Modeling Energy Transition in ASEAN

LTES Asia Webinar

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Zulfikar Yurnaidi
Manager, Energy Modeling and Policy Planning (MPP) Department

One Community
for Sustainable
Energy

ASEAN Centre for Energy (ACE) – Roles and Responsibilities

Intergovernmental organisation within ASEAN structure that represents the 10 ASEAN Member States' interests in the energy sector.

As a Think tank..

Conduct studies and provide policy recommendations

..Catalyst

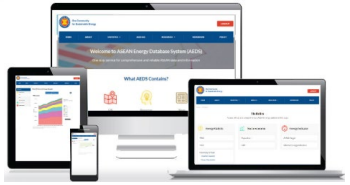
Collaborate with national, regional, and international entities

ASEAN+3 ASEAN+6 IEA ECCJ The Energy Conservation Center, Japan USAID FROM THE AMERICAN PEOPLE 한국에너지공단 KOREA ENERGY AGENCY

..and Knowledge hub

Data and knowledge repository and analysis

AEDS ASEAN Energy Database System



THE 6TH ASEAN ENERGY OUTLOOK 2017-2040

Implementing Agency of Regional Blueprint

ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025 Phase II 2021-2025

APAEC and the ASEAN Energy Outlook (AEO)

ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025 Phase 2: 2021-2025

Theme: "Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All"

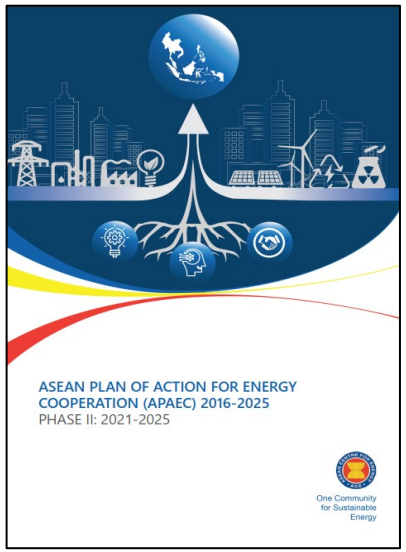
Sub-Theme: "Accelerating Energy Transition and Strengthening Energy Resilience through Greater Innovation and Cooperation".

RENEWABLE ENERGY TARGET

Increase **RE share** to **23%** in **TPES** and **35%** in ASEAN **installed power capacity** by 2025

EI REDUCTION TARGET

Reduce **EI** by **32% in 2025** based on 2005 level.



- ASEAN Power Grid
- Trans-ASEAN Gas Pipeline
- Coal and Clean Coal Technology
- Energy Efficiency and Conservation
- Renewable Energy
- **Regional Energy Policy and Planning**
- Civilian Nuclear Energy

ASEAN Energy Outlook (AEO) **complements the APAEC** and **supports the creation of pathways** for achieving the **regional targets.** Guided by **Programme Area No. 6: Regional Energy Policy and Planning**; **Action Plan 1.2**: Publish regular regional energy outlooks and strategic reports on the thematic issue.

AEO Throughout the Years

1 AEO 1 to AEO3 (2006 – 2012*)

Almost fully developed by IEEJ (Japan), with ACE as the facilitator.

2 AEO 4 (2014 – 2015)

- Presented at 33rd AMEM: Minister-CEO Dialogue in KL, Malaysia, September 2015.
- **80% work by External Consultant**, ACE supported on data collection process.

3 AEO5 (2015 – 2017)

- Launched at 35th AMEM in Manila, the Philippines, September 2017
- **ACE worked 40%** not only on data collection but also on modelling work.

4 AEO6 (2018 – 2020)

- Launched at 38th AMEM in Vietnam, November 2020.
- **ACE do about 70%** of the modelling work, engaging the External Consultant mostly on the analytics part.

5 AEO7 (2021 – 2022)

- Launched at 40th AMEM, 2021.
- **ACE do up to 100%** of the modelling work, engaging the External Consultant mostly as advisory role.

The Principles of AEO

ASEAN Energy Outlook (AEO) **complements the ASEAN Plan of Action for Energy Cooperation (APAEC)** and **supports the creation of pathways** for achieving the **regional targets.** Guided by **Programme Area No. 6: Regional Energy Policy and Planning**; **Action Plan 1.2**: Publish regular regional energy outlooks and strategic reports on the thematic issue.

COLLABORATION	HARMONISATION	VALIDATION
Consultation with experts from all 10 AMS through individual country visits for data collection, scenario discussion, and regional targets	Each AMS model is done individually in one regional environment, making it possible to standardise the data for all AMS while still able to analyse individual country	Close and constant coordination with the assigned Focal Points for data collection & target interpretation

AEO aims to be the voice of ASEAN for the energy sector, as it incorporates major involvement from all 10 AMS in every process

Supported by:
Implemented by
Technical Support:

The 7th ASEAN Energy Outlook (AEO7)

Launched in 40th ASEAN Ministers on Energy Meeting in Cambodia

Introduction

Establishes contextual setting of the ASEAN energy landscape, challenges, efforts, ambitions, and the role of regional cooperation and outlook in addressing energy dynamics within the region

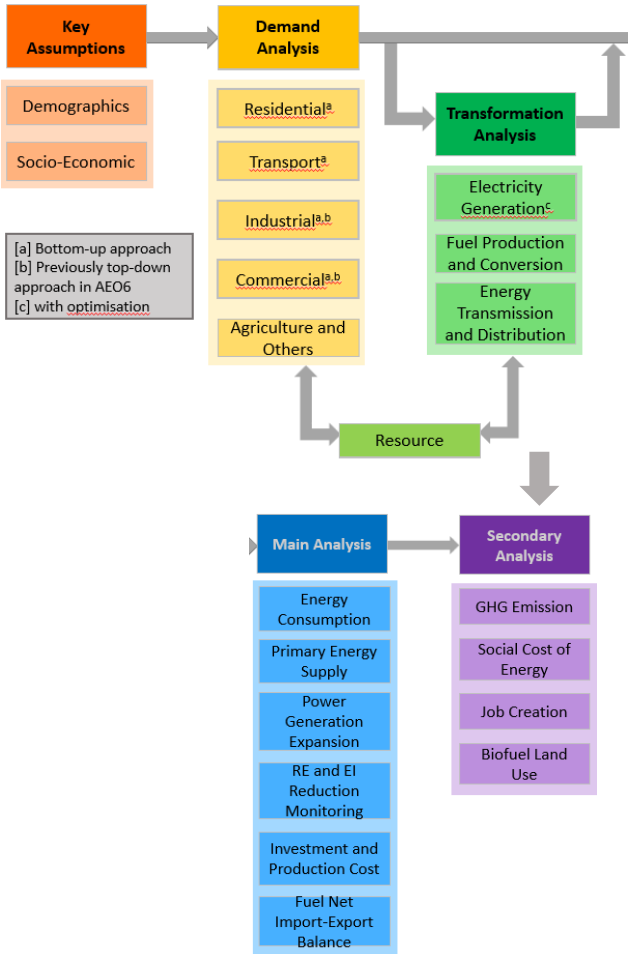
The population and economic growth activities linked to global energy dynamics and implications for the energy sector

The elements of energy security, accessibility, affordability, inclusivity, and sustainability challenges for ASEAN

The role of energy cooperation under the ASEAN Plan of Action for Energy Cooperation (APAEC) and AEO7 supports in creation of pathways to address the challenges

Methodology

Provides the reasoning behind the AEO7 modelling arrangement

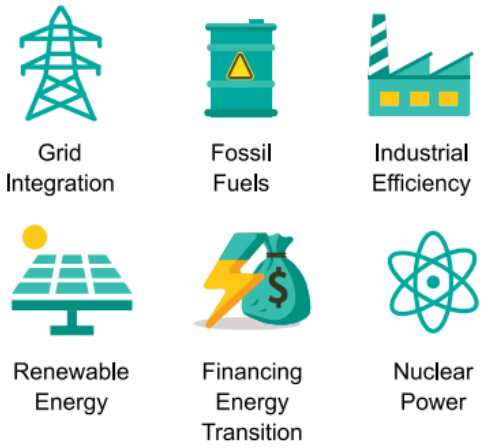


Exploring Multiple Futures

Explains the analysis of the modelling results based on the AEO7 scenarios and the implications for energy demand and supply, emissions, and socio-economic impacts in the ASEAN region, including social cost of energy, renewable job creation, and land use of biofuel

Assessing Measures for Energy Resilience

Elaborates on six emphasised energy sectors considered essential to attaining secure and reliable energy amidst transition



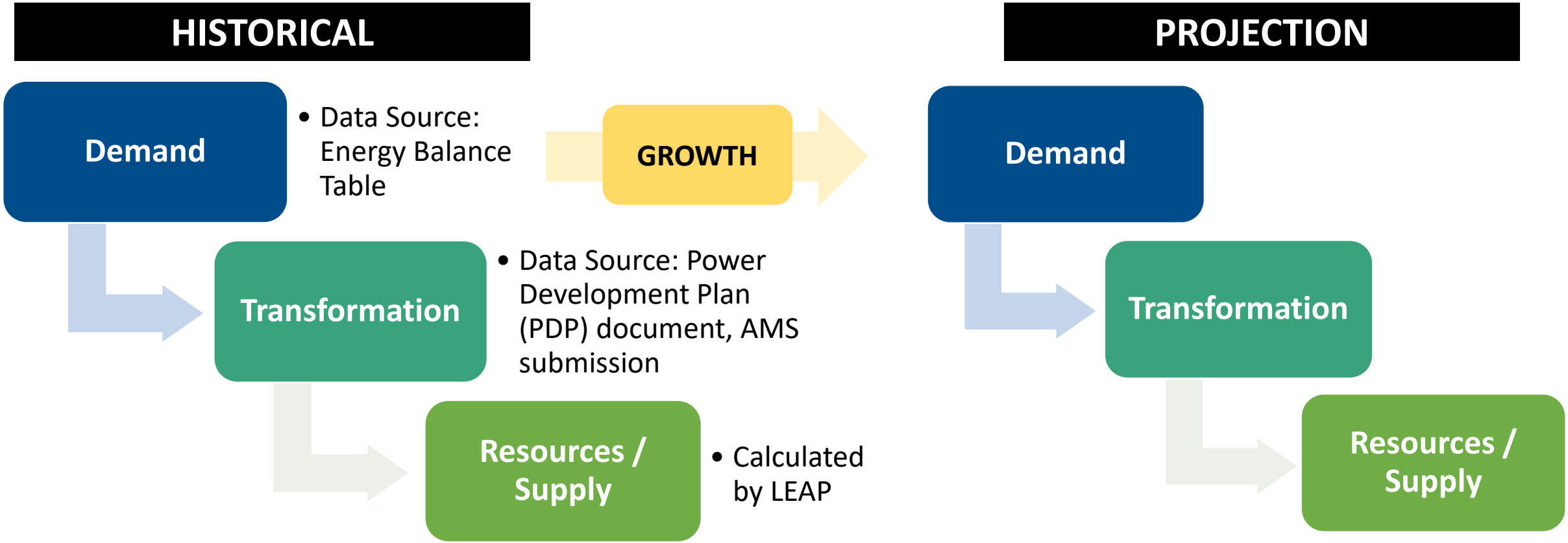
Recommendations and Improvements

Offers key energy policy proposals and strategic steps to address barriers in utilising resources to meet the demand of the ASEAN Member States from end-use and power sectors, and aligning them with the regional targets, in conjunction with institutional, data, and model improvement prospects for the subsequent editions of the ASEAN Energy Outlook

