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Thailand NDC 3.0

Increasing Ambition of the Next Generation NDCs

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JCM MOC between Thailand and Japan (Bangkok July 8, 2024)

On July 8, 2024, OTAKA Masato, Ambassador Extraordinary and Plenipotentiary of Japan to the Kingdom of Thailand and Pol. Gen. Phatcharavat Wongsuwan, Deputy Prime Minister and Minister of Natural Resources and Environment, the Kingdom of Thailand, signed the Memorandum of Cooperation on the Joint Crediting Mechanism (JCM) in Bangkok.

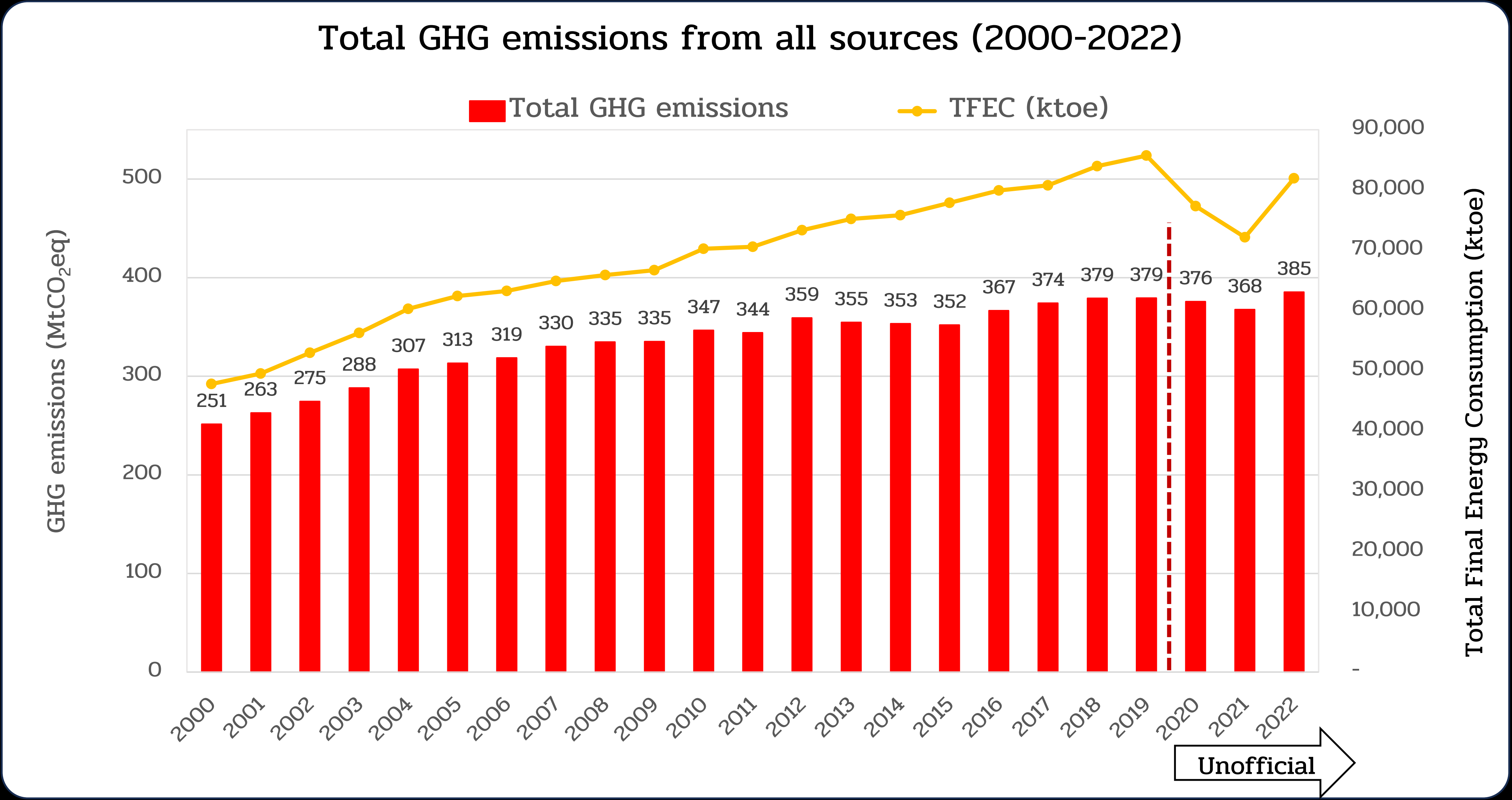
MOC between MONRE and MOEJ (Bangkok July 9, 2024)

