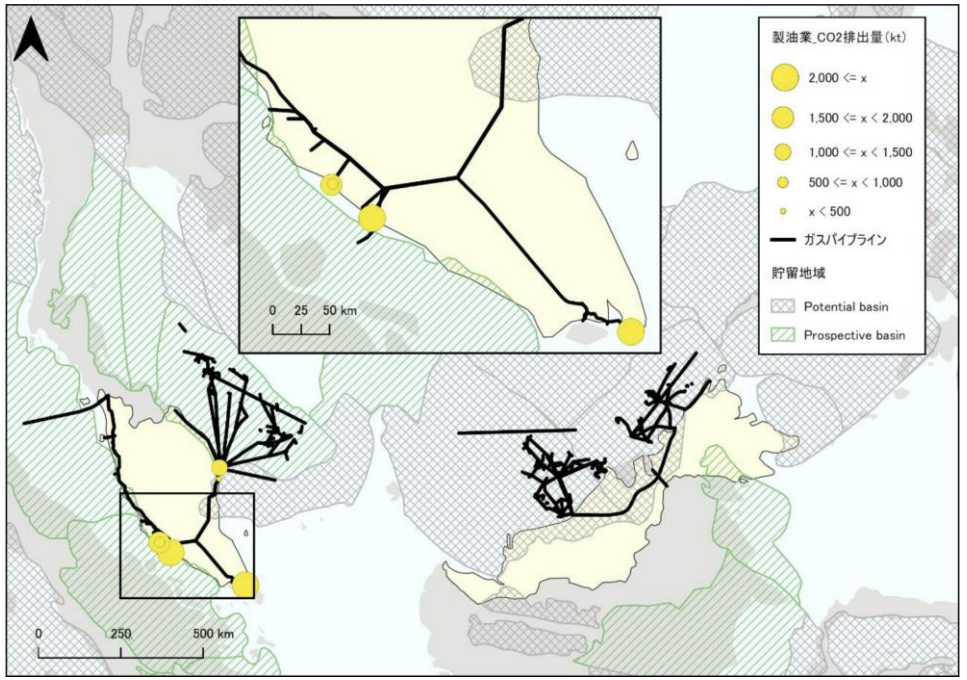


Source：令和２年度二国間クレジット取得等のためのインフ ラ整備調査事業（国際貢献定量化及びＪＣＭ実現可能 性調査（ＣＣＵＳ含む）、人材育成事業支援事務局及 びＣＥＦＩＡ国内事務局業務）報告書

排出源-セメント

セメント×貯留地

- セメント工場についても、個別のプラントごとに規模を公表していない企業が 多いが、YTL グループがセメント市場の半分以上を占めている

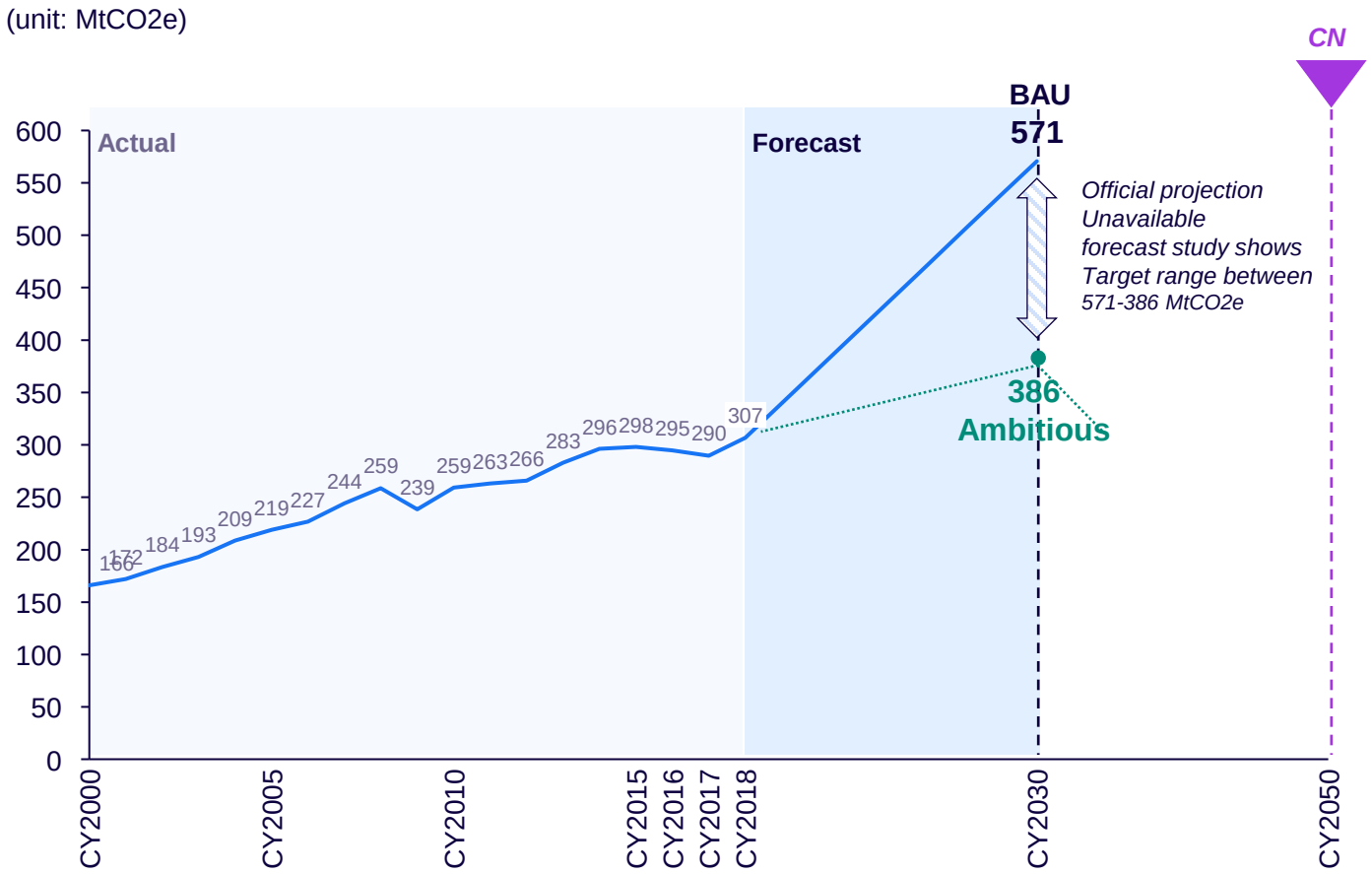


Source：令和２年度二国間クレジット取得等のためのインフ ラ整備調査事業（国際貢献定量化及びＪＣＭ実現可能 性調査（ＣＣＵＳ含む）、人材育成事業支援事務局及 びＣＥＦＩＡ国内事務局業務）報告書

NDCでは2030年に2005年GDP比35%削減を宣言し、第12次マレーシア計画では2050年にカーボンニュートラルを公約に掲げる

GHG Target

- Malaysia has targeted carbon neutrality by 2050 based on draft 12th Malaysia Plan (12MP), with updated National Energy Policy to be released in early 2020
- Based on Malaysia's NDC in Paris Agreement (2015), Thailand expects to reduce 35% of GHG emission from 2005 base
- Malaysia doesn't have official GHG emission projection
- Countermeasure are taken focus on reduce energy consumption in biofuel development for transport sector – as Malaysia is the world's 2nd largest palm oil producer – and renewable energy power generation



Source：12th Malaysia Plan, National Energy Policy 2022-2040

CN達成に向けて、2050年までに罰則と規制が設けられる見込みで、ETSや炭素税などの手段を検討

GHG Target

アメの政策	助成金	■ Subsidy is provided to alternative energy sector to boost adoption and usage	■ Feed in Tariff for RE
	税制優遇措置	■ Tax related incentives such as reduced overall tax or tax holiday boosting overall financial viability	■ Progressive vehicle tax based on carbon emission and EV tax incentives (Lower road tax, green parking, and tolls) as well as tax incentive for EV production under planning
ムチの政策	排出権取引制度 (ETS)	■ Carbon credit trading system to meet carbon credit/emission related criteria	■ Under development – Domestic Emissions Trading System (DETS) will be implemented as part of carbon pricing policy to be in line with Carbon Border Adjustment Mechanism by the European Union in 2023
	罰則	■ Penalty imposed via higher taxes or cess to disincentivize usage	■ Carbon tax or carbon pricing to be implemented following ETS as part of 12MP
	規制	■ Mandates to increase alternative energy source ■ Limiting new coal fire plant construction ■ Forced emission reporting disclosure for monitoring and control	■ 31% renewable energy mix in power generation target by 2025 with limitation of new coal fire power plant ■ National fuel standard (gasoline and biodiesel)

Source：12th Malaysia Plan, National Energy Policy 2022-2040

輸送と発電が、マレーシアのNDC計画に基づく、GHG排出削減の主な取組部門

産業部門	CN目標	政策方針の概要
電力	■ **NA** – Malaysia does not set projection target for GHG emission reduction	■ Promotion of RE usage (large scale hydropower and solar) and attractive FiT mechanism with 31% renewable energy mix in 2025 ■ Increase energy efficiency through National Energy Efficiency Action Plan (NEEAP) e.g. BEI labeling for machinery and factory ■ Green building scheme with promotion of environment-friendly construction material and certification (Infrastar, MyCrest)
輸送	■ **NA** – Malaysia does not set projection target for GHG emission reduction	■ Promotion of rail-based public transport (MRT, KLIA express) in urban area (Klang Valley) ■ Infrastructure development to promote green mobility (walking and cycling, etc.) ■ Promotion of energy efficient vehicle (EEV) both ICE and xEV with national fuel economy standard ■ Promotion of biofuels (biodiesel) usage with target B20 as national standard and preparation toward B30 adoption toward 2025 ■ Promotion of NGV vehicle in public transport sector
廃棄物処理・その他	■ **NA** – Malaysia does not set projection target for GHG emission reduction	■ Sustainable waste management – e.g. waste paper recycling and biogas recovery from palm oil mill ■ Promotion of sustainable forest management and conservation ■ There are many gas and oil fields in Malaysia, and CCS is a priority area.

1 – Energy usage includes energy generation and consumption e.g. from manufacturing industry
Source: Ministry of Environment and Water (KASA)

国家エネルギー戦略において以下の分野の技術に注目(1/3)
- 石油/ガス・水力発電

Contents	Overall	Highlighted Technology
Oil &Gas	The oil and gas sector continues to face unique challenges, which requirestechnology analytics, development, adoption and commercialisation to optimisethe lifespan of indigenous oil and gas resources. These include technologies fordeepwater and ultra-deepwater fields, technologies to ensure economical andenvironmentally sustainable production in sour gas fields as well as enhancedoil recovery technology for mature fields	・use of data analytics; artificial intelligence (AI) and machine learning (ML) ・ integrated carbon capture, utilisation and storage **(CCUS)** facilities;
Hydroelectric	Hydroelectric will be a key technology focus area, driven not only by its potential as an electricity generation source but also as a key enabler towards increasing green hydrogen competitiveness.	・technologies to enhance hydro resources as a source of energystorage ・ technologies to improve the **efficiency and uptime of mini-hydro resources** ・Technology developments on potential breakthrough **including Restoration Hydro Turbine (RHT)**

Source：12th Malaysia Plan, National Energy Policy 2022-2040

国家エネルギー戦略において以下の分野の技術に注目(2/3)
- 太陽光・バイオ燃料

Contents	Overall	Highlighted Technology
Solar Ecosystem	Solar energy has high potential to increase its share in the installed capacityof RE in line with rapidly decreasing levelised cost of energy (LCOE). One keyfocus area of technology is to further increase environmental sustainabilityand reduce the environmental impact of large-scale solar farms. I	・develop and adopt technologies in areas such as **floating solar** ・potentials of **rooftop solar** and other solar-related technologies should also be focused on, in accordance with local characteristics
Bio Based Energy	Malaysia is the second-largest palm oil producer globally and has largepotential to harness bioenergy from agricultural products for circular economybenefits as well as improve environmental sustainability and domestic energysecurity.The need to develop technologies suited to domestic bio-basedresources will be critical for future competitive advantage.	・first and second generation bioenergy technologies, efforts will be given towards the objective of **driving cost-effectiveness** of energy generation on ・Strategic development of third and fourth generation bioenergy

Source：12th Malaysia Plan, National Energy Policy 2022-2040

国家エネルギー戦略において以下の分野の技術に注目(2/3)
- 省エネ/スマートデバイス・低炭素自動車・水素

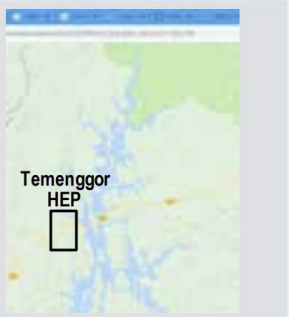
Contents	Overall	Highlighted Technology
Energy Efficiency Smart Device	Energy efficiency technologies have been gaining significant traction with theuse of digital and smart devices related to the Fourth Industrial Revolution(4IR) in residential and commercial appliances, driven by energy transition andthe push for increased environmental sustainability	・energy-efficient Digital Smart Device
Low Carbon Mobility	Malaysia has severalkey foundational advantages that should be harnessed in technologicaldevelopment for low carbon mobility. The country has a legacy of automotivemanufacturing capabilities, including partnerships with global automotivemanufacturers who have vast experience in EV manufacturing	・EV / NxGV(Next Generation Vehicles)
Hydrogen	Malaysia's indigenous resources in natural gas and renewablessuch as hydroelectric, solar and bioenergy, positions the country effectively forthe competitive production of blue and green hydrogen. the national long-term potential to be anexport hub for green hydrogen due to competitive advantages, especiallyfor local hydroelectric.	・electrolyser technologies, export terminal technologies, and hydrogen transporttechnologies between production sites and export terminals ・long-range transport, options using carriers such as ammonia, liquid hydrogen, liquid organic hydrogen, or metalhydride

Source：12th Malaysia Plan, National Energy Policy 2022-2040

水力発電と、浮体式太陽光も検討

Case study
Leveraging large hydroelectric plant dams for floating solar PV

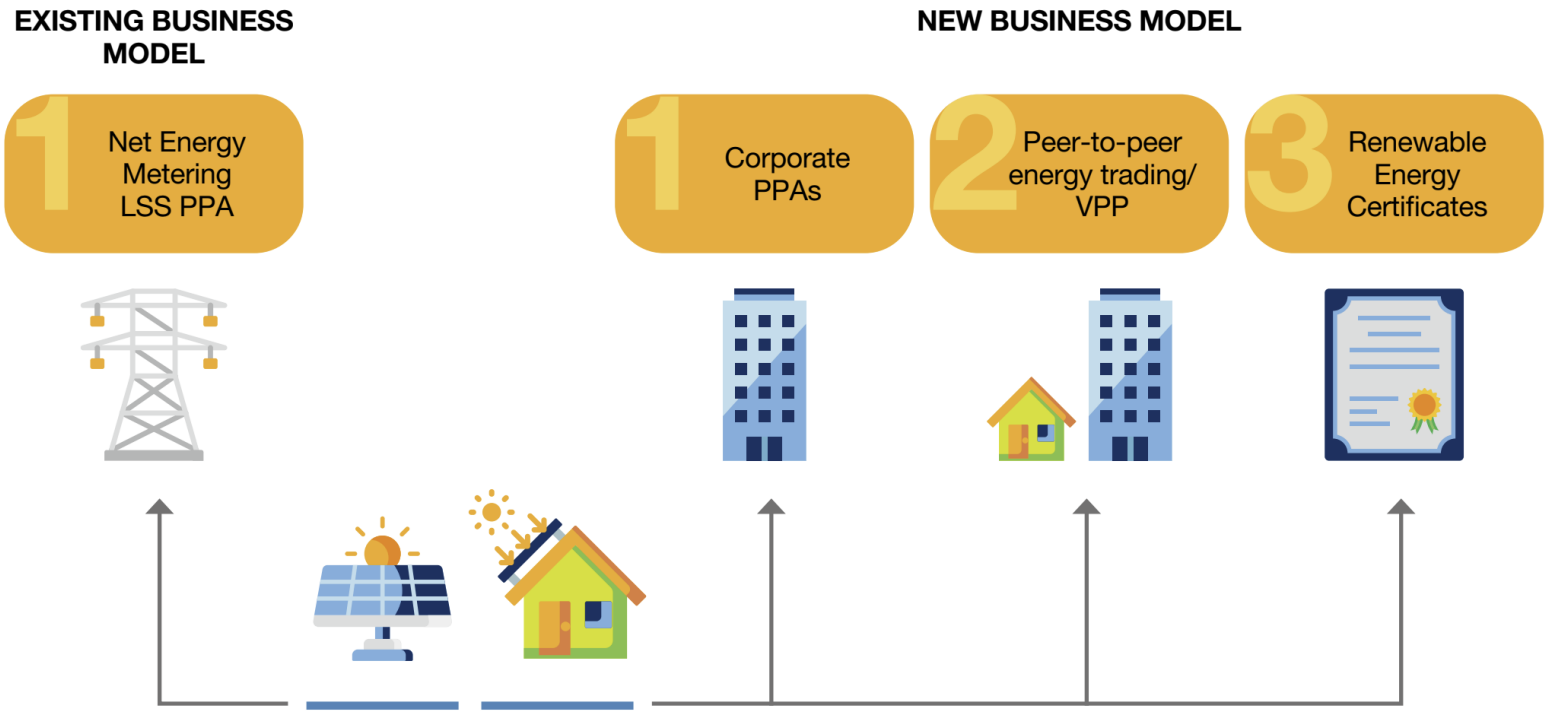
Large hydroelectric power dam such as Kenyir, Temenggor and Chenderoh are built on reservoirs with large water surface areas that potentially can be used for floating solar PV installation. Even by using only part of the reservoir area, significant capacity can be built. For example, using approximately 10%[89] of the Kenyir, Temenggor and Chenderoh reservoirs can yield 2 GW, 1 GW and 115 MW capacity respectively. Because these hydroelectric power plants are owned by TNB, there is potential to leverage TNB's interconnection point for floating solar PV systems, thus reducing interconnection costs.