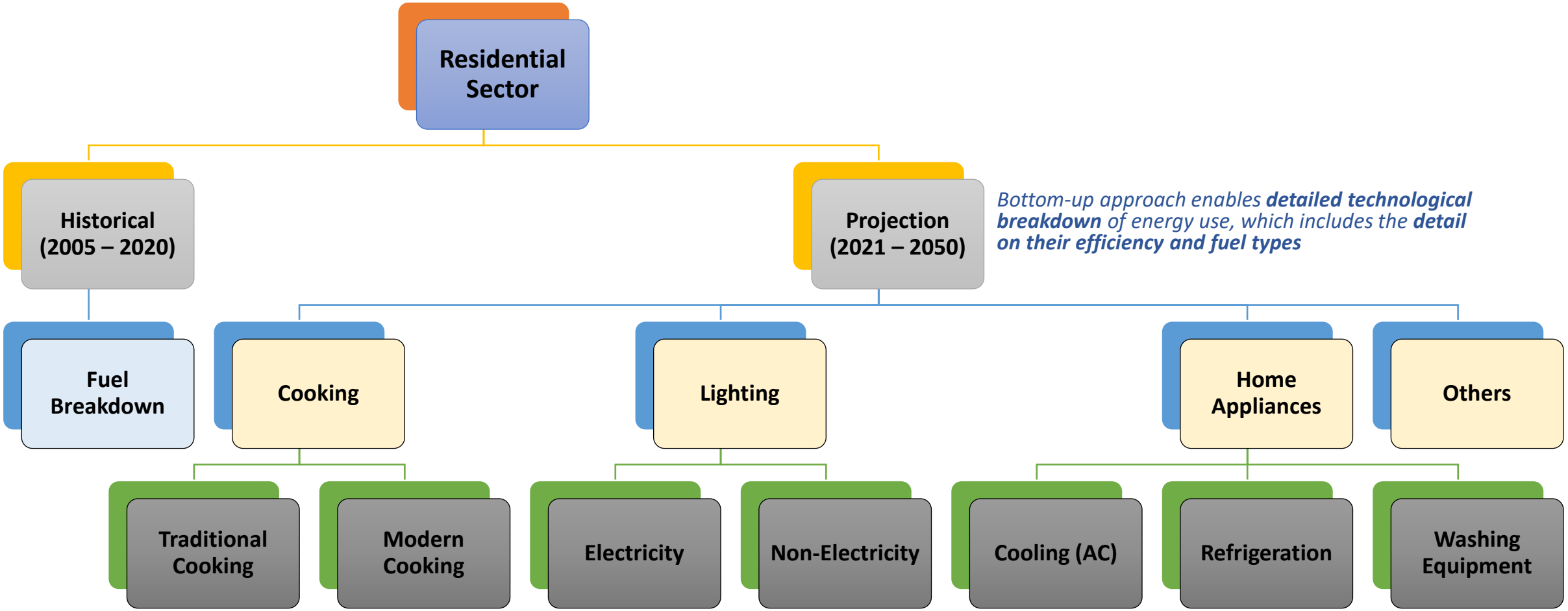
The Modeling of AEO

AEO mainly uses Low Emissions Analysis Platform (LEAP) software, a scenario-based demand-driven modeling tool that can be used to track energy consumption, production and resource extraction in all sectors of an economy

Simplified version of energy balance and projection calculation

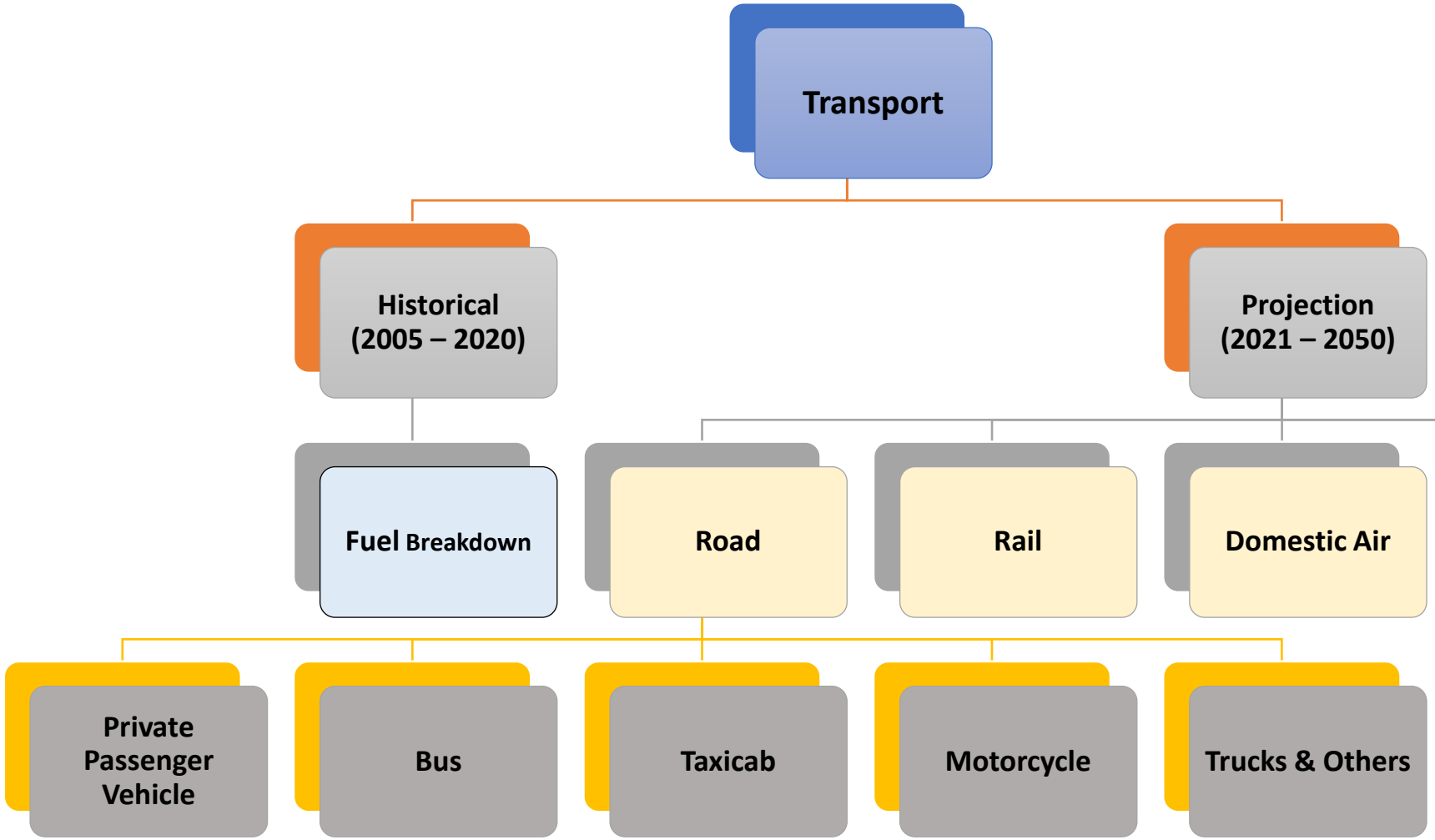


Modelling Approach – Residential Sector



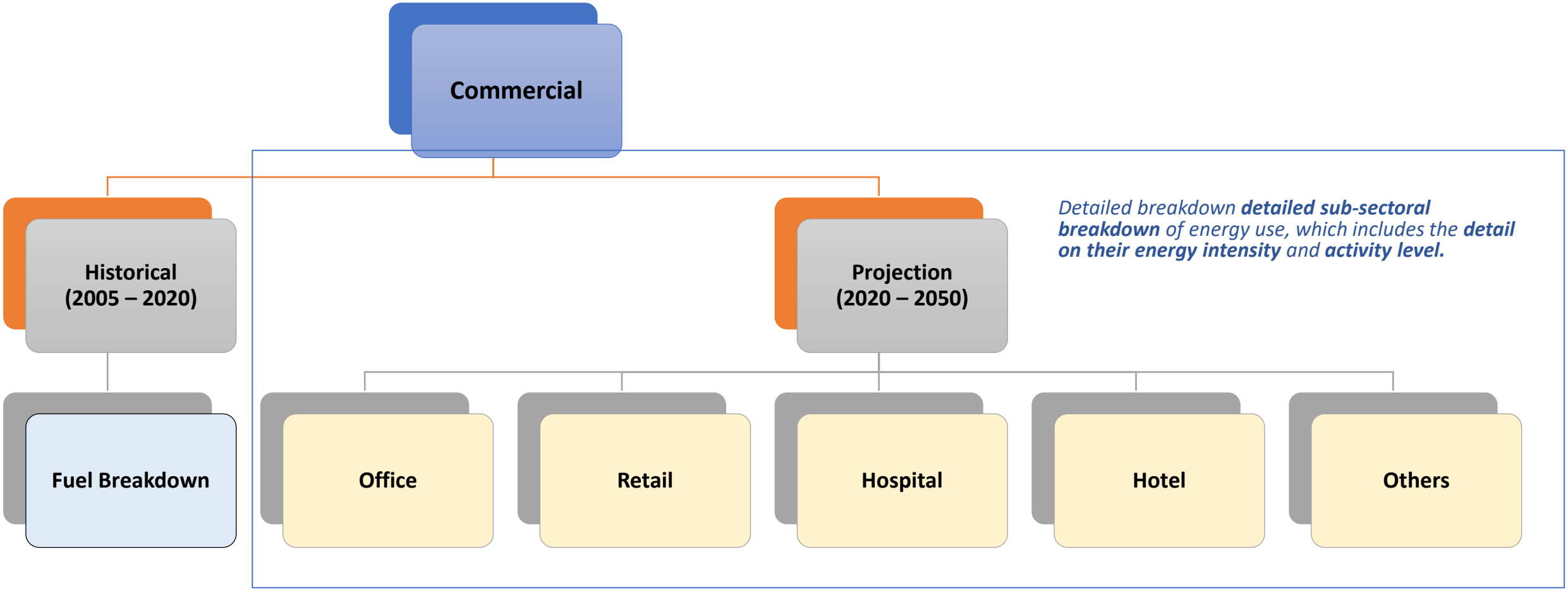
*Bottom-up approach enables **detailed technological breakdown** of energy use, which includes the **detail on their efficiency and fuel types***

