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Role of Biomass in Energy Transition

‘A Low-Carbon Energy Transition in the ASEAN Region’
4th East Asia Energy Forum

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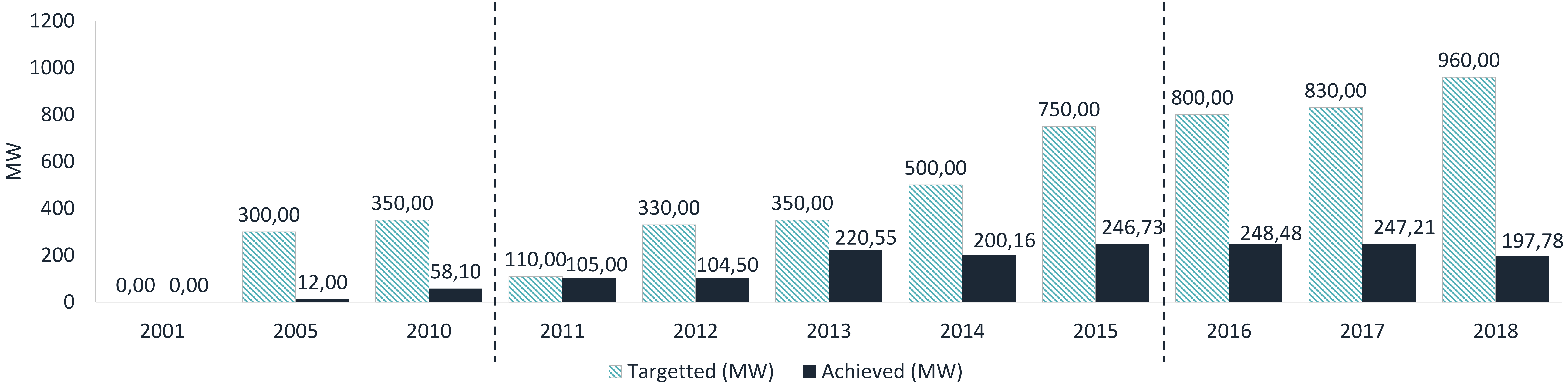
nergy Transition: Policy & Biomass Development in Malaysia

BIOMASS ROLE IN ENERGY TRANSITION

2001–2010	2011–2016	2017 and current
Policy development		
2001–2010 - Five-fuel Diversification Policy	2011–2015 – 10th Malaysia Plan	2016 – Net Energy Metering (NEM)
2001–2005 - 8th Malaysia Plan	2011 – Renewable Energy Act (Act 725)	2018 – Midterm review 11 Malaysia Plan
2001 - SREP Programme	2011- SEDA Act (Act 726)	2018 – NEM 2.0
2002 - UNDP-GEF Biogen Project	2011 – Feed-In Tariff Programme	2020 – NEM 3.0
2006 – 2010 – 9th Malaysia Plan	2011 – National Biomass Strategy 2020	2021–2025 – 12th Malaysia Plan
2009 – National Green Technology Policy	2016–2020 – 11th Malaysia Plan	2021 - RETR 2035
2010 – Economic Transformation Programme		
2010 - New Energy Policy		
Installed capacity (MW)		