	Kenyir HEP Dam	Temenggor HEP Dam	Chenderoh HEP Dam
State	Terengganu	Perak	Perak
Reservoir area	369 km^2	174 km^2	20.5 km^2
Potential capacity[1)]	2,075 MW	978 MW	115 MW
Ownership	Tenaga Nasional Berhad	Tenaga Nasional Berhad	Tenaga Nasional Berhad
Map			

Source: SEDA; Department of Irrigation and Drainage

Source：MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

屋根置き太陽光やCorporate PPAも検討



Source： MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

5 発電事業者

発電事業者はEC1)から下記のライセンスを受けることが必要。ただし、定量的要請（例：電圧レベル等）についてはライセンス文書には記載が見られない模様

Supply by licensee

- Duty to supply on request
- Exceptions to duty to supply electricity
- Power to fix tariffs
  - Licensee may levy surcharge
- Power to recover expenses
- Power to require security
  - Return of security with interest
- Special agreement with respect to supply
- Determination of dispute
- Fixing of maximum prices for reselling electricity
- Charge for supply of electricity to be ascertained by appropriate meter

詳細例

A) Subject to the following provisions of this Part and any regulation made thereunder, a licensee shall upon being required to do so by the owner or occupier of any premises
   I. give a supply of electricity to those premises; and
   II. so far as may be necessary for that purpose, provide supply lines or any electrical plant or equipment.

B) Where any person requires a supply of electricity under subsection (1) he shall give to the licensee a notice specifying
   I. the premises in respect of which the supply is required;
   II. the day on which the supply is required to commence;
   III. the maximum power which may be required at any time; and
   IV. the minimum period for which the supply is required to be given.

C) Where a licensee receives from any person a notice under subsection (2) requiring him to give a supply of electricity to any premises and—
   I. he has not previously given supply of electricity to those premises;
   II. the giving of the supply requires the provision of supply lines or electrical equipment or plant; or
   III. other circumstances exist which make it necessary or expedient for him to do so,

Source： LAWS OF MALAYSIA ELECTRICITY SUPPLY ACT 1990

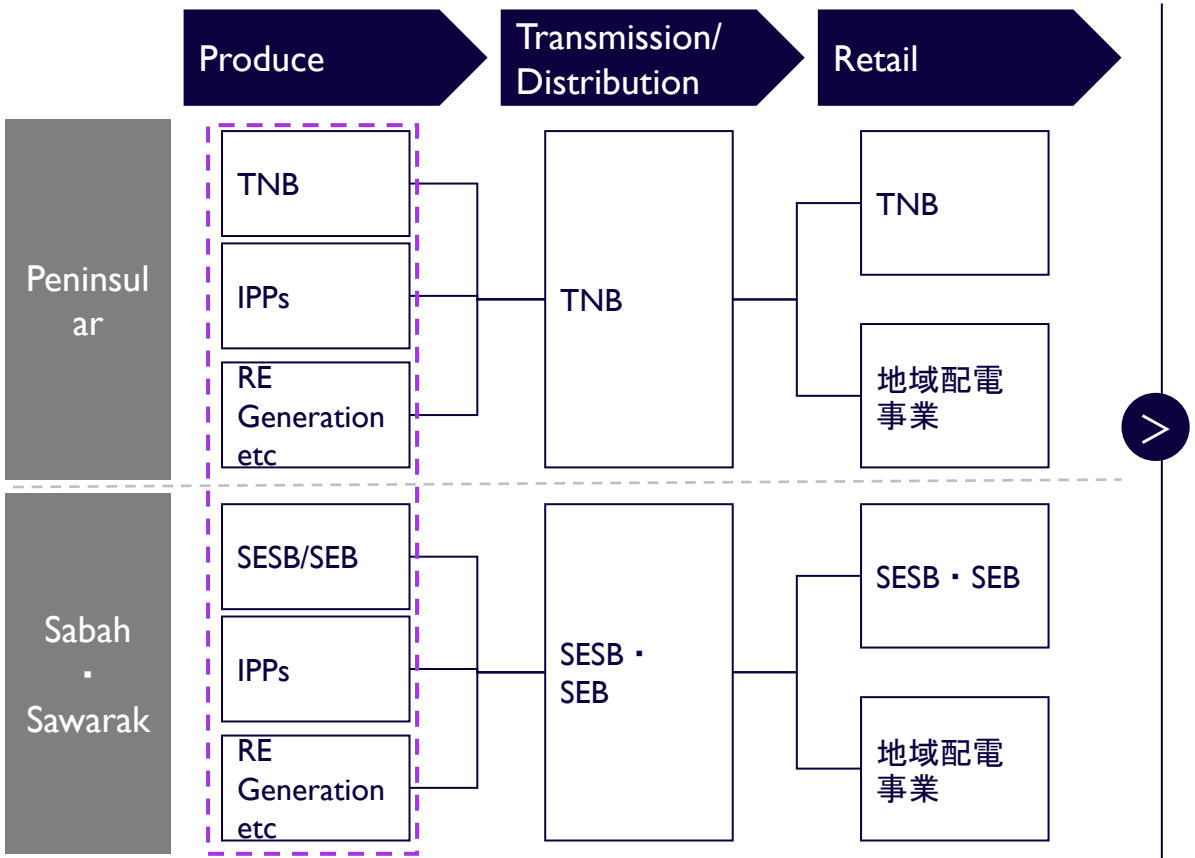
マレーシアでは地域ごとに3つの電力会社が存在
（半島部：TNB, サバ州：SESB, サラワク州：SESCO)

Electricity Power and Utility Companies in Malaysia

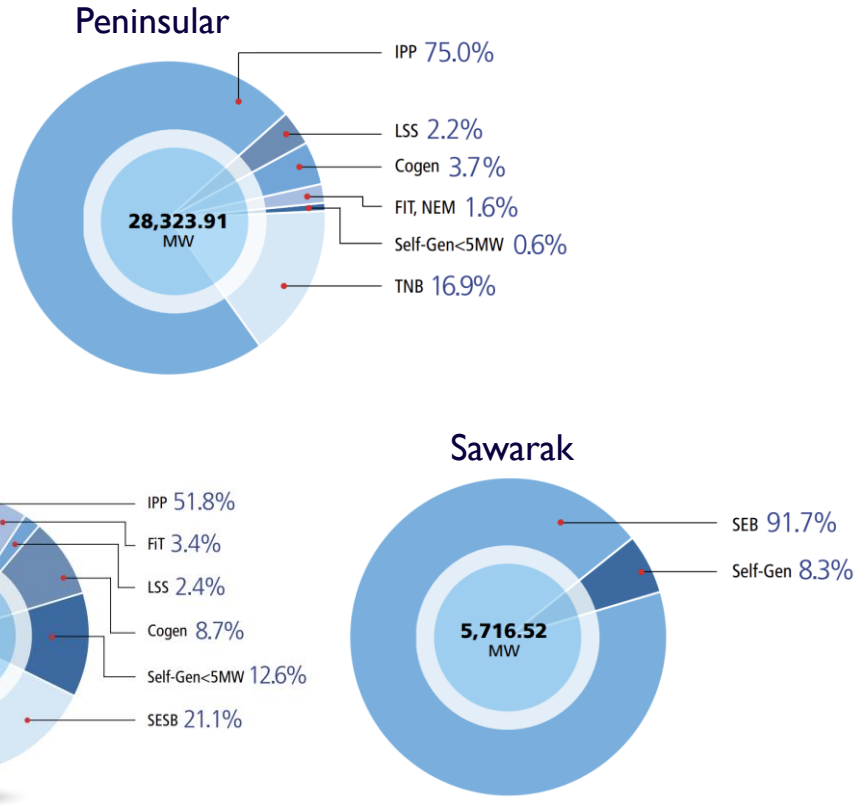
Source：Suhranjaya Tenage

発電事業は自由化しており、IPPの存在感あり（特にマレー半島）

Electricity Power and Utility Companies in Malaysia



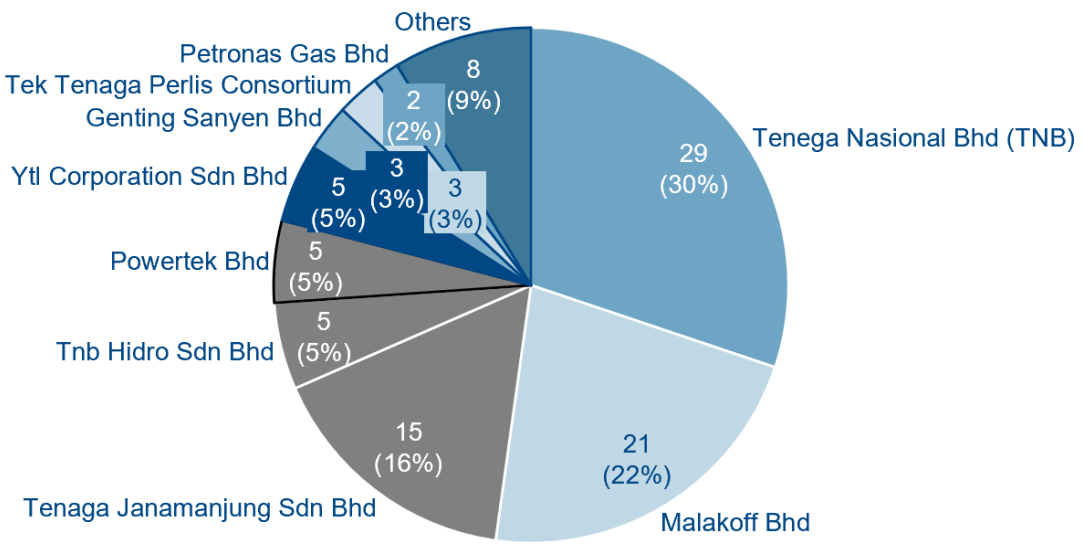
Produce Structure （MW）



Source：Performance＆Statistial Information on the Malaysian Electricity Supply Industry

特に存在感があるIPPは、Malakoff Bhdである

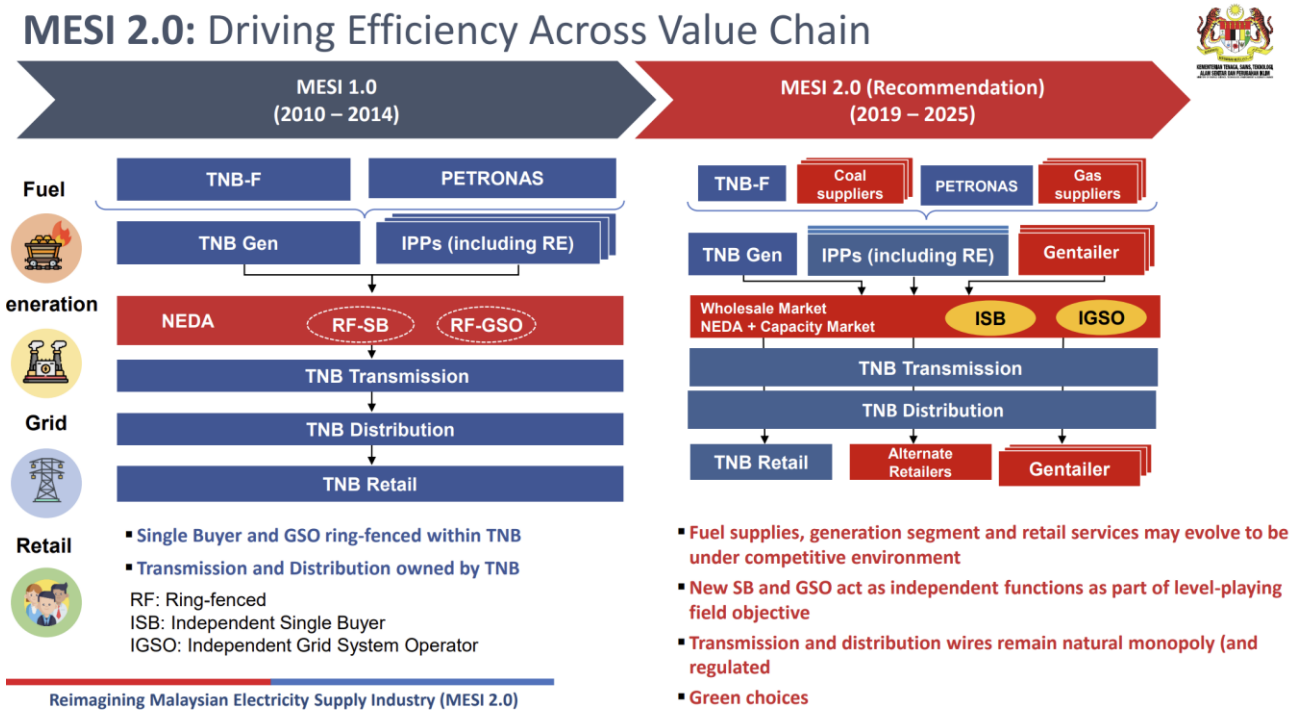
Market share in terms of generated power in2017