Modelling Approach – Transport Sector



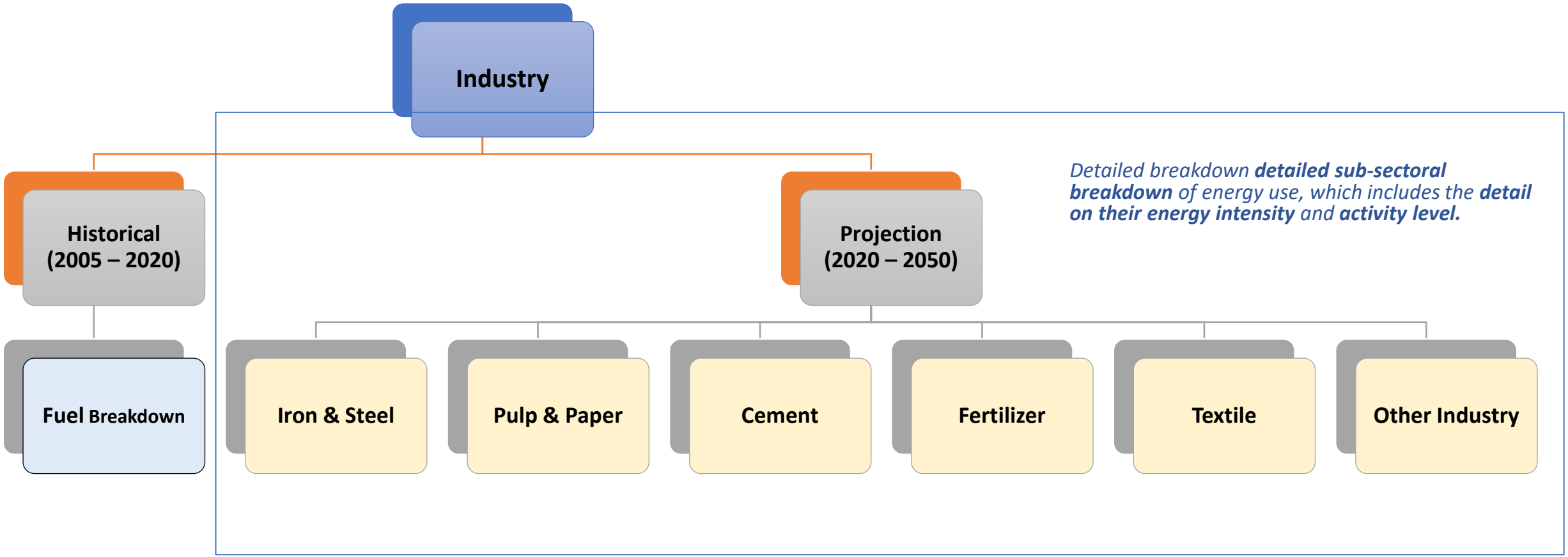
*Bottom-up approach enables **detailed technological breakdown** of energy use, which includes the **detail on their efficiency and fuel types***

Modelling Approach – Commercial Sector



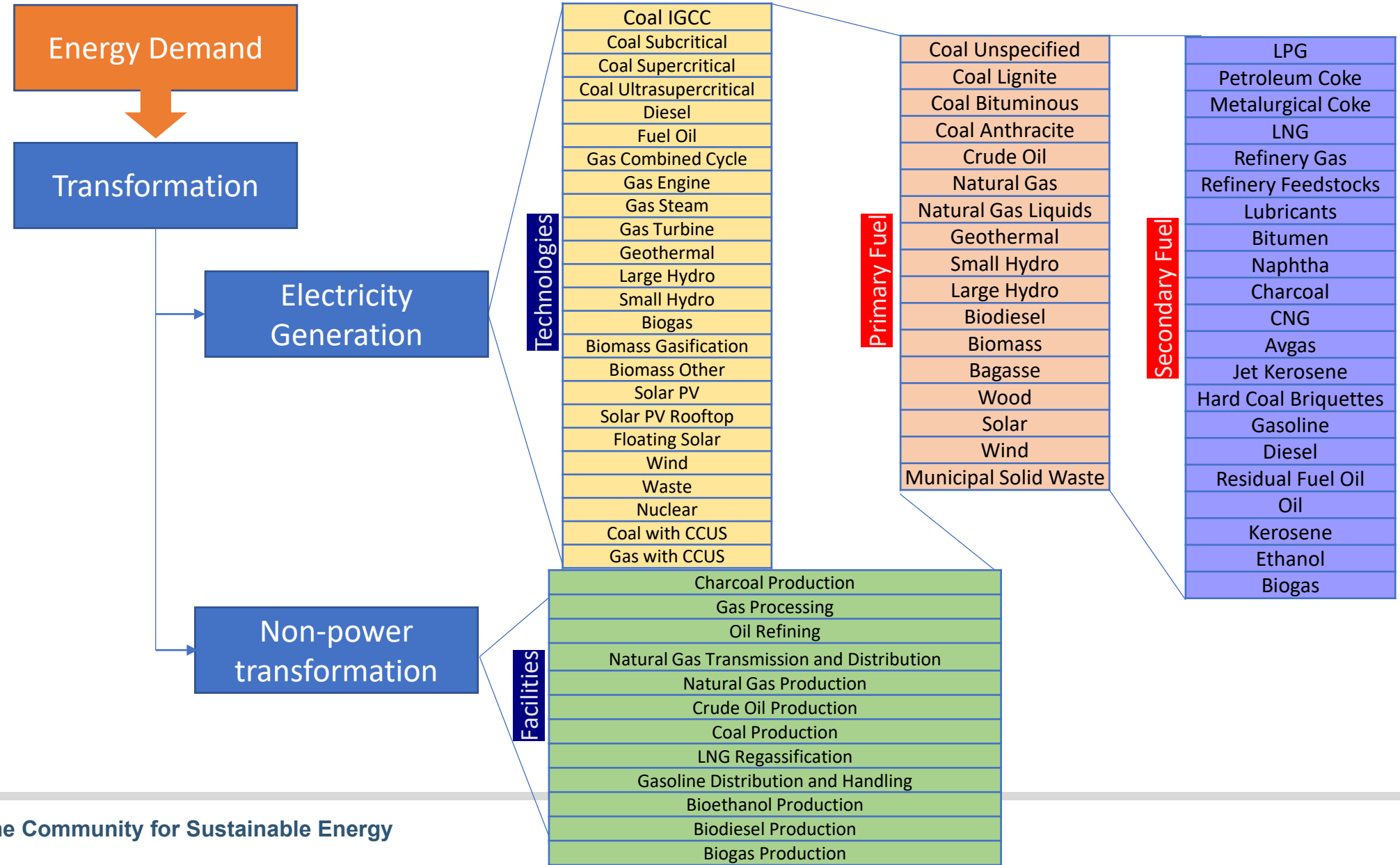
*Detailed breakdown **detailed sub-sectoral breakdown** of energy use, which includes the **detail on their energy intensity** and **activity level.***

Modelling Approach – Industry Sector



*Detailed breakdown **detailed sub-sectoral breakdown** of energy use, which includes the **detail on their energy intensity** and **activity level.***

Modelling Approach – Transformation Sector



AEO7 Scenario Overview

Historical data from 2005 – 2020 are projected out to 2021 – 2050 in four scenarios

Scenario	**Baseline Scenario** The energy growth pattern kept at a constant level as of the last historical year.	**AMS Targets Scenario (ATS)** Achievement of ASEAN official national energy targets.	**APAEC Targets Scenario (APS)** Achievement of APAEC'S aspirational regional targets on RE and EI.	**Least-Cost Optimisation (LCO)** Least-cost power sector dispatch to attain APAEC's regional targets.
Energy Efficiency	Kept constant at the level for last historical year	Based on individual Member States' targets	Raise individual Member States' targets to meet the regional target	Same deployments of EE&C strategies with APS to meet the regional target.
Renewable Energy	Growth rate kept based on the last historical year	Based on individual Member States' targets	Raise individual Member States' targets to meet the regional target	The power system was optimised to determine the least-cost dispatch that allows attainment of national and regional RE targets
Installed Power Capacity	No installed capacities from national Power Development Plan (PDP)	Consistent with PDP, prioritising renewable energy when adding new capacity	Included PDP at minimum but accelerated deployment of RE capacity based on each country's potential	The PDP capacity additions are included but model is allowed to build additional plants, and select the dispatch that constitutes the least-cost

Increase ambitions of RE and EE/EI standards

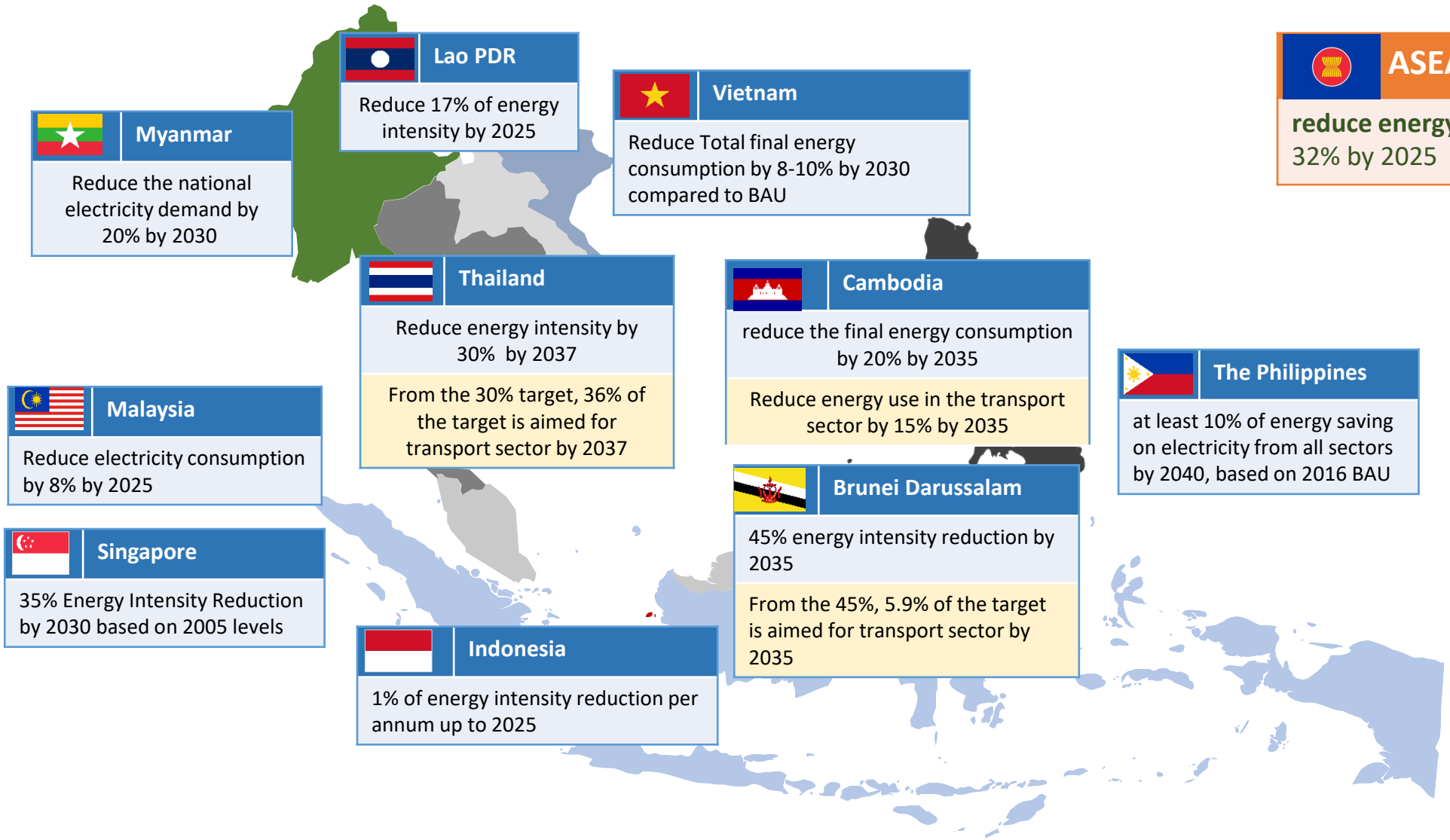
Least-cost option in power sector

AMS National RE targets

Country	Official Target on Renewable Energy
Brunei Darussalam	Achieve a 30% share of RE in the power generation mix by 2035
Cambodia	25% increase in renewable energy in the power mix (generation capacity) by 2030 (solar, wind, hydro, biomass)
Indonesia	• Increase RE share to 23% in primary energy supply by 2025 and 31% by 2050 • Biodiesel blending ratio target 30% by 2025; Bioethanol blending ratio 20% by 2025 and 50% by 2050 • Achieve a 19.6% share of RE in electricity production in 2030
Lao PDR	• 30% share of RE in total energy consumption by 2025, including 20% renewable electricity share (excluding large-scale hydro) and 10% biofuel share (blending ratio 5%-10%) • 13 GW total hydropower capacity (domestic and export use) in the country by 2030
Malaysia	Increase the RE share to 31% in the power capacity mix by 2025 and 40% by 2035
Myanmar	Increase the share of RE to 39% in electricity generation by 2030 (28% hydro or 5156 MW, and 11% other RE or 2000 MW)
Philippines	• Increase the RE share to 35% in the power generation mix by 2030 and 50% share by 2040 • Implement 5% blending for biodiesel starting in 2022
Singapore	Increase solar energy deployment to at least 1.5 GWp by 2025 and 2 GWp in 2030
Thailand	Increase the RE share to 30% in TFEC by 2037, including 15%–20% renewable electricity in a total generation; 30%–35% of consumed heat from renewables; and a 20%–25% biofuel share in TFEC
Vietnam	• Increase the RE share in TFEC to 32.3% by 2030 and 44% by 2050 • Increase the RE share in power generation to 32% by 2030 and 43% by 2050