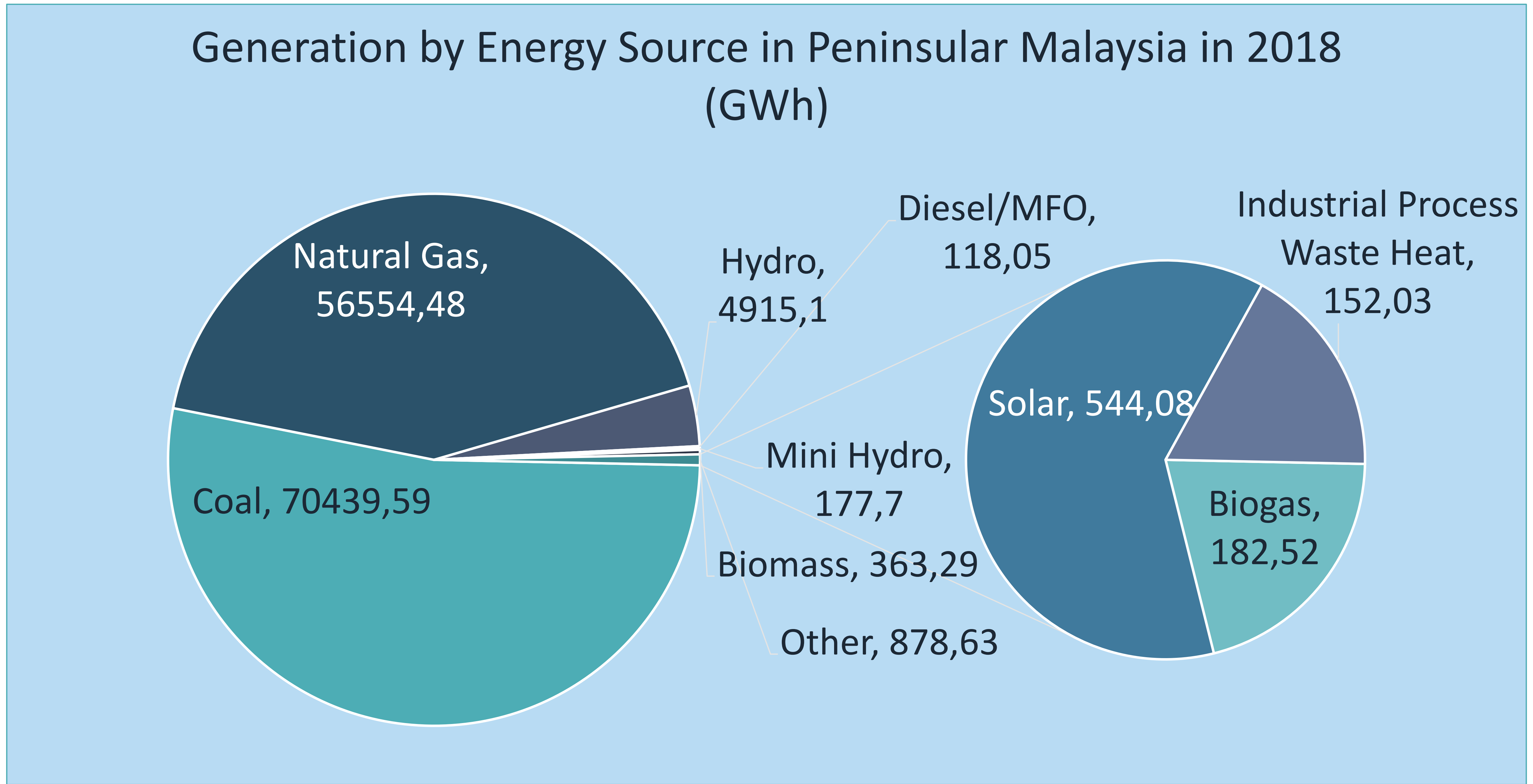
- The transition from SREP to the FiT has ensure continuance of long term investment security for RE investors.
- the government has revised the current plan to raise the national target of renewable energy in electricity generation mix to 31% by 2025 and 40% by 2035
- RETR 2035 is expected to be one of the 12th Malaysia Plan formulation game-changers from 2021 to 2025.



Source: Energy Commission Malaysia, 2011-2018. Sustainable Energy Development Malaysia, 2011-2018, Unit Perancang Ekonomi. RMKe-12, 2021-2025. Unit Perancang Ekon; 2021 F.S. Mohd Chachuli et al.

The Role of Biomass Energy in ASEAN & Malaysia

The IPCC stated that in order to keep global warming below 2°C and avoid the most dangerous consequences of climate change, GHG emissions must be reduced by 50- 85% by 2050 – and peak no later than 2015[4]



Malaysia's Biomass Installed Capacity (MW) 2018	
FiT	44.85
Private Co-Gen	12.41
Self Generation	296.05

- Malaysia currently has around 13.5GW (40%) of installed coal-fired capacity and its monthly coal-fired power generation averaged 9.3GW in 2020.

