ASSESSMENT OF THE ROLE OF COAL IN THE ASEAN ENERGY TRANSITION AND COAL PHASE-OUT

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Abbreviations

ACE	ASEAN Centre for Energy
ADB	Asian Development Bank
AEO	ASEAN Energy Outlook
AFOC	ASEAN Forum on Coal
AIMS	ASEAN Interconnection Masterplan Study
AMS	ASEAN Member States
APAEC	ASEAN Plan of Action for Energy Cooperation
APS	Announced Pledges Scenario
ASEAN	Association of Southeast Asian Nations
ATB	ASEAN Taxonomy Board
ATS	AMS Target Scenario
BAU	Business As Usual
BESS	Battery Energy Storage System
CAES	Compressed Air Energy Storage
CCS	Carbon Capture and Storage
CCT	Clean Coal Technology
CCUS	Carbon Capture, Utilization, and Storage
CFPP	Coal-Fired Power Plant
CHP	Combined Heat and Power
COD	Commercial Operation Date
COP	Conference of the Parties
CPD	Coal Phase-Down
CPO	Coal Phase-Out
EFB	Empty Palm Fruit Bunches
EI	Energy Intensity
EO	Environmental Objective
ETM	Energy Transition Mechanism
EU	European Union
EVN	Vietnam Electricity
FC	Financial Close
FF	Foundation Framework
GDP	Gross Domestic Product
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	Greenhouse Gas

GW	Gigawatt
HELE	High-Efficiency, Low-Emission
IEA	International Energy Agency
JETP	Just Energy Transition Partnership
LCO	Least Cost Optimization
LCOE	Levelized Cost of Electricity
LDES	Long Duration Energy Storage
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land-Use Change, and Forestry
MEMR	Ministry of Energy and Mineral Resources
MTOE	Million Tonnes of Oil Equivalent
MW	Megawatt
NREL	National Renewable Energy Laboratory
NZE	Net Zero Emissions
NZP	Net Zero Pathway
PLN	Perusahaan Listrik Negara
PLTU	Pembangkit Listrik Tenaga Uap
PS	Plus Standard
PSH	Pumped Storage Hydro
PV	Photovoltaic
RE	Renewable Energy
REO	Renewable Energy Outlook
SCR	Selective Catalytic Reduction
SDG	Sustainable Development Goal
SMR	Small Modular Reactor
SRF	Solid Recovered Fuel
TSC	Technical Screening Criteria
TWh	Terawatt-hour
UK	United Kingdom
UNFCC	United Nations Framework Convention on Climate Change
US	United States
USD	United States Dollar
VALCOE	Value-Adjusted Levelized Cost of Electricity
VRE	Variable Renewable Energy
WCA	World Coal Association

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Executive Summary

The latest versions of the ASEAN Taxonomy (2[nd] and 3[rd] versions) incorporate distinct criteria for assessing coal phase-out (CPO) initiatives. To be labelled as "green", activities must align with a trajectory aiming for a 1.5-degree pathway and be congruent with the IEA Net-Zero Emission trajectory, involving a CPO by the late 2040s. Notably, coal power plants constructed after December 2022 will not meet the "green" criteria. On the other hand, "amber" activities encompass slightly less strict prerequisites, permitting a phase-out by 2050. Both classifications mandate that the operational lifespan of coal-fired power plants (CFPPs) be limited to 35 years from their commercial operation date (COD).

However, the latest versions of the ASEAN Taxonomy may require some refinement to clarify some ambiguities and avoid unintended consequences. CPO classification within Version 2 of the Taxonomy shows an inadequacy in distinguishing between abated and unabated CFPPs. This classification may inadvertently include abated CFPPs in the early retirement initiatives. Furthermore, the Taxonomy's classification of electricity generation activities appears limited, as it excludes electricity generation from abated coal-fired power plants equipped with carbon capture technology. This omission persists even though the Taxonomy does not outright prohibit electricity generation from fossil fuels, in line with the Technical Screening Criteria (TSC) for Environmental Objective 1 (EO1) principles on climate change mitigation. Fortunately, Version 3 of the ASEAN Taxonomy has specified the inclusion of CFPPs that are equipped with abatement technologies such as CCUS as long as the resulting lifecycle greenhouse gas (GHG) emissions meet the TSC requirement.

Relying primarily on the IEA's Net Zero Emission (NZE) Pathway as the Taxonomy's foundation is also overly ambitious and not sufficiently tailored to the unique circumstances found in Southeast Asia. IEA's assumptions in their Net Zero Pathway (NZP) do not apply to Southeast Asia on many accounts, as they overestimate solar and wind's reliability, lifespan, and energy returns, while underestimating the costs of upgrading grid infrastructure. This would make solar and wind more expensive than coal, jeopardizing industry and households. As a result, the phase-out strategy may not yet be suitable for the region given its existing energy landscape. **Coal Phase-down (CPD)** at the right time is more relevant than Coal Phase-out (CPO). CPD will provide some relief to recently commissioned coal power plants to have 30 years of operational lifespans rather than being decommissioned earlier. Implementing a gradual reduction in coal usage provides a transitional period for identifying and developing economic and environmentally beneficial renewable energy sources. CPD will support the growth of technologies and energy storage solutions necessary for scaling up renewable energy capacity. Taking the example from the experience of the EU during the 2022-2024 energy crisis, phasing down coal would still allow countries to secure their energy instead of completely phasing out coal.

After all, coal phase-out poses tremendous challenges for ASEAN due to the role of coal in providing sufficient energy supplies at the lowest cost possible, its contributions to the region's economy and its employment of thousands of people in coal-dependent areas. The transition away from coal should therefore be done in a just, gradual way when economically and environmentally viable alternatives are available at grid scale, to avoid sacrificing economic growth and equity as well as social stability. It has to be underscored that energy transition efforts should not sacrifice energy affordability, where the drive to replace coal as an energy source must ensure that it will not result in continuously rising energy prices, especially as a result of overlooking the hidden cost of the considerable transmission and equipment upgrades needed to bring intermittent RE sources online. Moreover, replacing the stable generation of baseloads electricity—as well as steam and heat as the secondary outcome critical in industrial facilities—that to date have been met by CFPPs will need massive amounts of RE and battery storage to be immediately made available according to the timeline of the coal retirements.

Furthermore, on the basis of the region's continuing projected economic growth, which is relatively more rapid compared to developed economies, energy demand in ASEAN is projected to triple by the year 2050 compared to the 2020 level. The recent update of the IEA's NZE pathway itself, "An updated Roadmap to Net Zero Emissions by 2050", released in September 2023, shows that the earlier NZE Scenario had not adequately anticipated an increase of energy demand post-pandemic, where the global energy demand in 2021 increased by 5.4% due to the global economic rebound which also saw increased coal use and a surge in CO_2 emissions. Indeed, the NZE Scenario assumes that energy consumption per capita must decline as the global population grows, which has proven to be a challenging feat considering the massive suppression of energy use imposed on large parts of the world.

Coal indeed will remain an important energy source in ASEAN, according to the latest 7th ASEAN Energy Outlook. This remains the case even when the ASEAN Member States (AMS) pursue the regional target (APAEC), especially if the least-cost optimisation (LCO) Scenario is to be achieved. Under this scenario, coal-fired generation constitutes almost half of ASEAN's total generation in 2030 and drops to only 28% in 2050. Even in energy systems that are transitioning to a higher share of RE, including those in Europe, the coal fleets are still expected to play a role as a source of flexible generation. Their ability to fine-tune their operations and serve swiftly as a reliable energy supply backup is critical to the avoidance of potential power disruptions when the various forms of variable RE (VRE) experience intermittency issues.

In fact, coal currently outperforms other energy sources in terms of supply security, reliability, affordability and—to some extent—sustainability in ASEAN's power generation. The coal-to-gas initiative seems to be a low-hanging fruit for decarbonising ASEAN's power sector, but as some AMS are lacking liquefied natural gas (LNG) terminals and pipelines for gas transportation, it requires huge investments in gas infrastructure. Moreover, Southeast Asia has abundant coal resources relative to natural gas resources. As the region is predicted to become a net importer of natural gas by 2025, increasing the dependence on gas will expose the region to the volatile global natural gas markets even deeper. Coal also serves as a reliable baseload generation source that can provide a stable and continuous supply of electricity—one feature that VRE is lacking unless it is coupled with storage technology, which may inflate the costs further to achieve comparable stability. The analysis of the value-adjusted levelised cost of electricity (VALCOE) also shows that coal is still competitive compared to hydroelectric and solar PV because of its affordability and flexibility to respond to demand fluctuations. Meanwhile, nuclear—including the small modular reactors (SMRs)—as the energy source with the most comparable capabilities with coal is still under development in ASEAN with several complex non-technical challenges, including low public acceptance. Meanwhile, the adoption of biomass in power generation is still encountering various challenges, particularly in infrastructure and supply continuity, including potential sustainability issues such as competition with agricultural lands, water resources and food supplies, loss of biodiversity, deforestation, drainage of peatland, soil erosion and social conflicts. Geothermal power has the second-highest capacity factor after nuclear. Still, its deployment is stagnant and has faced several issues in Indonesia and the Philippines pertaining primarily to institutional, regulatory and tariff-related factors.

Key Recommendations

The inclusion of CPO in the ASEAN Taxonomy should be carefully evaluated,

especially the conditions of its technical screening criteria (TSC). This includes the rationale of using the IEA's Net Zero Emissions (NZE) Scenario in 2050 as the primary reference instead of the 7th ASEAN Energy Outlook (AEO7) in 2022 and the upcoming 8th ASEAN Energy Outlook (AEO8) in 2024 (which will include the least cost optimisation or LCO Scenario for regional net zero targets). As the IEA NZE Scenario from the World Energy Outlook 2022 was highly influenced by the advanced economies (US and EU) and China, and over-emphasised the levelized cost of electricity (LCOE) instead of VALCOE, ASEAN's adoption of the outcomes from this document must be thoroughly assessed given that ASEAN and other emerging countries have very different energy and growth landscapes. In fact, when the IEA released its 2021 NZE pathway, it acknowledged this was not the pathway but one of potentially narrow pathways applicable on average to the global scenario and was not intended to be uniformly applied as the baseline for all countries or regions.

It is essential to also provide clarity regarding the utilisation of lifecycle GHG—including methane—emission thresholds for electricity generation within the CPO's TSC.

If such thresholds are indeed in use and widely acceptable for countries and regions that do not have a status comparable to developed economies, a re-evaluation of this TSC is deemed essential, and it should involve consultations with relevant stakeholders. This is particularly critical given the evolving technological landscape because the current approach may preclude any coal power plants from receiving a "green" label, even those incorporating CCS/CCUS technologies, supplying fly ash to cement manufacturing to create emission savings, or implementing co-firing with biomass or ammonia to reduce coal consumption.

Additional items in the subsequent versions of the Taxonomy therefore need careful evaluation to avoid counterproductive or unclear messages, including the exclusion of certain types of power plants (e.g., abated CFPPs with CCS/CCUS) that may still technically meet the lifecycle GHG emissions specified in the TSC or the inclusion of "best in class technology", "affordable" and "accessible" criteria that lack unambiguous definition, among many other critical conditions and considerations. The ASEAN Taxonomy Board (ATB) has been proven to continuously refine the Taxonomy by revising these two criteria presented in version 2.

We must consider the far-reaching implications of CPO before advocating such a policy.

These include potential financial losses from the anticipated revenues from power generation, stranded assets from retired power plants, job losses along the coal value chains, affordability issues from rising energy cost and weakened energy security since natural gas imports, as the immediate substitute for coal, may need to be intensified. The largest users of coal, China and India, for instance, have their net zero targets in 2060 to 2070, respectively, indicating room for the region to calibrate to a more realistic and balanced coal phase-down. Moreover, the need for a massive and immediate ramp-up of RE and storage is indispensable if we want to achieve the 1.5^{0} C target, demanding investments five times larger than when a reasonable, gradual increase of RE share is pursued.

A strategic shift from coal should be implemented at the right time as soon as economic and environmentally friendly alternatives at the grid scale become available.

This is in order to ensure a just and seamless transition without compromising economic development and social stability. These strategies include the adoption of clean coal technologies (CCTs), such as high-efficiency, low-emission (HELE) power plants, biomass and ammonia co-firing and CCS/CCUS. They also include strengthening regulatory frameworks so that market mechanisms reduce emissions while providing support to industry players, and developing comprehensive, long-term energy planning that incorporates grid improvement, financial incentives for phase-down of coal-based emissions and energy efficiency, and exploration of new alternative energy sources. **At this time, the latest versions of the Taxonomy need not define a particular year for CPO** but can be tailored towards encouraging the flow of financial resources to retire old, inefficient and un-abatable coal plants, and replace them with new HELE coal plants (possibly with combined heat and power (CHP) and partial CCS) with combined heat and power (CHP) and partial CCS) with comparable capacity to slash emissions while retaining effective investments in a system that can deliver base/intermediate and peak load output and protect ASEAN's competitiveness. The next version of the Taxonomy can then benefit from the AEO8 in determining a more strategic phase-down plan.

Support for grid improvements and upgrades is particularly critical.

It is to enhance capacity and resilience to accommodate a surge in electricity supply and address the supply-demand fluctuations caused by VRE as we reduce dependency on coal. Vietnam's experiences, where actual dispatch of RE power to the grid saw significant curtailments due to limited transmission capacity, show how building a resilient and robust grid infrastructure is as important as increasing the share of VRE. These efforts may include grid modernisation, integration with energy storage, application of smart grids and demand-side management.

Channelling the necessary investments to support the transition towards clean energy is also equally important,

as is establishing supportive transition finance mechanisms. These investments should emphasise comprehensive solutions that do not favour specific energy sources and instead focus on clean technologies and practice, which may include gasified coal with CCS or efficient mining and transportation. To ensure that the region can balance its role as the engine of global economic growth and be a leader in reducing GHG emissions, the ASEAN Taxonomy should also be tailored to the AMS' status and needs and be flexible enough to incorporate comprehensive transition policies and technologies.

Introduction

The ASEAN Taxonomy for Sustainable Finance Versions 2 and 3 incorporate qualitative methodologies to evaluate economic operations, and quantitative methodologies to harmonise the definition of sustainable activities and assets in ASEAN with global, systematic and science-based approaches to classify sustainable activities and assets, including technical screening criteria (TSC) as the quantitative classification method used in the Plus Standard (PS) for key sectors. The second version includes guidance on coal phase-out (CPO) TSC, which was a global first for a regional taxonomy. The third version, which was released one year after the second version, reinforced the Taxonomy by incorporating the TSC with two additional focus sectors, namely transportation and storage as well as construction and real estate.

This acknowledgement of CPO in the second version highlights its role in achieving decarbonisation in the ASEAN region, as it outlines specific guidelines for categorising CPO activities as “green” or “amber” under the PS framework of this version. This would potentially enable a just and seamless energy transition that does not compromise energy security, accessibility and affordability without undermining the Taxonomy’s credibility and ASEAN’s commitment to sustainability. The influence of ASEAN Taxonomy on the direction and development of national taxonomies by the ASEAN Member States (AMS) is also noted.

The Taxonomy incorporates distinct criteria for assessing CPO initiatives. To be labelled as “green” the activities must align with a trajectory aiming for a “1.5-degree pathway” and be congruent with the IEA’s Net-Zero emissions trajectory, involving a CPO by the late 2040s. Notably, coal power plants achieving financial close (FC) after December 2022 will not meet the “green” criteria. On the other hand, “amber” activities encompass slightly less strict prerequisites, permitting a phase-out by 2050. Both classifications mandate that the operational lifespan of coal-fired power plants (CFPPs) be limited to 35 years from their commercial operation date (COD).

Nonetheless, a degree of ambiguity has been recognised in the foundation for establishing the framework for ASEAN Taxonomy in general and the CPO classification in particular. They include:

- The rationale of using IEA’s Net Zero Emission Pathways to formulise the taxonomy.
- Some qualitative terms used in the Technical Screening Criteria (TSC).
- The reasons to set 2040 as the final year for coal phase-out.
- The type of coal-fired power plants (e.g., abated or unabated) for coal phase-out.
- Omission of electricity generation activities from abated coal power plants (e.g., equipped with biomass co-firing or CCS/CCUS).
- The basis for determining the lifecycle GHG emission threshold, particularly for electricity generation activities.

Some of the above points are presented in Version 2 and are already being addressed and revised in Version 3: the inclusion of abated CFPPs eligible for being considered as ”green” activities and the omission of the “best-in-class technology” requirement in TSC for CPO that lacks clarity.

Critical Assessment of Coal Phase-out (CPO) in the Taxonomy

The introduction of CPO as an Activity since ASEAN Taxonomy Version 2 is to support several initiatives and reports which are developed by various international stakeholders (see pages 19-20), namely the Energy Transition Mechanism (ETM) by the Asian Development Bank, Just Energy Transition Partnership (JETP) by international partners (US, EU, Japan and Canada), and the Managed Phaseout Programme by the Glasgow Financial Alliance for Net Zero (GFANZ). If the emphasis on the inclusion of CPO was made, the ASEAN Taxonomy to support those initiatives would raise the concern that political interest takes precedence over science-based economic development rationales. Therefore, it is important to thoroughly assess the inclusion of CPO in the ASEAN Taxonomy since it has potentially significant impacts on the region, affecting energy security if it is implemented while RE and other low-carbon technologies are progressing.