Source: Multiple official documents

AMS National EE&C Targets



Lao PDR

Reduce 17% of energy intensity by 2025

Myanmar

Reduce the national electricity demand by 20% by 2030

Vietnam

Reduce Total final energy consumption by 8-10% by 2030 compared to BAU

ASEAN

reduce energy intensity by 32% by 2025

Thailand

Reduce energy intensity by 30% by 2037

From the 30% target, 36% of the target is aimed for transport sector by 2037

Cambodia

reduce the final energy consumption by 20% by 2035

Reduce energy use in the transport sector by 15% by 2035

The Philippines

at least 10% of energy saving on electricity from all sectors by 2040, based on 2016 BAU

Malaysia

Reduce electricity consumption by 8% by 2025

Brunei Darussalam

45% energy intensity reduction by 2035

From the 45%, 5.9% of the target is aimed for transport sector by 2035

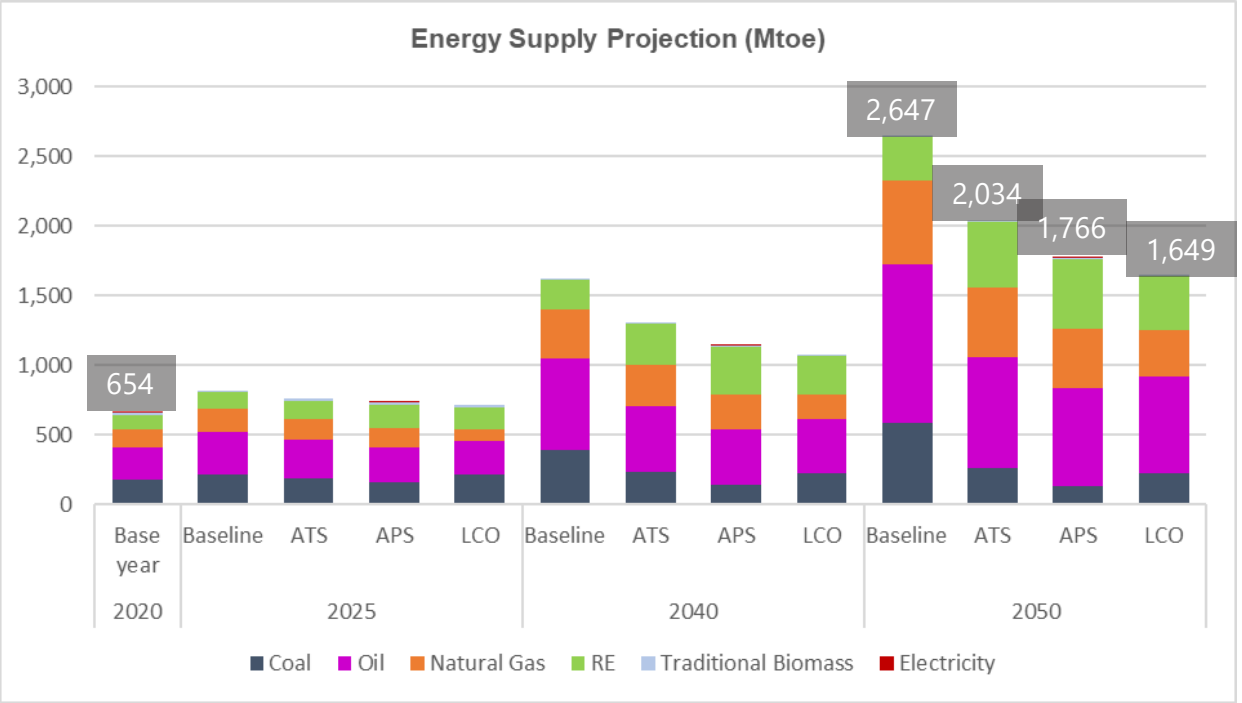
Singapore

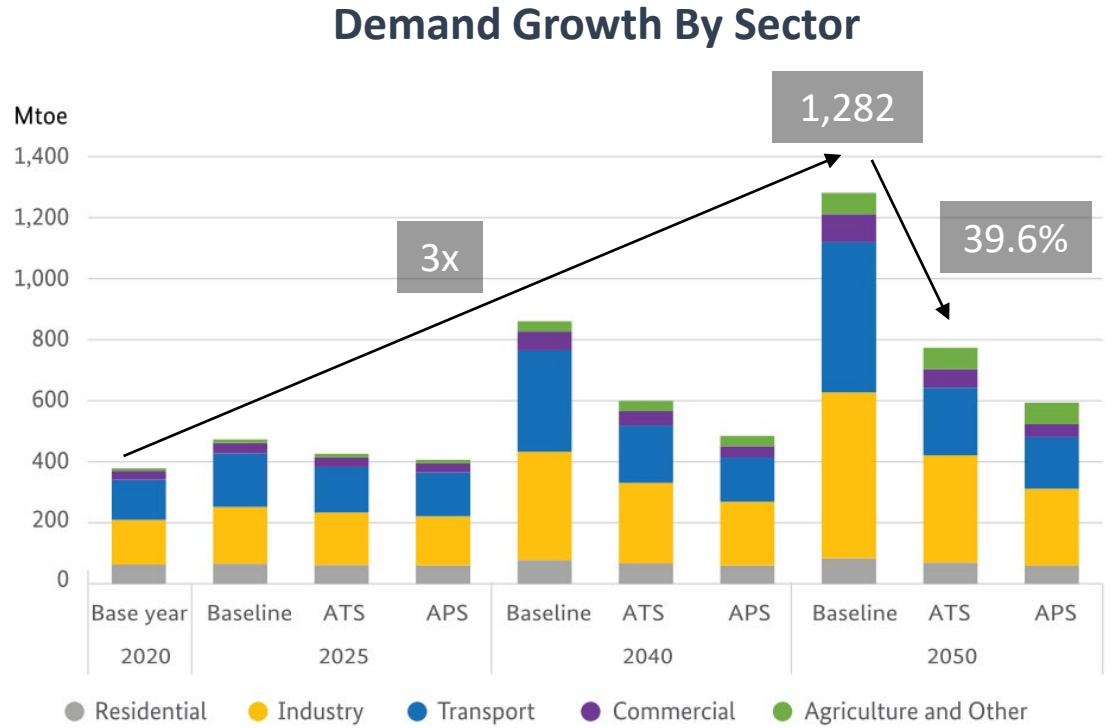
35% Energy Intensity Reduction by 2030 based on 2005 levels

Indonesia

1% of energy intensity reduction per annum up to 2025

Key Analyses: Pathways of ASEAN energy system



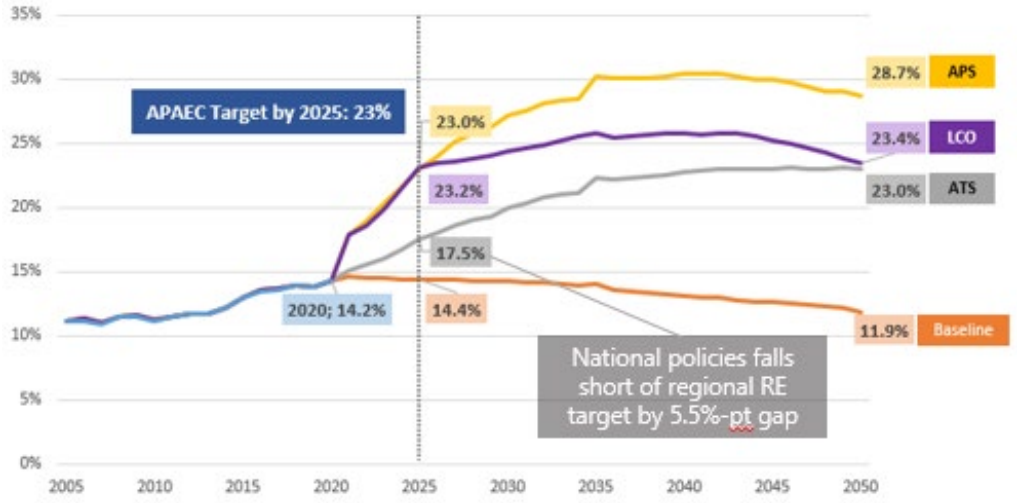


- Baseline Scenario projected a 4x of energy required to fuel the economic growth from 2020 to 2050. Energy efficiency measures reduce the need of energy to 3x and 2.7x in ATS and APS.
- LCO Scenario reduces the demand further to 2.5x of 2020.
- In all scenarios, fossil fuels remain the largest component.

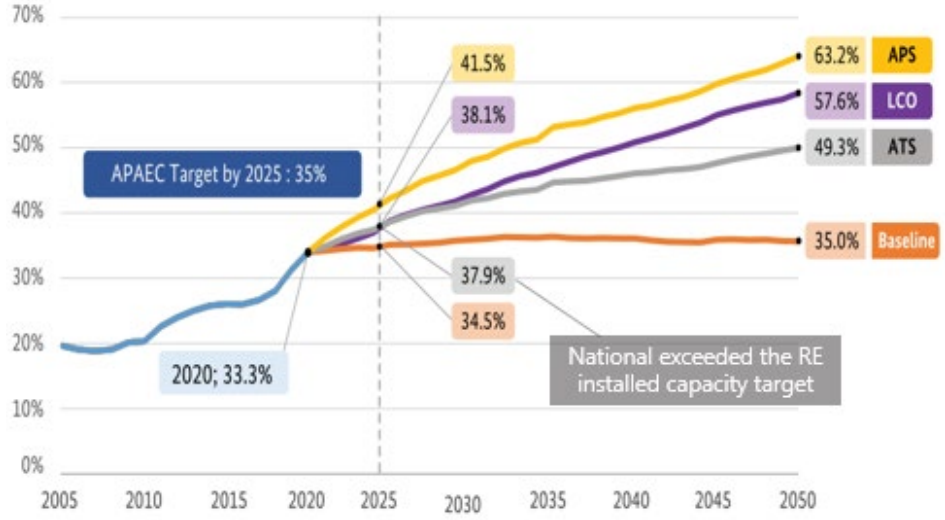
Industry and transport sectors continue to be the highest energy consuming sectors in the region