4th Thailand – Japan Policy Dialogue (Bangkok July 9, 2024)

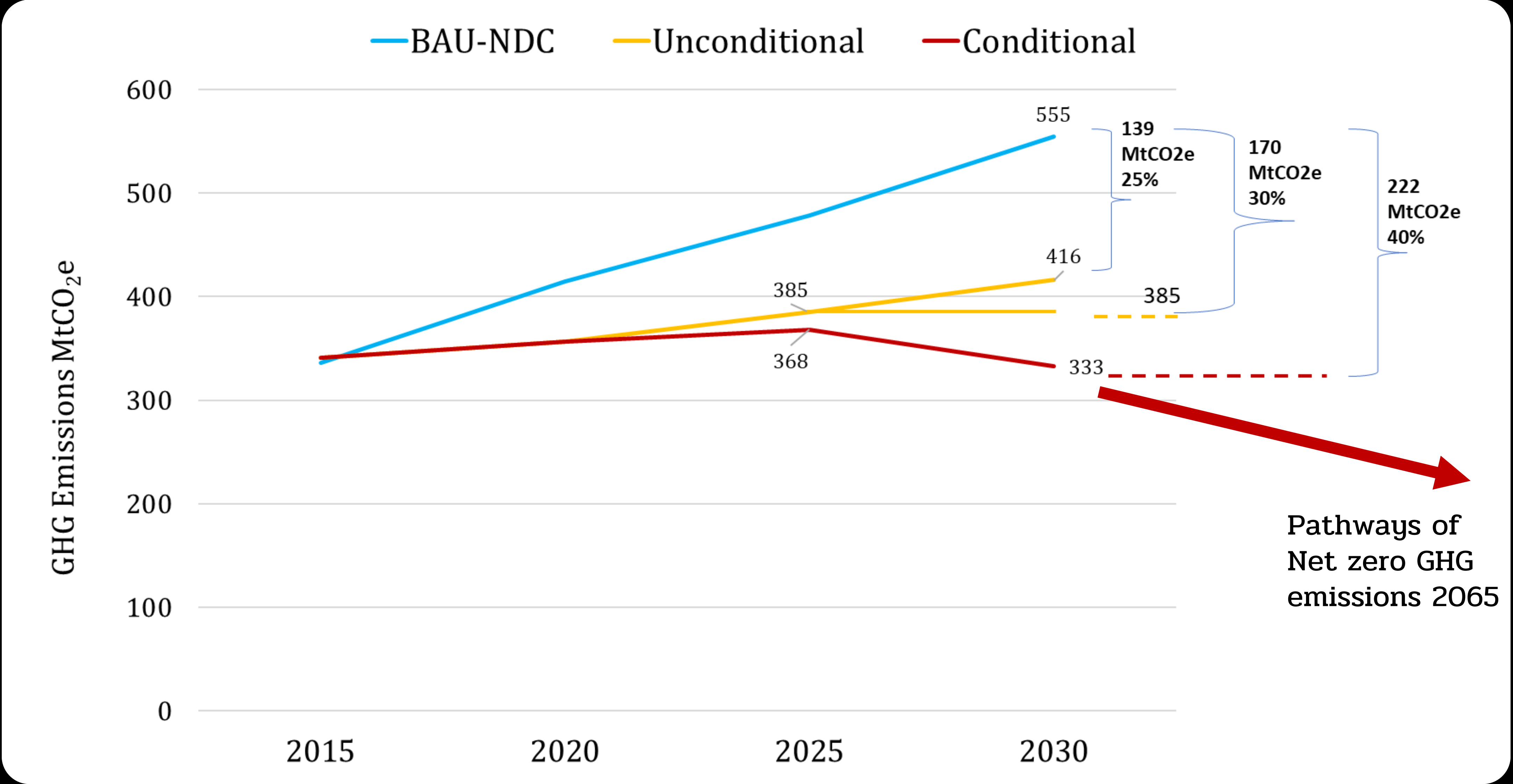
4^{th} Thailand – Japan Policy Dialogue (Bangkok July 9, 2024)