IEA's Net Zero Emissions (NZE) Scenario may be incompatible with the ASEAN's current energy and climate policies

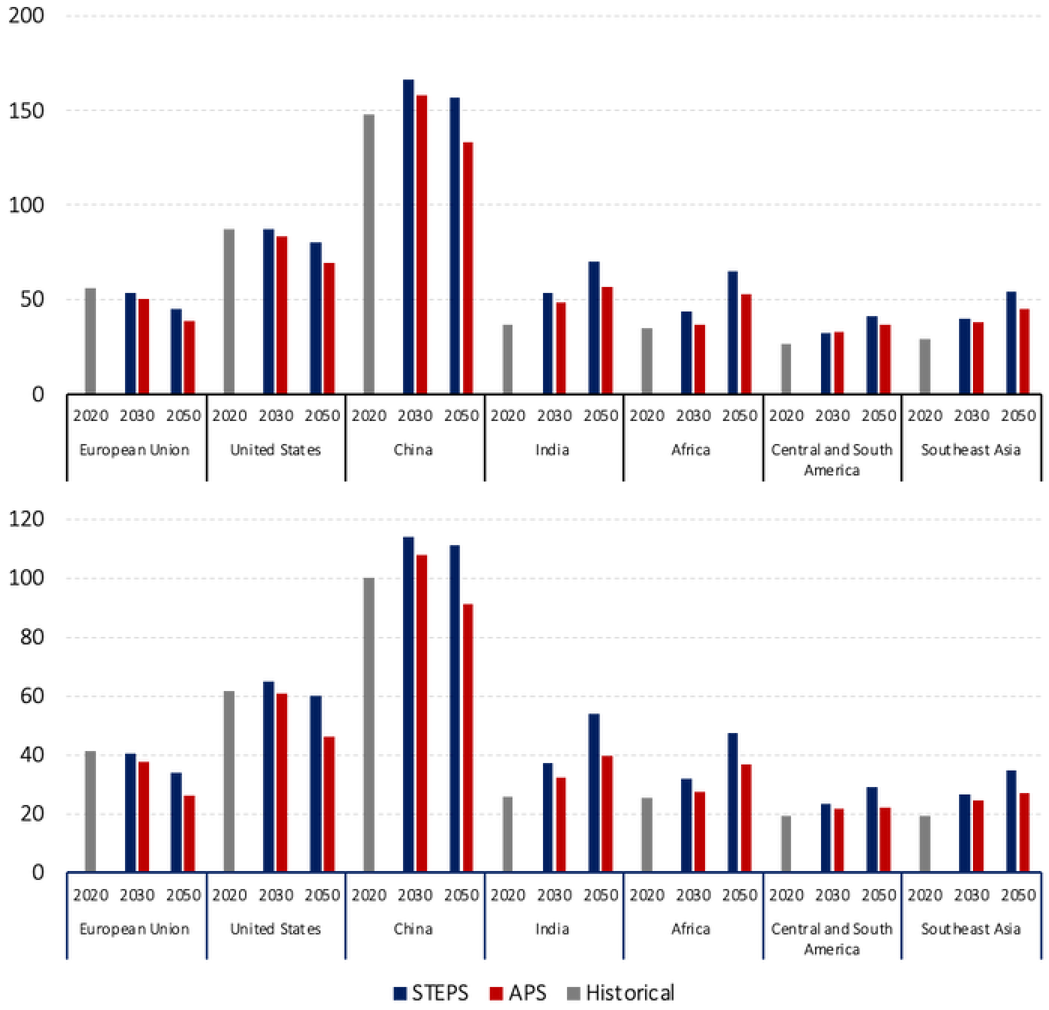
Table 1. *ASEAN Member States' Targets on Emissions Reduction (Source: UNFCC)*

Country	Official Emission Reduction Target	Carbon Neutrality or NZE Target
Brunei Darussalam	Reduce GHG emissions by 20% from BAU scenario by 2030	NZE by 2050
Cambodia	Reduce GHG emissions by 42% from the BAU scenario by 2030	Carbon Neutrality by 2050
Indonesia	Reduce GHG emissions by 31.89% from BAU scenario by 2030 (unconditionally) and 43.2% from BAU scenario by 2030 (conditionally)	NZE by 2060
Lao PDR	Reduce GHG emissions by 60% from the BAU scenario by 2030 (unconditionally)	NZE by 2050
Malaysia	Reduce carbon intensity (against GDP) by 45% from 2005 level by 2030	NZE by 2050
Myanmar	Reduce GHG emissions by 244.5 Mt CO_{2e} by 2030 (unconditionally) and by 414.75 Mt CO_{2e} by 2030 (conditionally)	Partial NZE from LULUCF by 2040
Philippines	Reduce GHG emissions by 75% from the BAU scenario by 2030 of which 2.71% is unconditional and 72.29% is conditional	N/A
Singapore	Reduce GHG emissions to around 60 $MtCO_{2e}$ in 2030 after peaking emissions earlier	NZE by 2050
Thailand	Reduce GHG emissions by 30% from the BAU scenario by 2030	Carbon Neutrality by 2050, NZE by 2065
Vietnam	Reduce GHG emissions by 15.8% from the BAU scenario by 2030 (unconditionally) and by 43.5% from the BAU scenario by 2030 (conditionally)	NZE by 2050

The ASEAN Taxonomy classifies CPO activities as either "green", "amber" or "red" under the PS framework by using quantitative threshold-based TSC. To be labelled "green", the Activity must align with a 1.5 degree C outcome and be consistent with the IEA's NZE Pathway for the power sector to achieve net zero emissions by 2050 [IEA, 2022]. However, at the regional level, there is still no commitment to net zero targets by 2050. Instead, only individual AMS have commitments to achieving carbon neutrality and/or net zero targets, as shown in **Table 1**. Moreover, methane emissions, which put LNG on par or even worse than coal, are yet to be considered in most cases, The IEA's Net Zero Pathway also makes various other assumptions and assertions that question the viability of its use in ASEAN, especially those relating to RE. The scenario relies on the unrealistically high capacity factor of solar and wind with prolonged operation lifetime, unreasonably positive net energy return (for solar PV at grid scale) and inflated usable resources (for wind). It also underestimates the financial and technical requirements to upgrade and expand transmission and storage infrastructure to balance the grid at all times including during monsoons and at night. These requirements render wind and solar much more expensive than coal at grid scale, posing threats to the industrial sector and households.

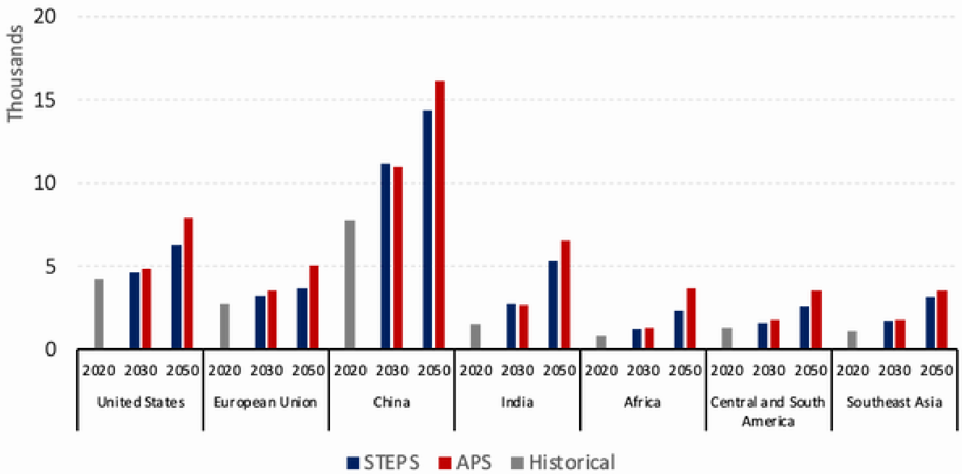
In addition, the IEA's NZE Scenario notes that energy intensity improvements in 2030 are nearly three times faster than over the past decade due to energy efficiency improvements, material efficiency improvements and behavioural change. However, ASEAN's energy intensity (EI) reduction would only double in 2050 based on the 7th ASEAN Energy Outlook. Such significant differences between EI reduction in the IEA's NZE Scenario and ASEAN's situation mean that EI reduction in the IEA's NZE Scenario is too optimistic for the ASEAN.

***Figure 1.** Total energy supply in EJ (top) and total final consumption in EJ (bottom) of different jurisdictions and countries by scenario (Data source: World Energy Outlook 2022).*



As depicted in **Figure 1**, emerging countries, including those in Southeast Asia, Latin America and Africa, and India have similar increasing total energy supply and total final consumption trends in the Announced Pledges Scenario (APS) between 2020 and 2020. Likewise, Southeast Asia's total energy supply and total final consumption will grow by 50% and 37%, respectively, during the same period. In contrast, the advanced economies (US and EU) and China have a decreasing total energy supply and total final consumption trends in the APS.

Figure 2. Electricity generation in TWh of different jurisdictions and countries by scenario (Data source: World Energy Outlook 2022).



Similarly, total electricity generation in APS will grow four-fold in 2050 relative to the 2020 level in emerging countries as shown in **Figure 2**. Conversely, the advanced economies (US and EU) and China will only grow by 83% during the same period. This projection suggests that the emerging and developing economies, including those in Southeast Asia, should be treated differently from the advanced economies. As the IEA's World Energy Outlook 2022 looked at the global level and was highly influenced by the advanced economies and China, the outcomes from this document cannot be appropriately applied to Southeast Asia.

Given their different priorities and situations, the AMS need unique pathways to achieve their energy transitions towards more efficient and cleaner energy sources. It is prudent to avoid specific pathways being imposed on the respective countries or regions. The world's largest users of coal, India and China, for instance, set their net zero targets for 2060 to 2070, respectively, indicating room for ASEAN to calibrate to a more realistic and balanced coal phase-down.

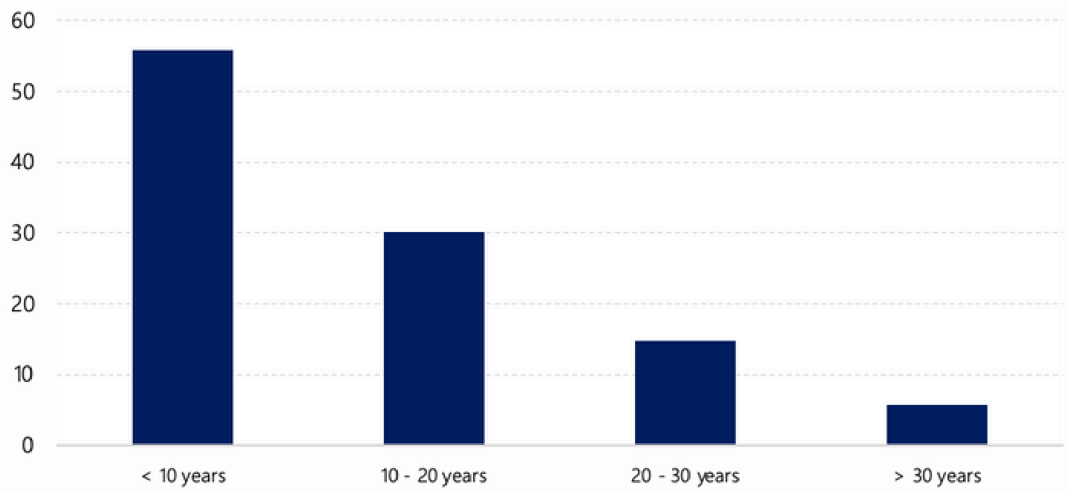
It would be beneficial to know the background as to why employing the IEA NZE Scenario by 2050 was chosen as the reference. In addition, to reflect more on the ASEAN energy landscape, it is helpful to consider the results of the 7th ASEAN Energy Outlook (AEO7) published in September 2022 and the upcoming 8th ASEAN Energy Outlook (AEO8) by the ASEAN Centre for Energy (ACE). The Outlooks explore four scenarios from 2020 to 2050. A key highlight is that the share of coal in the region's power generation will persist at approximately 21% by the year 2050, equivalent to about 548 TWh. Moreover, learning from the IEA's "Net Zero by 2050: A Roadmap for the Global Energy Sector" in 2021, the rebound effect from the Covid-19 pandemic and the global energy crisis in 2022 have prioritised energy security concerns over sustainability goals. In 2021, emissions rose by a record 1.9 Gt to reach 36.6 Gt, driven by rapid post-pandemic economic growth, slow progress in improving energy intensity and a surge in coal demand to supply the electricity needs. A recent article on Britain's concerns about meeting its net zero ambitions warned us that implementing net zero targets is much more complex than what we framed in the UK's net zero emission roadmap. It said that if Britain continues to pursue its net zero goals, it is inevitable that household electricity costs will steadily increase and remain high. Germany, by rising energy costs resulting from the energy crisis since 2022. This outcome reflects the limitations of the existing methods to generate clean electricity. The demands for electricity is set to surge if fossil fuel boilers are phased out and electric cars become mandatory. Given the costly consequences, many EU countries do not plan to completely phase out coal. After all, electricity generated from fossil fuels remains the cheapest option, even for developed countries. Furthermore, fossil fuels, including coal, allow more flexibility in securing affordable energy supplies.

Early closure deadlines could create unintended consequences as most coal fleets in Southeast Asia are relatively young

The ASEAN region hosts the youngest CFPPs in the world [IEA, 2021]. In 2023, approximately 53% (by capacity) have operated for merely a decade or even less as depicted in **Figure 3**. The mean age of the currently operating CFPPs in the ASEAN region is around 14.3 years. This assessment is in alignment with the approximations provided by the IEA for burgeoning Asian economies, which projected an average age of 12 years in 2020 [Kitchen, 2020]. By comparison, the average age of CFPPs currently operating in the US and the EU are 40 and 35 years, respectively. Several of the earliest coal power plants within the ASEAN region, which are currently operational, were constructed in the 1980s. Given that the worldwide average lifespan of CFPPs is around 50 years, it follows that with proper upkeep, these plants could continue to function for the next multiple decades.

The 2040 deadline for phase-out specified in the Taxonomy poses challenges, appears unrealistic and is economically undesirable. Most notably, if the existing CFPPs in 2023 were to be classified as "green" for phase-out, that would give us only about 17 years to establish alternative, clean energy sources to replace a significant portion of power generation from coal. This is less time than what Germany has had over the past 20 years, even after spending about one trillion USD on the "energy transition" towards an affordable way to generate sufficient reliable electricity and provide industrial heat and energy.

*Figure 3. **Age distribution of CFPPs in ASEAN (Data source: Global Energy Monitor).***



The development of new energy sources should, in theory, start as early and rapidly as possible since it takes considerable time for the technologies to mature and become economically feasible for the developers, and to become affordable for the consumers. If insufficient time is given to develop and implement seamless replacement strategies, countries risk falling into energy security and affordability issues. Accordingly, both Versions 2 and 3 of the Taxonomy need not define a particular year for CPO. Alternatively, the focus could shift towards incentivising investment to retire aging, inefficient coal plants in the area and replace them with new HELE coal plants. These new plants could incorporate CHP and partial CCS to maintain capacity while reducing emissions. This approach ensures continued investment in a system capable of meeting base, mid and peak load demands, safeguarding ASEAN's competitiveness. The next version can also benefit from the AEO8 in determining a more strategic phase-down plan.

Coal phase-out does not distinguish between abated and unabated CFPPs

If the AMS were to pursue energy policies consistent with the IEA's NZE targets, the unabated CFPPs would need to be retired entirely by 2040. However, the categorisation of CPO in the Taxonomy reveals a deficiency in its ability to differentiate between CFPPs that already have implemented emissions reduction measures and those that have not. This classification could technically only be applicable to newer CFPPs, which may still have the option to retrofit CCTs or employ other pollution-reduction methods, to meet the green standards, potentially allowing older, unabated CFPPs to continue operating.

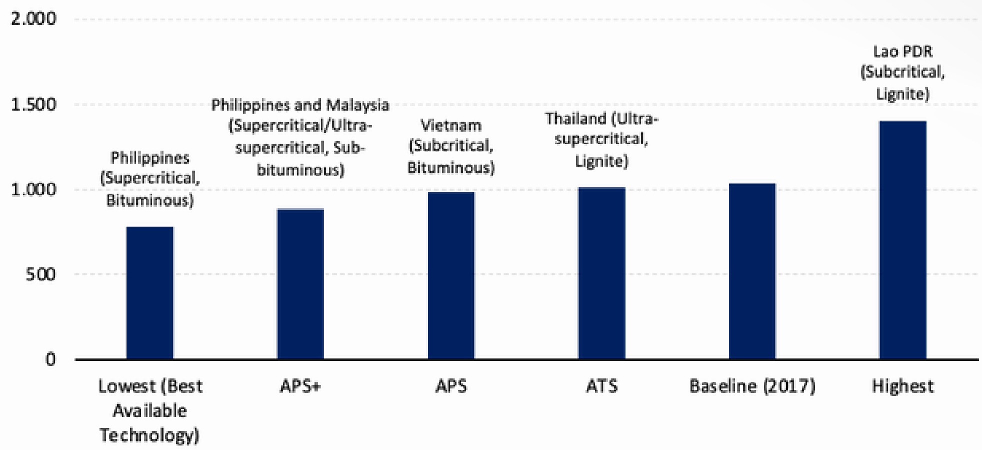
Electricity generation from abated CFPPs is excluded from the classification

The Taxonomy's categorisation of electricity generation activities seems fairly restricted since it does not encompass electricity production from CFPPs that have implemented CCTs to reduce emissions. This omission could translate to an opportunity lost as it precludes abatement efforts in the existing CFPPs, such as CCS/CCUS retrofits, even though the Taxonomy does not explicitly forbid electricity generation from fossil fuels in alignment with the principles outlined in the TSC for Environmental Objective 1 (EO1) concerning climate change mitigation. Fortunately, Version 3 of the ASEAN Taxonomy has specified the inclusion of CFPPs that are equipped with abatement technologies such as CCUS as long as the resulting lifecycle GHG emissions meet the TSC requirement.