Key Analyses: Monitoring and Projection of Targets

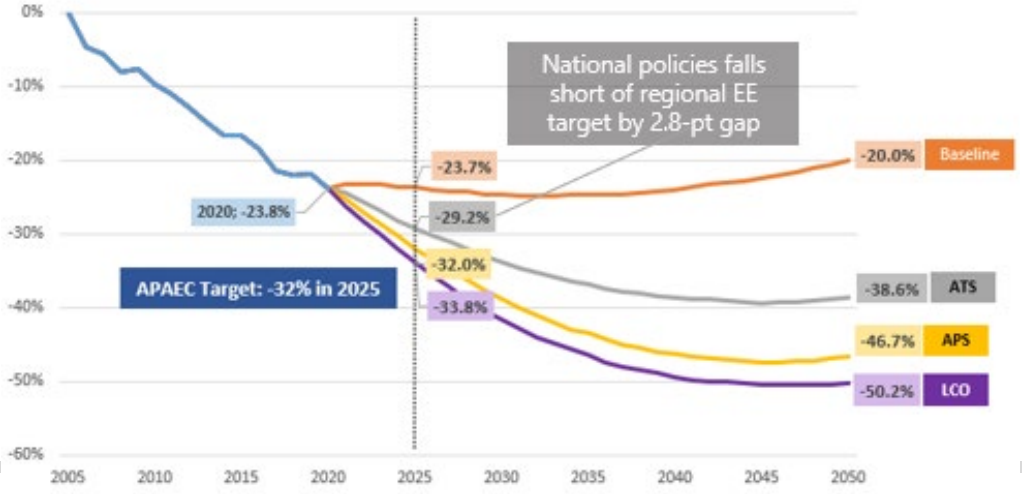
Renewable Share in Total Primary Energy Supply



Renewable Share in Installed Power Capacity



Energy Intensity Reduction from 2005 Level



2025	Renewable Share in Total Primary Energy Supply	Renewable Share in Intalled Power Capacity	Energy Intensity Reduction based on 2005 level
APAEC Target	23%	35%	32%

Baseline Scenario
The energy growth pattern kept at constant level as of last historical year

AMS Targets Scenario (ATS)
Achievement of ASEAN official national energy targets

APAEC Targets Scenario (APS)
Achievement of APAEC's aspirational regional targets on RE and EI

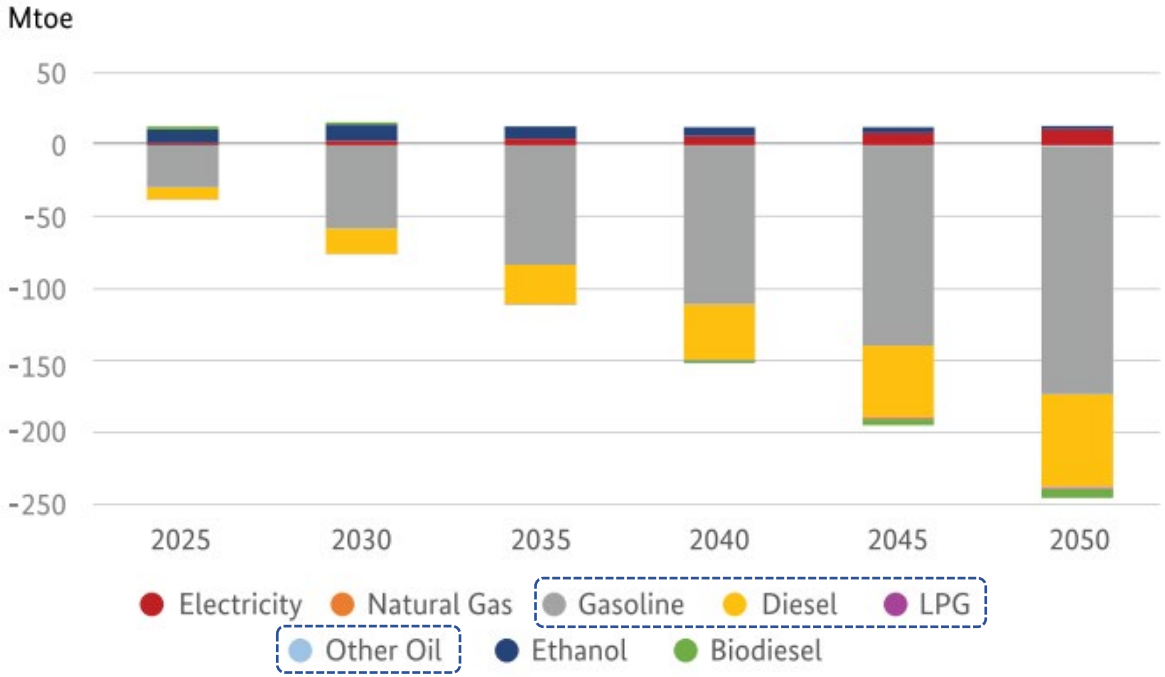
Least-Cost Optimisation (LCO)
Least-cost power sector dispatch to attain APAEC's regional targets

Increase ambitions of RE and EE/EI standards → Least-cost option in power sector

Source: The 7th ASEAN Energy Outlook, 2022
http://go.aseanenergy.org/AEO7

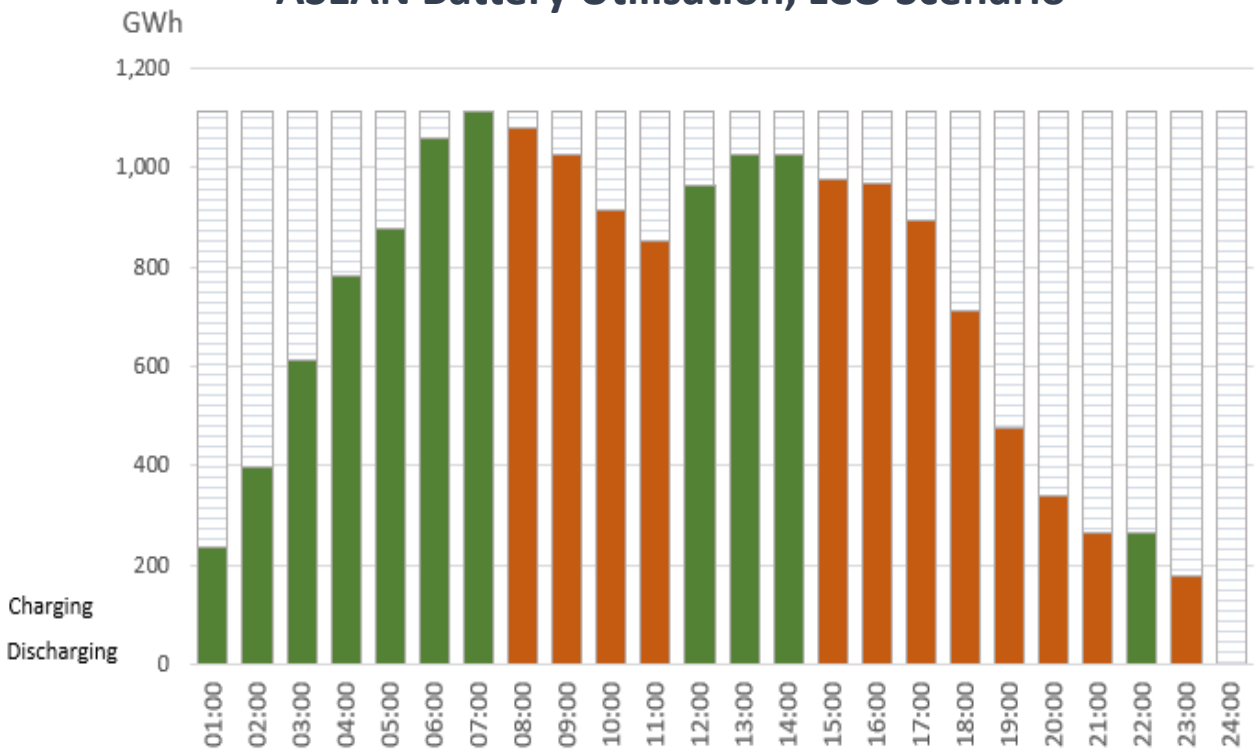
Key Analyses: Technologies and Policies

Fuel shifting in Road Transport, APS vs Baseline



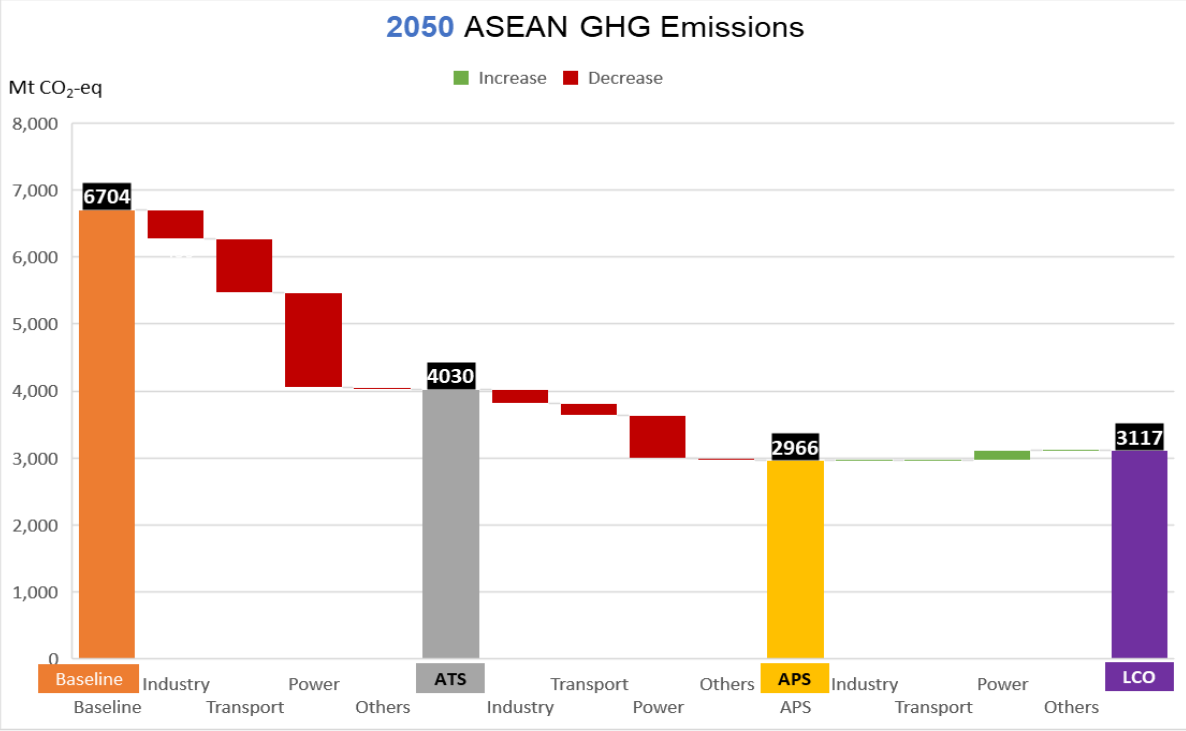
- **Oil products** remain the largest fuel in the transport sector, about 91% of the energy consumption of the vehicle fleet in 2050 under the Baseline Scenario.
- In the APS, deploying more efficient electric and hybrid vehicles **reduces gasoline and diesel usage** by about 72% and 59%, respectively.