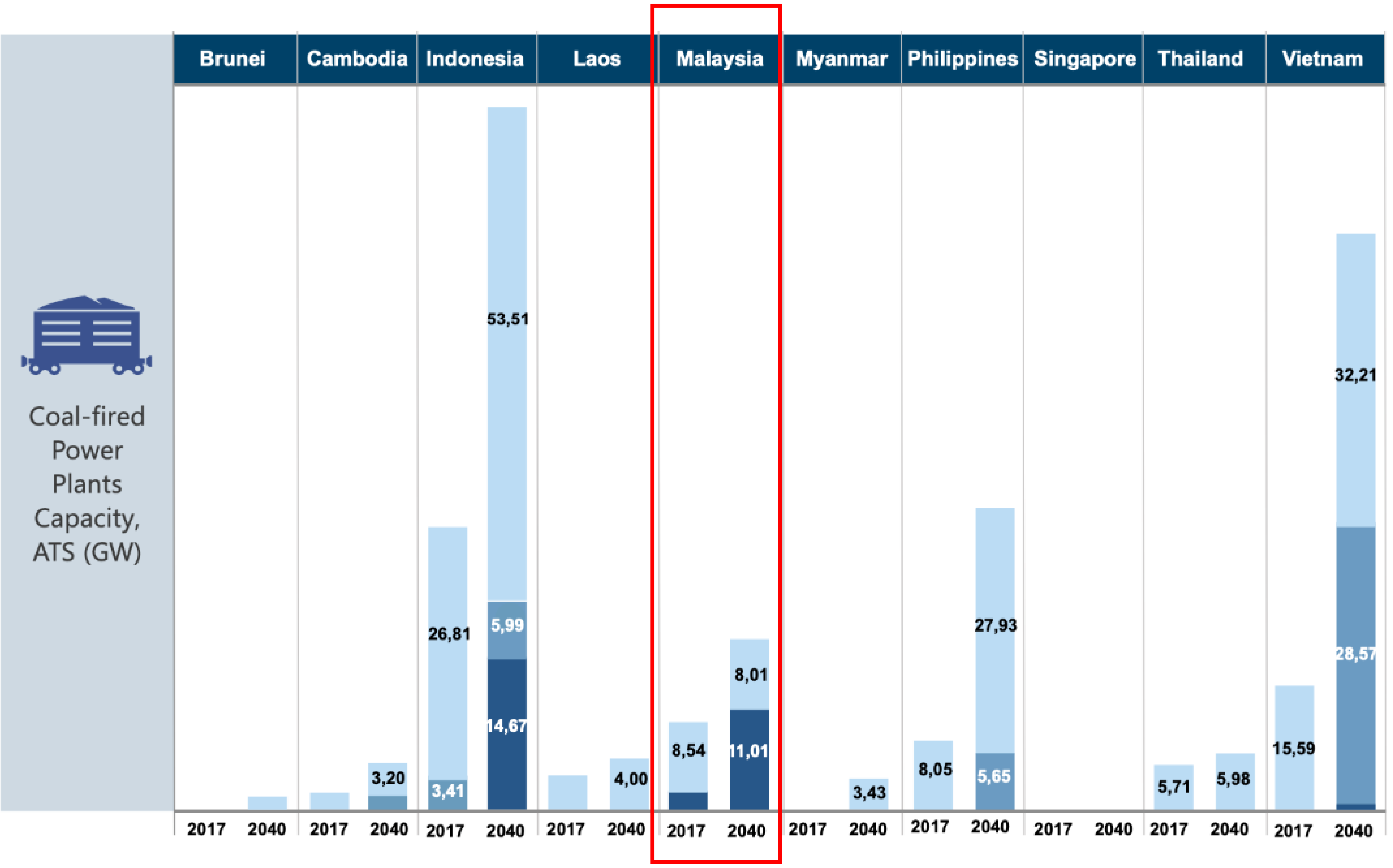