The lifecycle GHG emission threshold for power generation activities practically rules out even the most advanced CFPP technologies equipped with CCS/CCUS

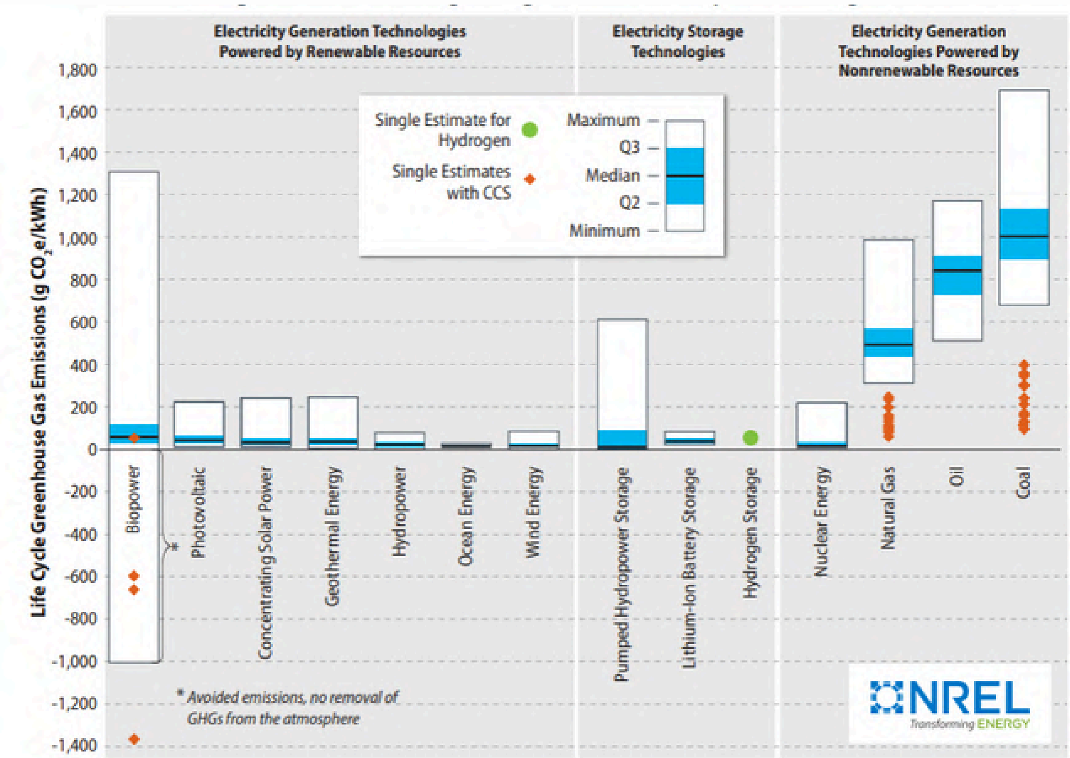
To achieve Tier 1 criteria, power generation assets must have lifecycle emissions of below 100 grams of CO_2 equivalent per kilowatt-hour (gCO_2/kWh) – comparable to the European Union Taxonomy. Theoretically, the most advanced CFPP of the advanced-ultra supercritical (A-USC) type has a CO_2 intensity of 670-740 gCO_{2e}/kWh [Hassan, et al, 2021]. Given the ongoing advancements in energy technology, the TSC requirement specified in Version 2, which did not specify abated CFPPs, might disqualify coal power plants from being labelled as "green" altogether, even those using CCS/CCUS technologies supplying fly ash to cement production for emissions reduction, or employing co-firing with biomass or ammonia to decrease coal usage. Yet, Version 3 of the ASEAN Taxonomy has addressed it by specifying the inclusion of CFPPs that are equipped with abatement technologies such as CCUS, provided that the resulting

Figure 4. Reference CFPP emission factors in g/kWh in ASEAN (Source: ACE).



lifecycle GHG emissions meet the TSC requirement. However, there remains a risk that any CFPP, even those equipped with emission abatement technology, will not qualify for the "green" category. According to an ACE study [ACE, 2021], among all the CFPPs in ASEAN, the best emissions factor is found to be that of a supercritical CFPP fuelled by bituminous coal in the Philippines at 782 gCO_{2e}/kWh (see Figure 4). According to a study by Wu, et al. (2014), CFPPs fuelled by pulverised coal with post-combustion CO_2 capture would have lifecycle CO_2 emissions of 182.7 gCO_2/kWh. Furthermore, a 2021 study from NREL [NREL, 2021] shows that the median lifecycle GHG emissions from unabated CFPPs averages around 1,001 gCO_{2e}/kWh, while that of the abated CFPPs (i.e., those with CCS/CCUS) is 231 gCO_{2e}/kWh, with only 1 data point being below 100 gCO_{2e}/kWh (see **Figure 5**). These imply that any currently operating CFPPs might not qualify for Tier 1, even after being retrofitted with CCS. In other words, even the best CCTs could not be qualified as "green", rendering the inclusion of coal power generation with CCS/CCUS practically futile.

Figure 5. *Lifecycle GHG Emissions for Selected Electricity Generation and Storage Technologies (Source: NREL, 2021)*



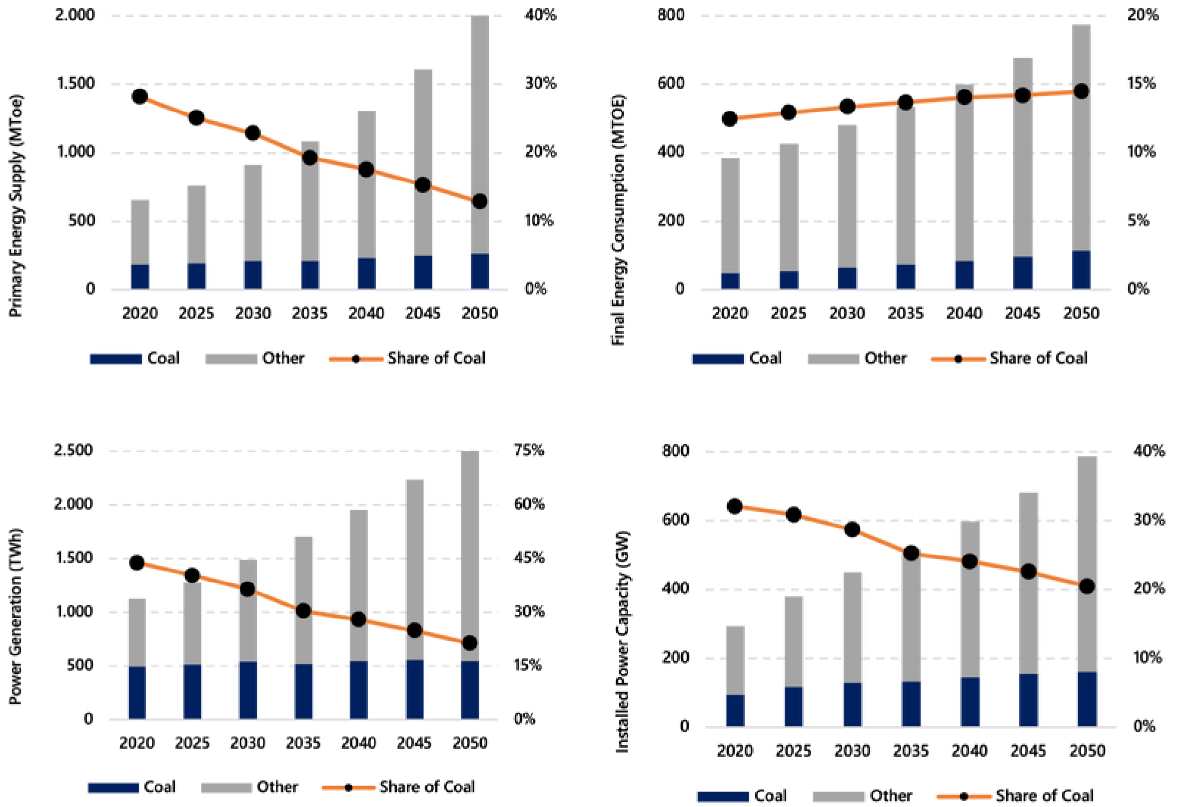
The Role of Coal in Southeast Asia

Coal is projected to remain an important energy source in Southeast Asia

Historically, overall electricity production throughout the region saw a notable rise between 2005 and 2020, escalating from 510 terawatt-hours (TWh) to 1,125 TWh, marking a notable surge of 120.5%. A significant portion of this power was generated through the combustion of fossil fuels. As of 2020, approximately 76% of the total electricity generation was attributed to fossil fuel combustion. Coal's contribution to the total energy supply within the AMS in that year stood at about 28%, ranking second after oil which accounted for 33%.

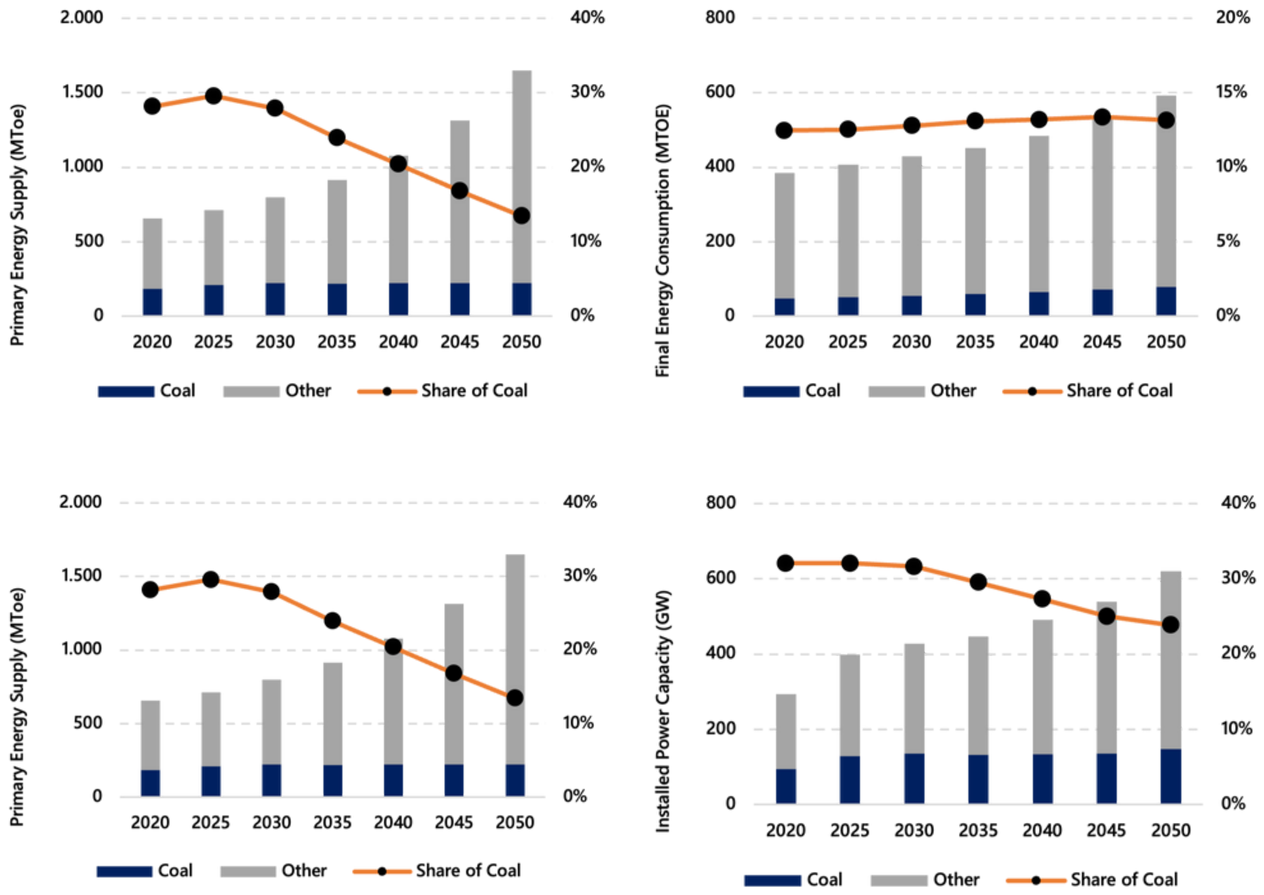
Due to the expected rapid economic growth across ASEAN, it is projected that the region’s energy demand will triple the 2020 level by the year 2050. Coal will maintain a pivotal role in fulfilling the energy requirements of ASEAN, and this situation is expected to persist into the foreseeable future as depicted in **Figure 6**. Under the AMS Target Scenario (ATS) in AEO7, it is projected that coal's share in the region's power generation, installed capacity, and primary energy supply will decline yet retain a significant portion (between 11% to 21%) by the year 2050. The role of coal in the final energy consumption shows an anomaly, where its share increases from 12.5% to 14.5% between 2020 and 2050.

Figure 6. Coal in primary energy supply, final energy consumption, power generation, and installed capacity based on the AMS Target Scenario (ATS) (Source: AEO7)



Even when the Least Cost Optimisation (LCO) scenario is considered, which is consistent with the regional aspiration, coal's contribution to the energy system in ASEAN persists as shown in **Figure 7**. In fact, as coal may still be one of the cheapest energy sources, coal will maintain a 12% contribution to the primary energy supply in 2050, which is almost identical to that in the current policy scenario (ATS) in Figure 6. In the power sector, coal-fired generation accounts for more than one-quarter of the total power generation in 2050.

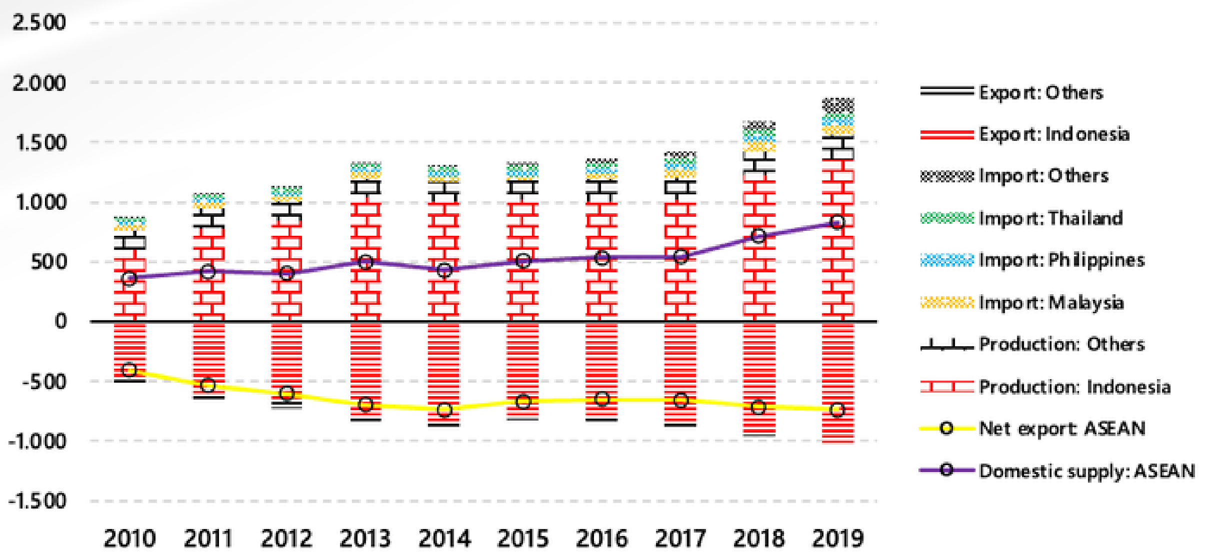
Figure 7. Coal in ASEAN's (a) Power Generation, (b) Installed Power Capacity, (c) Primary Energy Supply, and (d) Final Energy Consumption based on LCO (Source: AEO7)



Coal has contributed to the economic development of Southeast Asia

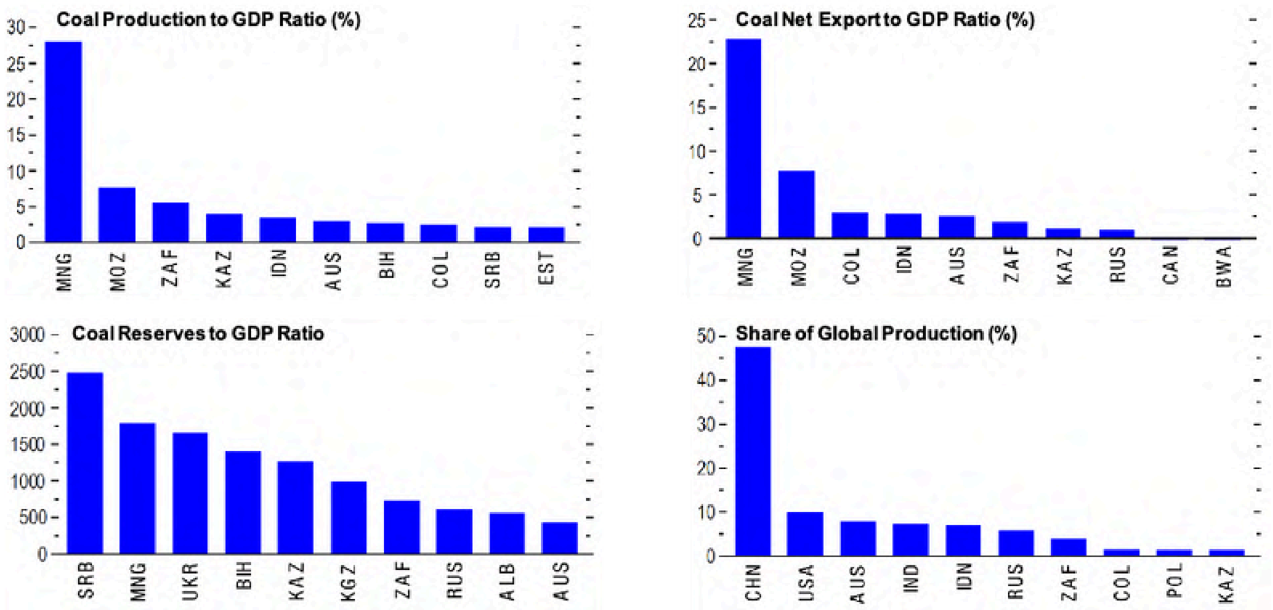
Coal has emerged as the most cost-effective energy option in the ASEAN region, notably within Indonesia, Malaysia, the Philippines, Thailand and Vietnam. Indonesia also relies on coal as a substantial earner of foreign exchange, with over half of its coal production being exported to satisfy global energy demands (as shown in **Figure 8**) and generating over USD 14.5 billion in 2020. On the other hand, Malaysia has been importing coal to support its industrial sector, while Vietnam's domestic production is primarily absorbed by its domestic market.