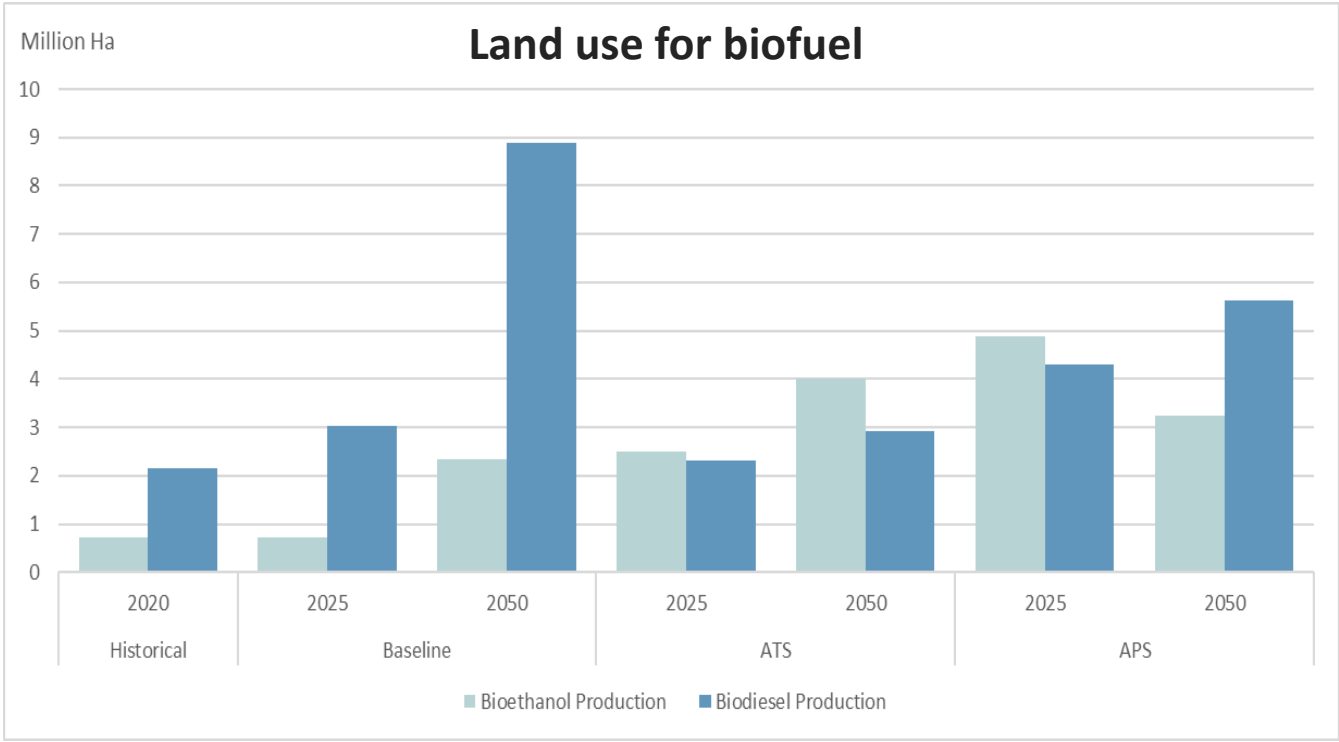
ASEAN Battery Utilisation, LCO Scenario



- Batteries can be used to provide stored power during peak hours. Crucial in enabling higher penetration of RE and maintaining the power grid's stability.
- In the LCO Scenario, the region is expected to require 26.6 GW of capacity to store about 1,100 GWh of electricity by 2050.

Secondary Analyses: Emissions, Land Use, etc.





In 2050, the annual GHG emissions from energy system would reach 6.7 Gt $CO_{2\text{-eq}}$ in Baseline Scenario

In 2050 Baseline Scenario, 8.8 million Ha of land is required to produce biodiesel (oil palm) and 2.3 million Ha for bioethanol (sugarcane), or about 2.5% of the AMS land mass

Thank You

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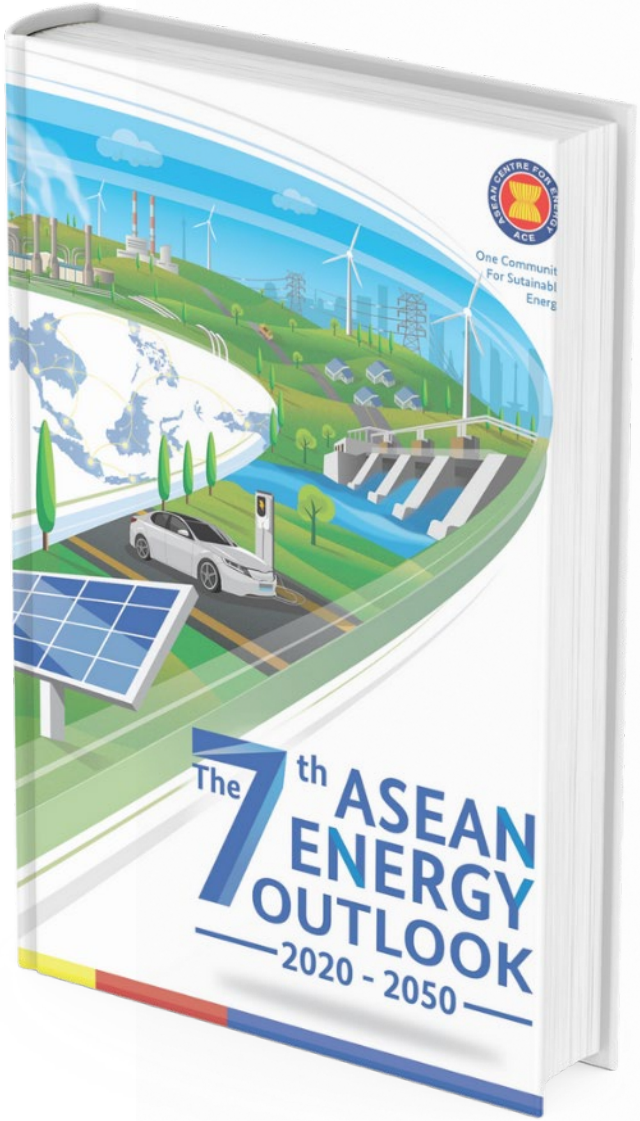


SCAN HERE

go.aseanenergy.org/AEO7

ASEAN Centre for Energy
One Community for Sustainable Energy

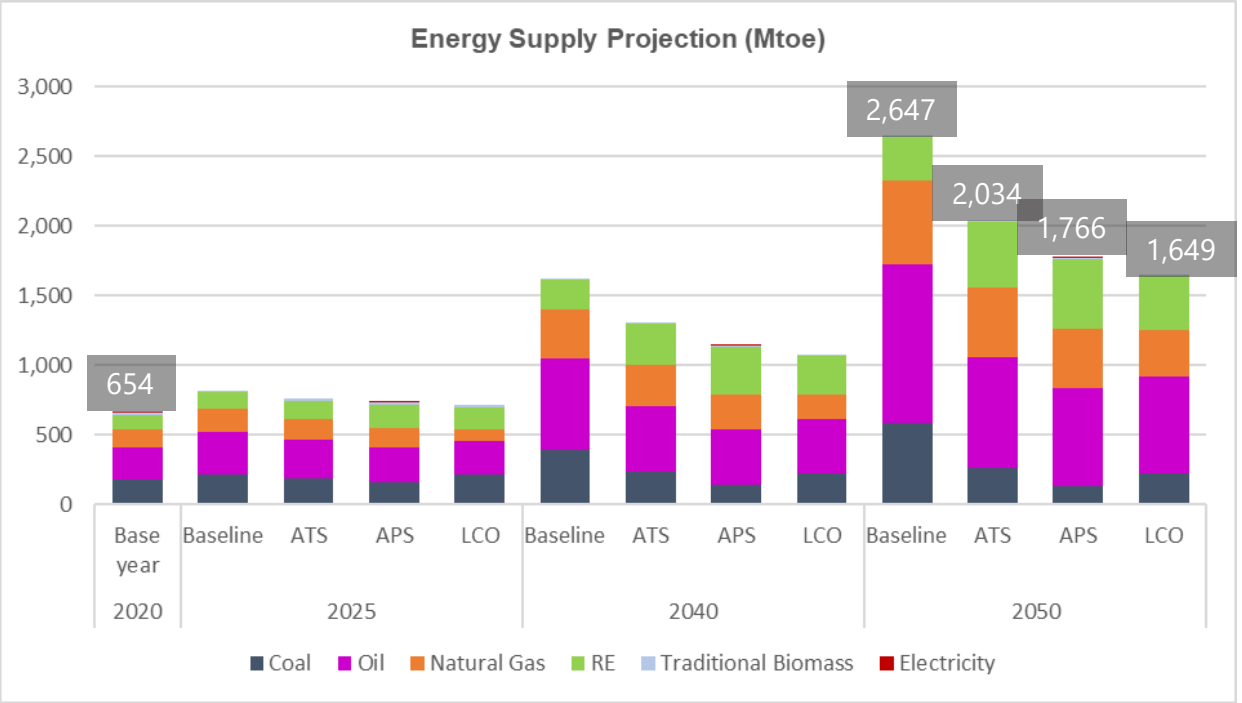
Supported by:

ASEAN-German Energy Programme (AGEP)

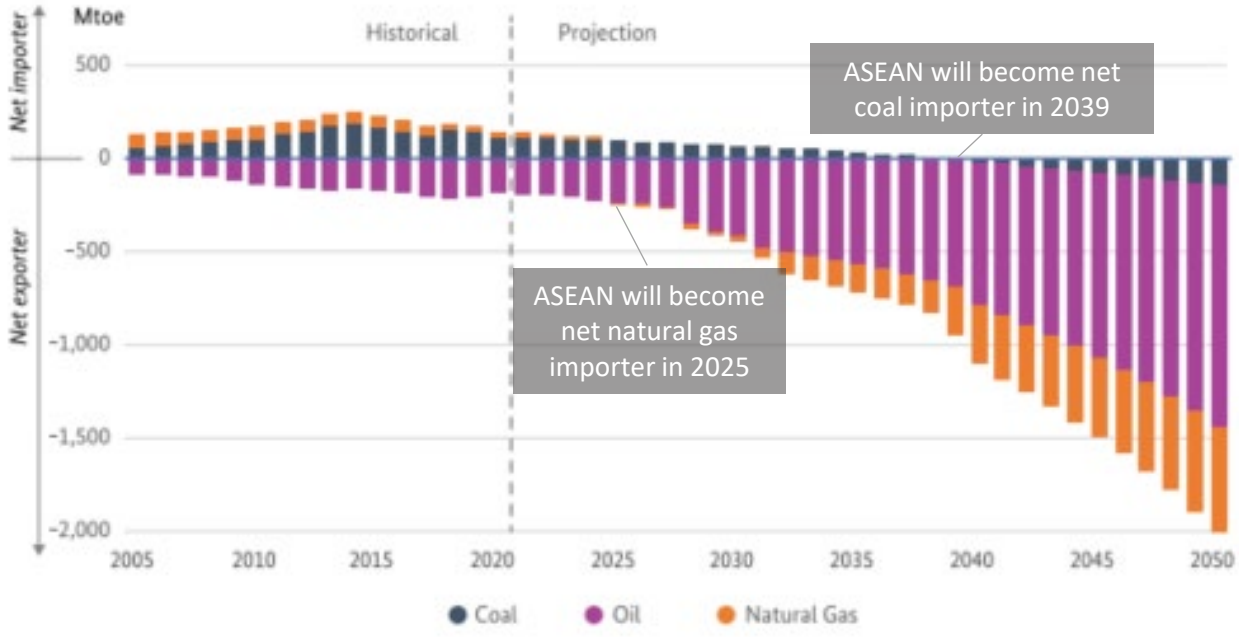
METI
Ministry of Economy, Trade and Industry

ACCEPT
ASEAN climate change and Energy Project

Energy security & sustainability are key for ASEAN. Why?



Net Import, Baseline Scenario



- Baseline Scenario projected a 4x of energy required to fuel the economic growth from 2020 to 2050. Energy efficiency measures reduce the need of energy to 3x and 2.7x in ATS and APS.
- In all scenarios, fossil fuels remain the largest component.
- To reach APAEC targets in 2025, **energy efficiency measures need to be coupled with increasing share of RE**.