Total capacity = 94.744 TWh

Source： http://enipedia.tudelft.nl/wiki/Portal:Power_Plants

電力の小売りなど自由化に向けた動きであるMISI2.0 を進めているが、コロナの動きもあり計画見直し中



- Single Buyer Model
- 配電事業者とのPPA

[主要改革点]
- *IPPの資源選択権*
- *容量市場への移行*
- *送配電は独占状態が続く*
- *グリーン電力の促進*

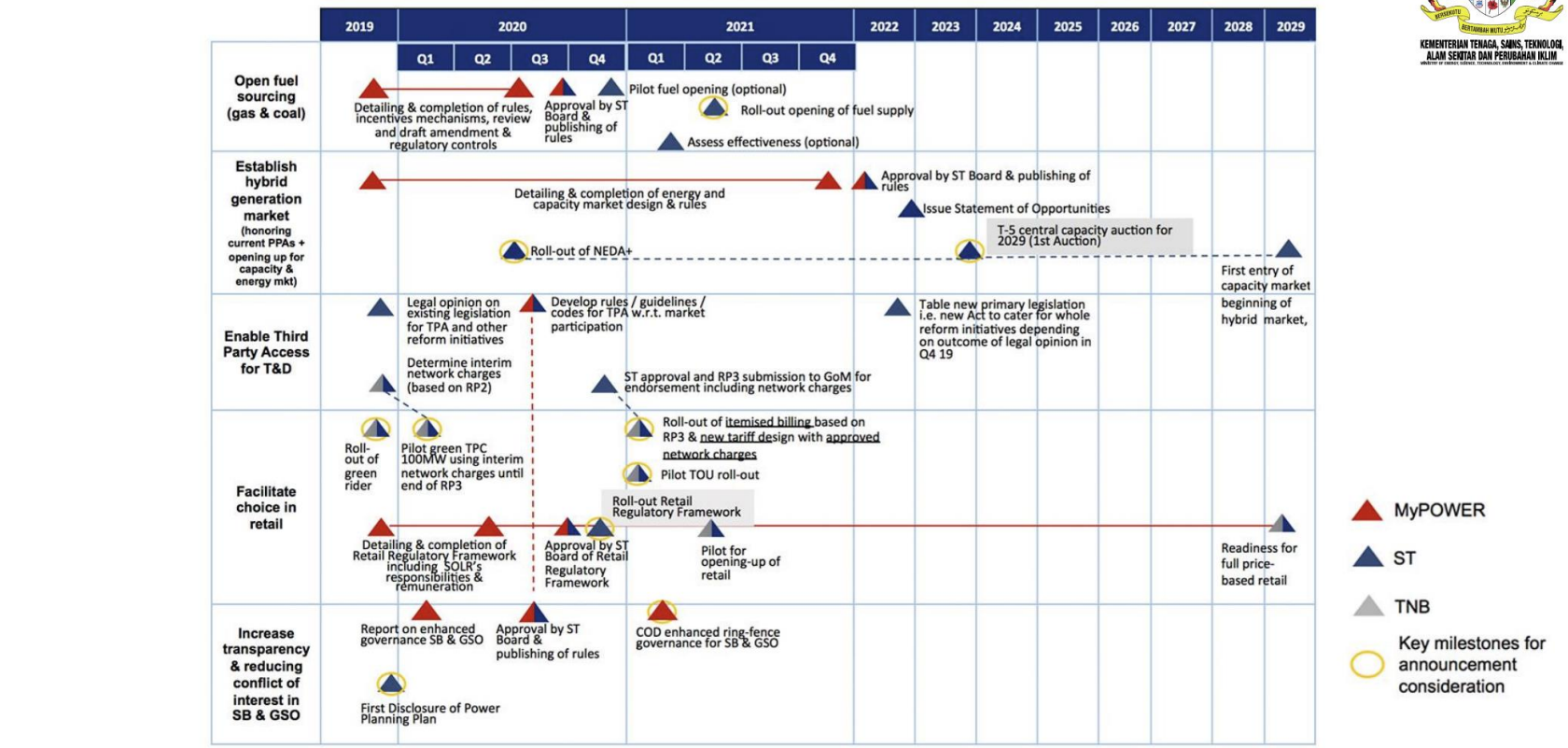
→動きを受け、TNBは発電と小売りの分社化を実施

→ただしもろもろの計画はコロナの影響もあり見直し中

Source：Reimaginin Malaysian Electricity Supplya Industry（MESI2.0）、一般社団法人 海外電力調査会

当初計画は以下（当初は、容量市場オークションを2023年末に予定等）

Aggregated timeline for MESI initiatives

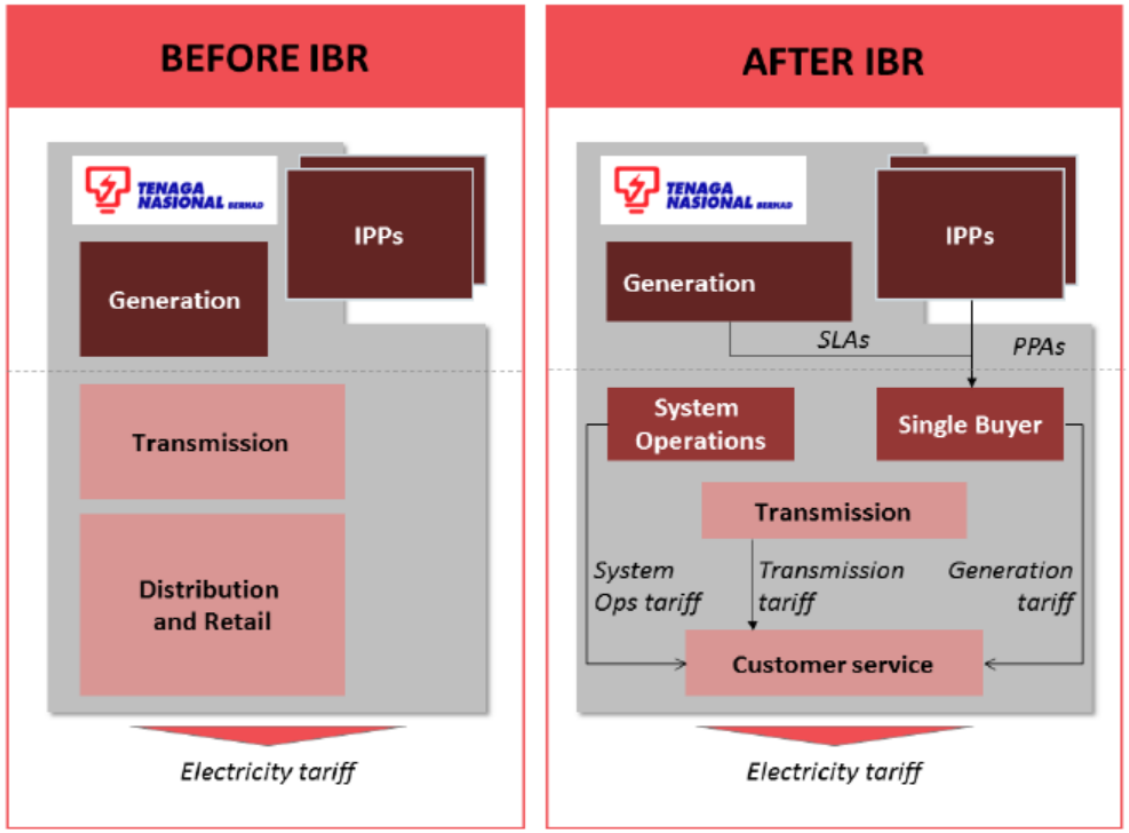


Reimagining Malaysian Electricity Supply Industry (MESI 2.0)

Source：Reimaginin Malaysian Electricity Supplya Industry（MESI2.0）

マレーシアではシングルバイヤー構造をとっている

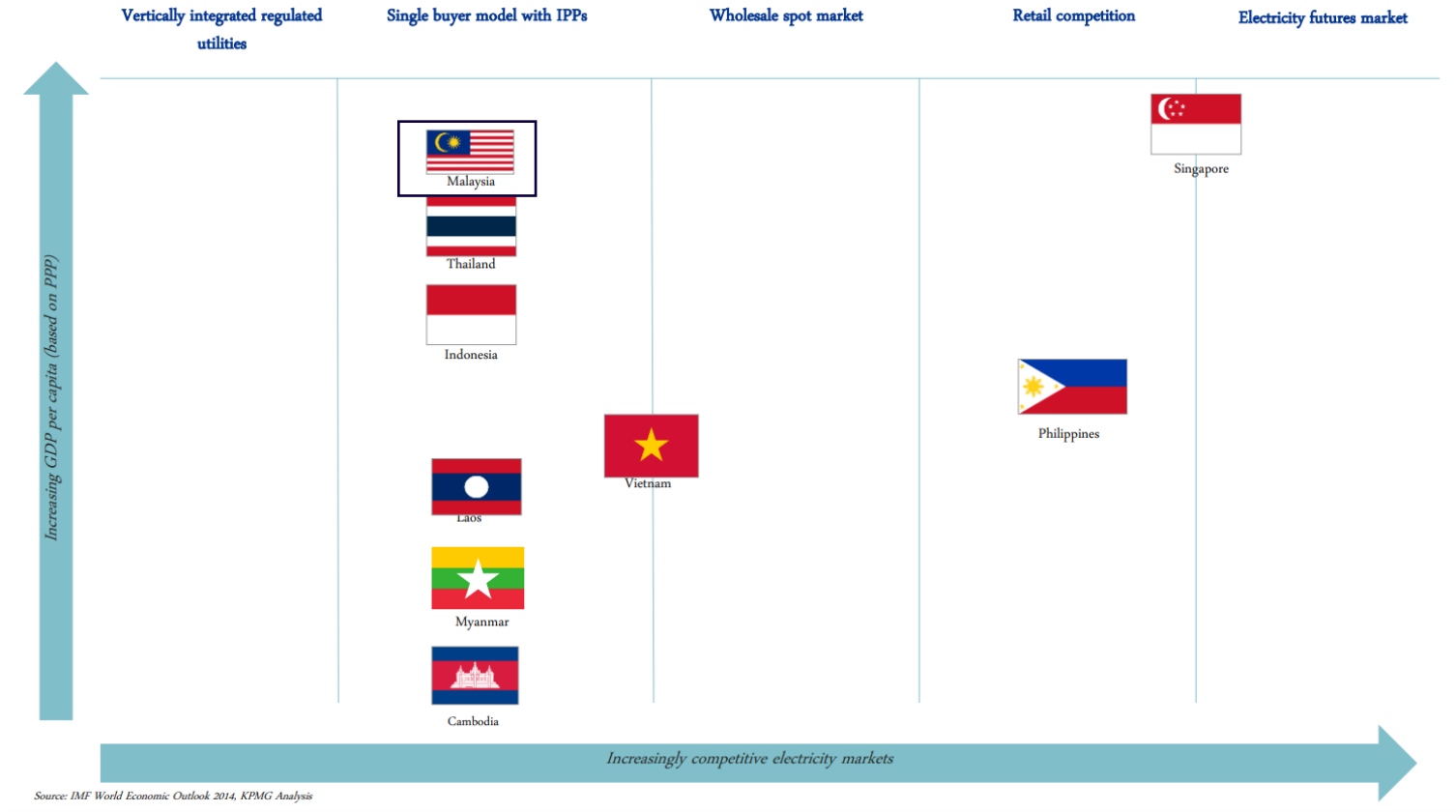
New structure of the electricity sector(Before/After Incentive based regulation)



Source : http://www.iesingapore.gov.sg/~/media/IE%20Singapore/Files/ASIR/PreConference_workshop_Sharad_Somani.pdf

マレーシアの送配電は国営企業による独占運営で、発電事業は自由化されている

Power Market Structures in SEA



Source：http://www.iesingapore.gov.sg/~/media/IE%20Singapore/Files/ASIR/PreConference_workshop_Sharad_Somani.pdf

マレー半島で送配電事業を展開するTNBは発電事業でも最大シェアを誇っている

Share of electricity generation by major power producers

		Total Generation Capacity	Number of customers	Maximum Demand
Tenaga Nasional Berhad	TENAGA NASIONAL	16,642 MW (2020)	9,433,561 (2020)	18,808 MW (2020)
Sarawak Energy	SARAWAK ENERGY	28,088 MW (2020)	712,110 (2020)	3,664 MW (2020)
Sabah Electricity Sdn. Bhd	SESB	,178 MW (2020)	637,297 (2020)	987 MW (2020)

Source：：Malaysia Energy Statistic Handbook 2021

発電事業者は天然ガスの購買価格を低減されており、ある意味補助金を受け取っているのと同義だったが現在は天然ガスへの補助金は限定的となっている

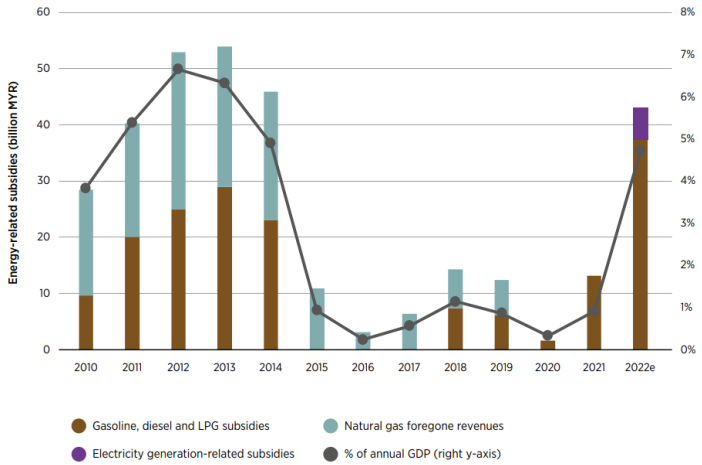
Previous:Subsidy to electricity generators and users

- Electricity generators are subsidized through a centrally imposed low gas price. Currently, subsidy rationalisation of gas to the Power Sector in Peninsular continues with three price revisions from MYR15.20/mmBtu (January – June 2015) to MYR19.70/mmBtu (July – December 2016) to MYR22.70/mmBtu (July – December 2017). In Sabah, gas price for power sector is controlled at MYR 6.40/mmBtu, 86% lower than the average market price of MYR 46.93/mmBtu (2014).
- Electricity users are subsidized by a monthly rebate. Since 2008, the government has provided a MYR20 (USD$6.4) subsidy on monthly electricity bills to all customers of TNB costing MYR1.303 billion (US$ 335 million) from period of July to December 2017. Furthermore, TNB gives its “privileged customers” (including government schools and institutions of higher learning, places of worship and welfare homes) a 10 per cent discount on their electricity bills (TNB, 2012). This concession cost TNB MYR7.8 million (US$2.5 million) in 2012, and is due to be extended to institutions that are partly funded by the government (TNB, 2012). SESB also receives substantial diesel and fuel oil subsidies from the government to lower the cost of electricity generation, amounting to MYR543.4 million (US$173.3 million) in 2012 (TNB, 2012).

Current :Subsidy to electricity generators and users

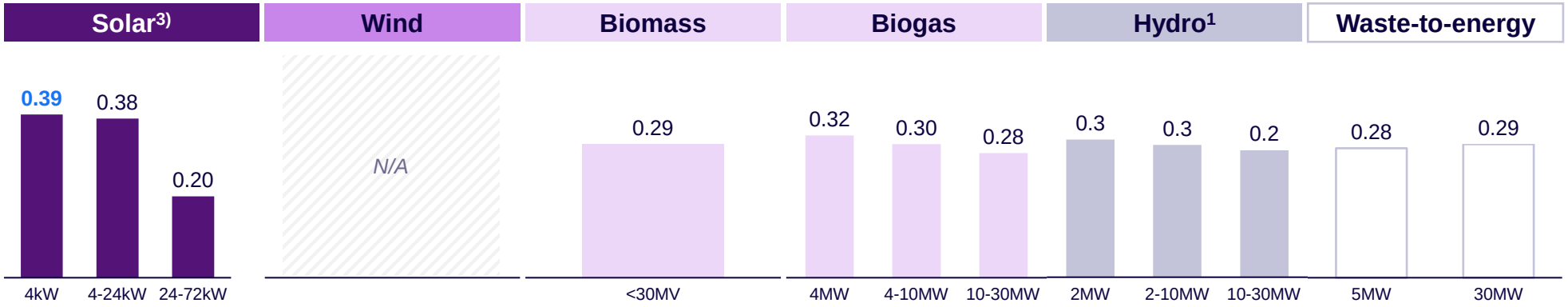
- Subsidies for natural gas are currently limited.