Figure 8. Coal domestic supply and trade balance of selected AMS (Data source: EIA)



The International Monetary Fund reported the effect of coal dependence on the global economy and found that coal contributed to the overall GDP per capita in countries with significant coal reserves, production and net exports [IMF, 2020] (see **Figure 9**). Indonesia's production reached around 8% of global coal production in 2017, which equated to 8% of the country's GDP and 3% of its net exports. These figures demonstrate how a CPO would directly impact the country's economy, and also have indirect effects on other sectors' domestic output.

Figure 9. The macroeconomic relevance of coal presented by selected indicators based on 2017 data (Source: IMF).



Coal is superior to most energy sources in terms of affordability and flexibility

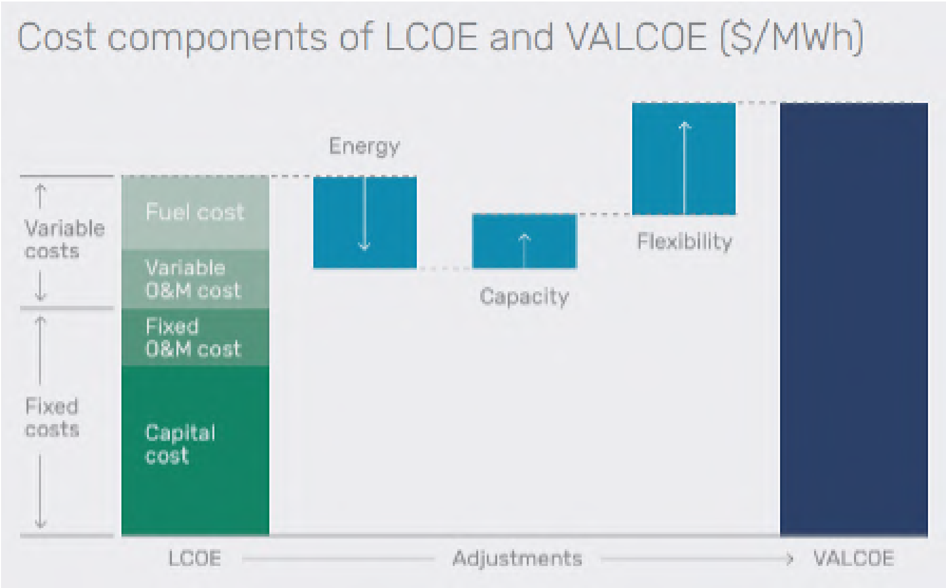
ACE and the World Coal Association (WCA) jointly released a report titled "Achieving Equitable, Secure, and Sustainable Energy with Clean Coal Technology in ASEAN," highlighting the favourable aspects of coal in power generation. At this point in history, dependable and consistent provision of electricity relies on stable, uninterrupted supplies of either fossil fuels or nuclear sources, commonly called baseload electricity. Given the rapid urbanisation and consistent provision of electricity relies on stable, uninterrupted supplies of either fossil fuels or nuclear sources, commonly called baseload electricity. Given the rapid urbanisation and industrialisation taking place within ASEAN, establishing secure on-grid electricity, including coal-generated power, is essential now and in the future.

It is important to note that the ASEAN region is becoming increasingly susceptible to extreme weather events, necessitating a flexible energy system. When faced with disruptive occurrences, power generators must rapidly adjust by either increasing electricity supply, decreasing demand or employing both strategies. Modern, flexible coal plants possess the capability to adjust power output swiftly to meet demand variations. In addition, they offer crucial grid stabilisation functions such as maintaining inertia, controlling frequency and regulating voltage. These capabilities are particularly crucial in addressing the escalating electricity requisites arising from the electrification of transport and industrial sectors.

A significant opportunity exists to utilise contemporary CCTs in ensuring universal access to affordable, reliable, sustainable and modern energy, as stated in Sustainable Development Goal (SDG) 7. To realise this potential, national and international policy frameworks and financing mechanisms need to support the implementation of the cleanest and most efficient coal technologies. Without such frameworks in place, less efficient technologies with more significant environmental impacts may prove more cost-effective and thus more appealing compared to the pricier yet cleaner and more efficient alternatives.

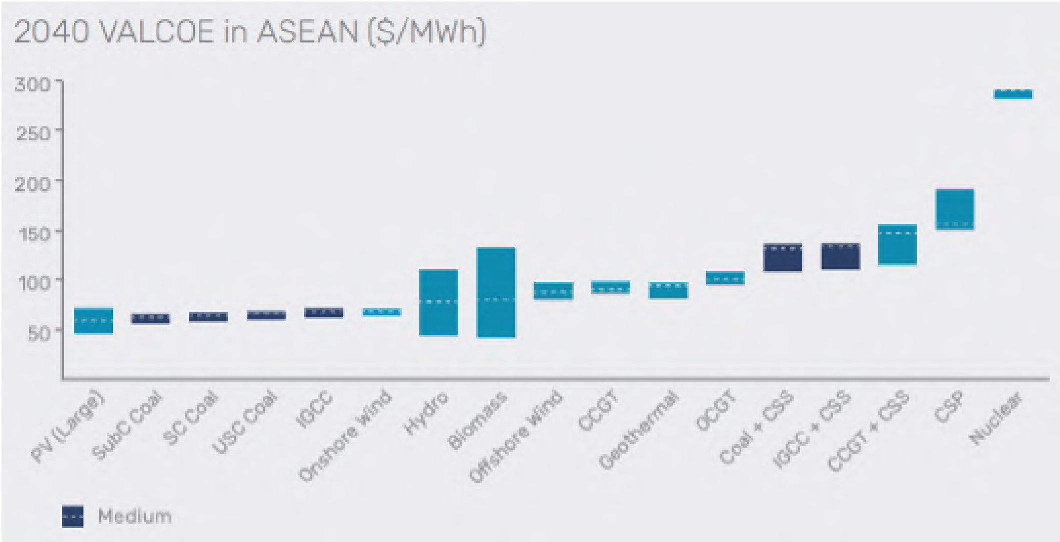
As ASEAN's industrial sector continues to expand, energy consumption, particularly electricity, will also rise. The AMS governments all recognise that electricity prices must remain low if the region is to remain attractive to foreign investment. The WCA measures the cost of running a reliable power system using the VALCOE associated with each technology. This metric extends from the basic LCOE by adding three additional factors: the value of the electricity generated, the contribution of the technology to the period of peak demand and the technology's flexibility to respond to demand fluctuations. **Figure 10** shows the difference between LCOE and VALCOE.

Figure 10. Cost components of LCOE and VALCOE (Source: WCA and ACE, 2021).



Based on 2018 data, coal is competitive against hydroelectric and solar PV. CFPPs with more advanced technology can operate more efficiently and burn less coal, which in turn lowers operating costs. Fixed costs can also be reduced by automation and less maintenance. These advantages remain unaffected by the VALCOE adjustment at least until 2040, as shown in **Figure 11**. Even though PV and onshore wind become increasingly competitive in the future, coal will still be ahead compared to these two renewable sources because their intermittency does not guarantee the secure electricity supply that coal does.

Figure 11. Projected range of VALCOE of different technologies in 2040 under low, medium, and high price assumptions (Source: WCA and ACE, 2021).



Moreover, in December 2020 the IEA confirmed that its VALCOE metric revealed how the system value of variable renewables such as wind and solar decrease as their share in the power supply increases. In other words, the cost of wind and solar increases the higher their share in the power system. It must also be noted that the costs from network integration and environmental externalities still need to be considered in order to compare intermittency with dispatchable power, as well as fuel diversity and the impact of long duration energy storage (LDES) requirement.

Coal is critical to enabling higher penetration of renewable energy

In 2021, a substantial portion of Germany's electricity generation capacity (almost 18%) came from CFPPs that use hard coal and lignite as energy sources. At the same time, RE sources played a remarkable role, accounting for nearly 62% of the total installed capacity. Within the renewable category, VREs like offshore wind, onshore wind and solar contributed 55.5%. Germany saw a notable shift in its power generation landscape, with VREs dominating the scene, as illustrated in **Figure 12**. On average, during the first ten days of November 2021, VREs met approximately 31% of the country's electricity demand. The lowest contribution of VREs to the generation mix occurred on 3 November, accounting for only 11% of the total generation, while CFPPs supplied nearly half of the electricity generation, around 42.5%. However, this situation was reversed on 7 November with VREs taking the lead in the generation mix, contributing 59%, while the share of the CFPPs dropped to 15%.

Figure 12. Power generation of all power plants by sources in Germany (top) and power generation from conventional power plants by sources over 10 days in November 2021 (Source: Agora Energiewende).

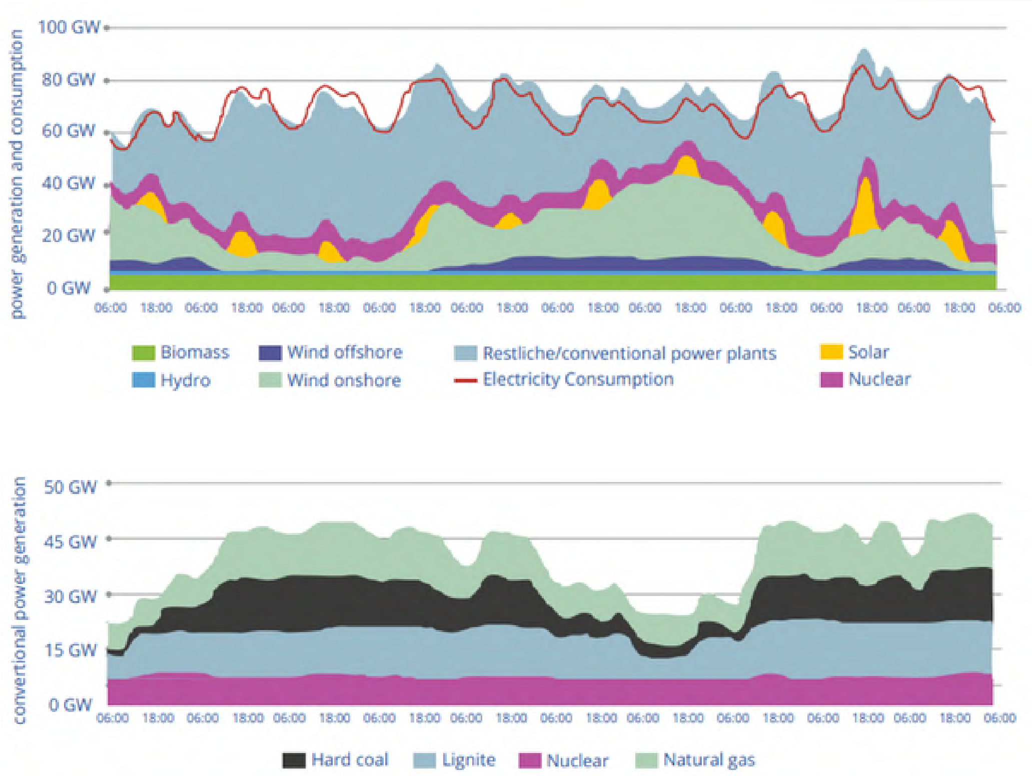


Figure 12 demonstrates that electricity consumption in Germany remained relatively stable during this period. High levels of VRE penetration can be seen in the early hours on day 5, 6, and 7, during which VREs consistently provided more than 40% of the total generation. Conventional power plants, as depicted in the bottom graph of **Figure 12**, immediately responded to these surges in VRE generation by adjusting their output during the same timeframe. As VRE generation decreased in the subsequent days, conventional power plants increased their output to meet the rising demand, particularly on 8 November. These conventional power plants, including CFPPs, demonstrated their flexibility in alignment with the fluctuations in RE generation.

Implications of Coal-Phase Out

Several of the AMS have already expressed their commitment to gradually decreasing coal utilisation through the coal phase-out/phase-down programme. However, without adequate countermeasures, there are some possible challenges involved in phasing out coal to generate electricity which must be addressed.

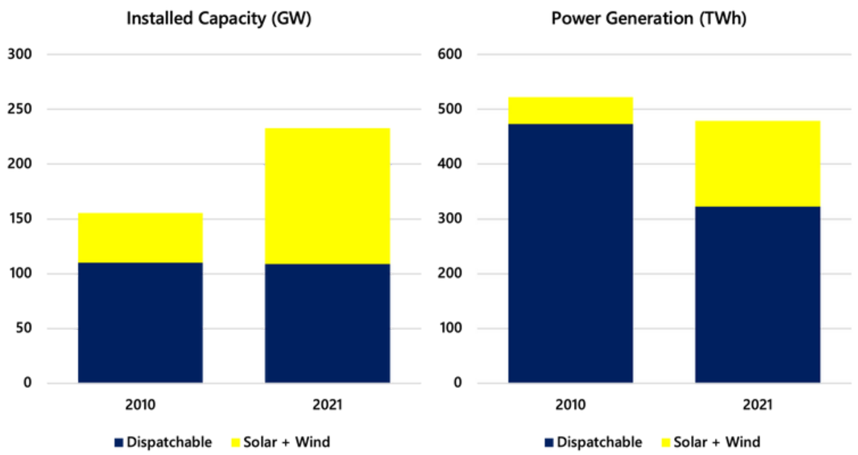
Reduced availability of dispatchable energy

Installed capacity from RE (e.g., wind, solar) produces neither the same amount nor the same quality of dispatchable energy, compared to coal capacity. Replacing the energy previously met by retired CFPPs will need massive amounts of additional capacity from RE to be immediately made available according to the timeline of the coal retirements. In addition, backup and storage systems are required and network integration needs to be considered. None of these are available or of sufficient capacity today, and none are expected to be available within the next decade. Overriding dispatchable energy sources in the grid system and overlooking the storage requirements could impact stable energy supply as the deployment of VRE is not able to completely replace the dispatchable energy sources.

For instance, **Figure 13** compares the 2010 energy landscape in Germany with that in 2022. In 2010, most of the installed capacity (approximately 71%) was comprised of energy sources that could be readily dispatched. This dominance is also evident in the energy generated, with over 90% of the energy being generated from dispatchable sources, while wind and solar contributed to only around 9% of the total. At that time, the development of RE sources, particularly wind and solar, was still in its nascent stages, both in terms of infrastructure and financial support.

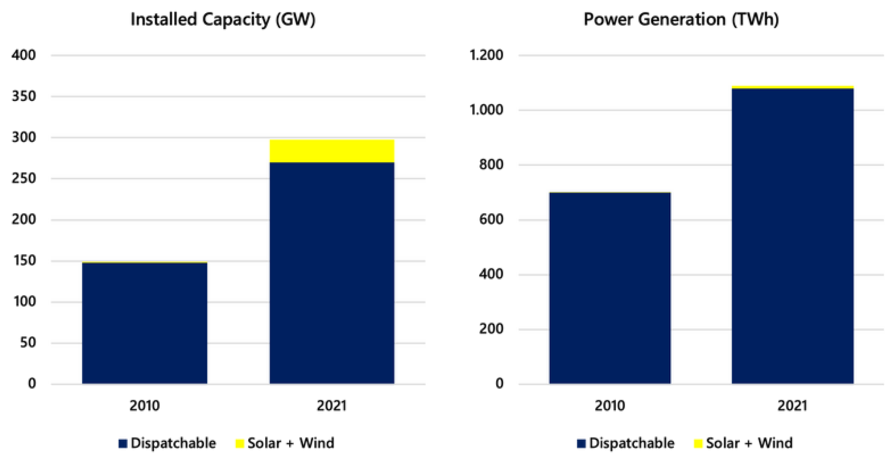
One decade later, wind and solar energy saw significant expansion, with their share in installed capacity (measured in GW) increasing by 174% compared to the 2010 levels. By 2021, wind and solar energy accounted for roughly 53% of the total installed capacity. However, their contribution to the total electricity generation was only 33%. The primary energy share of wind and solar was only 5%, far below fossil fuels, which make up about 80% of Germany's primary energy today as they did 20 years earlier. This indicates that while it was fairly easy for Germany to adjust its energy landscape in terms of installed capacity, the amounts of electricity generated from RE have not been growing much over the past 20 years.

Figure 13. Comparison of installed capacity and power generation from dispatchable and RE sources in 2010 and 2021 in Germany (Data source: Energy-Charts).



Similarly for the ASEAN region, as depicted in **Figure 14**, the vast majority of installed capacity in 2010 came from dispatchable energy sources, accounting for nearly 100%. A decade later, there was a substantial increase in the deployment of wind and solar energy, with their share in installed capacity increasing significantly compared to 2010. By 2021, wind and solar energy accounted for approximately 9% of the total installed capacity. However, their contribution to total electricity generation was only 1.6% - far below their portion of the total installed power capacity.