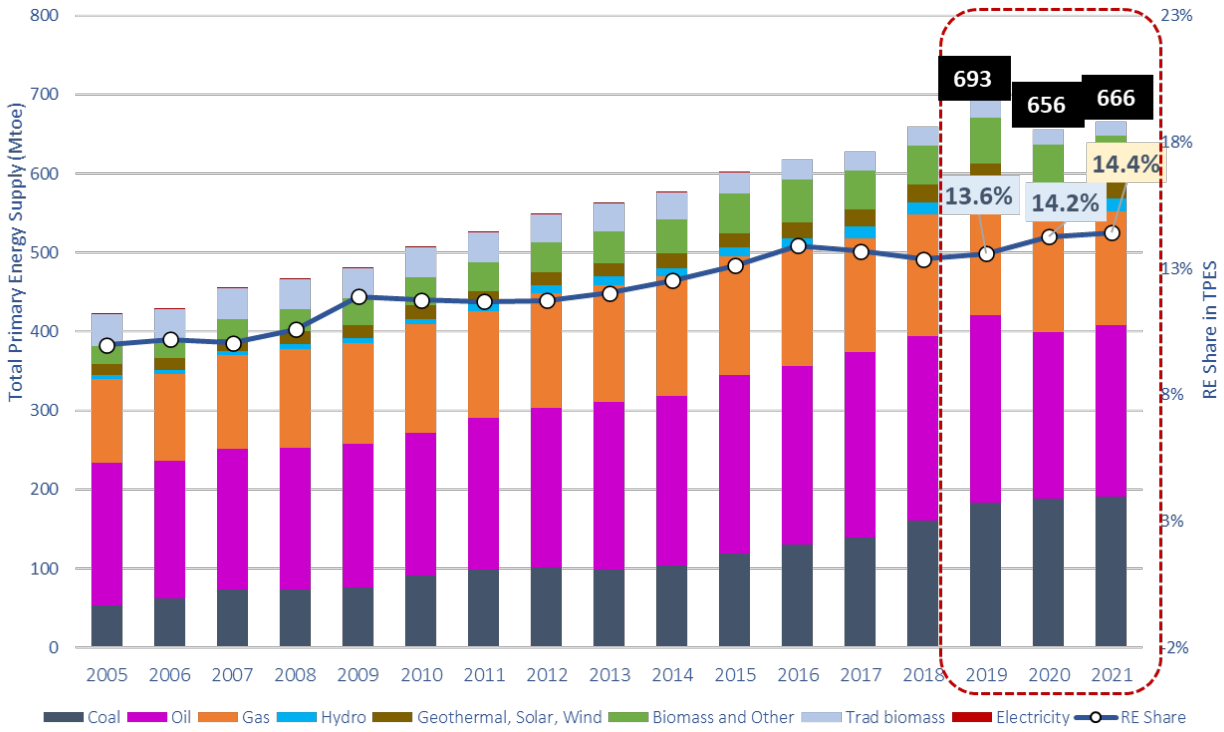
- In Baseline Scenario, without significant discoveries and/or additions to existing production infrastructures, and with continuous utilisation of fossil fuels, ASEAN would become **a net importer of natural gas and coal** starting from 2025 and 2039, respectively.

Climate Targets: 10/10 Emission Reduction 9/10 Carbon Neutrality

ASEAN Country	Emissions Reduction Target		Carbon Neutrality / Net Zero Target
	Unconditional	Conditional	
Brunei Darussalam	• 20% GHG emissions reduction by 2030 compared to Business as Usual (BAU) • At least 10% GHG emissions reduction by 2035 through better supply and demand management of electricity consumption	N/A	Net zero emissions by 2050
Cambodia	N/A	42% GHG emissions reduction or 64.5 $MtCO_2eq$ by 2030 compared to BAU	Carbon neutrality by 2050
Indonesia	31.89% GHG emissions reduction by 2030 compared to BAU	43.2% GHG emissions reduction by 2030 compared to BAU	Net zero emissions by 2060 or sooner
Lao PDR	60% GHG emission reduction compared to the Baseline Scenario, or around 62 $MtCO_2eq$ in absolute terms	N/A	Net zero emissions by 2050 conditionally
Malaysia	Economy-wide carbon intensity (against GDP) reduction of 45% in 2030 compared to the 2005 level	N/A	Carbon neutrality by 2050
Myanmar	244.52 $MtCO_2eq$ emissions reduction by 2030	414.75 $MtCO_2eq$ emissions reduction by 2030	Carbon neutrality by 2050
Philippines	2.71% GHG emissions reduction by 2030 compared to BAU	72.29% GHG emissions reduction by 2030 compared to BAU	N/A
Singapore	Achieve peak emissions at 60 $MtCO_2eq$ around 2030	N/A	Net zero emissions by 2050
Thailand	30% GHG emissions reduction by 2030 compared to BAU	40% GHG emissions reduction by 2030 compared to BAU	Carbon neutrality by 2050 and net zero emissions by 2065
Vietnam	15.8% GHG emissions reduction by 2030 compared to BAU	43.5% GHG emissions reduction by 2030 compared to BAU	Net zero emissions by 2050

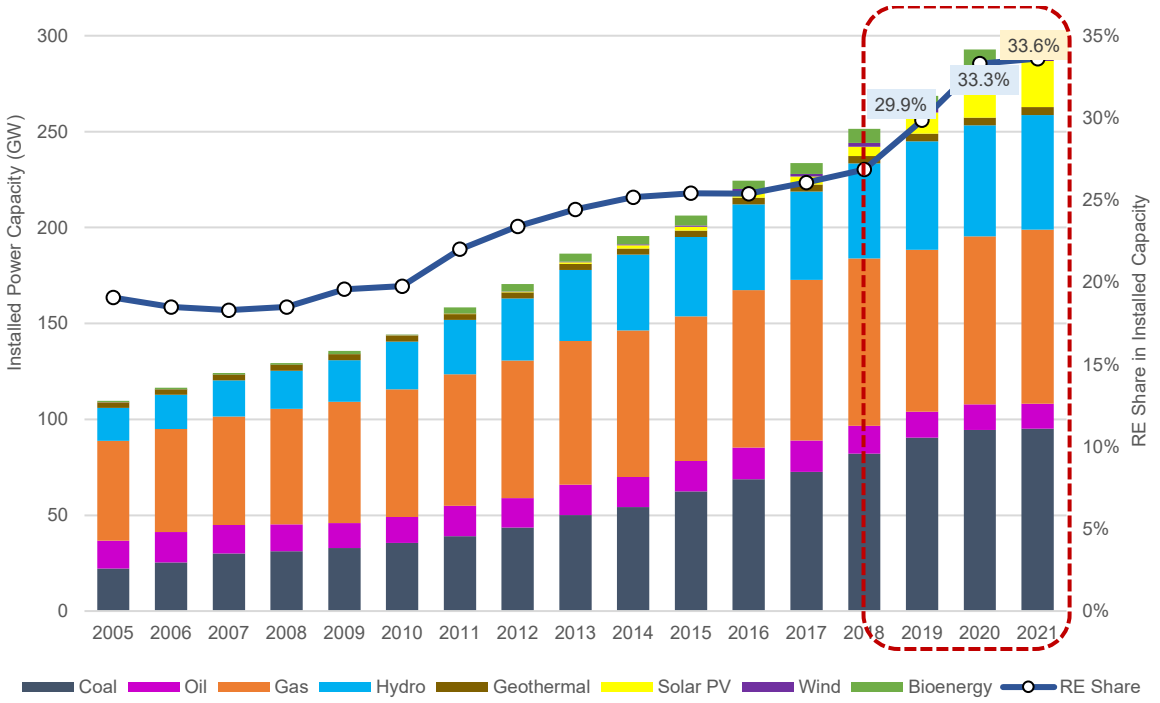
Energy Transition is Inevitable: Regional Push on RE

2021 Status of RE target: RE Share in TPES



- **RE share in TPES** reached **14.4%** in 2021. It is an increase of 0.2%-point from 2020.
- RE supply was 96 mtoe out of 666 mtoe.

2021 Status of RE target: RE Share in Power Capacity



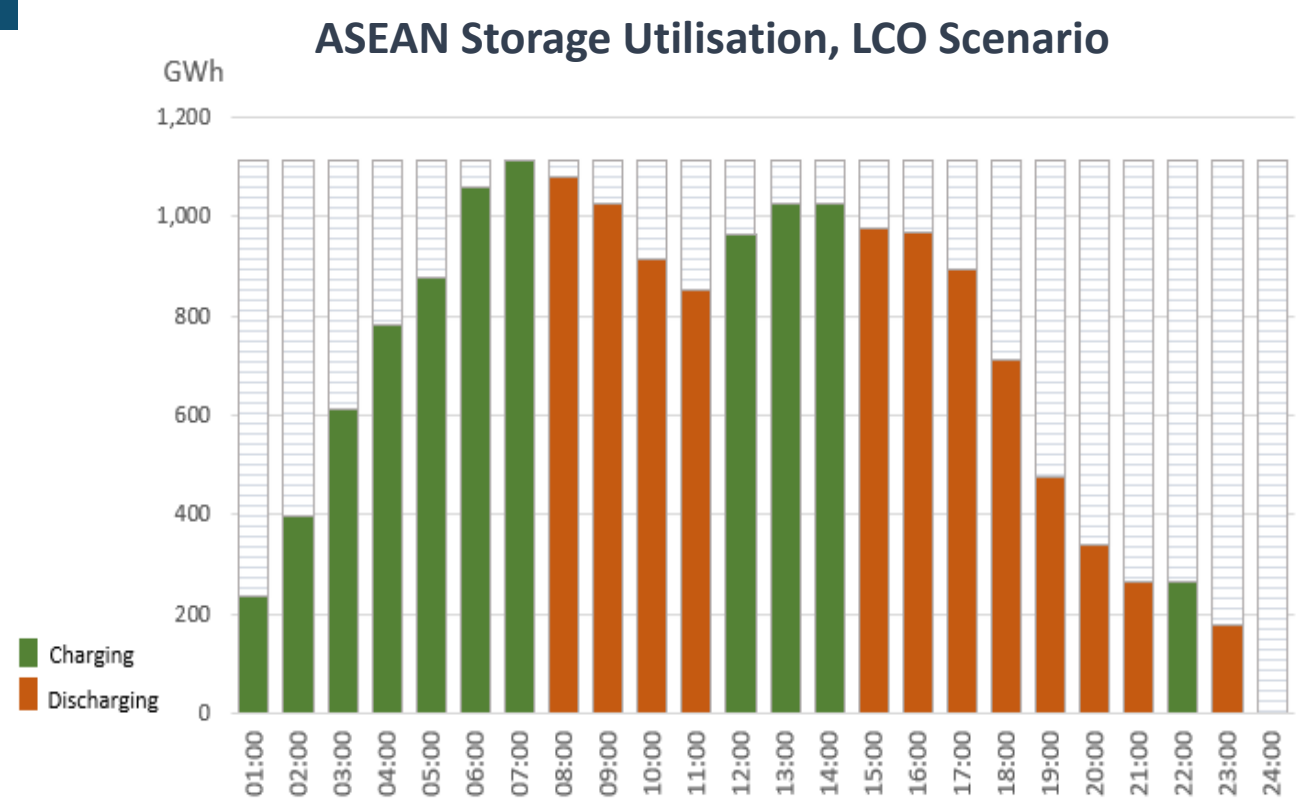
- **RE share in Installed Power Capacity** reached **33.6%** in 2021. It is an increase of 0.3%-point from 2020.
- RE installed capacity was 99 GW out of total 295 GW.