Figure 9 Estimated energy subsidies in Malaysia, 2010 to 2022



Source：：A citizens’ guide to energy subsidies in Malaysia, https://www.tnb.com.my/announcements/imbalance-cost-pass-through-tariff-rebate1

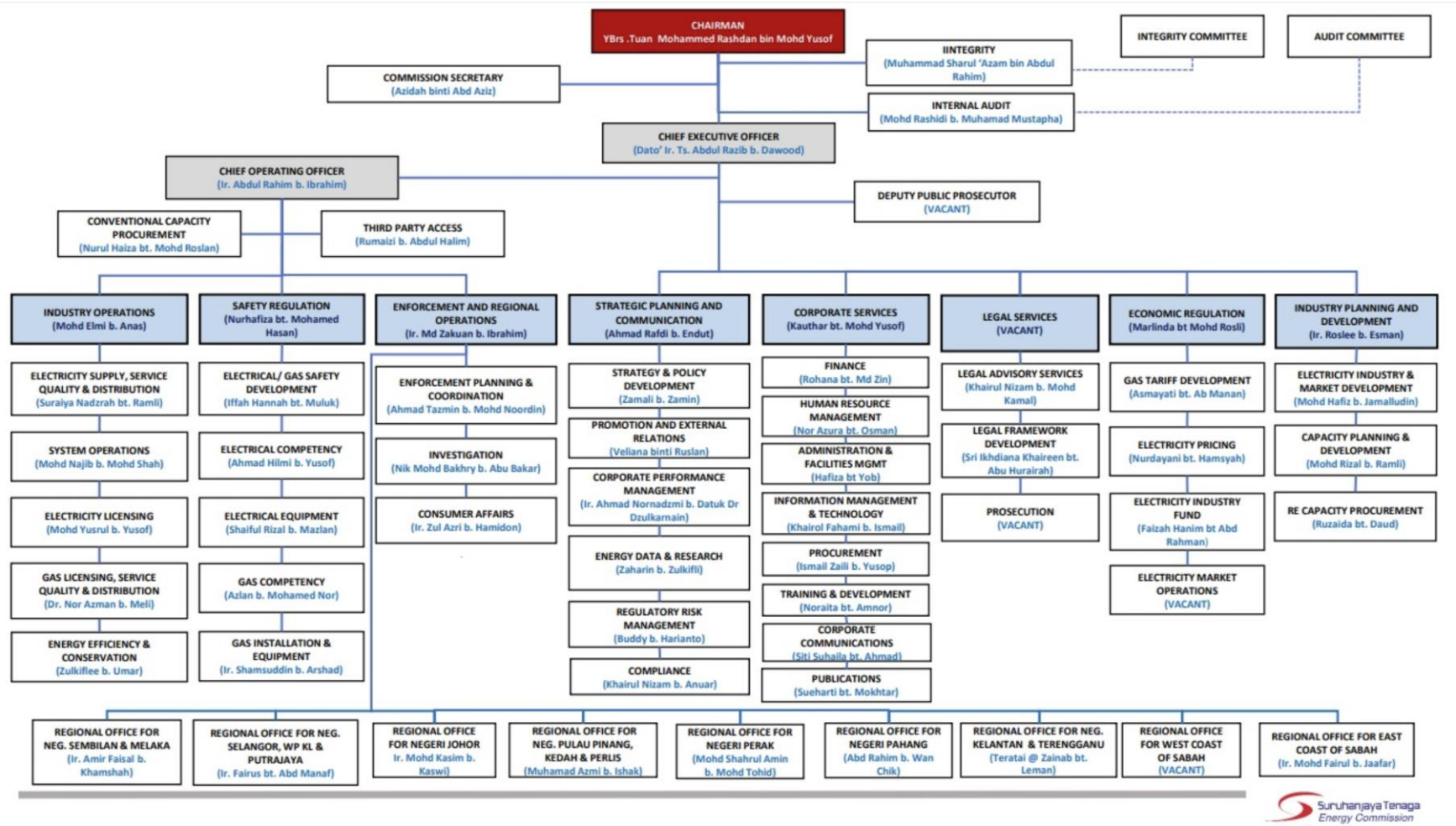
再エネ事業者へのFIT制度以外のインセンティブが存在



	Solar[3]	Wind	Biomass	Biogas	Hydro[1]	Waste-to-energy
Corporate tax incentives	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**
Import duties	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment
Additional incentives	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	• **Green Technology Financing Scheme** with guaranteed value of USD 700k • Financing increased to 80%

Note:[1]Small hydro; [2]Bonus FiT rates given if meet additional criteria 3: solar Pv community
Source: SEDA(1/1/23), Tax Incentive Guidelines, ADL research

Structure of Energy Commission



Source : https://www.st.gov.my/en/details/aboutus/6

6 発電所

Map of Power plant (Coal-fired and Natural gas and Hydropower)

Map of Major Power Stations in Malaysia by area

Peninsular

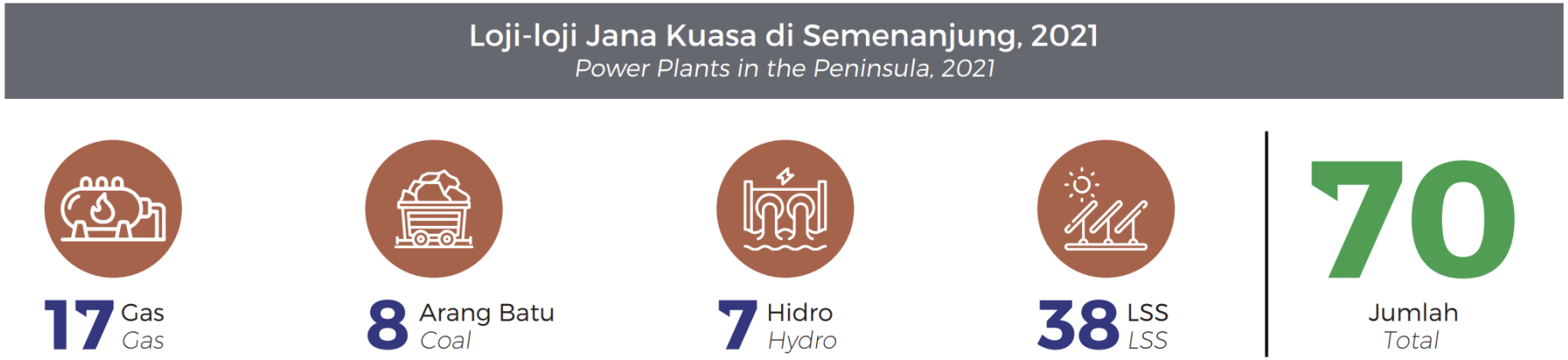
Sabah

Sarawak

Source : Performance and Statistical Information on the Malaysian Electricity Supply Industry 2019

List of Power plant (in Peninsular)

全体像



Source : ST Annual Report2021

List of Power plant (Coal-fired and Natural gas and Hydropower)

List of top 20 power plants in Malaysia by capacity (2023)

#	PPA/SLA Expiry Year	Name	Fuel	Type	Capacity (MW)
1	2042 Dec	Edra Melaka Power Plant (Block 1, 2, 3)	Gas	CCGT	2242
2	2031 Sep	Tanjung Bin Power Sdn Bhd	Coal	Thermal	2100
3	2030 Aug	TNB Janamanjung Sdn Bhd (M123)	Coal	Thermal	2070
4	2044 May	Jimah East Power Sdn Bhd	Coal	Thermal	2000
5	2029 Jul	Kapar Energy Ventures Sdn Bhd	Coal	Thermal (U3-U6)	1474
6	2042 Jan	Southern Power Generation Sdn. Bhd. (SPGP)	Gas	CCGT	1440
7	2033 Dec	Jimah Energy Ventures Sdn Bhd	Coal	Thermal	1400
8	2027 Jun	Segari Energy Ventures Sdn Bhd	Gas	CCGT	1303
9	2036 Feb	TNB Prai Sdn Bhd	Gas	CCGT	1071.43
10	2040 Mar	TNB Janamanjung Sdn Bhd (M4)	Coal	Thermal	1010
11	2041 Mar	Tanjung Bin Energy Sdn Bhd	Coal	Thermal	1000
12	2042 Sep	TNB Manjung Five Sdn Bhd	Coal	Thermal	1000
13	2023 Feb	Panglima Power Sdn Bhd	Gas	CCGT	720
14	2030 Jan	S.J Tuanku Jaafar, Port Dickson	Gas	CCGT PD2	708
15	2028 Aug	S.J Tuanku Jaafar, Port Dickson	Gas	CCGT PD1	703
16	2026 Feb	Kuala Langat Power Plant Sdn. Bhd. (KLPP)	Gas	CCGT	675
17	2024 Mar	Teknologi Tenaga Perlis Consortium Sdn Bhd	Gas	CCGT	650
18	2022 Aug	S.J Sungai Perak (under extension)	Water	Hydro	645
19	2022 Dec	GB3 Sdn Bhd	Gas	CCGT	640
20	2037 Aug	S.J Pergau	Water	Hydro	600

Source : Grid System Operator 2023

List of Power plant (Coal-fired and Natural gas and Hydropower)

List of existing power plants in Peninsular region

TNB

	Stesen Jana Kuasa / Power Station	Sumber Tenaga / Energy Source	Kapasiti Terpasang (MW) / Installed Capacity (MW)	TAAC (MW)
TNB	SJ Temenggor (SKIM SUNGAI PERAK)	Hidro Hydro	348.00	341.80
	SJ Bersia (SUNGAI PERAK SCHEME)	Hidro Hydro	72.00	72.00
	SJ Kenering (SUNGAI PERAK SCHEME)	Hidro Hydro	120.00	118.54
	SJ Chenderoh (SUNGAI PERAK SCHEME)	Hidro Hydro	40.50	39.19
	SJ Sg Piah (Lower & Upper)	Hidro Hydro	68.60	68.60
	SJ Pergau	Hidro Hydro	600.00	600.00
	SJ Kenyir	Hidro Hydro	400.00	400.00
	SJ Sultan Yussuf (Jor)	Hidro Hydro	100.00	100.00
	SJ Sultan Idris (Woh)	Hidro Hydro	150.00	150.00
	SJ Hulu Terengganu	Hidro Hydro	250.00	265.00
	SJ Tembat	Hidro Hydro	15.00	
	SJ Ulu Jelai	Hidro Hydro	372.00	372.00
	SJ Putrajaya	Gas asli Natural gas-OCGT	252.00	249.00
	SJ Sultan Ismail	Gas asli Natural gas-CCGT	257.00	257.00
	SJ Gelugor	Gas asli Natural gas-CCGT	310.00	310.00
	SJ Tuanku Jaafar	Gas asli Natural gas-CCGT	1,411.00	1,411.00
	SJ Jambatan Connaught	Gas asli Natural gas-CCGT	0.00	0.00
	SJ Hidro mini[d] Mini hydro power stations[d]	Hidro mini Mini Hydro	20.36	
		Jumlah Total	**4,786.46**	**4,754.13**

IPP

	Stesen Jana Kuasa / Power Station	Sumber Tenaga / Energy Source	Kapasiti Terpasang (MW) / Installed Capacity (MW)	TAAC (MW)
IPP	GB3 Sdn. Bhd.	Gas asli Natural gas-CCGT	640.00	640.00
	Kuala Langat Power Plant Sdn. Bhd.	Gas asli Natural gas-CCGT	675.00	675.00
	Pahlawan Power Berhad	Gas asli Natural gas-CCGT	322.00	322.00
	Panglima Power Berhad	Gas asli Natural gas-CCGT	720.00	720.00
	Prai Power Sdn. Bhd.	Gas asli Natural gas-CCGT	350.00	341.20
	Segari Energy Ventures Sdn. Bhd.	Gas asli Natural gas-CCGT	1,303.00	1,303.00
	Teknologi Tenaga Perlis Consortium Sdn. Bhd.	Gas asli Natural gas-CCGT	650.00	650.00
	YTL Power Generation Sdn. Bhd. (Paka)	Gas asli Natural gas-CCGT	585.00	585.00
	Pengerang Power Sdn. Bhd.	Gas asli Natural gas-Cogen	600.00	600.00
	Port Dickson Power Berhad	Gas asli Natural gas-OCGT	0.00	0.00
	Powertek Berhad	Gas asli Natural gas-OCGT	434.00	434.00
	TNB Pasir Gudang Energy Sdn. Bhd.	Gas asli Natural gas-CCGT	275.00	275.00
	TNB Connaught Bridge Sdn. Bhd.	Gas asli Natural gas-CCGT	375.00	375.00
	TNB Prai Sdn. Bhd.	Gas asli Natural gas-CCGT	1,071.43	1,071.43
	Kapar Energy Ventures Sdn. Bhd. (KEV) – GF1	Gas asli Natural gas-OCGT	600.00	578.00
	KEV – GF4	Gas asli Natural gas-Thermal konvensional Conventional thermal	220.00	191.86
	KEV - GF2	Arang batu Coal- Thermal	600.00	600.00
	KEV – GF3	Arang batu Coal- Thermal	1,000.00	937.50
	Jimah Energy Ventures Sdn. Bhd.	Arang batu Coal- Thermal	1,400.00	1,400.00
	Tanjung Bin Power Sdn. Bhd.	Arang batu Coal- Thermal	2,100.00	2,100.00
	Tanjung Bin Energy Sdn. Bhd.	Arang batu Coal- Thermal	1,000.00	1,000.00
	TNB Janamanjung Sdn. Bhd.	Arang batu Coal- Thermal	3,080.00	3,080.00
	TNB Manjung Five Sdn. Bhd.	Arang batu Coal- Thermal	1,000.00	1,000.00
	Jimah East Sdn Bhd	Arang batu Coal- Thermal	2,000.00	2,000.00
	NUR Generation Sdn. Bhd.[d]	Gas asli Natural gas- CCGT	220.00	
	Musteq Hydro Sdn. Bhd.[d]	Hidro mini Mini hydro	20.00	
		Jumlah Total	**21,240.43**	**20,878.99**
		Jumlah Besar (TNB + IPP) Grand Total (TNB + IPP)	**26,026.89**	**25,633.12**

LAIN-LAIN (OTHERS)

	Kategori / Category	Sumber Tenaga / Energy Source	Kapasiti Terpasang (MW) / Installed Capacity (MW)
LAIN-LAIN (OTHERS)	FiT[d] & MySuria[d]	Biogas	93.16
		Biojisim Biomass	44.85
		Hidro Mini Mini Hydro	63.80
		Solar	240.08
		Jumlah Total	**441.89**
	Solar (Lesen TBB bukan FiT) Solar (Non-FiT RE Licence)	Solar	0.14
		Jumlah Total	**0.14**
	Cogen Awam[d] Public Cogen[d]	Gas Asli Natural Gas	441.63**
		Haba Sisa Proses Perindustrian Industrial Process Waste Heat	7.00
		Jumlah Total	**448.63**
	Cogen Persendirian[s] Private Cogen[s]	Gas Asli Natural Gas	504.27
		Haba Sisa Proses Perindustrian Industrial Process Waste Heat	72.00
		Biojisim Biomass	12.41
		Jumlah Total	**588.68**
	LSS	>30 MW	433.92
		<30 MW	180.96
		Jumlah Total	**614.88**
	NEM[d]	Solar[d]	31.27
		Jumlah Total	**31.27**
	Self-Gen <5 MW[s]	Gas Asli Natural Gas	20.94
		Diesel	39.40
		Biojisim Biomass	100.60
		Biogas	0.40
		Solar	8.06
		Hidro Mini Mini Hydro	2.13
		Jumlah Total	**171.53**
		Jumlah Besar (Lain-lain) Grand Total (Others)	**2,297.02**
		TNB + IPP + Lain-Lain TNB + IPP + Others	**28,232.91**

Source: Performance and Statistical Information on the Malaysian Electricity Supply Industry 2019

List of Power plant (Coal-fired and Natural gas and Hydropower)

List of existing power plants in Sabah region

SESB & IPP

	Stesen Jana Kuasa Power Station	Sumber Tenaga Energy Source	Kapasiti Terpasang (MW) Installed Capacity (MW)	Kapasiti Boleh Harap (MW) Dependable Capacity (MW)
SESB	SJ Tenom Pangi	Hidro Hydro	75.00	72.55
	Hidro mini Mini hydro Merotai	Hidro mini Mini hydro	1.00	0.50
	Hidro mini Mini hydro Bombalai	Hidro mini Mini hydro	1.00	0.80
	Hidro mini Mini hydro Melangkap	Hidro mini Mini hydro	1.00	0.00
	Hidro mini Mini hydro Sayap	Hidro mini Mini hydro	1.00	1.00
	SJ Melawa	Diesel/MFO - DE	0.00	0.00
	SJ Tawau	Diesel/MFO - DE	44.00	21.75
	SJ Patau-Patau	Gas - CCGT	112.00	103.40
	SJ Kubota	Diesel/MFO - DE	64.00	64.00
	SJ Batu Sapi, Sandakan	Diesel/MFO - DE	20.00	17.40
	SJ Sandakan	Diesel/MFO - DE	38.00	36.00
	SJ Labuk Canopy	Diesel/MFO - DE	0.00	0.00
	Tawau Canopy - Minor Station	Diesel/MFO - DE	14.55	10.56
	Hidro Mini Mini Hydro Kiau[d]	Hidro mini Mini hydro	0.35	0.00
	Hidro Mini Mini Hydro Carabau[d]	Hidro mini Mini hydro	2.00	1.80
	Hidro Mini Mini Hydro Naradau[d]	Hidro mini Mini hydro	1.76	1.20
	Ranau - Minor Station[e]	Diesel/MFO - DE	35.22	24.13
	Telupid - Minor Station[e]	Diesel/MFO - DE		
	Stesen-stesen Pedalaman[e] Rural Stations[e]	Diesel/MFO - DE	5.12	4.68
		Solar - Solar Hybrid	23.15	21.50
		Jumlah SESB **SESB Total**	**439.15**	**381.27**