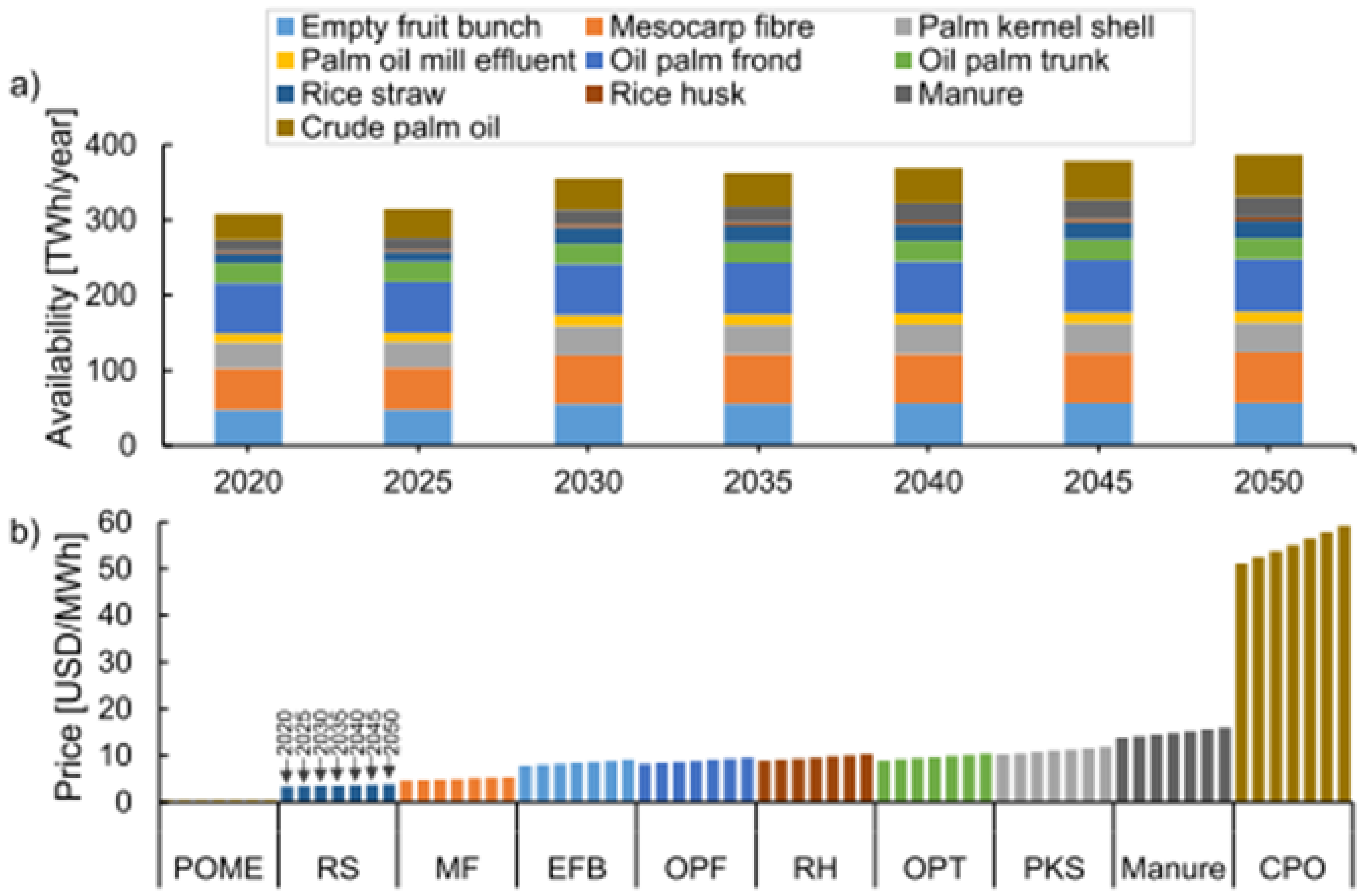