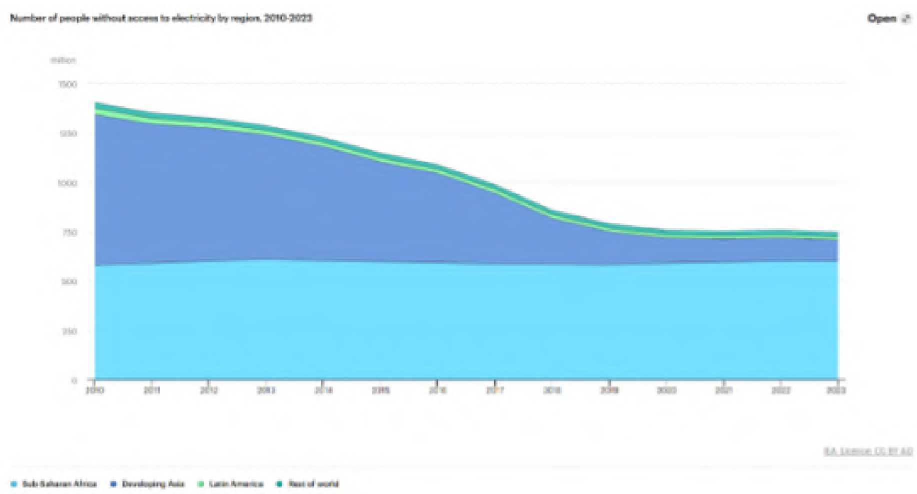
Figure 14. Comparison of installed capacity and power generation from dispatchable and RE sources in 2010 and 2021 in ASEAN (Source: ACE).



Increasing energy costs

The most important aspect of transitioning away from coal towards wind and solar is that they increase the cost of power exponentially because the more wind and solar that are in the system, the lower the overall reliability of electricity supply. This basic fact has deleterious effects on industrial and social development in ASEAN. As the cost of energy increases and reliability decreases, industrial activities look elsewhere for more supportive energy policies. The real concern is that the poorer half of the population may no longer be able to afford electricity, causing thousands of people to slide deeper into poverty, as indicated in **Figure 15**. This situation could be even worse in other parts of the world, such as Africa, where the poor were already heavily hit by the economic downturn resulting from COVID-19 and then ravaged by rising energy costs.

Figure 15. Global population without access to electricity by region between 2010 and 2023 (Source: IEA).



Financial and investment opportunity losses

As the usual economic lifespan of CFPPs is generally about 25 years, shutting down a large portion of the coal fleet prematurely would result in substantial financial setbacks for not only the plant proprietors/investors, but also the utility enterprises as the financing of these plants was based on the assumption that they would be operating for their full terms and consequently yield full returns on investment [ACE, 2022]. Conversely, plants that continue to operate beyond the point where they cover initial costs (more than 25 years) would encounter a decline in projected earnings, presenting an additional policy-related concern.

In recent years, an increasing number of banks have adopted a resolute stance by imposing stringent limitations on investments or loans for coal-related enterprises. In May 2021, the Asian Development Bank (ADB) introduced a preliminary Energy Policy, stipulating that the ADB will abstain from engaging in investments aimed at modernising, enhancing or refurbishing coal facilities that would prolong the operational life of existing coal-fired power and heating infrastructure [Shiga, 2021]. Following this policy, two prominent financial institutions in Malaysia also signalled their endorsement of the transition away from coal. Maybank declared its intention to cease financing coal activities as part of its five-year strategy, while CIMB bank unveiled a climate policy outlining its commitment to phasing out coal power from its portfolio by the year 2040 [CIMB, 2020 and Reuters, 2021].

The matters of stranded coal assets and their transformation are additional concerns that need to be tackled in the post-operational phase of these plants [ACE, 2022]. If nations opt to retire sections of their coal power plants, an additional consideration arises in determining how to repurpose the coal assets once they are retired. This could involve converting them into facilities that use natural gas, biomass, or other clean energy sources. In any case, establishing financial mechanisms is essential to enhance the economic viability of this approach.

Weakened energy security

The immediate retirement of a large coal power plant fleet is likely to have a broad impact on the energy security of the ASEAN region. In the event that the operational lifespan of coal plants is limited to 35 years in alignment with the 2°C target of the Paris Agreement, the region would need to retire 7.8 gigawatts (GW) of capacity within the next five years [ACE, 2022]. Meanwhile, as suggested in **Figure 6** and **Figure 7**, installed power capacity from coal between 2020 and 2030 still needs to be increased by 28 GW under the ATS Scenario (and 41 GW under the LCO Scenario) to meet the demand for electricity. Even though natural gas is a proven alternative for the short run, the AEO7 forecast indicates that ASEAN will be a net importer of natural gas as early as 2025. An abrupt coal retirement will increase the need for natural gas to serve as an immediate coal substitute, making it necessary to import large quantities of natural gas. As this situation is expected to happen in many other parts of the world, the global natural gas market will become increasingly tight. At the same time, the recent Russian invasion of Ukraine has raised many countries' import dependence, making the AMS' energy systems vulnerable to both price and supply shocks, undermining the region's energy supply security.

Huge investments for massive renewable energy deployment

Decommissioning coal power plants would necessitate the extensive rollout of RE and battery storage infrastructure to compensate for the energy gap resulting from deactivating baseload power-producing facilities—including steam and heat production as the secondary outcome critical in industrial facilities. Another primary technical challenge that all countries face when expanding RE generation is its intermittent nature. Several AMS have encountered issues with power fluctuations and interruptions due to the complexities of maintaining the stability of the electricity transmission system. Despite that well-established solutions are available to ensure the dependability of the power grid using battery and energy storage systems (BESS), including technologies like pumped storage hydropower (PSH) and compressed-air energy storage (CAES), installing them requires massive investments. Moreover, enhancing the grid infrastructure through integrating smart grid technologies and embracing flexible power generation methods like those from natural gas sources are other practical measures that need significant funding to implement.

From two ASEAN publications, the AEO7 and 2nd RE Outlook, it can be seen that investment requirements rise when a scenario requires higher shares of end-use electrification and RE. A scenario that is in line with the 1.5^{o}C climate target would require a 90% share of RE in electricity generation coupled with a 52% share of electricity in final energy consumption. Consequently, the investment for the power sector alone would need to be around 2-3 times higher than APS, as shown in **Table 2**.

Table 2. The investment requirements of selected scenarios in AEO7 and 2nd RE Outlook. (Source: ACE).

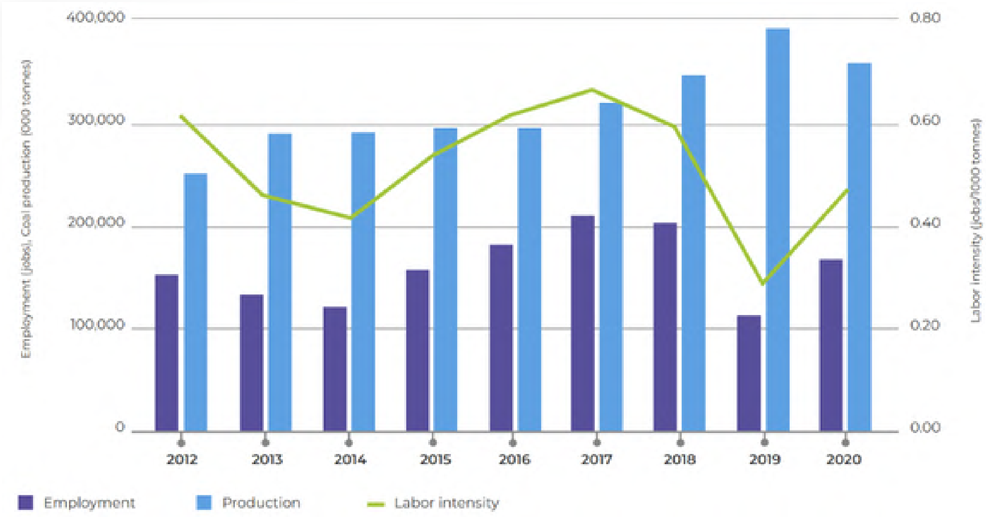
Scenario [1]	Investment – Power sector (billion US$)	Investment – Whole system (billion US$)	Electricity shares in final consumption (%)	RE shares in electricity generation (%)
AEO7 – ATS	879		50	25
2nd REO2 – PES	1,267	2,609	30	60
2nd REO2 – 1.5S	2,834 – 3,723	6,318 – 7,391	52	90

- AEO7: ASEAN Energy Outlook; ATS: AMS (National) Target Scenario; 2nd REO: 2nd RE Outlook; PES: Planned Energy Scenario; 1.5S: 1.5^{o}C Scenario.
- 2nd REO investment requirement covers 2018-2050.

Employment loss in the coal industry

Coal value chains can absorb a significant portion of labour, especially in countries which produce large amounts of coal and have large manufacturing capacity. Phasing out coal in the power and industrial sectors could reduce domestic demand for the commodity, which will also impact coal production, preparation and transportation activities. As one of the world's major coal producers, coal phasing out in Indonesia will directly affect thousands of workers along the coal value chain. According to data from Indonesia's Ministry of Energy and Mineral Resources (MEMR), there were 167,000 workers in coal companies in 2020 [IESR, 2022]. If workers not directly involved in the mining activities are included, the number reaches 250,000. The MEMR data in **Figure 16** also shows that even under no green transition aspiration, employment in the coal industry has been fluctuating as coal production activities are heavily influenced by coal prices.

Figure 16. Employment in the coal industry, coal production, and labour intensity between 2012-2020 (Source: IESR).



According to a simulation done by the Institute for Essential Services Reform, under a conservative CPO scenario, there could be between 14,000 and 110,000 job losses by 2040 [IESR, 2022]. The job loss numbers are aggravated by the fact that most coal workers in Indonesia are under 50 years old and are therefore still productive. Switching to other sectors would be challenging for these workers as they on average have relatively low education and have enjoyed relatively high salaries in the coal industry [Baran, et al, 2020]. In addition, based on 2021 data, though 60% had not finished high school, they were paid 58% higher than the national average [IESR, 2022].

Challenges in Developing Alternative Energy Sources to Coal

Nuclear development still faces complex non-technical challenges in ASEAN despite theoretically having the highest capacity factor

Nuclear power could play a vital role in providing baseload energy for power generation as well as energy for heavy industries where coal has accounted for around 31.5% of total coal consumption in the industrial sector due to its highest capacity factor of 92.5%. Small Modular Reactors (SMRs) would offer lower upfront costs than conventional nuclear power plants that could broaden access to nuclear power. However, development of these technologies has not yet gone beyond a pilot project in ASEAN.

Among the AMS, Indonesia, Malaysia, Vietnam and the Philippines are exploring the construction of nuclear power facilities between 2030 and 2035. Nevertheless, public acceptance of nuclear energy in the ASEAN region remains relatively low at around 42% [ACE, 2022]. The densely populated nature of ASEAN nations makes it challenging to construct nuclear power plants. In the event of an accident, there could be severe impacts on people, animals and the environment. Consequently, to enhance the public's acceptance of nuclear energy, it is imperative to actively involve them in discussions and decision-making processes. Failing to do so could result in a restricted future for nuclear energy within the ASEAN region.

Other challenges faced by SMR deployment include the lack of clear legal frameworks designed to support the operation of SMRs and the partnership between private and government to fund SMR construction. The difficulties in selecting a suitable site to contain nuclear waste also persist. These challenges need to be addressed first to ensure safe and risk-free nuclear construction and operation.

Biomass could be an alternative clean energy source, but its supply chains still need substantial enhancement

As the ASEAN region has vast potential of crop farming and agricultural waste, biomass could potentially support ASEAN's targets of 23% RE share in the energy mix and 35% RE share in the total installed power capacity. However, the adoption of biomass in power generation also encounters various challenges, including its technical complexity and unstable supply chain. Biomass often requires specific handling to avoid efficiency reduction and compatible with the plant equipment. Also, there must be a stable biomass feedstock supply chain to ensure continuous operation, which is proven to be challenging even in countries with vast lands for agriculture such as Indonesia. More fundamentally, the necessary financial support is currently inadequate and so is clear policies or roadmap. Another challenge is potential sustainability issues such as competition with agricultural land and water resources, food scarcity, biodiversity loss, deforestation, peatland degradation, soil erosion and social conflicts [28].

Some possible action could be taken, including organising a capacity-building forum in the region that would serve as a knowledge exchange platform. Expanding the collaboration with industries, such as the palm oil industry, could enhance the supply chain robustness. Establishing a biomass database and mapping system could also enhance the reliability of the biomass feedstock. Lastly, regulation to standardise biomass specifications for power plant intake could also be helpful to broaden the application of biomass for power generation.

Coal-to-gas conversion appears to be a low-hanging fruit for power sector decarbonisation, but it requires huge investments in gas infrastructure

Shifting from coal to natural gas in the power generation sector appears to be a readily achievable strategy for reducing carbon emissions in the ASEAN region (Lau, 2022). This is especially pertinent for Brunei Darussalam, Indonesia, Malaysia, Myanmar, Singapore and Thailand, where natural gas either constitutes the largest or second-largest source of electricity production. However, given that gas production in the ASEAN region is declining, major investments in LNG terminals will be essential to ensure a consistent supply of natural gas from sources outside the region. In some of the AMS, the lack of LNG import terminals as well as pipelines for natural gas transportation makes the transition from coal to gas challenging. Moreover, Southeast Asia has abundant coal resources relative to natural gas resources, so opting for coal is a more reasonable strategy to secure energy supply. Also, more dependence on natural gas will increase methane emissions, especially from leaks—a critical factor that is usually overlooked when promoting natural gas as the transitioning fuel from coal to renewables.

Geothermal development has stagnated as several issues obstruct advancement in Indonesia and the Philippines

Geothermal has the second-highest capacity factor (74.3%) to generate electricity. However, it is found only in Indonesia and the Philippines along the Ring of Fire. Yet, neither country has significantly expanded its geothermal energy capacity since 2020. The sluggish progress in increasing geothermal energy in these nations can be attributed to various factors, as outlined in a 2015 report by the Asian Development Bank and World Bank. In Indonesia, the impediments to geothermal energy development encompass institutional, regulatory and tariff-related issues. Meanwhile, restrictions on foreign ownership in this sector by the Philippines' government have discouraged foreign investments. Furthermore, the substantial expenses associated with drilling geothermal exploration wells place the majority of the initial financial burden on private investors in both countries, rendering geothermal electricity investments financially prohibitive. Unless the governments of Indonesia and the Philippines cultivate an environment that promotes private investment in the geothermal sector, the potential for growth in this sector will remain constrained.

Retrofitting existing CFPPs with biomass co-firing is promising but demands financial support from the Taxonomy besides the inherent challenges of biomass supply

One of the options to reduce emissions from CFPPs is to implement biomass co-firing, which entails substituting a portion of coal consumption (normally around 5-10%) with biomass. Biomass co-firing is also considered economically viable as additional capex is often minimum. The existing CFPPs simply need to install biomass pre-treatment units before the feedstocks enter the combustion equipment. Several potential biomass sources include wood pellets, sawdust, rice husks and empty palm oil fruit bunches. Several AMS have issued policies and regulations on biomass co-firing, such as Indonesia, Malaysia, Thailand and Vietnam, as shown in

Table 3. Indonesia is the leading country in retrofitting its CFPP with biomass co-firing, which has been operating 13 different power plants. One of the Indonesian coal plants, PLTU Tembilahan, has successfully tested a 100% biomass co-firing. Some major examples of biomass co-firing implementation in Indonesia can be found in **Table 4**.

Table 3. Major policies, regulations and initiatives in biomass use (including co-firing) in ASEAN.

Country	Policy/Regulation/Initiative	Capacity (MW)	Year	Objectives
Indonesia	Regulation of Co-firing Biomass with Coal Power Plant Generator Number 001/DIR/2020	PT Perusahaan Listrik Negara (PLN)	2020	Provide the basis for the implementation of co-firing in existing CFPPs, as well as to 910 synergize and accelerate the implementation of co-firing; (2) accelerate the aim to reach renewable energy share targets; (3) ensure co-firing is implemented at PLN's CFPP; (4) monitor implementation of co-firing; and 95) ensure the use of biomass in a controlled manner
Malaysia	Malaysia Renewable Energy Roadmap	Sustainable Energy Development Authority (SEDA) Malaysia	2021	Provide 4 strategic pillars to determine the renewable energy targets in the power generation composition to 2035 and determine strategies to achieve RE targets, with pilar number 2: bioenergy,for which one of the key actions is to explore the implementation of equitable and feasible support mechanism for biomass co-firing
Thailand	Alternative Energy Development Plan (AEDP) 2018	Electricity Generating Authority of Thailand (EGAT)	2018	Aimed to increase the renewable energy share target to 30% by 2037 through several sub-initiatives, of which one is adding a"Community-Based power Plant for Local Economic Project" which accounts 1,993 MW (biomass, biogas, and solar hybrid)
Vietnam	Power Development Plan VIII (PDP VIII)	Ministry of Industry and Trade (MOIT), and Government of Vietnam	2022	Launch initiatives to help Vietnam to reach its RE share target; (1) Vietnam will stop building new coal power plants after 2030; (2) after 20 years of operation, CFPPs will burn biomass fuel, starting at 20% and gradually increasing to 100%; and (3) by 2050, there will be no CFPPs in the power system

In its World Energy Outlook 2022, the IEA emphasised the importance of considering repurposing plants to focus on flexibility by retrofitting them with biomass co-firing or combining them with CCS/CCUS. However, it is noted that these initiatives have yet to gain support from financial institutions. Therefore, it is essential to include biomass co-firing activities in the Taxonomy to expand financing opportunities for such initiatives.

Table 4. CFPPs in Indonesia that have successfully tested biomass co-firing with 1-5% ratio (Source: ESDM).