	Stesen Jana Kuasa Power Station	Sumber Tenaga Energy Source	Kapasiti Terpasang (MW) Installed Capacity (MW)	Kapasiti Boleh Harap (MW) Dependable Capacity (MW)
IPP	Ranhill Powertron Sdn Bhd (Teluk Salut)	Gas - CCGT	208.64	190.00
	Sepanggar Bay Power Corporation	Gas - CCGT	113.80	100.00
	Powertron II (Rugading)	Gas - CCGT	214.80	190.00
	Kimanis Power Sdn Bhd	Gas - CCGT	367.20	285.00
	SPR Energy (M) Sdn Bhd	Gas - CCGT	108.20	100.00
	Staratavest Sdn Bhd (Libaran)	Diesel/MFO - DE	64.40	30.00
		Jumlah IPP **IPP Total**	**1,077.04**	**895.00**

LAIN-LAIN (OTHERS)

	Kategori Category	Sumber Tenaga Energy Source	Kapasiti Terpasang (MW) Installed Capacity (MW)
LAIN-LAIN (OTHERS)	Cogen Awam[d] Public Cogen[d]	Biojisim Biomass	29.20
		Jumlah Total	**29.20**
	Cogen Persendirian[s] Private Cogen[s]	Gas	65.00
		Biojisim Biomass	87.00
		Jumlah Total	**152.00**
	FiT[d]	Biojisim Biomass	25.80
		Biogas	9.60
		Hidro mini Mini hydro	6.50
		Solar	28.66
		Jumlah Total	**70.55**
	LSS	LSS>30MW	48.00
		LSS<30MW[d]	2.00
		Jumlah Total	**50.00**
	Self-Gen <5 MW[s]	Gas	3.90
		Diesel	137.28
		Biojisim Biomass	78.96
		Biogas	42.54
		Jumlah Total	**262.68**
		Jumlah Lain-lain **Total Others**	**564.43**
		SESB + IPP + Lain-lain **SESB + IPP + Others**	**2,080.62**

Source: Performance and Statistical Information on the Malaysian Electricity Supply Industry 2019

List of planned power plants in Peninsular region

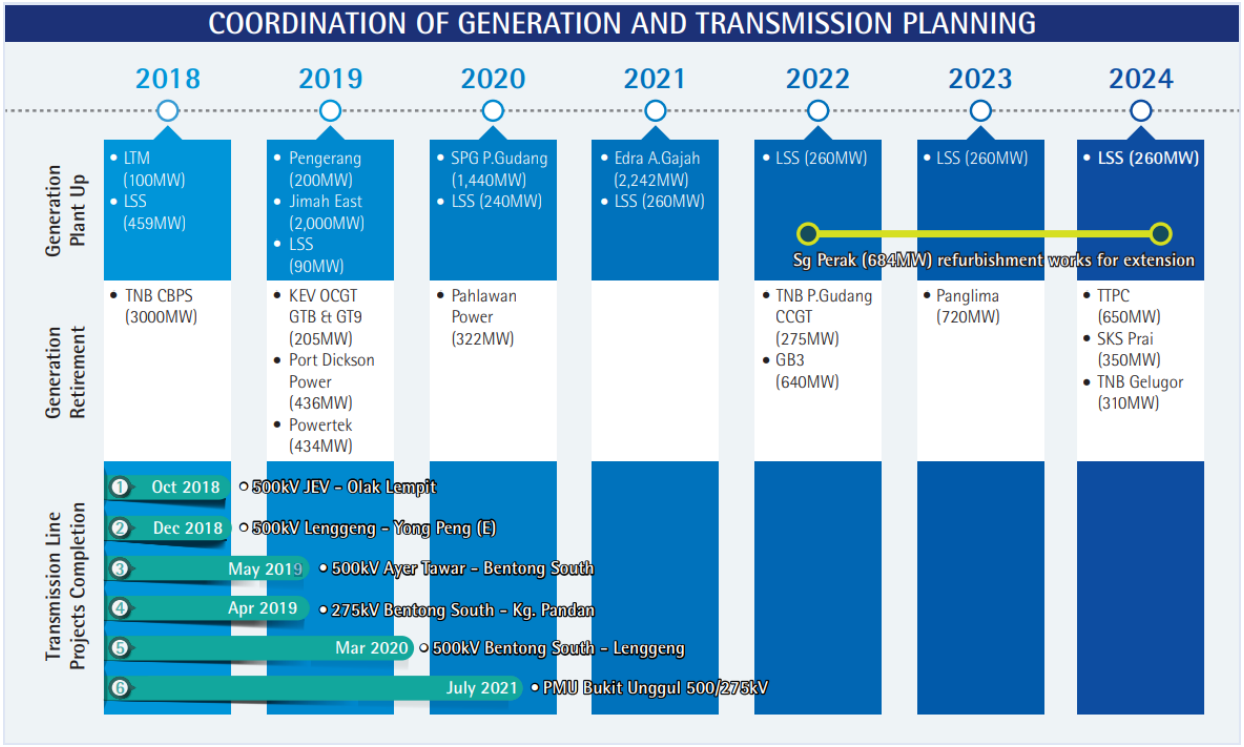
List of Planned power plants in Malaysia by output

#	Project Name	Power Type	Companies	Capacity (MW)	Status
1	Baleh Dam, Upper Rejang Basin, Sarawak	Hydropower	Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia},Sinohydro Corporation[Construction]{Mainland China},General Electric[Construction]{United States},Untang Jaya Sdn Bhd[Construction]{Malaysia},China Gezhouba Group Corporation (CGGC)[Construction]{Mainland China}	1,285	Under construction
2	Tadmax Combined Cycle Power Plant, Pulao Indah, Selangor	Gas	Mitsubishi[Equipment]{Japan},POSCO[Construction]{South Korea},Korea Electric Power Corporation (KEPCO)[Consultant/Project Management]{South Korea},Government of Malaysia[Sponsor]{Malaysia},Tadmax Resources Bhd[Operator]{Malaysia},Worldwide Holdings Berhad[Sponsor]{Malaysia},Jacobs Consultancy[Consultant/Project Management]{United States}	1,200	At planning stage
3	Kedah Combined Cycle Power Plant, Kedah	Gas	Treasure Specialty Co Ltd[Sponsor]{Thailand},Ranhill[Sponsor]{Malaysia}	1,150	At planning stage
4	Tanjung Kidurong (Bintulu) Power Station Expansion, Sarawak	Gas	Sinohydro Corporation[Construction]{Mainland China},General Electric[Construction]{United States},Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia}	842	Under construction
5	Pelagus Dam, Sarawak	Hydropower	Hydro Tasmania[Consultant/Project Management]{Australia},Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia},Norconsult[Consultant/Project Management]{Norway}	465	At planning stage
6	Merit Pila Coal-fired Power Plant, Kapit, Sarawak	Coal	Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia}	300	At planning stage
7	Bakun Hydroelectric Power Plant Extension, Sarawak	Hydropower	SMEC[Feasibility]{Australia},Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia}	300	At planning stage
8	Baram 3 Hydropower Project, Sarawak	Hydropower	Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia}	300	At planning stage
9	Gua Musang Hydroelectric Power Plant, Mukim Ulu Nenggiri, Jajahan Gua Musang, Kelantan	Hydropower	Tenaga Nasional Berhad[Sponsor]{Malaysia},Malaysian Ministry of Energy - Green Technology and Water (KeTTHA)[Sponsor]{Malaysia},Andritz Hydro[Equipment]{Austria}	300	Under construction
10	Trusan 2 Hydropower Project, Sarawak	Hydropower	Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia}	240	At planning stage

Source: Fitch Solutions – Malaysia Power Report 2023

List of Power plant (Coal-fired and Natural gas and Hydropower)

List of Planned power plants in Peninsular region



- *Between 2018 and 2024, there are four major generation projects. They are Pengerang Power (200MW, gas) Jimah East Power (2,000MW, coal), Southern Power Generation (1,440MW, gas) and Edra Energy (2,242MW, gas) scheduled for completion by 2021. In addition, 11 plants are earmarked for retirement and six major transmission projects are to be completed during this period.*

Source: Peninsular Malaysia Electricity Supply Industry Outlook 2019

List of Power plant (Coal-fired and Natural gas and Hydropower)

List of Planned power plants in Sabah region

YEAR	WEST COAST	EAST COAST	RETIREMENT
2018	Tadau LSS (48MW)	-	-
2019	-	GT Melawa (18MW), Tawau Rehab (13MW)	-
2020	One River HEP (30MW)	-	-
2021	Enhanced Kolopis-Segaliud Line (400MW)	-	Tawau (47MW), TSH (10MW)
2022	Sarawak Interconnection (50MW)	-	-
2023	-	-	-
2024	-	New Capacity of 100MW	Diesel Genset (135MW)
2025	-	New Capacity of 100MW	-
2026	-	-	Patau-Patau (103MW)
2027	Upper Padas HEP (192MW)	-	-

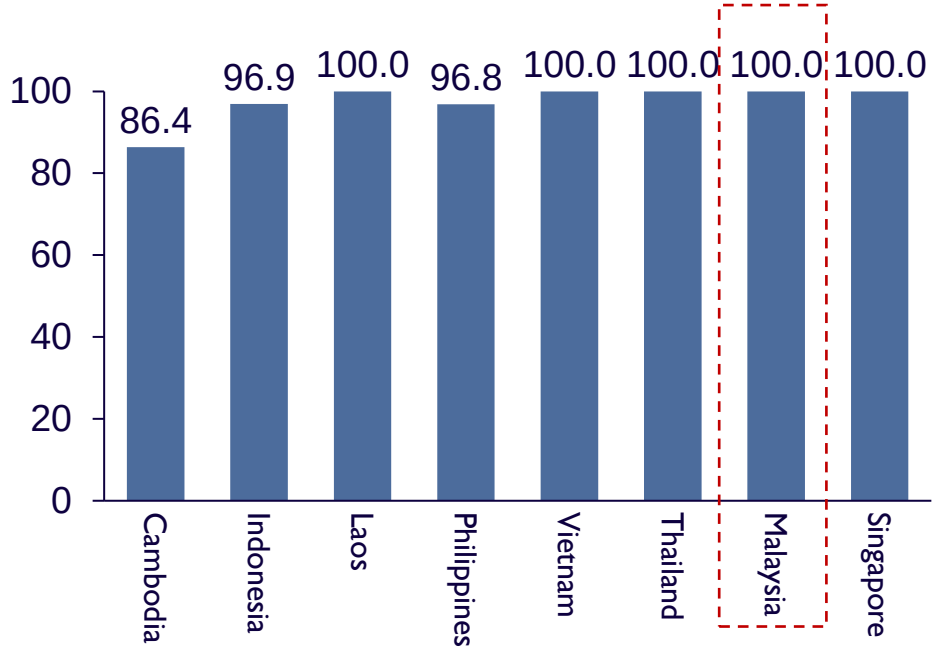
Source: Sabah Electricity Supply Industry Outlook 2019

7 電力品質

マレーシアの電力インフラの整備が進んでおり品質は比較的高い

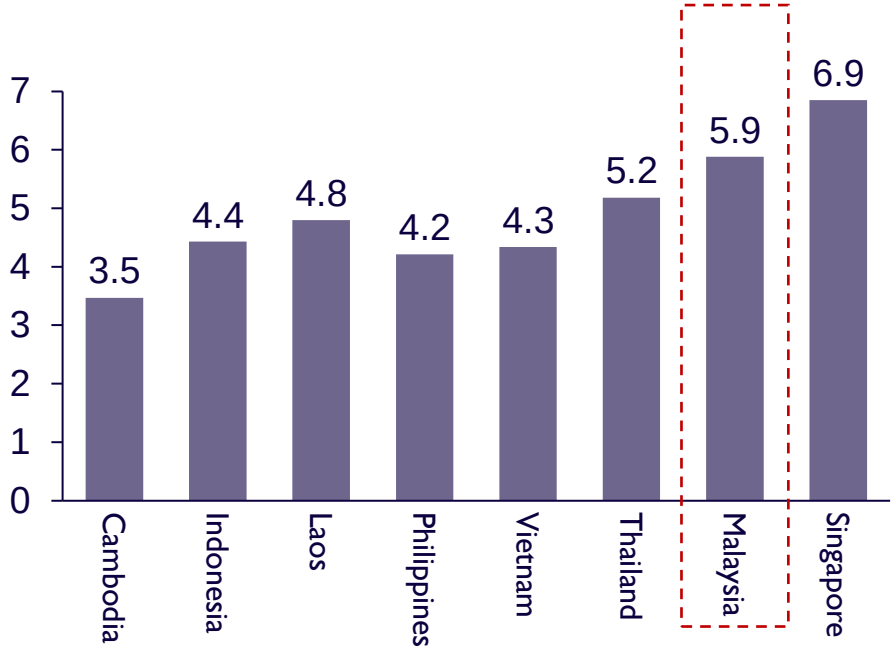
Access to Electricity

(% of population with access to electricity, 2020)



Quality of electricity supply

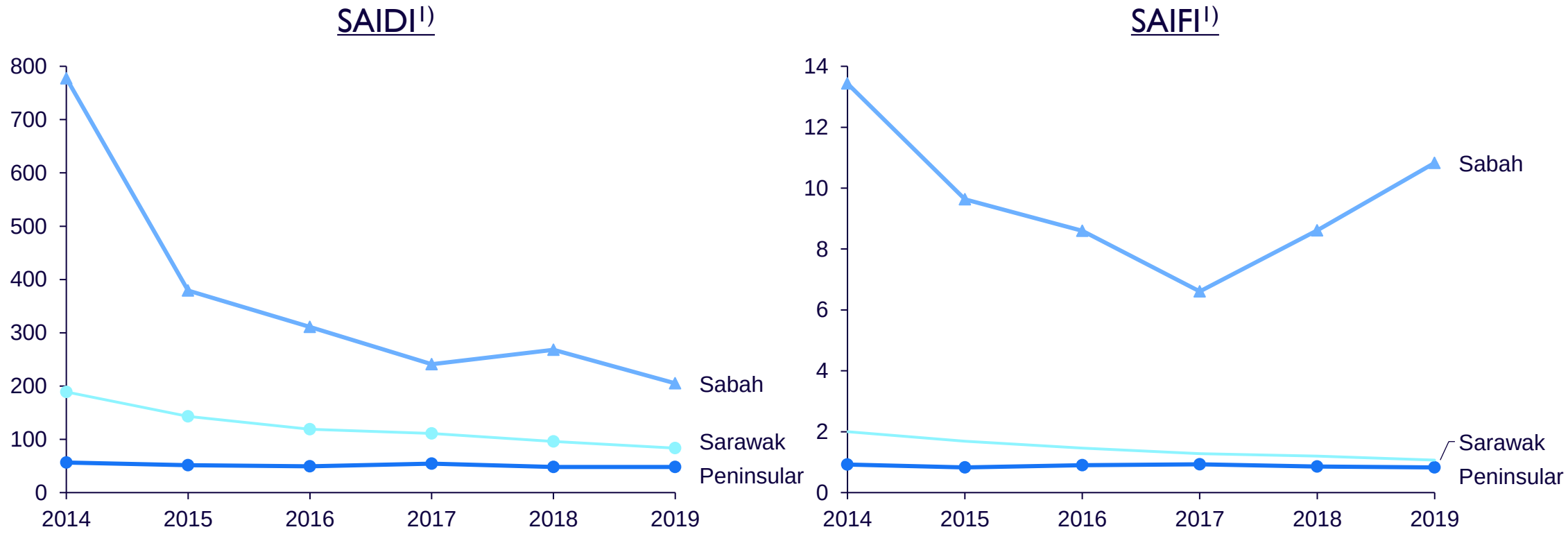
(Score over 7, 2017)



Source : World Bank Global Electrification Database

マレーシアの中ではマレー半島の電力品質が最も高く、サバ州が最も低い

Malaysia Electricity Quality Index (By Region, 2014-2019)