Hands-on AIM Training at DCCE (Bangkok July 10, 2024)

Estimated GHG Inventory under ETF of Paris Agreement



Thailand Updated NDC 2022



Thailand Updated NDC 2022

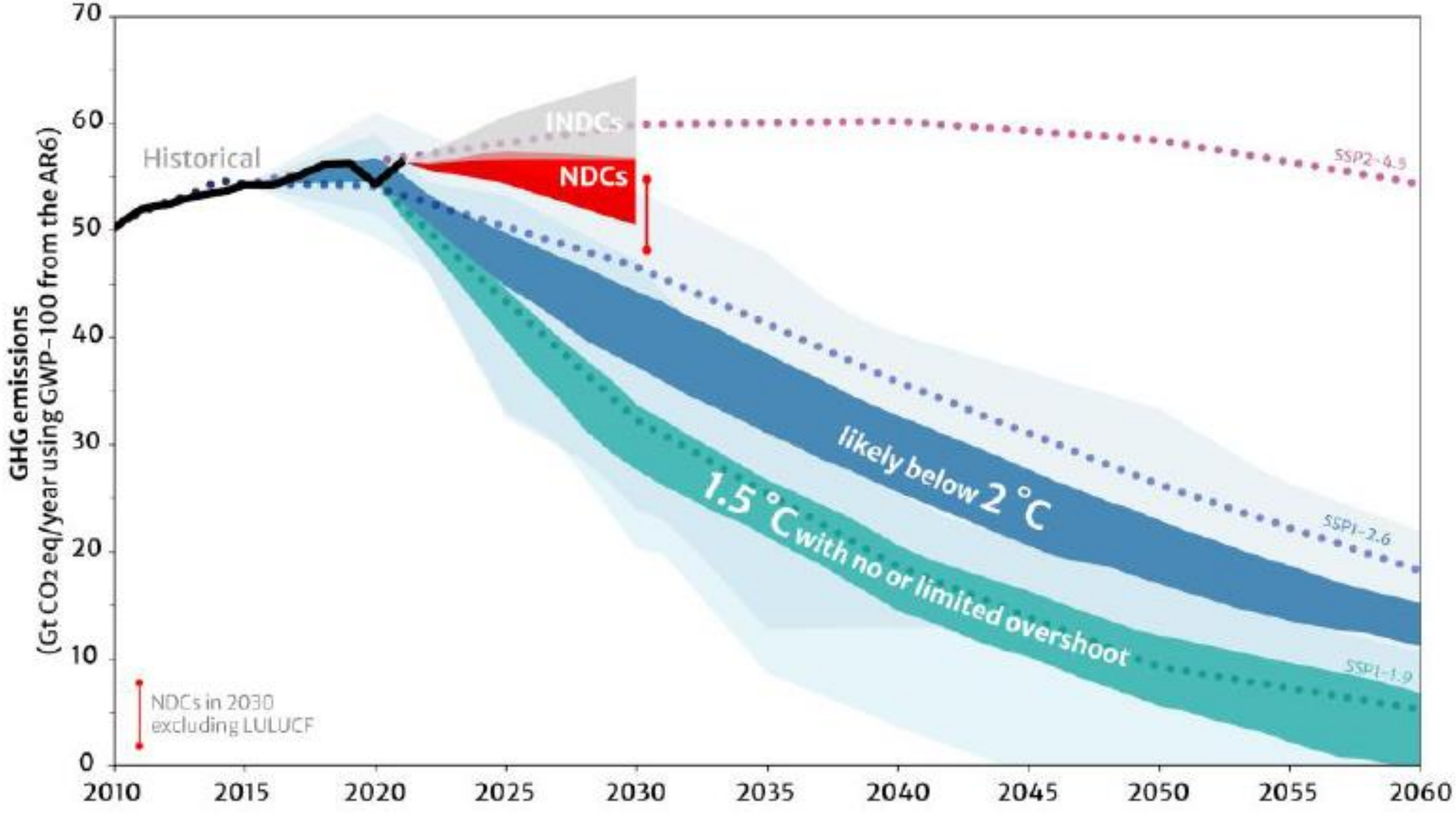
Sectoral Emissions Mitigation Targets by 2030