Figure 4 ASEAN Total Installed Capacity of CFPP under the ATS.

Source: (ACE, 2020)

Source: Fourth Assessment Report, the IPCC, 2020, Salleh et al., 2020

Bioenergy Feedstock in Malaysia



The types, availabilities, and prices of bioenergy feedstock

Estimated potential energy by biomass type					Power generation capacity (MW) for 7200 h operation		
Biomass type	Produced[a] (Million tonnes)	Dried[b] (Million tonnes)	Calorific value[b] (MJ/kg)	Total energy available (Million MJ)	Boiler efficiency		
					20%	30%	40%
Palm mesocarp fibre (PMF)	13.20	8.32	19.06	158,539	1223	1835	2447
Palm kernel shell (PKS)	5.38	4.73	20.09	95,096	734	1101	1468
Empty fruit bunches (EFB)	21.52	7.10	18.88	134,053	1034	1552	2069
Total					2991	4487	5983

Power generation potential of palm oil biomass (MW)

- Malaysia produces more than **103 million tons of biomass**, (agricultural waste, forest residues and municipal waste)
- Agricultural waste represents **91% of the biomass (most is derived from palm oil mill residues)**
- Malaysia is the 2nd largest palm oil producer (total plantation area of 5.6 million hectares, **485 mills to process > 98 million FFB in 2018**)
- The estimated installed capacity potential from biomass generated at the mills (empty fruit bunches (EFB), palm mesocarp fibres (PMF) and palm kernel shell (PKS) is between **2400 and 7460 MW** and **410 and 483 MW** for biogas from palm oil mill effluent (POME)

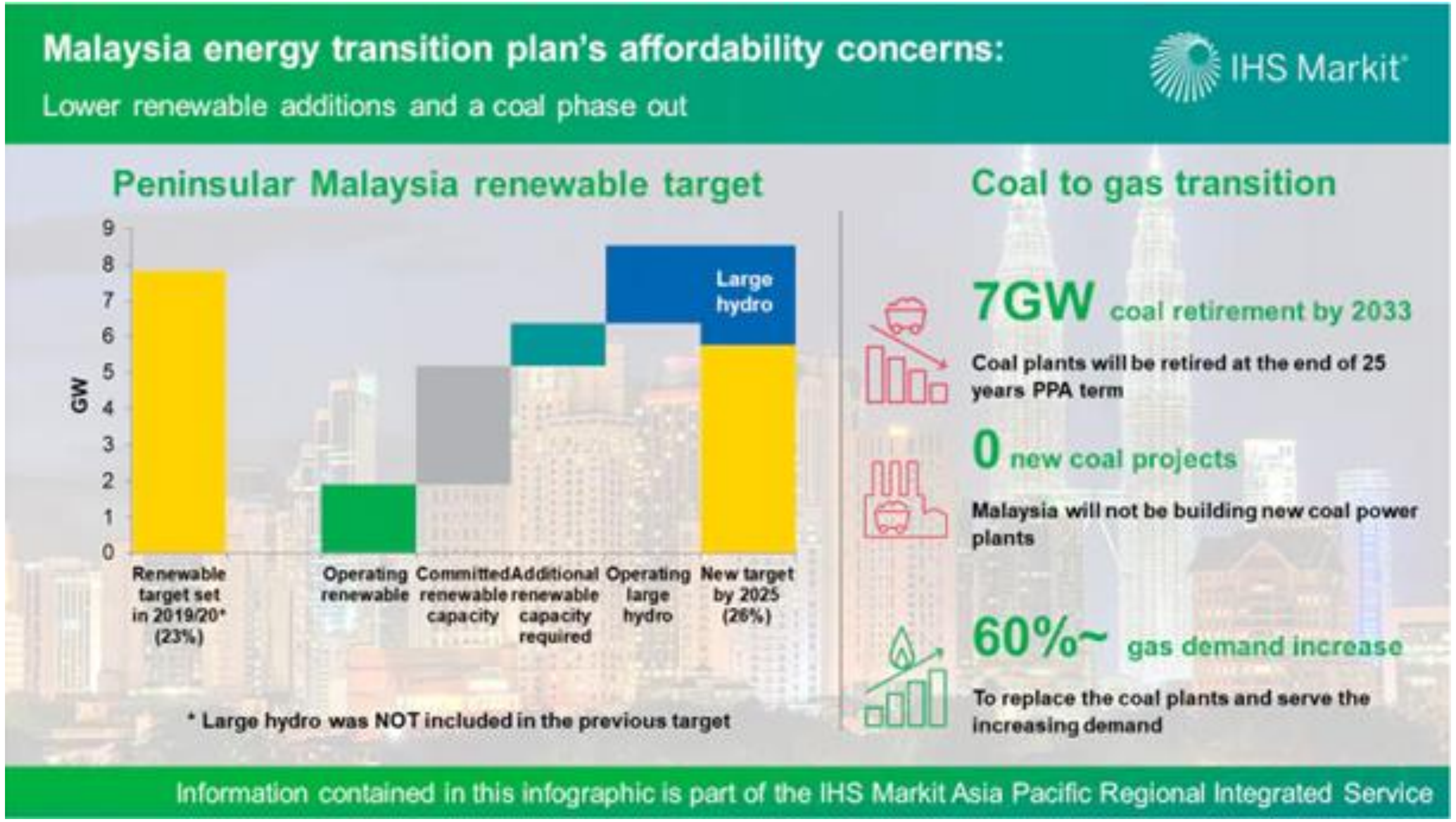
Source:
Mohd Idris MNM, Leduc S, Yowargana P, Kraxner F. Datasets and mathematical formulation of the BeWhere Malaysia model. https://dare.iiasa.ac.at/ 108/; 2020.
Salleh et al. Energ Sustain Soc (2020) 10:38 https://doi.org/10.1186/s13705-020-00269-y