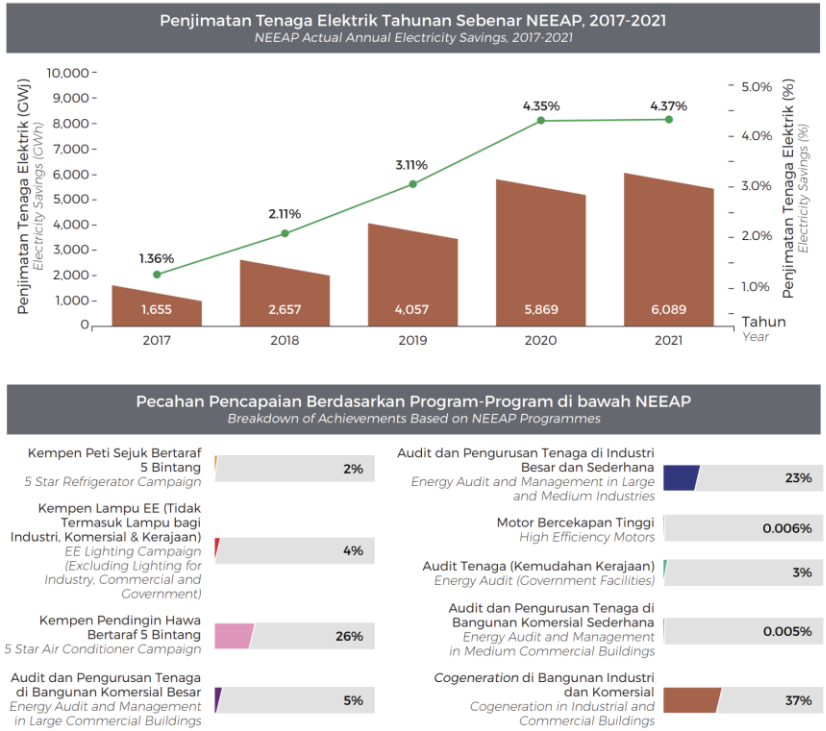
[1]System Average Interruption Duration Index (Minutes/Customer/Year)
[2]System Average Interruption Frequency Index (Number of Interruptions/Customer/Year)
Source: Performance and Statistical Information on the Malaysian Electricity Supply Industry 2019

省エネプロジェクトにより、4.37%の省エネを達成

Initiatives of National Energy Efficiency Action Plan (NEEAP)

KEY	INITIAVE	REMARKS
1	**Promotion of 5-Star Rated Appliances**	Labelling of appliances is an effective tool to inform consumers about the energy consumption of the goods. Labels have already been applied for refrigerators, fans, air conditioners and TV's. Promotion of 5-star rated appliances based on the labeling is the main focus in this initiative.
2	**Minimum Energy Performance Standards (MEPS)**	The MEPS will set the minimum energy performance for energy consuming equipment to be sold in the market. By introducing MEPS to equipment, it can ensure that low efficient technologies are not dumped in the market. Currently, MEPS has been introduced for refrigerators, fans, air conditioners, televisions and lamps. MEPS will be extended for more equipment under the NEEAP.
3	**Energy Audits and Energy Management in Buildings and Industries**	Energy audits are consultancy services for identification of energy saving potentials in facilities. It has been demonstrated in earlier studies that savings of 10% or more are readily available at low or no cost, just by introducing better practices and reducing leaks etc. Energy audits and energy management will be done in commercial buildings and industries. As a kick start activity, Government facilities will be subject to energy audits and energy management as well.
4	**Promotion of co-generation**	As co-generation can have high thermal conversion efficiencies, it will be promoted. This will be done by reducing barriers to an increased uptake of co-generation process, including by having revised top up and standby rates for co-generation installations.
5	**Energy Efficient Building Design**	For new buildings, programme will be undertaken to demonstrate energy efficient design features. This will be in the form of demonstration and show-case projects within various building types e.g. offices, shopping centres, hotels and dwellings, development of guidelines and enhancement of the uniform building by-laws.

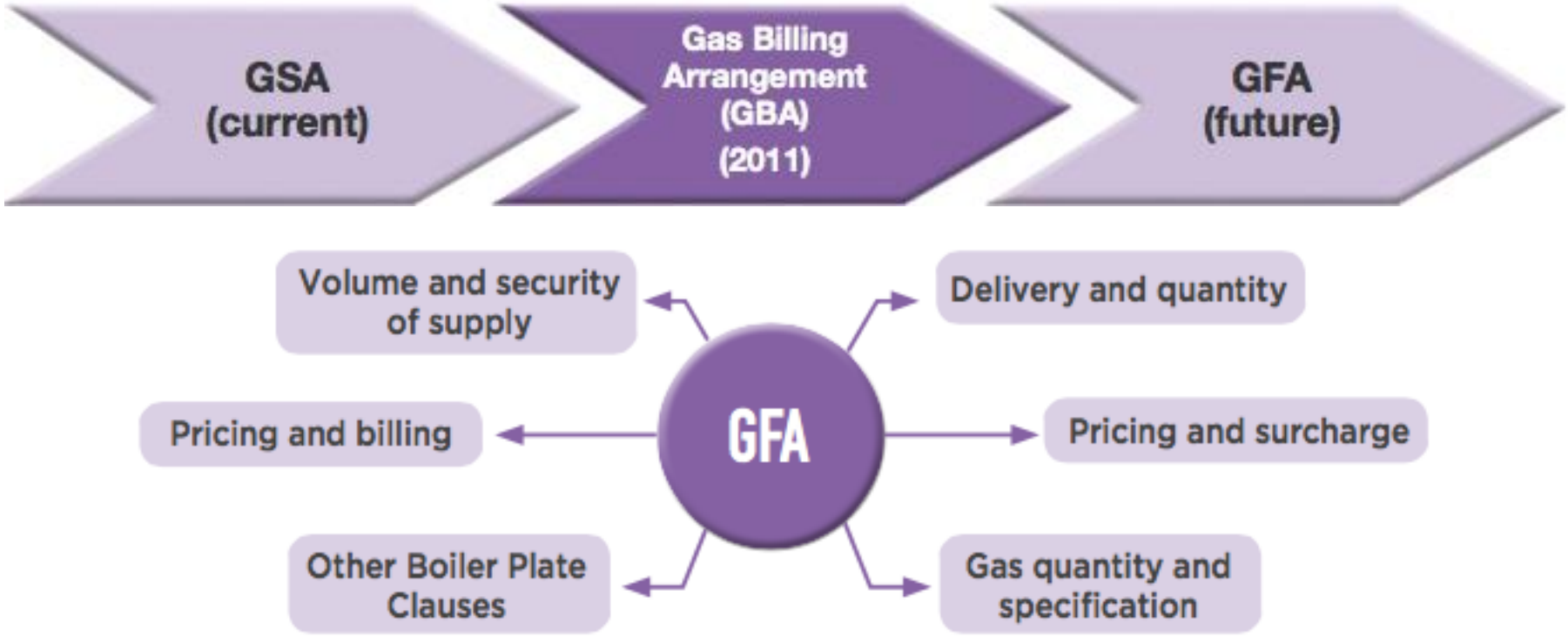
Result



Source:Suruhanjaya Tenaga Energy Comission, 2016

Industry Reform initiatives

GSA and Gas Framework Agreement (GFA) Relationship



Source : Suruhanjaya Tenaga Energy Comission, 2016

修正された電力供給に関する指針（Act 2015）は電力品質を改善するためのものであり、需要家に対して安全・安定な電力供給を約束し盗難などに対する懲罰を強化している

Penalties for the most serious electricity-related offences

Offence	Penalties (*Electricity Supply Act 1990*)	Penalties (*Electricity Supply (Amendment) Act 2015*)
Tampering / adjusting any electrical installation, or manufacturing / importing / selling equipment that may endanger other people or property	RM100,000 fine / 5 years of imprisonment / both penalties	RM1,000,000 fine / 10 years of imprisonment / both penalties
Causing damage to any person or property, through either rash action or negligence	RM50,000 fine / 3 years of imprisonment / both penalties	RM100,000 fine / 5 years of imprisonment / both penalties
Illegal consumption of electricity / tampering or preventing normal operation of electricity meters	RM100,000 fine / 3 years of imprisonment / both penalties	**Domestic consumers:** First offence: RM1,000 – 50,000 fine / 1 year of imprisonment / both penalties Second and subsequent offences: RM5,000 – 100,000 fine / 3 years of imprisonment / both penalties **Non-domestic consumers:** First offence: RM20,000 – 1,000,000 fine / 5 years of imprisonment / both penalties Second and subsequent offences: RM100,000 – 5,000,000 fine / 10 years of imprisonment / both penalties

Source: mltic.my

Source: Electricity Supply (Amendment) Act 2015

8 送電網

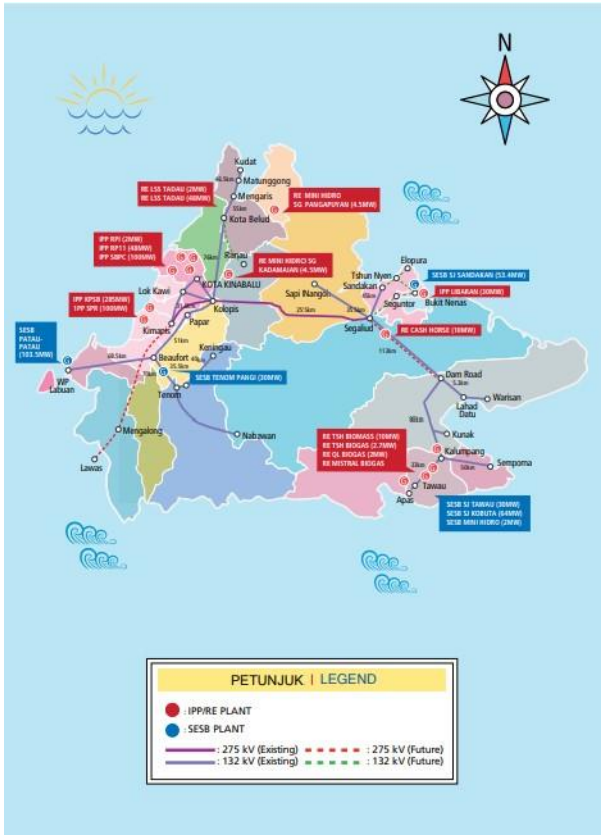
Industry reform initiatives

Power Transmission Lines(Peninsula）

Source: Performance and Statistical Information on the Malaysian Electricity Supply Industry 2019

サバ州、サラワク州では500kV送電線は利用されていない

Power Transmission Lines(サバ)



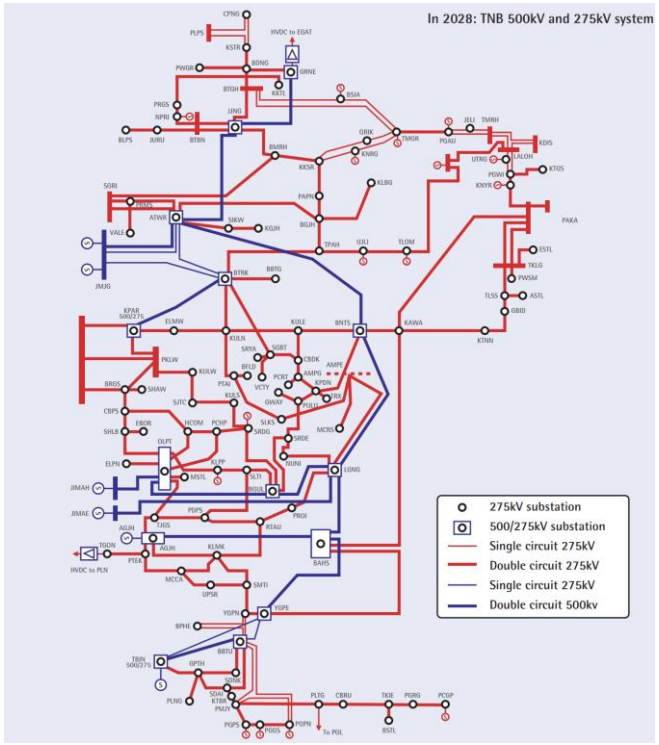
Power Transmission Lines(サワラク)

Source: Performance and Statistical Information on the Malaysian Electricity Supply Industry 2019

マレーシア本島では電力需要の中心である中部に向け北部/南部からの送電網を整備する計画

2018-Five year Plan

2018-Ten year Plan

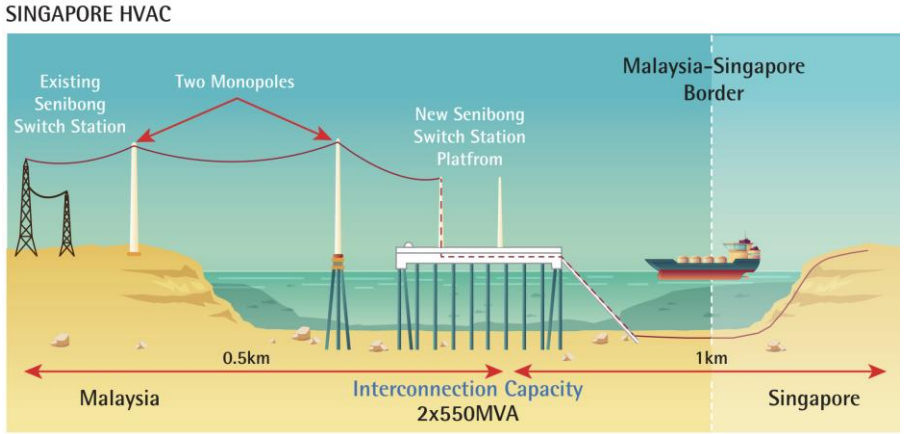


Source: Peninsular Malaysia Electricity Supply Industry outlook2019

ASEANのグリッド構築として、シンガポールとのナショナルグリット連結や、ラオス・タイとの3カ国電力取引網を構築

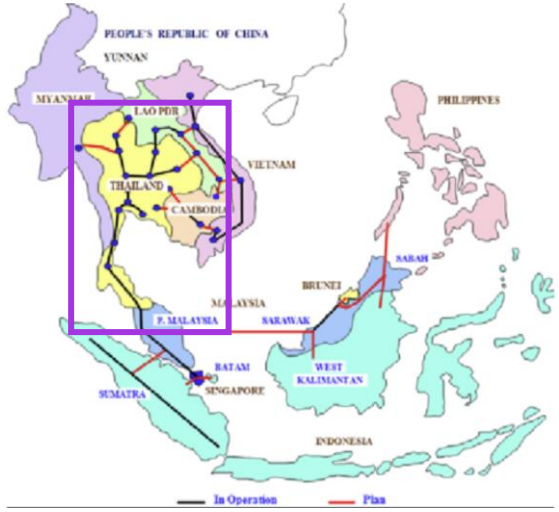
With シンガポール

- In the South, theNational Grid is connected to Singapore's transmission systemat Senoko via two 230 kV submarine cables.



With ラオス・タイ

Malaysia also supportsASEAN Power Grid initiatives.The success story of the LTMinterconnection proves that multilateral power trading underthe ASEAN Power Grid study can turn into real implementation.As per 2018's record, Malaysia received around 16GWh of powerfrom Lao PDR via Thailand under a non-firm arrangement.