Power plant	Province	Capacity (MW)	Fuel type
PLTU Pelabuhan Ratu	West Java	1,050	Sawdust
PLTU Rembang	Central Java	630	Wood pellets
PLTU Labuan	Banten	600	Solid Recovered Fuel (SRF)
PLTU Suralaya	Banten	1,600	Rice husks
PLTU Ketapang	West Kalimantan	20	Empty palm fruit bunches (EFB)
PLTU Adipala	Central Java	660	Sawdust
PLTU Paiton	East Java	800	Sawdust
PLTU Jeranjang	West Nusa Tenggara	150	Solid Recovered Fuel (SRF)
PLTU Sanggau	West Kalimantan	14	Empty palm fruit bunches (EFB)
PLTU Barru	South Sulawesi	100	Solid Recovered Fuel (SRF)
PLTU Pacitan	East Java	630	Sawdust
PLTU Anggrek	North Sulawesi	56	Solid Recovered Fuel (SRF)
PLTU Lontar	Banten	945	Rice husks

How Should the Gradual Reduction of Coal Fleets Be?

The plans for the gradual reduction of coal fleets in ASEAN must be done very carefully. The coal phase-down is only possible after economically and environmentally viable alternatives, at grid scale, have become available and been proven entirely workable.

Coal phase-down is more relevant than coal phase-out

Nine of the ten AMS have committed to achieving net zero emissions or carbon neutrality by 2050 at the earliest. As part of this effort, ASEAN plans to gradually reduce the use of fossil fuels, including coal. Rather than completely phasing out coal at an accelerated pace, a coal phase-down at the right time will provide relief to recently commissioned coal power plants that may have remaining operational lifespans of 20-30 years.

Implementing a gradual reduction in coal use will provide a transitional period for shifting towards truly economically and environmentally grid-scale “renewable” energy sources. This careful phasedown of coal will support the growth of the technologies and energy storage solutions necessary for scaling up RE capacity. The phase-down of coal usage at the right time also offers some reassurance to the investors involved in coal-based projects, as these projects have been facing funding challenges. Most of the funding for such projects comes exclusively from domestic financiers.

The experience of the EU during the 2022 energy crisis should be noted. Germany, Austria, France and the Netherlands annoounced plans to enable increased coal power generation in the event that Russian gas supplies suddenly stop:

- **Germany**'s parliament approved a new energy law on 8 July 2022, which includes the Replacement Power Plant Provision Act. This act allows 8.2 GW of CFPPs to be placed on standby within a supply reserve facility. The reserve includes both hard coal (6.3 GW) and lignite (1.9 GW) plants. The lignite facilities will be reactivated only as a last resort if the hard coal units alone cannot meet electricity demand. In addition, the new energy law sets a higher target for RE, aiming for an 80% share of total electricity generation by 2030.
- The **Netherlands** made changes to its existing legislation, which previously limited its hard coal plants (4.5 GW) to operating at a maximum of 35% capacity since January 2022. In July 2022 they were granted permission to run at full capacity until the end of 2023.
- **France** will temporarily reopen its 595 MW Emile Huchet 6 coal unit during the winter months.
- **Austria**'s 246 MW Mellach plant will also come out of retirement temporarily and use coal instead of gas.

Several AMS have already articulated their commitment to gradually reducing coal usage, but they require more comprehensive regulatory frameworks and detailed roadmaps to facilitate a seamless transition. Consequently, it is suggested that the process of phasing down coal use should be executed in three distinct phases:

- Enhancing the electrical grid capacity and resilience to accommodate higher levels of RE integration by grid expansion and modernisation.
- Establishing financial mechanisms that incentivise CCS retrofits of existing CFPPs. This entails implementing more stringent emission standards, instituting carbon pricing initiatives, aligning with the global market mechanisms stipulated by the Glasgow Climate Pact, and providing assistance to coal plant operators that empowers them to reinvest the capital released from plant closures into conversion or replacement with renewable sources, thereby generating returns on their investments.
- Carrying out sustained exploration into alternative energy resources, clean technologies and digitalisation to advance the development of viable and eco-friendly options.

It should also be noted that in many energy systems in the world, including in Europe, coal fleets still play a role in securing energy supply—even with a system that is transitioning to RE. Many countries use CFPPs for flexible and/or back-up generation to ensure reliable energy supply amidst disruption.

Crucial roles of grid resilience and improvement prior to CPO

To support 2025 regional targets towards 23% share of RE in the energy mix, 35% share of RE in total installed power capacity and 2050 ASEAN carbon neutrality, the ASEAN Power Grid will play a critical role. Region-wide interconnections can solve the problem of misbalance between electricity supply and demand, increasing the attractiveness of variable forms of RE, such as wind and solar. The plans for the gradual reduction of coal fleets in ASEAN must be done very carefully. The coal phase-down is only possible after economically and environmentally viable alternatives, at grid scale, have become available and been proven entirely workable.

The ASEAN Interconnection Masterplan Study (AIMS) III provides a framework to update the APG plan and focus on increasing RE integration through greater interconnections. AIMS would address the AMS' different conditions and pursue higher interconnections to enable higher RE utilisation. These interconnections could enhance regional energy security and minimise the economic impact caused by price volatility in the global market.

Grid readiness to allow the smooth operation of higher VRE penetration is a prerequisite. It can be seen from Vietnam's experiences in 2020, that variable solar power could lead to grid overload. Consequently, the actual dispatch from the VRE power to the grid saw significant curtailments due to limited transmission capacity. Some technical challenges were also observed, such as grid congestion, renewable generation surplus, low system inertia, imprecise RE forecasts and low short-circuit ratios (SCR). Vietnam Electricity (EVN NLDC) has addressed these challenges through various short-term mitigation plans, including the application of online inertial monitors and improving RE forecast accuracy. In the longer term, cross-border interconnections with the neighbouring countries, and the application of battery energy storage systems could be applied to enhance the flexibility from the higher integration of VRE.

If a CPO is implemented, more VRE is expected to be introduced into the energy systems to ensure stable energy supplies. From Vietnam's experiences, it is apparent that preparing resilient and robust grid infrastructure is as important as increasing the share of VRE. These efforts may include modernising and strengthening grid resilience through enhancing power system reliability and quality assessment, integration of VRE with energy storage, application of smart grids and demand-side management.

Reducing emissions from the existing CFPPs

To balance the issues of energy security and sustainability, the region should explore technological alternatives that facilitate the operation of the young coal fleets with reduced emissions. These alternatives encompass strategies like biomass co-firing, CCUS and other HELE technologies. Regionally, these strategies are guided by the APAEC's Coal and Clean Coal Technology Programme Area.

In Indonesia, a total of 17 coal plants have initiated the adoption of co-firing, substituting as high as 5% of their fuel (by mass) with biomass to curb emissions as a mitigation measure [Argus Media, 2021]. There are ambitions to further increase the proportion of biomass in their fuel mixture in the future [MEMR, 2021]. Plans are also in motion for integrating CCUS technology into existing coal plants for enhanced oil/gas recovery [ITB, 2017]. After the establishment of the National Center on CCUS in 2017 and the issuance of the MEMR (Minister of Energy and Mineral Resources) Decree 22/2019 on Emission Inventory and Mitigation in the Energy Sector marked the initial groundwork, the MEMR recently issued another decree (2/2023) regulating the implementation of CCUS in upstream oil and gas operations [MEMR, 2023].

The deployment of CCS/CCUS and other CCTs has been met with diverse public opinions. Some view them as necessary, pivotal transitional tools while the region navigates its way towards a low-carbon economy. Others contend that these technologies might perpetuate reliance on fossil fuels rather than reduce it. Regardless, CCUS holds significant potential for decarbonisation within the regional grid, especially when retrofitting existing plants.

Acknowledging a shift away from coal, the 21st AFOC Council Meeting also noted that coal continues to hold relevance in ensuring energy stability and generation while pursuing some initiatives aimed at decarbonisation, such as adopting HELE technologies and CCUS. It was reiterated at the meeting that energy security and system stability represent crucial concerns during the ongoing energy transition phase.

Development of legal and regulatory frameworks

Countries like Indonesia, Malaysia, the Philippines, Thailand and Vietnam have demonstrated their commitment to gradually reducing the use of coal at the right time, thereby creating an opportunity for greater uptake of RE in their grids. Recent developments show that half of the AMS endorsed the Global Coal to Clean Power Transition statement at the 26thConference of Parties (COP26), pledging to cease authorising new unabated coal power plants and achieve a complete transition to cleaner energy sources by 2040 in the context of developing nations. This commitment marks a significant milestone in ASEAN's energy transition.

Indonesia's national power company PLN (Perusahaan Listrik Negara) has outlined plans to retire all CFPPs by 2056 and halt the approval of new ones. In Vietnam, the government released the Eighth National Power Development Plan (PDP8) for the 2021-2030 period on May 2023, with the objective of decreasing the share of coal-fired power capacity [Green FDC, 2023]. In parallel, the Malaysian Minister of Energy announced intentions to retire 7 GW of coal-fired capacity [Zheng and Khoo, 2021]. Thailand has adopted a new power development plan that lowers coal-related targets and elevates the targets for RE for the year 2027. Moreover, the Philippine Department of Energy introduced a coal moratorium, leading to the cancellation of up to 10,700 MW of coal power projects [Ahmed and Brown, 2020].

However, AMS that have pledged to uphold these new policies are still in the process of devising legal and regulatory frameworks for their effective execution. Gaps in policy formulation might involve more stringent emission standards and implementing carbon pricing mechanisms that incentivise investments in lower-carbon technologies. Moreover, regulations pertaining to the integration of energy storage and improvements in grid operations and pricing need to be defined. Capacity-building frameworks are necessary to facilitate the transition from conventional energy sector employment to environmentally friendly jobs. Furthermore, clear guidelines are needed to determine which power plants are most suitable for retirement.

While coal remains a prominent fuel for the power grid due to its perception as a cost-effective and reliable energy source across numerous AMS, the shift away from coal can only be achieved through well-crafted policies and effective instruments. Phasing out a significant portion of the coal fleet necessitates resolute commitment from policymakers, as well as financial and technical support from relevant dialogue partners and international organisations.

Inclusion financing transitional period of coal in the Taxonomy

The Taxonomy functions as a set of guiding principles instead of rigid legal mandates. The decision on whether to incorporate the Foundation Framework (FF) and Plus Standard (PS) of the Taxonomy into their legislation rests with each country. The 21st AFOC Council Meeting stressed that the shift towards cleaner energy should be pursued comprehensively, encompassing not just the power sector but also extending to other domains like transportation. The meeting also underscored the significance of reducing emissions while safeguarding energy security.

As coal will remain important in our energy systems, minimising or even eliminating pollutants, particularly from coal-fired facilities (in power and industrial sectors), becomes indispensable to protect public health and the environment. Ways to reduce coal consumption, such as co-firing with biomass, are readily available. Indonesia, for example, has implemented biomass co-firing in multiple locations at the commercial level as per 2023 data with a total power generation of 325 GWh and emission savings of 321 ktCO_2 [MEMR, 2023]. Other advanced technologies to eliminate CO_2 emissions, such as CCS, or using CO_2, such as co-firing with hydrogen and ammonia, are waiting to be commercially available. Implementing all of these technologies will require financial in addition to regulatory support, and the Taxonomy could provide an avenue to enable this opportunity particularly for power producers.

Conclusions and Way Forward

ACE recognises the pivotal role played by the ASEAN Taxonomy in aligning the definition of sustainable activities and assets within ASEAN to global standards. This recognition extends to the commendable endeavours in applying systematic, science-based methodologies for categorising sustainable activities and assets in the region, particularly through the use of the TSC as the quantitative classification tool under the PS. Furthermore, ACE acknowledges the substantial impact of the Taxonomy on shaping and advancing national taxonomies across the AMS. Finally, ACE endorses the judicious inclusion of the term “coal phase-out “within the Taxonomy, recognising its potential to facilitate an equitable and smooth energy transition while safeguarding energy security, accessibility and affordability. This inclusion is seen as a testament to both the Taxonomy's credibility and ASEAN's steadfast commitment to sustainability.

ACE, however, raises several important considerations regarding the ASEAN Taxonomy. Firstly, ACE believes that relying primarily on the IEA's Net Zero Emission Pathway as the Taxonomy's foundation might be overly ambitious and not sufficiently tailored to the unique circumstances prevailing in Southeast Asia. Additionally, ACE expresses concerns about the CPO classification within the Taxonomy, specifically highlighting its inadequacy in distinguishing between abated and unabated CFPPs. This classification may inadvertently leave older, unabated CFPPS in operation even longer and favour the retirement of newer ones, which still have the potential to be retrofitted with carbon capture technologies or other abatement measures. Furthermore, ACE notes that the Taxonomy's classification of electricity generation activities appears limited, as version 2 of the Taxonomy excludes electricity generation from abated CFPPS equipped with CCT. This omission persists even though the Taxonomy does not outright prohibit electricity generation from fossil fuels, in line with the principles of the TSC for Environmental Objective 1 (EO1) on climate change mitigation. All of these may potentially harm people and economies as we inherently only focus on the environment as part of our sustainability agenda. Nevertheless, ACE highly appreciates the ATB’s response in its newest version of the Taxonomy by addressing some of these issues. ACE is hopeful that the remaining issues will be addressed in the subsequent versions.

ACE offers several key recommendations for the ASEAN Taxonomy. Firstly, ACE suggests that the Taxonomy should comprehensively emphasise the transitional efforts required by Southeast Asian nations to align with climate goals, considering factors such as their readiness, distribution and the abundance of indigenous energy resources, all within the context of their economic development levels. Secondly, ACE advises that the ASEAN Taxonomy should use the most recent ASEAN Energy Outlook published by ACE as the foundation for classifying sustainable activities and assets. This would ensure that the Taxonomy is a more accurate reflection of the current situation in Southeast Asia. Lastly, ACE recommends that phase-out classification emphasises unabated CFPPs to avoid unintended consequences on the abated counterparts.

ACE also requests that the ATB provide clarity regarding the use of lifecycle GHG emission thresholds for electricity generation within the TSC of the CPO. If such thresholds are indeed in use in regions or countries comparable to the AMS, a re-evaluation of this TSC is deemed essential, and should involve consultations with relevant stakeholders.

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APPENDIX: Comparison between Version 2 and Version 3 of the ASEAN Taxonomy regarding coal power generation and coal phase-out

Note for colour codes:

- **Purple**: The parallel of the major points in Version 2 are present in Version 3, but the wording is either partially or completely modified. Contingent upon the case, the modification may or may not add or reduce the message in Version 2
- **Red**: Present in Version 2 but deleted in Version 3
- **Blue**: Not present in Version 2 but added in Version 3

Changes	Version 2	Version 3	Notes
Published	March 27, 2023	March 27, 2024	
Effective	February 19, 2024	Not defined yet	
Stakeholder consultation results		Following the publication of Version 2 of the ASEAN Taxonomy, the ATB requested input from stakeholders through consultations. This was conducted through various methods including an online survey, roundtables and interviews between June to November 2023. Participants from all AMS, industry groups, official and private sector stakeholders as well as various organisation types were involved in the stakeholder consultation. Key findings from the consultation process included: • Stakeholders welcomed the Taxonomy's inclusive approach in accommodating companies at various stages of development with the sector-agnostic principles-based FF and threshold-based PS. They also commended the ASEAN Taxonomy as a credible, science-based tool and the Taxonomy's emphasis on interoperability, in particular, the alignment of the PS Green Tier with the EU Taxonomy. • There was no significant pushback on the TSC for the Energy sector. There was also general positive consensus on the usage of the IEA's Southeast Asia Sustainable Development Scenario (IEA SEA SDS) pathway as the reference in developing the TSC for the Energy sector as part of the PS, given its granularity. • Furthermore, the inclusion of CPO as an activity in the PS was commended as a powerful tool for transition and was one of the first for a sustainable finance taxonomy. The CPO criteria would help to encourage decarbonisation by reducing dependence on coal power in the region. • The bulk of the feedback received pertained to suggestions to improve clarity in definitions and usability of Version 2 of the ASEAN Taxonomy. The more	In the initial draft of the position paper, it is noted that the taxonomy should explicitly consider electricity generation from fossil fuels that are equipped with abatement technology as long as they can meet the lifecycle emission requirement. This point has been included in Version 3. Besides, it is noted that requirements in the TSC, such as "best-in-class technology" in TSC for coal phase-out, are not accompanied by specific quantitative criteria to prevent ambiguity. In Version 3, this specific criterion for TSC (Tier 1) for coal phase-out is dropped (even though the same criterion may instead be added in the Tier 3 requirements).