Deployment of Biomass for Decarbonization

Enhanced Bioenergy Conversion Efficiency & Waste Management	Biomass Cofiring in Coal Power Plant	Biogas Conversion to Biomethane & Bio-Compressed Natural Gas (Bio-CNG)	Large-scale Biomass Power Plant

Malaysia to **reduce coal capacity by 4.2GW by 2039**

The Malaysian government plans to retire around **7GW of coal-fired capacity by 2039**, with Kapar Energy Venture's 1.5GW plant retiring in 2029, Tenaga Nasional Berhad's Janamanjung's 2GW plant retiring in 2030, Tanjung Bin Power's 2.1GW facility in 2031 and Jimah Energy Venture's 1.4GW unit in 2033.



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https://ihsmarkit.com/research-analysis/malaysias-new-energy-transition-plan-lower-renewable-capacity.html

Environment Impact & LCOE of Biomass Co-firing

- **Co-firing** offers **a fast- track, low-cost opportunity** to add renewable energy capacity economically.

- Co-firing biomass with coal at one typical coal-fired will replace almost **3,000 tons of coal per year**, could divert up to about **5,000 tons of bio- mass from landfills**, and will reduce net carbon dioxide **(CO_2) emissions by more than 8,000 tons per year**.

- **Payback periods** are typically between **one and eight years**, and **annual cost savings could range from $60,000 to $110,000** for an average-size boiler.
- These savings depend on the availability of low-cost biomass feedstocks.

Coal usage reduction (tons/yr)	Biomass used (tons/yr)	Annual CO_2 saving (tons/yr)
2,947	5,057	8,103

Feedstock	LCOE (USD/kW)	GHG (gCO_2 eq/kWh)
Wood chip	0.059	
Rice husk	0.053	
Corn stalk	0.056	
Low Co-firing	150	
Low Co-firing with CCS	1,038	
Medium Co-firing	139	
Medium Co-firing with CCS	1,027	
Retrofitting for 100% biomass	640	
20% biomass co-fired		742 ~ 750
20% biomass co-fired with CCS		-79 ~ -130

Notes:
- Industrial stoker boilers operating today.
- Assumptions for the average project were: 120,000 lb/hr steam capacity per boiler, 2 boilers at site, 15% heat from biomass, a 25% capacity factor.
- Depending on the source of biomass, "biomass used" could be avoided landfilled material.
- Carbon savings can easily be calculated from CO_2 savings (i.e., carbon savings = 12 / 44 x CO_2 savings).