Source:各種2次情報よりADL作成

TNBは2015年に向けて、電力供給安定化（送電ロス・停電等の低減）に向けた技術革新に取り組み

Key Action Plans under the five year Gemilang 2015

1. *Enhancing supply reliability via Zero Tripping Action Plan (ZTAP) & Critical Installation Maintenance (CRIM) Initiatives*
   - *These initiatives are to mitigate the strategic risk of inability to fully ensure reliability and quality of supply as to maintain low system minutes. The activities focused on refurbishment and replacement of ageing and problematic equipment that have been identified at critical installations, for instance ;replacement of earthing transformer, surge arrester, wooden to composite arm and under-rated capbank tuning reactor, transformer oil reclamation, installation of anti-theft lock nut, and replacement of static and electromechanical relay.*
2. *Enhancing supply reliability via the development and implementation of pilot Smart Grid–Wide Area Intelligence System (WAIS) to maintain zero major disturbance*
   - *Fully completed and operational 3 out of 6 key activities:*
     i. *Real time application platform: Intelligent processing unit capable of gathering data and able to make real time decision and perform automated control actions.*
     ii. *Advance overload protection scheme: Second level protection system to minimize the risk of cascading trippings.*
     iii. *Under voltage load shedding scheme: Intelligent under Voltage Load shedding using wide area information.*
3. *Reducing transmission losses by introducing low loss conductor:*
   - *6 projects have been identified and one is currently under implementation: 60-km-circuit length of 275kV overhead lines (OHL) Ulu Jelai-Tapah.*
4. *Deploying innovation and proven technology through the International Electrotechnical Commission Standard IEC 61850 based Substation Protection Automation and Control System (SPACS)a*
   - *Successfully commissioned the following:*
     i. *Real Time Digital Simulator (RTDS) with IEC 61850 Interface and Digital Teleprotection Simulator as the testing facilities to test the SPACS*
     ii. *IEC 61850 based Substation Intelligent Management System (61850 SIMS) as a component of SPACS*
     iii. *Awarded the IEC 61850 SPACS pilot project in a transmission substation at PMU Kajang Estate 132/33kV GIS*
   - *On building capacity, SPACS technical expert has been conducting a series of courses for transmission and distribution protection engineers using the IEC 61850 System Verification & Simulation laboratory (IEC 61850 SVS Lab) at TNBR.*

Source: TNB annual report 2012

List of the planned transmission line projects and the main construction companies

List of the planned transmission line projects in Malaysia

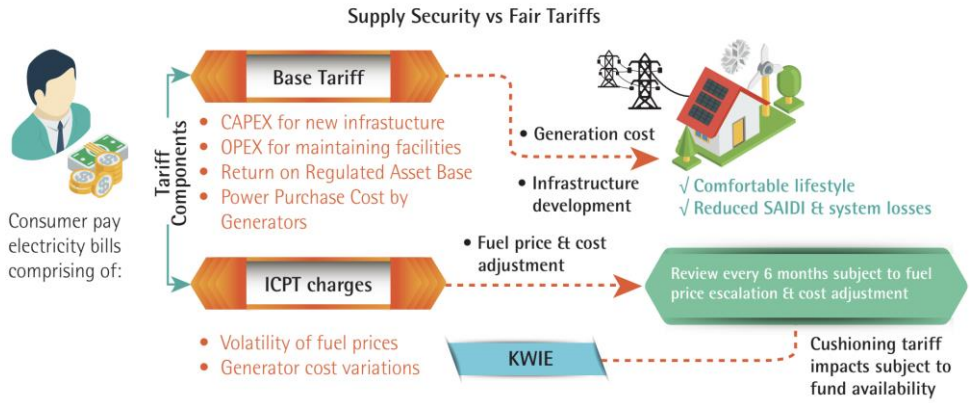
#	Project Name	Value (USD mn)	Size	Owner	Construction Start	Status
1	Backbone Transmission Project, Sarawak (Lachau - Tondong)		500 kV	Trenergy Inc[Construction]{Canada},Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia},Sinohydro Corporation[Construction]{China}	2019	Under construction
2	Backbone Transmission Project, Sarawak (Mapai - Lachau)		500 kV	Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia},Sinohydro Corporation[Construction]{China},Trenergy Inc[Construction]{Canada},Hunan Tengda Electric Power Construction Co. Ltd.[Construction]{China}	2019	Under construction
3	Melaka - Pekanbaru Interconnection Project, Interconnection, Malaysia - Indonesia	200	600 MW	Perusahaan Listrik Negara (PT PLN)[Sponsor]{Indonesia},Tenaga Nasional Berhad[Sponsor]{Malaysia}		At planning stage
4	Sarawak - Brunei-Muara Interconnection Project, Interconnection		50 MW	Sarawak Energy Berhad (SEB)[Sponsor]{Malaysia},Department of Electrical Services of Brunei[Sponsor]{Brunei Darussalam}		At planning stage

Source: BMI Key Power Projects Database (latest revision 22nd May 2023)

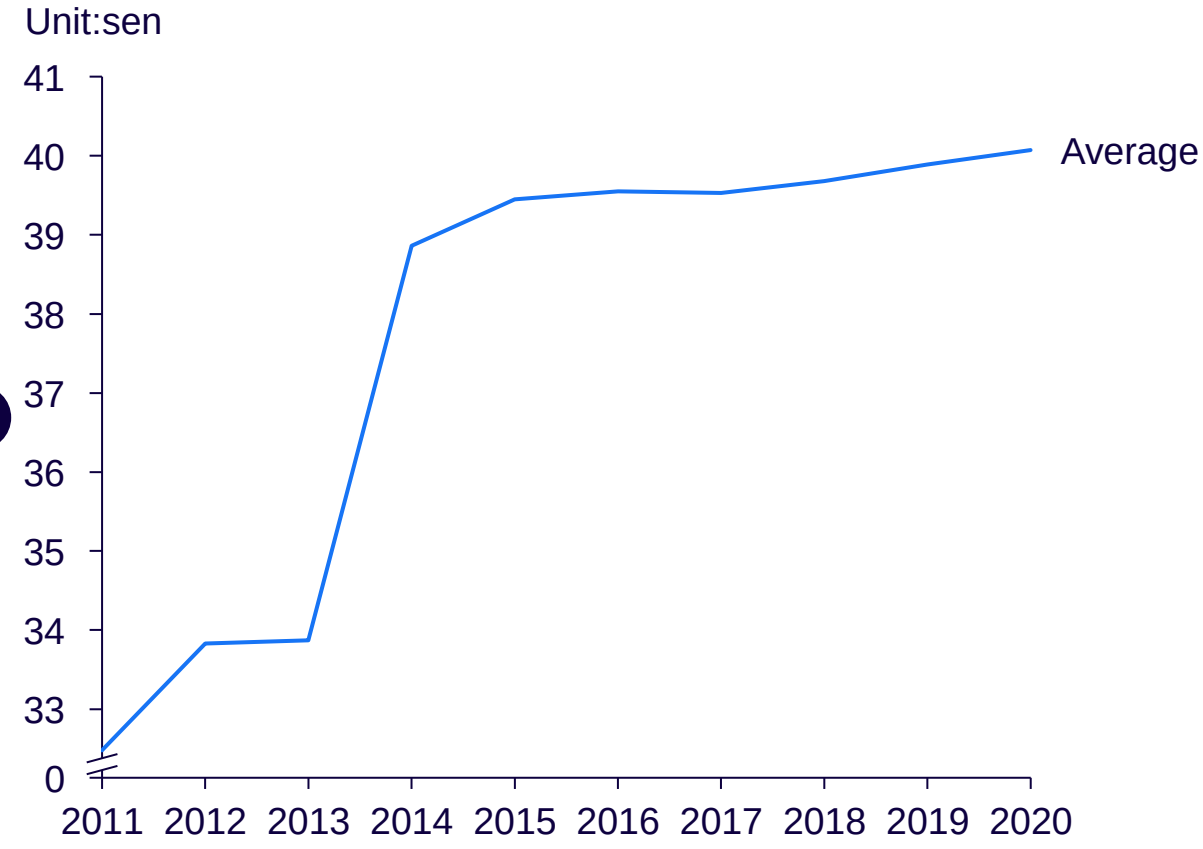
9 電力料金

原料価格に応じて、ICPTが変動。近年は電力料金は上昇傾向

Electricity Tariff Logic



Electricity Tariff Trend



Source:Malaysia Energy Statics Handbook2021

電力料金はICPTが採用されており、近年の原料価格高騰を受け価格が大幅に上昇(大規模需要家向け)

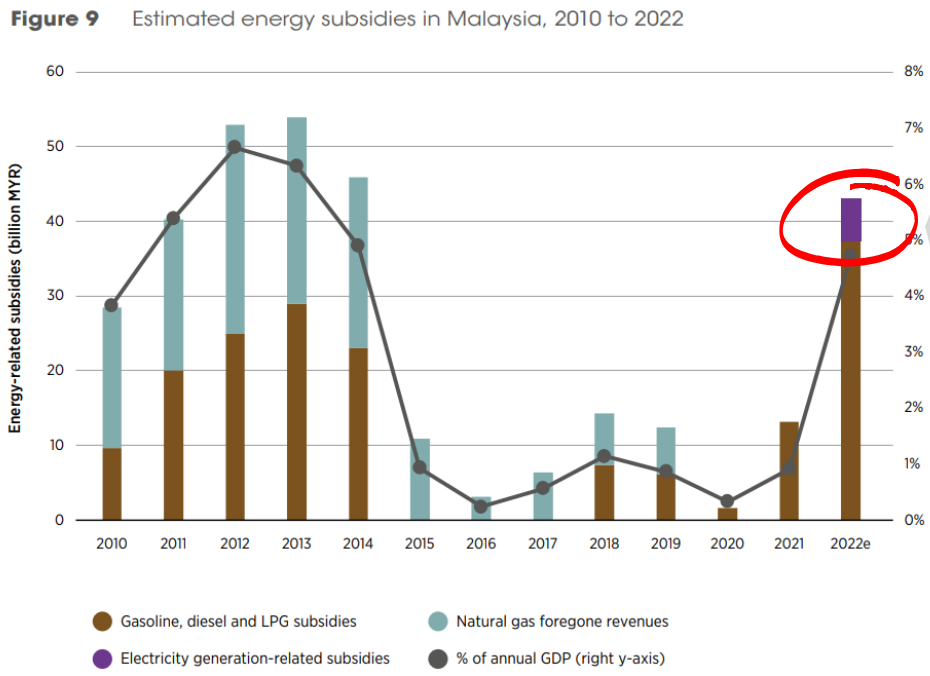
Electricity Tariff

- In January 2014, a pass-through mechanism was introduced that adjusts electricity tariffs every six months, which is called Imbalance Cost Pass-Through (ICPT), to reflect changes in fuel costs and allow other fixed costs to be recovered. The ICPT mechanism also allows industries to respond positively to price fluctuations in the international market. This works in both ways where when the fuel prices are low such as during the early months of 2020, consumers enjoy considerable amounts of ICPT rebates. However, if the fuel prices spike, the additional costs trickle down to the consumer through the ICPT mechanism.
- Malaysia has also been reforming electricity prices, while making sure that power remains affordable for low-income households on a targeted basis.
- A surcharge of 20 cents per kilowatt-hour (kWh) will be imposed on medium- and high-voltage contracts (large-scale electricity users), such as large factories and large buildings, starting January 1.The surcharge of 2 cents per kilowatt-hour for general consumers will be maintained. In addition, the existing surcharge of 3.7 cents per kWh will be maintained for farmers, livestock producers, restaurants, grocery stores, bakeries, small factories, and other commercial and industrial businesses. Therefore, more than 90% of electricity users in the Malay Peninsula will not be affected by the price increase.Minister Nick explained that 10.76 billion ringgit in subsidy costs will be contributed to maintain the electricity tariff, and that 4.16 billion ringgit will be saved by setting the surcharge for large electricity users, which can be used for another subsidy..
- In past, the government indirectly subsidies electricity by regulating the price of natural gas, a primary source of electricity generation. When the utilities had racked up big losses when shortages of domestically produced natural gas supplied at regulated prices required them to switch to more expensive LNG imports, distillates or fuel oil to run power plants.

Source: Tenaga Nasional Berhad, Energy Watch

燃料価格増に対応すべく、電気料金への補助金を投入

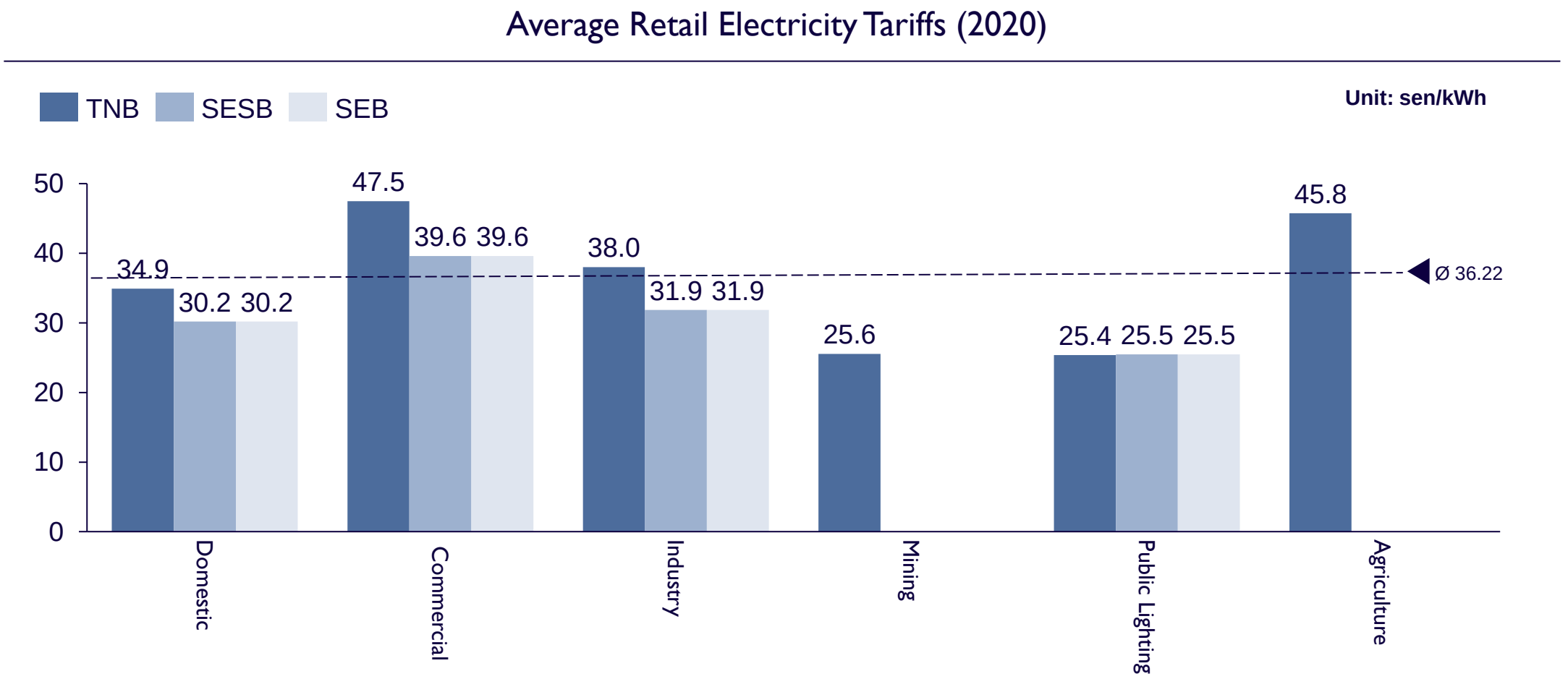
Subsidy for Electricity in Malaysia



In the first half of 2022, Malaysia experienced a significant rise in fuel and coal prices, which form a major part of the country's electricity generation mix. International coal prices, particularly from Malaysia's largest supplier, Indonesia, nearly doubled from the previous year, reaching US$320 per metric ton in June. To address this situation, the Malaysian government decided to continue implementing subsidies for electricity tariffs. In January 2022, they announced a tariff surcharge of 3.7 sen per kilowatt hour (kWh) for non-domestic users, while maintaining a two sen rebate for domestic users, covering the period from February to June 2022. In total, the government committed to subsidizing RM5.8 billion to offset the increased costs in fuel and generation.