Catalyst for energy transition: Energy interconnection

Figure 3.31

Status	MW
Existing Projects	7,720
Ongoing	555 - 625
Future	18,369 - 21,769
Grand Total	26,644 - 30,114

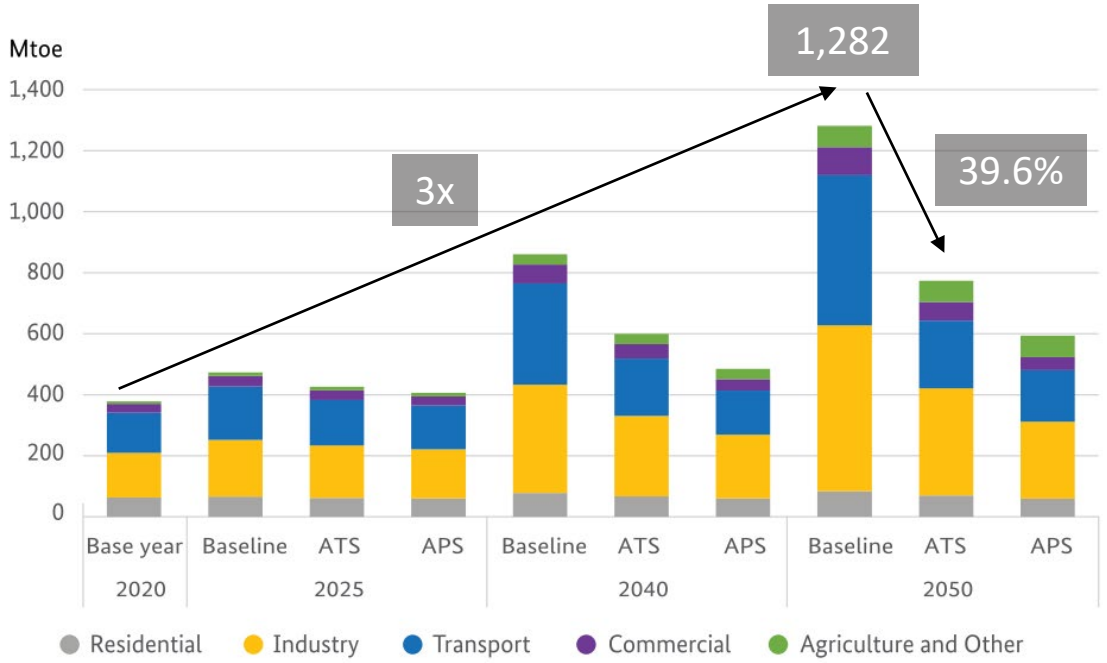
- Realisation of ASEAN's cross-border interconnection system with higher penetration of variable renewable energy (solar and wind), under the ASEAN Power Grid.



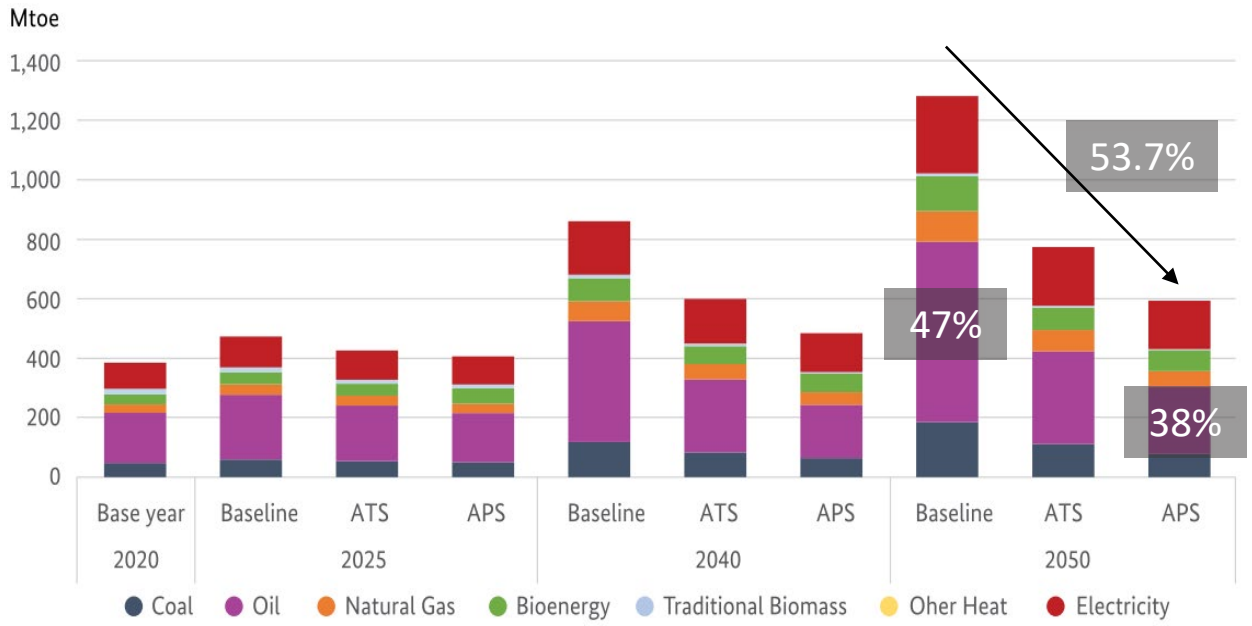
- Various forms of energy storage can be used to provide stored power during peak hours. Crucial in enabling higher penetration of RE and maintaining the power grid's stability.
- In the LCO Scenario, the region is expected to require 26.6 GW of capacity to store about 1,100 GWh of electricity by 2050.

ASEAN energy demand: Industry-Transport and Oil

By Sector



By Fuel

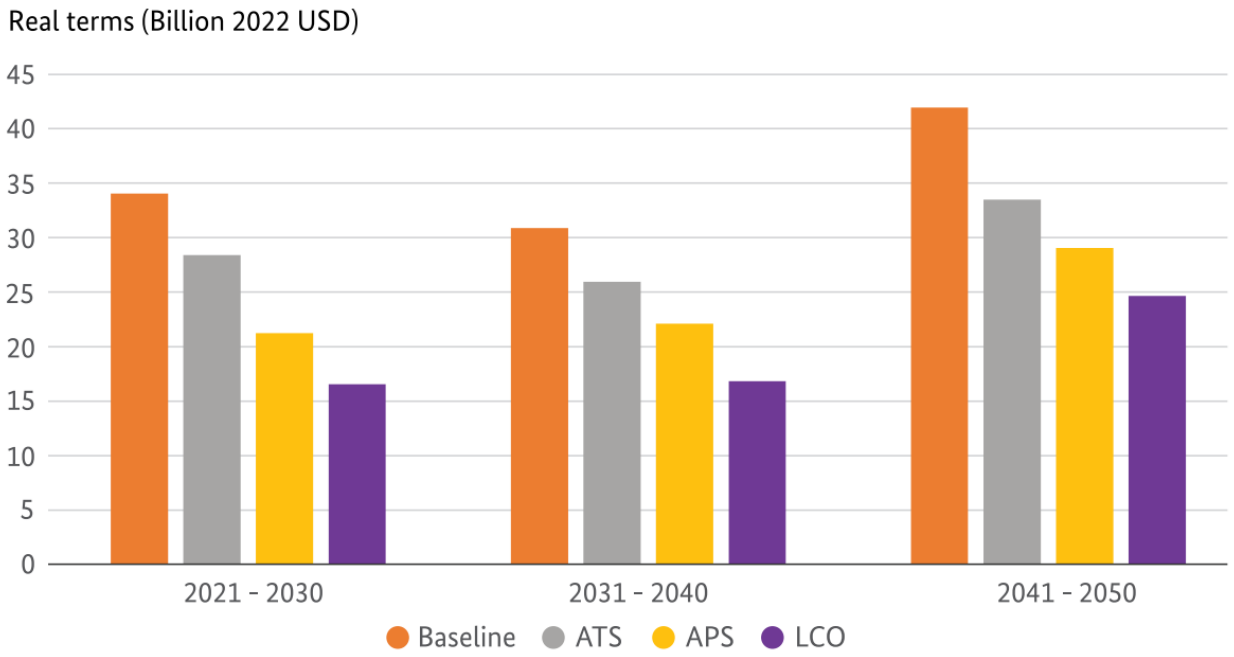


Industry and transport sectors continue to be the highest energy consuming sectors in the region

Oil products remain the largest to be consumed, with 47% share in 2050 Baseline Scenario, and reduced to 38% in APS for the same year

Financing can become either the bottleneck and catalyst

Annual Power Investment Cost



- The power sector investment cost is strongly impacted by the energy efficiency measures by end-users. The APS and LCO Scenario show the lowest power investment requirements in the later years, highlighting lower electricity demand.
- Cumulative investment in 2021-2050 (in Billion) – Baseline: USD 1,070; ATS: USD 879, APS: USD 726, LCO: USD 582.

Investment Needs based on Various Scenarios

	AEO7 – ATS	AEO7 – APS	2nd REO – PES	2nd REO – 1.5S
Investment – Power	879 billion	726 billion[1)]	1,267 billion[2)]	2,834 - 3,723 billion
Investment – All Energy			2,609 billion	6,318 - 7,391 billion
RE in Electricity Generation	50.4%	67.9%	60%	90%
Electricity Share in TFEC	25.5%	27.4%	30%	52%

1) Higher RE share but also lower overall energy demand due to stronger EE measures

2) 2nd REO investment need covers 2018-2050

- Higher share of RE coupled with higher electrification would require higher level of investment as well.
- A report by ACE and IRENA showed that 52% of end-use electrification and 90% renewable electricity generation require 2.8-3.7 trillion USD in power generation and 6.3-7.4 trillion USD for the whole energy system (4-5x of APS)

ASEAN Strategy for Carbon Neutrality

Identifies 8 regional strategies and 16 specific initiatives will deliver 4 key outcomes

Outcomes	Boost green industries	Enable ASEAN interoperability	Establish global credibility	Build green capabilities
	Capturing full value of regional green industries	Accelerating exchanges of green products & feedstocks	Attracting international capital & increasing liquidity	Developing talent & expertise to drive the transition
Initiatives	Identify & boost opportunities for greenification of the manufacturing value chains regionally	Upgrade ATIGA to comprehensively include circular products	Harmonize measurement, reporting & verification standards and policies to access global liquidity and regional carbon sink potential	Promote de-risking through adoption of innovative sustainable finance instruments
	Enable ASEAN feedstocks pathways for biofuels to capture global markets	Enable regional power trading, physical interconnection, and policy cooperation	Establish globally credible regional GHG inventory to flow from national reports	Incentivize green fund managers to locate in ASEAN, and local funds to develop
	Coordinate development of regional policies and regulations to support CCS/CCUS infrastructure	Enable interoperability of regional transport & logistics infrastructure	Standardize globally credible frameworks for corporate climate reporting	Establish green skills taxonomy & facilitate movement of natural persons
		Promote regional energy efficiency (EE) & conservation	Encourage adherence to ASEAN Taxonomy on Sustainable Finance	Facilitate best practice sharing to support effective just transition at national level
				Conduct capability building for sustainable infrastructure & smart cities

Strategies

- Accelerate green value chain integration
- Regional circular economy supply chains
- Connect green infrastructure & market
- Interoperable carbon markets
- Credible & common standards
- Attracting & deploying green capital
- Green talent development & mobility
- Green best practice sharing