Source: Federal energy management program

Co-Firing Ratio	g CO_2 Equivalent Emissions/kWh					
	Farmed Trees	with CCS	Switchgrass	with CCS	Forest residue	with CCS
0%	893	143	893	143	893	143
5%	861	90	864	93	862	77
10%	825	34	829	41	826	9
15%	783	−22	790	−12	785	−60
20%	742	−79	751	−65	744	−130
100%	61	−1449	121	−1345	7.9	−1818

Amanda D.C et al, Energies 2015, 8, 1701-1715; doi:10.3390/en8031701

Issue & Challenges of Biomass Co-firing

Poor fuel economy

Coal-biomass **co-firing is not very profitable** thus its reliance on policy support is high

Unstable biomass supply

Biomass collection, seasonal feedstock and purchase price is low

Negative effect on boiler

Low calorific value and high moisture biomass causing boiler combustion efficiency decrease

Imperfection of relevant supporting policies

Incentive policy for biomass co-firing, and **compensation mechanism for biomass consumption**. Electricity price policies of pure biomass power generation issued earlier. In terms of electricity, there is only a certain degree of policy inclination.

Difficulties in government supervision

It is **difficult to accurately measure the biomass fuel entering the boiler and biomass power generation** for the coal-biomass co-firing power generation technology

Monitoring & Verification

The Monitoring and verification will be critical components of any **large-scale deployment**

Governance

Appropriate governance and sequestration is critical because overly lax oversight would lead to ineffective CO_2 removal and loss of public confidence, while overly strict oversight would limit deployment

Technical Understanding

there is limited understanding of the kinetics of CO_2 uptake, long-term consequences of depositing crushed reactive minerals in agricultural soils, along the coasts, or into the shallow ocean