		immediate points of clarification have been incorporated in the updated iteration of Version 2, made effective on 19 February 2024. This includes clarification of the definitions and criteria for EOs and EC under the FF, updated guiding principles for all EOs, inclusion of a red list of activities from ASEAN Taxonomy Version 1, future TSC for Electricity, Gas, Steam and Air Conditioning Supply activities as indicative thresholds, finalised criteria for CPO, updated DNSH guiding principles, streamlined DNSH criteria and guidance on grandfathering. Other improvements will be rolled out in tandem with the release of subsequent versions of the ASEAN Taxonomy. page: 17	
Environmental Objective (EO) 1: Climate Change Mitigation - Description	Under this EO, Activities must be in alignment with decarbonisation trajectories that aims to meet the 1.5oC target under the Paris Agreement which were ratified by all AMS in 2017. page: 25	Activities shall be assessed in alignment with AMS specific decarbonisation pathways. Where possible, Activities shall be aligned to the decarbonisation trajectories that aims to meet the 1.5oC target under the Paris Agreement which were ratified by all AMS in 2017. page: 26	
Environmental Objective (EO) 2: Climate Change Adaptation - General Principles	1. Activity shall positively contribute to a reduction in material physical climate risk and/or shall reasonably reduce material physical risk from current and future climate change. This can include obvious physical risks, such as flooding, but also less immediately visible effects, such as impact on health from higher temperatures. 2. Impact assessments under a broad range of climate scenarios shall be conducted to provide better understanding and insights on the effectiveness and benefits of the Activity. 3. Activity that enables adaptation of other Activities should reduce the impact of material physical risk from other Activities and/or reduce barriers to adaptation through technology, services or products. 4. Activity must not adversely affect the adaptation efforts, or increase the physical risk, of other stakeholders. page: 26	1. Activity shall positively contribute to a reduction in material physical climate risk and/or shall reasonably reduce material physical risk from current and future climate change. This can include obvious physical risks, such as flooding, but also less immediately visible effects, such as impact on health from higher temperatures. 2. Impact assessments under a broad range of climate scenarios shall be conducted to provide better understanding and insights on the effectiveness and benefits of the Activity. 3. Activity that enables adaptation of other Activities should reduce the impact of material physical risk from other Activities and/or reduce barriers to adaptation through technology, services or products. 4. Activity must not adversely affect the adaptation efforts, or increase the physical risk, of other stakeholders. 5. Adaptation solutions should be location-specific and context-specific and shall be assessed and ranked in order of priority using the best available climate projections in order to prevent and/or reduce the adverse impact on people, nature or assets. page: 27	
Environmental Objective (EO) 3: Protection of Healthy Ecosystems and Biodiversity -	An Activity intended to promote EO3 shall conform with several or all the principles shown below: 1. Enable ecosystem restoration and/or facilitate protection of ecosystems. 2. Implement necessary measures to protect ecosystems and biodiversity.	An Activity intended to promote EO3 shall conform with the following principles while simultaneously minimising or eliminating any direct or indirect adverse effects on the natural ecosystem and biodiversity: 1. Enable ecosystem restoration and/or facilitate the protection of ecosystems. 2. Implement necessary measures to protect ecosystems and biodiversity, including but not limited to actions such as the adoption of sustainable logging practices and ensuring timber products are sourced from sustainably managed	

General Principles	3. Prevent soil erosion and run-off into watercourse. 4. Enforce and empower existing policies related to the protection of natural areas. 5. Adopt sustainable logging practices and ensure timber products are sourced from sustainably managed forests. 6. Meet the goals set by the Convention on Biological Diversity 1992 (CBD, 2022). 7. Take into consideration the equitable use of biodiversity and ecosystem services. 8. Avoid or minimise adverse impacts on the environment by implementing pollution control mechanisms. 9. Avoid or minimise emissions of short and long-lived climate pollutants. 10. Avoid or minimise generation of hazardous and non-hazardous waste. 11. Minimise and manage the risks and impacts associated with pesticide use. page: 27	forests. 3. Enforce and empower existing policies related to the protection of natural areas. 4. Take into consideration the sustainable and equitable use of biodiversity and ecosystem services. 5. Substantially contribute to environmental protection from pollution by improving levels of air, water, and/or land quality, including the cleaning up of litter and other pollution. 6. Substantially contribute to achieving good environmental status of bodies of water, through protection, preservation, or restoration mechanisms; including improving water management and efficiency activities, as well as promoting the sustainable use of water through the long-term protection of available water resources. page: 28	
Environmental Objective (EO) 4: Resource Resilience and the Transition to a Circular Economy - General Principles	An Activity intended to promote EO4 shall fulfil some or all the principles: Strategy & Operations, Adjusting Business Models: 1. Uses renewable energy, bio-based resources, or other recovered materials to reduce rate of resource extraction. 2. Uses future-proof, sustainable considerations and specifications to design and produce products, assets or process technologies that enable circular economy strategies through: a. Designing for longevity, resource efficiency, durability, functionality, modularity, upgradability, easy disassembly, and repair; b. Using recyclable or biodegradable materials. 3. Prevents or reduces waste generation, including the generation of waste from the extraction of minerals and waste from the construction and demolition of buildings. 4. Optimises resource use and/or extends product use, including through: a. Replacement of virgin materials with secondary raw materials or by-products, either fully or partially;	An Activity intended to promote EO4 shall fulfil some or all the principles: Strategy & Operations, Adjusting Business Models: 1. Uses renewable energy, bio-based resources, or other recovered materials to reduce rate of resource extraction. 2. Uses future-proof, sustainable considerations and specifications to design and produce products, assets or process technologies that enable circular economy strategies through: a. Designing for longevity, resource efficiency, durability, functionality, modularity, upgradability, easy disassembly, and repair; b. Using recyclable or biodegradable materials. c. Substitutes substances in materials and products throughout their lifecycle by replacing such substances, where relevant, with safer alternatives and promoting traceability. 3. Optimises waste management, including the management and reduction of waste from (i) the extraction of minerals, and (ii) the construction and demolition of buildings. 4. Optimises resource use and/or extends product use, including through: a. Replacement of virgin materials with secondary raw materials or by-products, either fully or partially; b. Repair, reuse, donation, resale, upcycling activities or on-site composting; c. Repurposing, refurbishing, remanufacturing, disassembling, upgrading and repairing, and sharing of products. 5. Offers product as a service based on, inter alia, leasing, pay-per-use, subscription, or deposit return schemes to reduce the demand for new products and their embedded raw materials.	

	b. Repair, reuse, donation, resale, upcycling activities or on-site composting; c. Repurposing, refurbishing, remanufacturing, disassembling, upgrading and repairing, and sharing of products. 5. Offers product as a service based on, inter alia, leasing, pay-per-use, subscription, or deposit return schemes to reduce the demand for new products and their embedded raw materials. 6. Minimises the incineration of waste and avoids the disposal of waste, including landfilling, in accordance with the principles of the waste hierarchy. page: 28	6. Provides for cleaner and more efficient options for waste disposal, including minimising waste incineration and disposal to landfills. page: 29
Essential Criteria (EC) 1: Do No Significant Harm	DNSH refers to the principle that an Activity which contributes to one EO, shall also not significantly harm any other EOs. An Activity interacts directly or indirectly with the surrounding environment. While the Activity may contribute towards EOs, it may cause unintended significant harm to the broader environment. Assessment of DNSH to other EOs forms part of the classification assessment of an Activity and is undertaken after ascertaining the contribution of an Activity against EO-specific objectives. Note that, although DNSH relates to significant harm to EOs other than that for which the Activity is intended to make a contribution, an Activity may also be rejected for Green or Amber classification if it causes some direct or indirect effect which detracts from the contribution to the intended EO itself. page: 30	DNSH refers to the principle that an Activity which contributes to one EO, shall also not significantly cause any harm. An Activity interacts directly or indirectly with the surrounding environment. While the Activity may contribute towards an EO, it may cause unintended significant harm to the broader environment. Assessment of DNSH to other EOs forms part of the classification assessment of an Activity and is undertaken after ascertaining the contribution of an Activity against EO-specific objectives. Note that, an Activity may also be rejected for Green or Amber classification if it causes direct or indirect harm which impacts the positive contribution to the main EO under consideration. page: 31
Activities - Description	As stated in Section 2.2, the ASEAN Taxonomy Version 2 does not provide specific instructions on the classification of entities, portfolios, or financial instruments, as this document is intended to focus on the classification of Activities. An Activity is defined in the ASEAN Taxonomy	As stated in Section 2.2, the ASEAN Taxonomy does not provide specific instructions on the classification of entities, portfolios, or financial instruments, as this document is intended to focus on the classification of Activities. An Activity is defined in the ASEAN Taxonomy as an action and not as the assets used to perform that action. If the assets are also used for another purpose which does not meet the relevant TSC, the Activity may not receive that classification. For instance, for power generation, the Activity is the generation of

	as an action and not as the assets used to perform that action. If the assets are also used for another purpose which does not meet the relevant TSC, the Activity may not receive that classification. For instance, for power generation, the Activity is the generation of electricity and not the equipment/assets installed to generate the electricity. Similarly, classification is based on achievement of TSC which considers the output of the power generation facility. For an Activity to be classified under the ASEAN Taxonomy, it must be demonstrated that the assets are used only for an Activity which meets the TSC of the intended classification. page: 32	electricity and not the equipment/assets installed to generate the electricity. Similarly, classification depends on achievement of TSC based on the output of the power generation facility. For an Activity to be classified under the ASEAN Taxonomy, it must be demonstrated that the assets are used only for an Activity which meets the TSC of the intended classification. page: 33
Migration from Foundational Framework (FF) to Plus Standard (PS) - Description	Migration of an Activity from FF to PS can be determined by individual AMS in line with their respective national policies and other strategic priorities. AMS may require Activities being conducted to be assessed using TSC of PS. The migration of an Activity from FF to PS can be determined by individual AMS in line with their respective national policies and other strategic priorities. AMS may choose to allow an Activity previously classified under the FF to retain its classification when the AMS has changed its policy such that this Activity must now be classified under PS. Upon determining the effective date of migration of Activities from FF to PS, the AMS should consider establishing the following precedents: 1. New Activities need to be assessed according to the PS. 2. Activities that have been previously assessed according to the FF: a. Can retain their classification according to FF until the point when the Activities need to be reassessed, of which Activities will then be assessed by the PS; or b. Need to be assessed according to the PS. The ATB recommends that Companies may be allowed to continue to use FF in cases where its continued use can be justified in specific circumstances (see Section 5.1.2). However,	Migration of an Activity from the FF to the PS can be determined by individual AMS in line with their respective national policies and other strategic priorities. AMS may require Activities being conducted to be assessed using TSC of the PS. AMS may choose to allow an Activity previously classified under the FF to retain its classification when the AMS has changed its policy such that this Activity must now be classified under the PS. Upon determining the effective date of migration of Activities from the FF to the PS, the AMS should consider establishing the following precedents: 1. New Activities need to be assessed according to the PS. 2. Activities that have been previously assessed according to the FF: a. Can retain their classification according to the FF until the point when the Activities need to be reassessed, of which Activities will then be assessed by the PS; or b. Need to be assessed according to the PS. The ATB recommends that Companies may be allowed to continue to use the FF in cases where its continued use can be justified in specific circumstances (see Section 5.1.2). However, as stated in Section 5.1.3, the AMS holds ultimate decision-making authority regarding policies concerning the application of the ASEAN Taxonomy to Activities conducted on their own territories. page: 43

	as stated in Section 5.1.3, the AMS holds ultimate decision-making authority regarding policies concerning the application of the ASEAN Taxonomy to Activities conducted on their own territories. page: 42		
Selecting Assessment Approach - Description	The ATB does not provide direction as to which approach should be used for assessment. However, if an Activity does not have TSC defined under the PS, that Activity can by default only be assessed under the FF. For Activities where there are TSC defined in the PS, the Company needs to decide on the appropriate assessment approach with due consideration of country-level preference. Each AMS may state or establish as policy its preference for the PS to be used as the primary assessment approach (which will be published in Annex 4). AMS Policy shall be set by the AMS in which the Activity will take place. Where the Activity takes place in more than one AMS, the AMS with the more restrictive policy will apply, e.g., where one AMS has stated it prefers to use the PS, but another AMS has not, the PS will normally be used. A recommended process is illustrated in Figure 7. page: 43	The ATB does not provide direction as to which approach should be used for assessment. However, if an Activity does not have TSC defined under the PS, that Activity can by default only be assessed under the FF. For Activities where there are TSC defined in the PS, the Company needs to decide on the appropriate assessment approach with due consideration of country-level preference. Each AMS may state or establish as policy its preference for the PS to be used as the primary assessment approach (which will be published in Annex 4). AMS Policy shall be set by the AMS in which the Activity will take place. Where the Activity takes place in more than one AMS, the AMS with the more restrictive policy will apply, e.g., where one AMS has stated it prefers to use the PS, but another AMS has not, the PS will normally be used. If TSC have not been set for an Activity, it may only be assessed under the FF. Individual AMS may choose to set a policy which establish the PS as the primary assessment approach. Nevertheless, if the AMS has not established the PS as the primary assessment approach, the Company may still choose to undergo an assessment under the PS. However, if an AMS policy has established the use of the PS, but the Company wishes to use the FF, the Company must provide justification for using the FF. A recommended process is illustrated in Figure 7. page: 44	
Illustrative End-to-End Process Assessment of an Activity using FF - Description	Based on the primary EO identified at the user entry point (see Section 5.2), the Company can identify the corresponding decision tree (of the primary EO) to proceed with assessment of Activities. In total, there are four decision trees, and each decision tree is developed based on specific criteria of the EO elaborated in Sections 3.1.1 to 3.1.4. The Company assesses the Activity beginning with Question 1A and with reference to respective guiding questions, which serve to guide the Company. Details of the individual decision trees along with guiding questions are in Sections 5.3.2 to 5.3.5. Refer to Appendix D for examples of assessment of Activities using the FF.	Based on the primary EO identified at the user entry point (see Section 5.2), the Company can identify the corresponding decision tree (of the primary EO) to proceed with assessment of Activities. In total, there are four decision trees, and each decision tree is developed based on specific criteria of the EO elaborated in Sections 3.1.1 to 3.1.4. The Company assesses the Activity beginning with Question 1A and with reference to respective guiding questions, which serve to guide the Company. Implementation of guiding questions for the EOs and ECs need to suit the local environment and circumstances. Details of the individual decision trees along with guiding questions are in Sections 5.3.2 to 5.3.5. Refer to Appendix D for examples of assessment of Activities using the FF. page: 47	Emphasis on local context when implementing the guiding questions for assessing the Environmental Objectives (EOs) and Essential Criteria (EC) is added

	page: 46		
Environmental Objective (EO) 2: Climate Change Adaptation - Guiding Questions 1A	Does the Activity implement measures to increase the Company's resilience to climate change? 1. How does the Activity contribute to Company's resilience against adverse physical impacts of current and future climate change? (e.g., refurbishing infrastructure for greater resilience to impacts of sea level rise, building flood protection infrastructure to protect facilities, operation of road and rail adapted to current and future heatwaves through the use of more heat-resistant materials during its construction) ○ Has a climate risk assessment been conducted to establish the Activity's risk exposure towards physical climate risks? ○ Has robust and recent climate data, projections and scenarios been used for the assessment? ○ Do the results of the climate risk assessment showcase the impacts of climate change on the Activity? Is it a positive or negative impact? ○ Does the Activity consider the expected future climate in its current and planned practices? ○ Does the Activity avoid leading to an increase in the vulnerability of human or natural systems due to the effects of climate change and climate variability–related risks? page: 48	Does the Activity implement measures to increase the Company's resilience to climate change? 1. How does the Activity contribute to Company's resilience against adverse physical impacts of current and future climate change? (e.g., refurbishing infrastructure for greater resilience to impacts of sea level rise, building flood protection infrastructure to protect facilities, operation of road and rail adapted to current and future heatwaves through the use of more heat-resistant materials during its construction.) ○ Has a climate risk assessment been conducted to establish the Activity's risk exposure towards physical climate risks? ○ Has robust and recent climate data, projections and scenarios been used for the assessment? ○ Do the results of the climate risk assessment showcase the impacts of climate change on the Activity? Is it a positive or negative impact? ○ Does the Activity align with entity or national level climate adaptation plans? ○ Does the Activity consider the expected future climate in its current and planned practices? ○ Does the Activity avoid leading to an increase in the vulnerability of human or natural systems due to the effects of climate change and climate variability–related risks? page: 50	
Assessment of Essential Criteria (EC) - Description	Following the EO assessment (Sections 5.3.2 to 5.3.5), the assessor proceeds to the next layer of the decision tree and assesses the Activity against EC1 – as shown in decision boxes 2A and 3A, EC2 – as shown in decision boxes 2B and 3B, and EC3 – as shown in decision boxes 4A and 4B; with reference to the respective guiding questions (Table 17). page: 55	Following the EO assessment (Sections 5.3.2 to 5.3.5), the assessor proceeds to the next layer of the decision tree and assesses the Activity against EC1 – as shown in decision boxes 2A and 3A, EC2 – as shown in decision boxes 2B and 3B, and EC3 – as shown in decision boxes 4A and 4B; with reference to the respective guiding questions (Table 17). Similar to assessment of EO, where readily available, 3rd party certification or verification can be used to justify eligibility in meeting the EC. page: 57	
Grandfathering - Description	For Activities, classification is always based on the TSC extant at the time of assessment. When Activity TSC changes, i.e., either the Activity Tier is sunset by the ATB or decided to be phased out by an AMS, the preceding TSC	The ASEAN Taxonomy includes provisions for financial products and portfolios to be classified according to a TSC which may be subject to change over time. The rules contained within this section relate to the grandfathering of TSC which are aligned with the EOs of the ASEAN Taxonomy for all forms of financial instruments. A grandfathering period starts from the date a change is applied to	The newest version includes descriptions about grandfathering, which is not present in Version 2 but was already mentioned to be

	may no longer be used for assessment and classification. The rules for grandfathering will be set out in a subsequent version of the ASEAN Taxonomy. page: 70	a TSC related to Activities or related assets. During the grandfathering period, the classification of instruments created with the purpose of financing Activities or related assets according to their alignment with TSC shall retain the status quo extant before the change in TSC. Section 6.3.2.1 relates specifically to grandfathering of TSC as they pertain to bonds. Section 6.3.2.2 relates to all other financial instruments. During the grandfathering period, the classification of instruments created with the purpose of financing Activities or related assets according to their alignment with TSC shall retain the status quo extant before the change in TSC. The rules have been developed to ensure consistency in the classification of Activities or related assets that are funded by multiple financial instruments. The goal is to encourage a more effective flow of capital to support the decarbonisation agenda of ASEAN and ease the monitoring of classification of financial instruments throughout the duration of the instruments. This may include: • Green financial instruments, where all funds are allocated to investments where all underlying Activities or related assets are aligned with ASEAN Taxonomy Tier 1; or • Financial instruments, where funds may be allocated to a mixture of: o Investments where underlying Activities or related assets are aligned with ASEAN Taxonomy Tier 1; and o Investments related to a social objective. Other financial products and portfolios including other tiers will be covered in subsequent versions of the ASEAN Taxonomy, as explained in Annex 1, Section 4. page: 72	expected in the subsequent versions.
Grandfathering of Bonds - Description	-	6.3.2.1. Grandfathering of Bonds This subsection pertains to grandfathering rules for bonds for which the use of proceeds are to be allocated to Activities or related assets which align with Tier 1 TSC of the ASEAN Taxonomy. The rules described in this section have been set for compatibility with grandfathering rules applied by the EU Green Bond Standard ("EU-GBS")12. The rules apply to bonds, the proceeds of which are allocated, in part or in their entirety, to one or more of the following: • Fixed assets that are not financial assets; • Capital expenditure;13 • Operating expenditure that was incurred no more than 3 years before the issuance of the bond;14 • Financial assets, the proceeds of which are allocated to one of the uses listed above and which were created no more than 5 years after the issuance of the bond.	