Source: Malaysia Energy Transition Outlook, TheEdgeMalaysia

小売電力料金は供給者や需要家によって異なる



Source: Malaysia Energy Statistic Handbook 2021

SEDAによって設定されたFITは、太陽光発電・バイオマス・小水力発電に適用される

Feed in Tariff

Mechanism	Year Started	Lead Organization	Program Specification	Key Insights
Feed-in Tariff (FiT) - Solar	2011	seda	• MYR 0.50 - 1.77/kWh • 4 kW - 30 MW • 21 years	• Discontinued in 2017 and replaced by both LSS, SELCO and NEM • Only P. Malaysia and Sabah
Feed-in Tariff (FiT) - Biomass	2011	seda	• MYR 0.27 - 0.31/kWh • Up to 30 MW • 21 years	• Includes agriculture residues: palm oil and rice husk and straw • PPA revised to 21 years from 16 years in December 2019
Feed-in Tariff (FiT) - Biogas	2011	seda	• MYR 0.27 - 0.32/kWh • Up to 30 MW • 21 years	• In 2019, PPA tenure period extended from 16 years to 21 years • FiT rate offered for agriculture waste and landfill waste
Feed-in Tariff (FiT) - Waste To-Energy (WTE)	2011	seda	• MYR 0.27 - 0.31/kWh • Up to 30 MW • 21 years	• Effective 2019 new WTE projects who wishes to apply for FiT can apply under Biomass FiT (w/o use of solid waste as fuel source bonuses) • Government to implement auction/bidding system for WTE projects started in 2020 by KPKT
Feed-in Tariff (FiT) - Small Hydro	2011	seda	• MYR 0.23 - 0.29/kWh • Up to 30 MW • 21 years	• No degression rates due to long gestation period • FiT rate for low head and high head introduced in 2019
Large-scale Solar (LSS)	2016	Suruhanjaya Tenaga Energy Commission	• MYR 0.17 - 0.45/kWh • 1 - 100 MW • 21 years	• 3 auctions completed • 4th LSS released in 2020 with system size capped at 50 MW • Only P. Malaysia and Sabah
Solar Net Energy Metering (NEM)	2016	seda, Suruhanjaya Tenaga Energy Commission	• Based on consumers retail tariff • Up to 5 MW per applicant subjected to respective sectors • 10 years (one to one offset)	• Cumulative of 1 GW capacity to promote rooftop solar market • Revision of compensation rate to 'one-on-one offset' for 10 years in 2020 to induce uptake • Implementation of VNM allowing excess energy to be exported to designated premises under wholly owned subsidiary company • Only P. Malaysia
Solar Self-consumption (SELCO)	2017	Suruhanjaya Tenaga Energy Commission	• Tariff not applicable for SELCO • 75% of max demand / 60% of fuse rating • No tenure period	• Regulation began in 2017 but activity started before 2017 • SELCO replaced NEM in Sabah starting 2019

• FiT rate / ave. winning bid / tariff rate • System size • Tenure / period

移行

Detail

LSS

大規模太陽光発電プラン トのエネルギーコスト削減を目的として、大規模太陽光発電（LSS）競争入札制度が導入さ れている

NEM

- 太陽光発電のネットエネルギーメータリング（NEM）制度は、2018 年後半に導入された。 この制度は、太陽光発電による発電量から自家消費量を差し引き、余剰電力を国営電力会社 のテナガ・ナショナル社（TNB）に売電するもの
- ネットエネルギーメータリング制度において、最も顕著な成長を遂げているのは屋上太陽光発電（自家消費後の売電が可能）

SELCO

太陽光発電を自家消費目的で行い、余剰 分をグリッドに流せないケースに適用される。政府は個人、商業分野、工業分野の消費者が自家消費を目的に太陽 光発電システムを設置することを奨励

Source： MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

大規模発電用にLSSプロジェクトとして4度入札が行われてきたが買取価格は年々低下

LSS

Price

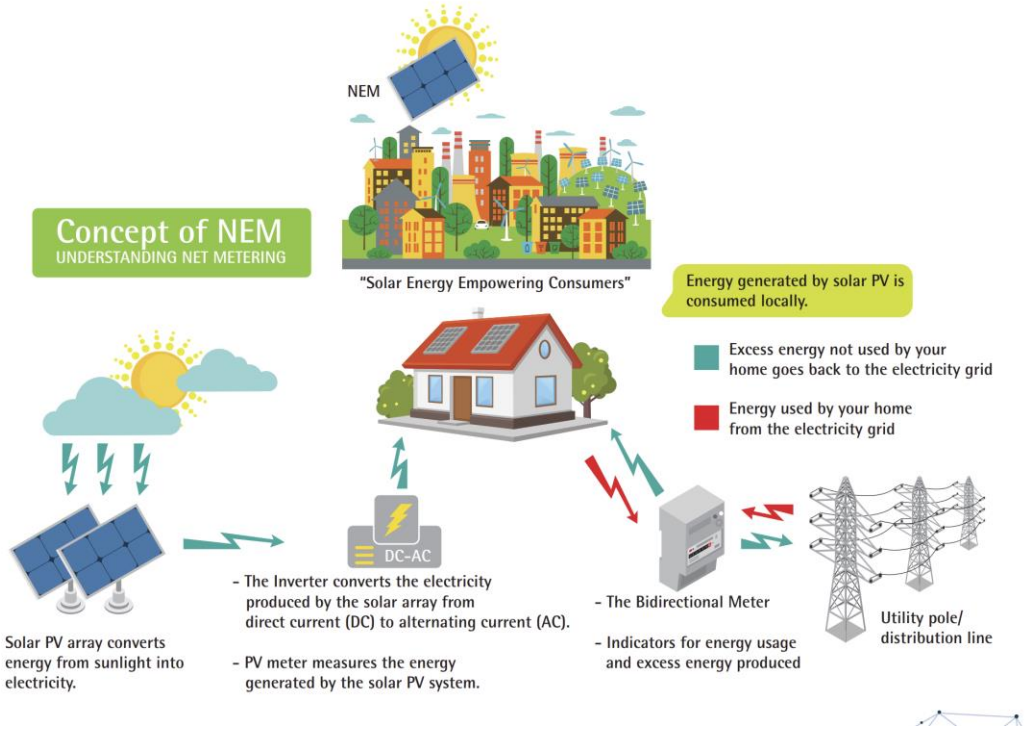
- LSS 1 was held in 2016 for 371 MW with the lowest bid submitted at MYR 0.39 / kWh[69];
- LSS 2 was held in 2017 for 526 MW with the lowest bid submitted at MYR 0.34 / kWh, a 13% reduction from LSS 1;
- LSS 3 was held in 2019 for 490.88 MW with the lowest bid submitted at MYR 0.17 / kWh, a 50% reduction from LSS 2[70]; and
- LSS 4 was held in 2020 for about 1,000MW with the lowest bid at MYR 0.1399 / kWh, a 18% reduction from LSS 3.

Source：MyRER – Renewable Energy Malaysia (seda.gov.my) @2021

2016年にマレーシア政府はNEM方針を打ち出して、需要家が太陽光発電を自家発電用に導入しやすいようにしている

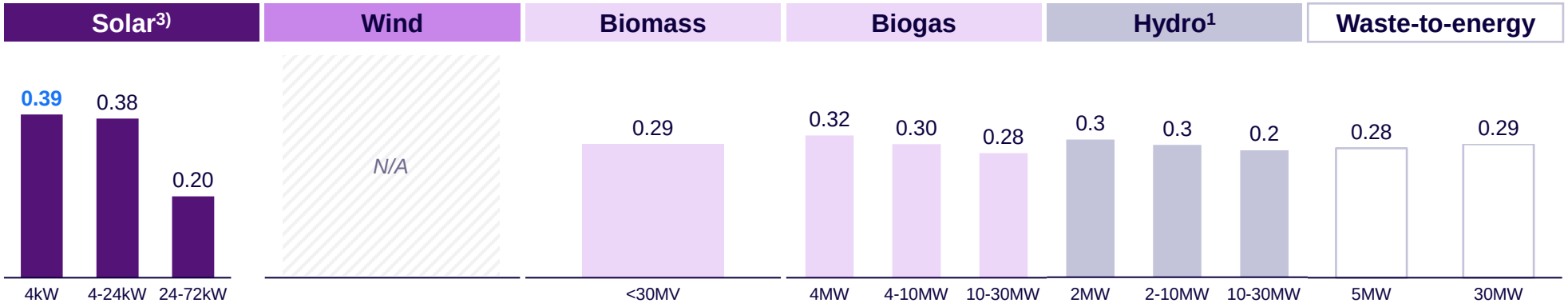
Net Energy Metring (NEM)

- As PV prices continue to fall, and electricity tariffs rise, it will make sense for more consumers to reduce their bill and hedge further increases in tariffs by installing PV on their rooftops, either on their own, or through PV leasing companies;
- Once a certain level of PV penetration under NEM is reached, utility can be allowed to charge a fixed monthly amount to NEM consumers to compensate for the capital expenditure on the Grid connection;
- Loss to the utility due to reduction in sales will also be compensated by reduction in utility costs due to reduced T&D losses;
- The nation will gain due to reduction in use of subsidized gas, as well as some energy some energy security and autonomy;
- Therefore, from commercial aspects alone, there will be a high penetraten of PV under NEM mechanism;
- Technological issues to the Grid arising from high penetration of PV have well-established solutions.



Source: Sustainable Energy Development Authority (SEDA) Malaysia, Peninsular__Malaysia_Electricity_Supply2019

FIT価格は以下の通り



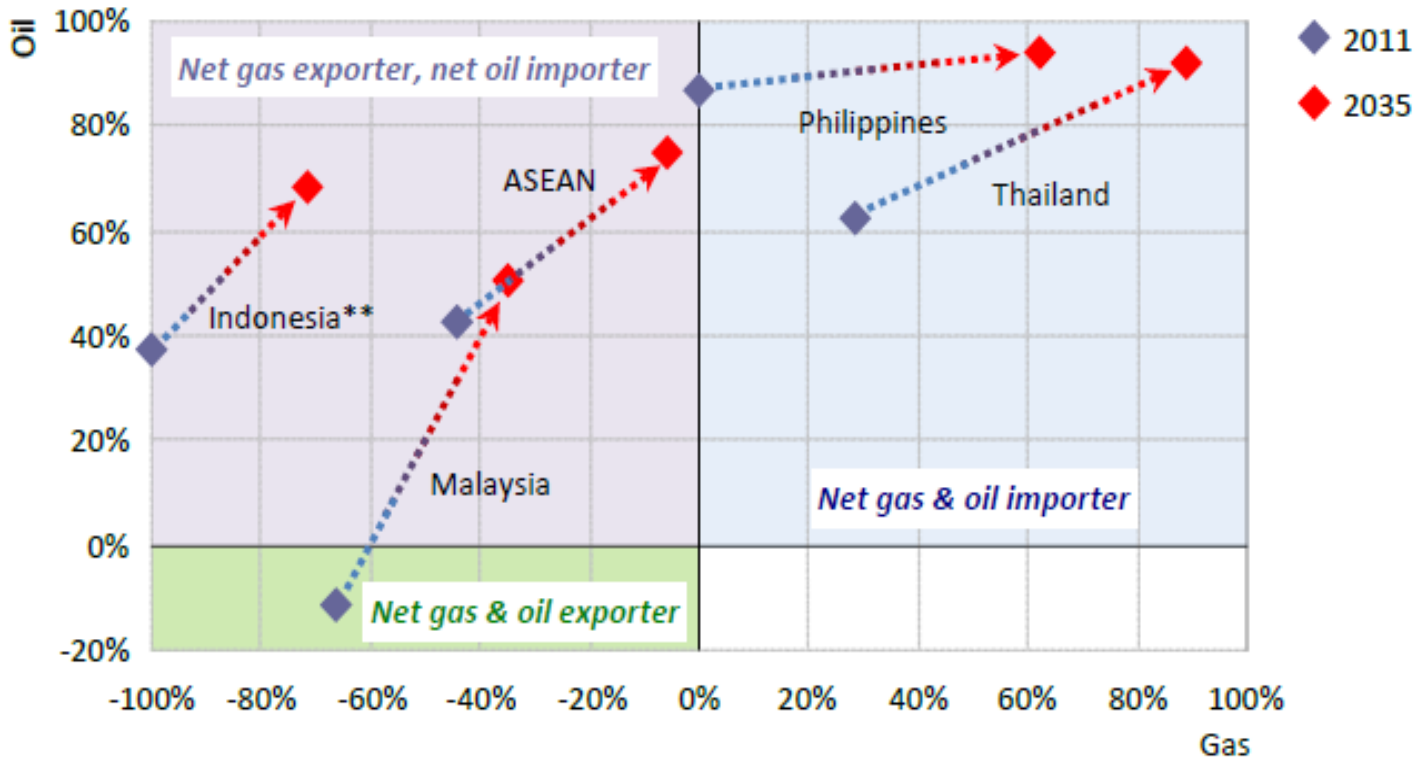
	Solar[3]	Wind	Biomass	Biogas	Hydro[1]	Waste-to-energy
Corporate tax incentives	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**	• **Tax allowance of 100%** of capital expenditure incurred • **Income tax exemption of 70%**
Import duties	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment	**Exemption** on machines and equipment
Additional incentives	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	**Green Technology Financing Scheme** with guaranteed value of USD 700k	• **Green Technology Financing Scheme** with guaranteed value of USD 700k • Financing increased to 80%

Note:[1]Small hydro; [2]Bonus FiT rates given if meet additional criteria 3: solar Pv community
Source: SEDA(1/1/23), Tax Incentive Guidelines, ADL research

10 電力需給状況

マレーシアはASEANの中では天然ガスの主要輸出国

Net oil and gas import dependency in selected ASEAN countries

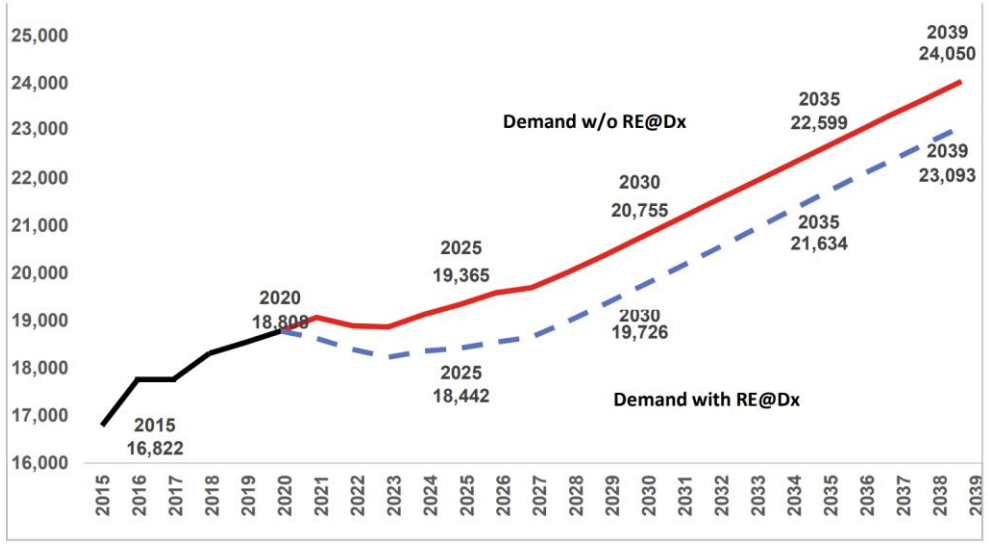


Source: IEA report (2013)

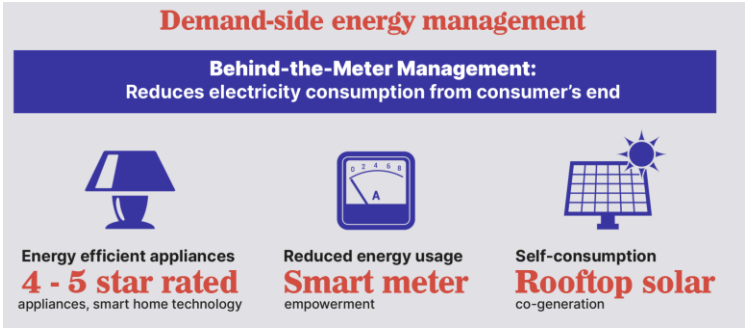
電力需要の増加に備え、需要家側の省エネ、創エネ、供給側のグリッド接続電源を拡充する

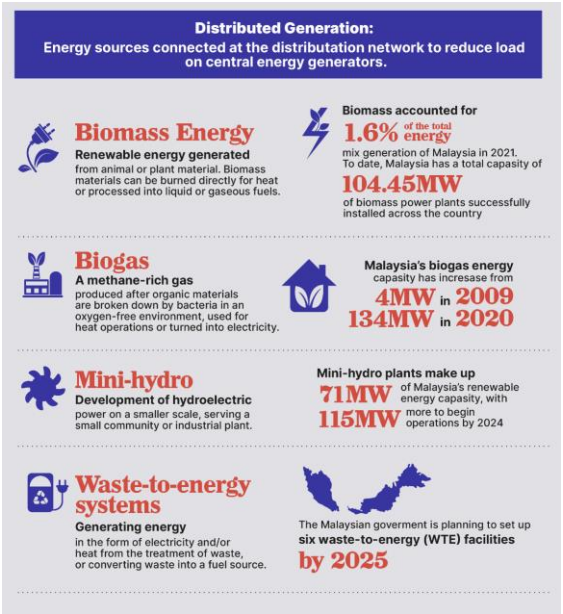
Peakdemand Forecast

- the netdemand is projected to grow by 0.6% p.a. for 2021-2030 and 1.8% p.a. for2030-2039. This net demand will be used for supply planning at thetransmission side.



Action





Source: Report on Peninsular Malaysia Generation Development Plan2020

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