CCS Challenges in Malaysia

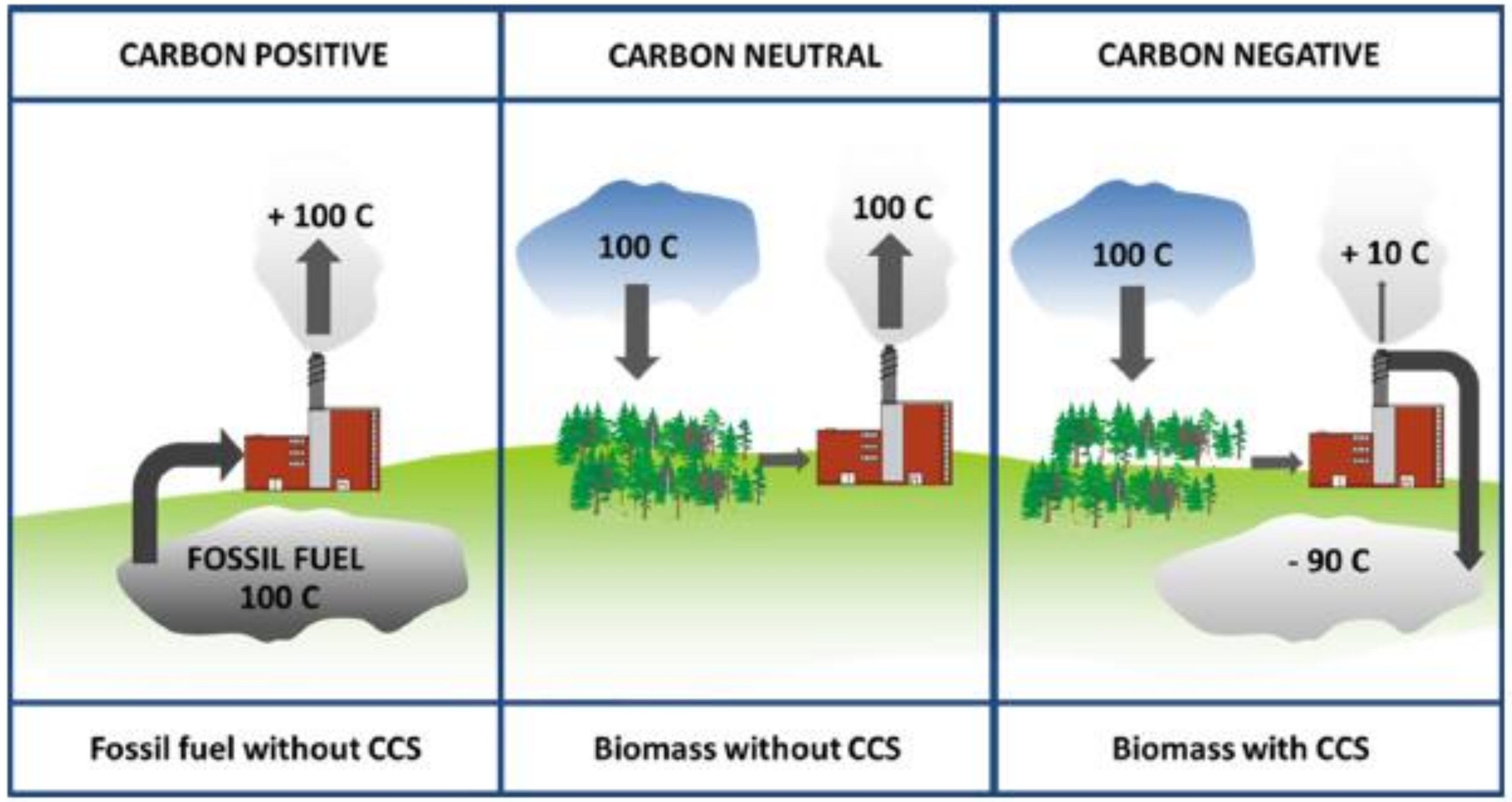
- The greatest challenge for CCS deployment in Malaysia is **funding**. In fact, state oil and gas producer, Petronas, sponsored one of the first applications for a CDM methodology for CCS.
- The Global GCCS Institute (GCCSI) has suggested that CCS will be of increasing interest to Malaysia, due to the resource and power industries that form the basis of its economy and the increasing CO_2 content of its remaining natural gas reserves.

The double counting measure: gives an administrative energy bonus and thus economic value to some biofuel production pathways, it has no budgetary impact

Binding blend-in target: an achievable sub-target for advanced biofuels would secure a market share. It would also reduce investment risk and lower competition with well-established biofuel production pathways

Tax incentives: could be implemented in the EU Energy Taxation Directive, which is currently under revision

Production support/feed-in tariff: initial fixed sales prices or fixed premiums help improve the business case for the investors that are needed to build the first wave of commercial-scale projects.



Policy Scenarios & Recommendation

Mandating Bio-CCS: Government would impose carbon taxes or standards to encourage shift from fossil fuel power Plant towards alternative fuels, such as biomass and carbon capture and storage system.

Funding Bio-CCS: Government should hand out resources to bio-CCS production by fixed payment rate on carbon Captured and stored, and guarantee a higher price for bio-CCS energy producers.

Persuasion of Bio-CCS: Government should convene multi-stakeholders and industry roundtable for bio-CCS transition Case through knowledge transfer and accreditation scheme to produce, distribute and advertise the technology.

- Optimize the biomass purchase system (**Initiate local and regional supply chain**, long fuel contract agreement, revision of PPA on biomass feedstock and power generation)
- Strengthen research on coal-fired coupled biomass power generation technology (**Proof of concept** – demonstration plant)
- Reasonably plan the **location of coal-biomass co-firing power plants** (nearby existing coal power plant)
- State support and supervision (**stakeholders engagement from various organisations**)

THANK YOU

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