		Proceeds of the bond must be allocated in alignment with TSC applicable at the time of issuance of the green bond. Where bond proceeds have been allocated to specific Activities or related assets Proceeds that have been allocated to specific Activities or related assets prior to any changes to the TSC will not be affected, and the classification of the related financial instruments will remain status quo, in line with the originally applied TSC. In this instance, the use of proceeds will be classified in alignment with the original TSC until the end of the originally stated term of the bond. For the avoidance of doubt, allocation of proceeds applies to all cases where a bond issuance programme with identified utilisation for specific Activities or related assets has been approved, and for which the issuer has made a commitment to disburse funds, regardless of whether disbursement be made via a single issuance (tranche) or multi-issuances (tranches). Where bond proceeds have not been allocated If TSC changes occur after the bond issuance but before the allocation to specific Activities or related assets, then the unallocated proceeds can be allocated based on the TSC which applied before the change during the 7-year grandfathering period. Where issuers' proceeds are allocated in accordance with a portfolio approach, issuers shall include in their portfolio only those assets whose underlying Activity is aligned with any TSC which were applicable at any point during the 7 years prior to the date of publication of any allocation report. page: 73	
Grandfathering of Other Financial Instruments - Description	-	This subsection relates to ASEAN Taxonomy Tier 1 TSC which are applied to financial instruments other than those described in Section 6.3.2.1. For Activities or related assets aligned with Tier 1 TSC, the length of the grandfathering period shall be 7 years after the TSC amendment. In addition to ensuring consistent treatment, as explained in 6.3.2, this grandfathering period was set with due consideration to developments in financial markets where new financial structures could be introduced (e.g., blended finance instruments and fixed income securities with equity features). page: 74	
Appendix G: Activities Classified Red		The ASEAN Taxonomy aims to promote environmentally sustainable Activities. The automatic Red classification of certain Activities reflects a commitment to mitigating climate change and transitioning towards cleaner, more sustainable energy sources. In this way, the ASEAN Taxonomy signals a focus on investments that align with the region's environmental goals, fostering a shift towards low-carbon and climate-resilient economies within the AMS. The following Activities may not be classified as Green or Amber by either the FF or the PS, and are therefore automatically classified as Red. Energy: • Coal or oil power generation without carbon capture, utilisation and storage (CCUS); • Heat recovery from coal or oil fuelled power generation; • Coal mining or oil extraction, refining, processing or production and associated	The ASEAN Taxonomy considers power/energy generation from fossil fuels with fossil fuels that are equipped with abatement technology as not a viable solution in energy transition or achieving 1.5 degree target. Yet, in the following sections, the TSC for power generation could consider coal abated with CCUS as long as it meets the TSC requirement.

		supply chain infrastructure. Transport: • New roads, road bridges, road upgrades, parking facilities, fossil fuel filling stations, etc; • Oil tankers or other ships solely transporting coal or oil. Waste: • Collection of waste that is going to landfill; • Landfill without gas capture. It should be noted that while abated coal is currently not included in this list, abated fossil fuels are currently technologically limited and may not yet be a viable solution in transitioning or achieving a 1.5oC outcome. Its application to subsequent versions of the ASEAN Taxonomy and inclusion in this Appendix will be further reviewed depending on technological developments. page: 107
New Activities	ISIC 351, including: o Electricity, gas, steam, and air conditioning supply ISIC 352, including: o Transmission and distribution networks for renewable and low carbon gases; and o Storage of renewable and low-carbon gases ISIC 353, including: o Production of heating/cooling through various means; and o Storage of thermal energy Outside ISIC: o Activity 000[010] Transport of CO2; and o Activity 000[020] Underground permanent geological storage of CO2. page: 103 (and page 110 of the version 3)	• ISIC 410 Construction; • ISIC 681 Real estate; • ISIC 492 Land transportation; • ISIC 501 Water transportation; and • ISIC 51 Air transportation. page: 110
Use of the TSC Annex - Description	This Annex contains details of the respective guiding principles and TSC for all Activities for which TSC have been defined for the PS. For each Activity, TSC have been defined for each Tier which is applicable to that Activity in each Environmental Objective (EO). Development of this Annex is ongoing, and ATB will seek consultation and conduct reviews on guiding principles and TSC for all EOs in	This Annex contains details of the respective guiding principles and TSC for all Activities for which TSC have been defined under the PS. For each Activity, TSC have been defined for each Tier which is applicable to that Activity in each Environmental Objective (EO). Development of this Annex is ongoing and ATB will seek consultation and conduct reviews on the Guiding Principles and TSC for all EOs in subsequent revisions of the Annex. It is only possible to classify an Activity under the ASEAN Taxonomy, under an

	subsequent revisions of the Annex. It is only possible to classify an Activity under the ASEAN Taxonomy under an EO if TSC have been set for that Activity in that EO for the respective Tier. The term “No TSC available” in this Annex means that the Activity cannot be classified under that EO at that Tier by use of the PS and that there are currently no plans to develop a TSC for that Activity Tier. For example, it is currently not expected that there will be Amber Tiers for Climate Change Adaptation (EO2) for power generation Activities. The reason is that it is expected that Amber for these Activities will normally only apply for Climate Change Mitigation (EO1), any and that classification under EO2 must demonstrate clear substantial contribution to EO2. The term, “TSC are presently not available for the Activities Tiers defined” means that it is expected that TSC will be developed for that Activity Tier in future revisions of this Annex. Details on the procedure for the assessment of an Activity for the purposes of classification under the PS can be found in the Main Report. Notwithstanding any TSC published in this Annex, any Activity which is directly or indirectly resulting in an effect which detracts from the EO to which it is intended to contribute should be classified as Red. Note that the information provided in this Annex was not intended for use in assessments conducted using the Foundation Framework (FF). page: 106	EO if TSC have been set for the Activity in that EO, for the respective Tier. The term “No TSC available” in this Annex means that the Activity cannot be classified under that EO at that Tier by use of the PS, and there are currently no plans to develop TSC for that Activity Tier. For example, it is currently not expected that there will be Amber Tiers for Climate Change Adaptation (EO2) for Activities defined under the Electricity, Gas, Steam, and Air Conditioning Supply focus sector. The reason is that it is expected that Amber for these Activities will normally only apply for Climate Change Mitigation (EO1), and that any classification under EO2 must demonstrate clear substantial contribution to EO2. The term, “TSC are presently not available for the Activity Tiers defined” means that the TSC could be developed for that Activity Tier in future revisions of this Annex. Details on the procedure for the assessment of an Activity for the purposes of classification under the PS can be found in the Main Report. Notwithstanding any TSC published in this Annex, any Activity which is directly or indirectly resulting in an effect which detracts from the EO to which it is intended to contribute should be classified as Red. Note that the information provided in this Annex is not intended for use in assessments conducted using the Foundation Framework (FF). page: 113
Bases for setting Technical Screening Criteria (TSC) for Electricity, Gas, Steam, and Air		Tier 1 (Green) 1. Activity where measures have been implemented to ensure own resilience to climate change and thereby contribute to overall local, national or regional resilience; OR 2. Activity enables other Activities to increase resilience to climate change. Tier 2 (Amber T2)

Conditioning Supply: EO2	No TSC available. Tier 3 (Amber T3) No TSC available. page: 116
Bases for setting Technical Screening Criteria (TSC) for Electricity, Gas, Steam, and Air Conditioning Supply: EO3	Tier 1 (Green) No TSC available. Tier 2 (Amber T2) No TSC available. Tier 3 (Amber T3) No TSC available. page: 117
Bases for setting Technical Screening Criteria (TSC) for Electricity, Gas, Steam, and Air Conditioning Supply: EO4	Tier 1 (Green) No TSC available. Tier 2 (Amber T2) No TSC available. Tier 3 (Amber T3) No TSC available. page: 117
Bases for setting Technical Screening Criteria (TSC) for Electricity, Gas, Steam, and Air Conditioning Supply: General	TSC for the Amber Tiers were set against future emissions projections for all Activities under the Electricity, Gas, Steam, and Air Conditioning Supply focus sector in Southeast Asia, as derived from the IEA Sustainable Development Scenario (SDS)1: • Amber Tier 2: reflects projected emissions intensity for SE Asia in 2030. • Amber Tier 3: reflects projected emissions intensity for SE Asia in 2027. **TSC were checked against the lowest carbon emitting technology currently that is technologically feasible**, for widespread use in ASEAN, both through review of publicly available technology comparisons2 and through consultation with regional stakeholders. This TSC does not include waste to energy, which would be considered an Activity under the Water Supply, Sewerage and Waste Management sector.
Bases for setting Technical Screening Criteria (TSC) for Electricity, Gas, Steam, and Air Conditioning Supply: Future	Tier 1 (Green) Lifecycle GHG emissions to be maintain <100 gCO2e/kWh throughout the 2024-2030, 2031-2035, 2036-2040, and 2041-2045 period Tier 2 (Amber T2) 2024-2030: Lifecycle GHG emissions >=100 and <425 gCO2e/kWh 2031-2035: Lifecycle GHG emissions >=100 and <285 gCO2e/kWh 2036-2040: Lifecycle GHG emissions >=100 and <185 gCO2e/kWh

TSC for power generation		2041-2045: Sunset Tier 3 (Amber T3) 2024-2030: Lifecycle GHG emissions >=425 and <510 gCO2e/kWh 2031-2035: Sunset 2036-2040: Sunset 2041-2045: Sunset	
Technical Screening Criteria (TSC) for 351[011] Electricity Generation from Fossil Gas: General	· Includes: o Power generation as part of cogeneration · Excludes: o Unabated power generation from coal or fuels derived from coal. o Co-firing of fossil fuels with fuels derived from renewable sources (refer to 351[012] and 351[014]) page: 110	• Includes: o Power generation as part of cogeneration. • Excludes: o Power generation using gas derived from coal except where it can be shown that, by abatement through CCUS, respective TSC below are fulfilled. o Co-firing of fossil fuels with fuels derived from renewable sources (refer to 351[012] and 351[014]). page: 121	Previously, electricity generation from coal/coal-derivative that uses abatement technology (such as CCUS) is not considered (neither included nor excluded), which signals ambiguity. In the newest version, it is now included, as long as it meets TSC requirement.
Technical Screening Criteria (TSC) for 351[012] Electricity Generation from Renewable Non-fossil Gaseous and Liquid Fuels, including co-firing with Fossil Fuels: General	· Includes: o Power generation as part of cogeneration · Excludes: o Unabated power generation from coal or fuels derived from coal. o Power generation from fuels derived from waste, other than bio-waste page: 113	• Includes: o Power generation as part of cogeneration. • Excludes: o Power generation using gas derived from coal except where it can be shown that, by abatement through CCUS, respective TSC below are fulfilled. o Power generation from fuels derived from waste, other than bio-waste. page: 123	Previously, electricity generation from coal/coal-derivative that uses abatement technology (such as CCUS) is not considered (neither included nor excluded), which signals ambiguity. In the newest version, it is now included, as long as it meets TSC requirement.
Technical Screening Criteria (TSC) for 351[013] Hybrid fossil, renewable power generation, T&D, and/or energy storage for Island Systems: General	· Includes: o Island System, which is defined as a collection of grid-connected power generation, electrical distribution, storage, control assets and loads, which have the ability to operate together independently of a wider electrical network. o Island Systems in this can refer to 'electrical' islands and do not need to be literal islands surrounded by water. o Any generation, T&D or related control, monitoring or management operating within the Island System may be classified if the whole Island System meets the terms of the relevant TSC for the relevant Tier, as well as Essential Criteria (EC).	• Includes: o Island System, which is defined as a collection of grid-connected power generation, electrical distribution, storage, control assets and loads, which have the ability to operate together independently of a wider electrical network. o Island Systems in this can refer to 'electrical' islands and do not need to be literal islands surrounded by water. o Any generation, T&D or related control, monitoring or management operating within the Island System may be classified if the whole Island System meets the terms of the relevant TSC for the relevant Tier, as well as Essential Criteria (EC). • Excludes: o Power generation from coal or fuels derived from coal except where it can be shown that, by abatement through CCUS, respective TSC below are fulfilled. o Power generation from fuels derived from waste, other than bio-waste. o Any Activity on an Island System with a total nameplate power generation capacity of >100 MW.	Previously, electricity generation from coal/coal-derivative that uses abatement technology (such as CCUS) is not considered (neither included nor excluded), which signals ambiguity. In the newest version, it is now included, as long as it meets TSC requirement.

	· Excludes: o Unabated power generation from coal or fuels derived from coal. o Power generation from fuels derived from waste, other than bio-waste. o Any Activity on an Island System with a total nameplate power generation capacity of >100 MW page: 115	page: 125	
Technical Screening Criteria (TSC) for 351[014] Electricity generation from bioenergy, including co-firing with fossil fuels: General	· Includes: o Power generation as part of cogeneration page: 118	• Includes: o Power generation as part of cogeneration. • Excludes: o Power generation from coal or fuels derived from coal except where it can be shown that, by abatement through CCUS, respective TSC below are fulfilled. page: 128	Bioenergy and fossil fuel co-firing for electricity generation is now specifically included as long as it is equipped by abatement technology (such as CCUS) such that the TSC is requirement is met.
Technical Screening Criteria (TSC) for 351[100] Coal power phase-out: EO1	Tier 1 (Green) Aligned with a 1.5°C outcome and is consistent with the IEA Net Zero Emissions Pathway for the power sector to achieve net zero emissions by 2050. Specific conditions under (1) include: a. Coal phase out by 2040; and b. Coal plants built after 31 December 2022 will not qualify; and c. Operation duration of the coal plant from commercial operation date (COD) is capped at 35 years; and d. Qualifying coal plants must demonstrate the adoption of best-in-class technology, provided that these technologies are affordable, accessible, reliable and can be implemented within a reasonable timeframe; and e. Qualifying coal plants have been independently verified or acknowledged by internationally recognised bodies or programmes as having demonstrated substantial absolute positive emissions savings over their expected lifetime compared to a case without a transition mechanism. Coal plants under the ADB ETM or JETP meet these criteria. Tier 2 (Amber T2)	Tier 1 (Green) Aligned with a 1.5°C outcome and is consistent with the IEA Net Zero Emissions Pathway for the power sector to achieve net zero emissions by 2050. Specific conditions under (1) include: a. Coal phase out by 2040; and b. Coal plants achieving financial close (FC) after 31 December 2022 will not qualify; and c. Operation duration of the coal plant from FC is capped at 35 years; and d. It has been independently verified or acknowledged by internationally recognised bodies or programmes that qualifying coal plants show climate impact through the demonstration of positive absolute emissions savings over the expected lifetime of the coal plant compared with a case with no intervention to phasing it out. Coal plants under the ADB ETM or JETP programs, or which meet the definition set out in the joint paper by CPI, RMI and CBI8, meet these criteria. Tier 2 (Amber T2) Aligned with a 1.5°C outcome for coal phase-out that is derived from regional- or country-specific pathways that are consistent with science-based pathways. Specific conditions under (1) include: a. Coal phase out by 2050; and b. Coal plants achieving FC after 31 December 2022 will not qualify; and c. Operation duration of the coal plant from FC is capped at 35 years. Tier 3 (Amber T3) 1. Operation duration of the coal plant from FC is capped at 35 years; and 2. Coal plants that achieve FC after 31 December 2022 will not qualify, except for coal plants:	Criterion that specifies adoption of best-in-class technology, which is deemed ambiguous in the initial draft of the position paper, is completely dropped in Tier 1. Meanwhile, the criterion is modified in Tier 3 to include the adoption of technologies that can result in minimum possible lifecycle greenhouse gas emissions. Yet, the criterion does not specify the threshold / what does it mean quantitatively by "minimum possible."

	Aligned with a 1.5°C outcome for coal phase-out that is derived from regional- or country-specific pathways that are consistent with science-based pathways. Specific conditions under (1) include a. Coal phase out by 2050; and b. Coal plants built after 31 December 2022 will not qualify; and c. Operation duration of the coal plant from commercial operation date (COD) is capped at 35 years. Tier 3 (Amber T3) 1. Operation duration of the coal plant from commercial operation date (COD) is capped at 35 years; and 2. Coal plants that are built after 31 December 2022 will not qualify, except for a. Coal plants that are built from 1 January 2023 up till 31 December 2027; and b. adopt best-in-class technology, provided that these technologies are affordable, accessible, reliable and can be implemented within a reasonable timeframe page: 132	a. that achieve FC from 1 January 2023 up till 31 December 2027; and b. which will result in minimum possible lifecycle greenhouse gas emissions using technologies which are affordable, accessible, and reliable. page: 141	

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