<table>
<tr><th rowspan="4">Sector</th><th colspan="6">Thailand NDC Mitigation target in 2030</th></tr>
<tr><th colspan="2" rowspan="2">Unconditional NDC</th><th colspan="4">Conditional NDC</th></tr>
<tr><th colspan="2">In process of Article 6</th><th colspan="2">Support needed</th></tr>
<tr><th>$MtCO_2e$</th><th>%</th><th>$MtCO_2e$</th><th>%</th><th>$MtCO_2e$</th><th>%</th></tr>
<tr><td>Energy</td><td>124.6</td><td>22.5</td><td>-</td><td>-</td><td>32.1</td><td>5.8</td></tr>
<tr><td>Transport</td><td>45.6</td><td>8.2</td><td>-</td><td>-</td><td>2.5</td><td>0.4</td></tr>
<tr><td>Waste</td><td>9.1</td><td>1.6</td><td>-</td><td>-</td><td rowspan="3">1.9</td><td rowspan="3">0.3</td></tr>
<tr><td>IPPU</td><td>1.4</td><td>0.3</td><td>0.1</td><td>0.02</td></tr>
<tr><td>Agriculture</td><td>4.1</td><td>0.7</td><td>1</td><td>0.18</td></tr>
<tr><td rowspan="3">Total</td><td rowspan="2">184.8</td><td rowspan="2">33.3</td><td>1.1</td><td>0.2</td><td>36.4</td><td>6.5</td></tr>
<tr><td colspan="4">37.5 $MtCO_2e$ or 6.7%</td></tr>
<tr><td colspan="6">222.3 or 40%</td></tr>
</table>

Source: NDC Action Plan (DCCE, 2024)

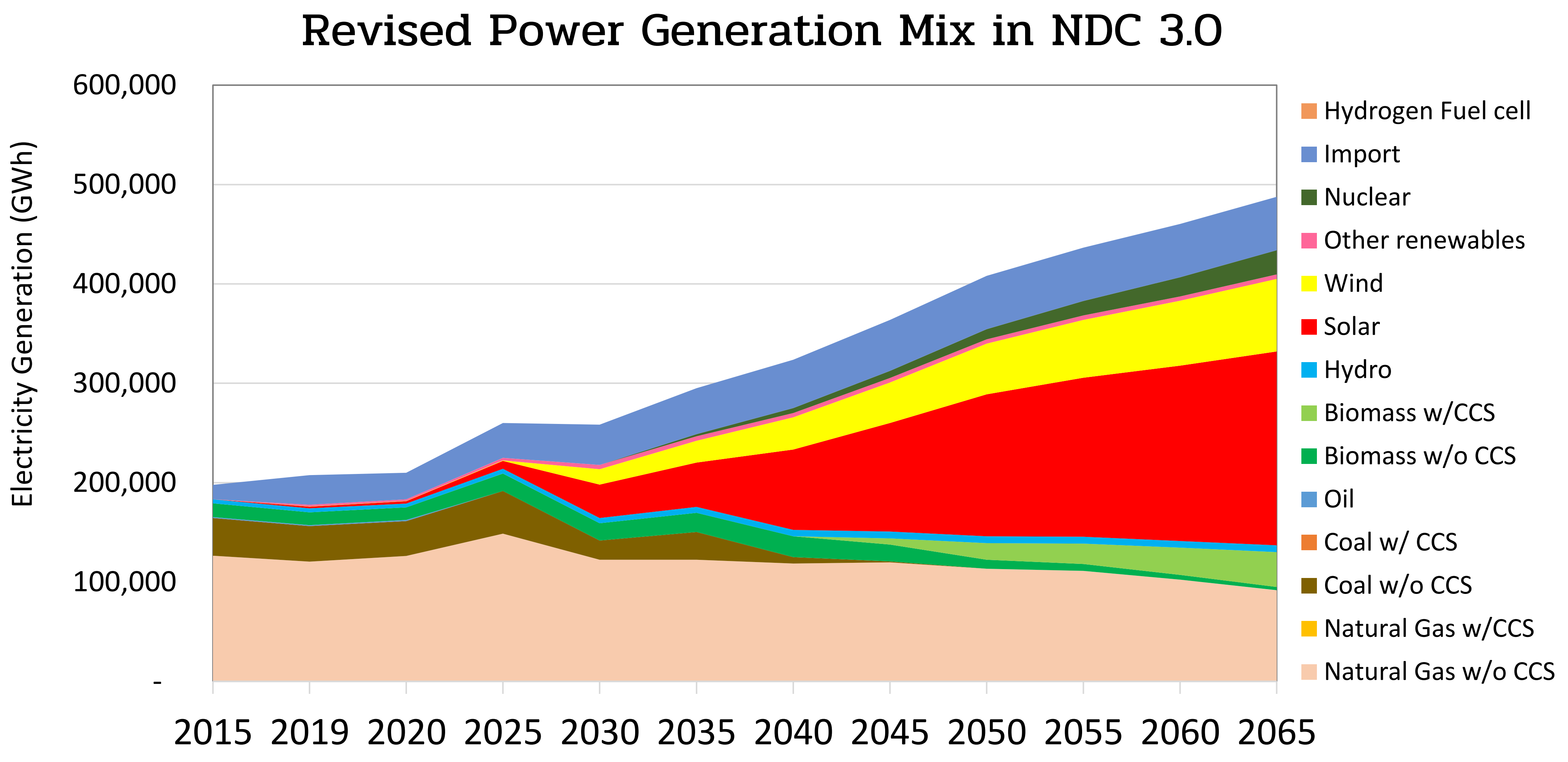
The 1st Global Stocktake 2023

Comparison of scenarios assessed in IPCC AR6 with NDC 2.0



Source: NDC Synthesis (UNFCCC,2023)

Increasing Ambition of the Next Generation NDCs



Increasing Ambition of the Next Generation NDCs

Featuring Thailand NDC 3.0

- Single year target/Multi-year trajectory emissions, Baseline and Base year
- The 1st Global Stocktake outcomes in NDC 3.0 scenario
- The next generation NDC 2035 is complied with the existing NDC action plans
- AIM models are employed and described in NDC 3.0 scenario development.
- GHG mitigation resulted from adaptation actions will not be included.
- Input data and assumptions will be improved with Limited Capacity
- Power sector will be the major revision compared to existing NDC action plans
- Sector coverage includes Energy, IPPU, AFOLU and Waste
- Supports needed, use of Article 6, etc.
- Emission pathways of NDC 3.0 will be complied with LT-LEDS, and NZE pathways

Thailand Climate Change Act

Section 1 General

Section 2 GHGs Targets

Section 3 National CC Committee

Section 5 Climate Change Master Plan

Mitigation

Section 6 GHGs Information

Section 7 Action Plan on Mitigation

Section 8 Emission Trading Schemes (ETS)

Section 9 Carbon Tax

Section 10 Carbon credit

Adaptation

Section 11
- Climate change database
- NAP
- Action plan

Section 4 Climate Change Fund

Section 12 Supportive Mechanism

Section 13 Taxonomy

Section 14 Penalties

Source: DCCE (2024)

Analysis of Thailand's net-zero emissions by 2050 using AIM/Enduse & AIM/CGE

"What will be the key milestones in the pathway to net zero emission in 2050?"

Sustainability Science
https://doi.org/10.1007/s11625-023-01319-y

Springer

IR3S Integrated Research System for Sustainability Science

IGES Institute for Global Environmental Strategies

SPECIAL FEATURE: ORIGINAL ARTICLE

Accelerating Actions for Leveraging a Climate-Neutral, Sustainable Society

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Thailand's net-zero emissions by 2050: analysis of economy-wide impacts

Salony Rajbhandari[1] · Pornphimol Winyuchakrit[1] · Bijay Bahadur Pradhan[1] · Achiraya Chaichaloempreecha[1] · Piti Pita[1] · Bundit Limmeechokchai[1]

Received: 10 December 2022 / Accepted: 9 March 2023

Abstract
This paper aims at exploring the economy-wide impacts of achieving net-zero greenhouse gas (GHG) emissions by 2050 in Thailand. This study developed a recursive dynamic Asia-Pacific Integrated Model/Computable General Equilibrium (AIM/CGE) model of Thailand for the assessment. The macroeconomic impacts of Thailand's net-zero GHG emission targets by 2050 are analyzed relative to its 2-degree pathway. Results indicate that Thailand should put more effort in GHG mitigation actions to achieve the emissions peak by 2025 and net-zero GHG emissions by 2050. Improvement in energy efficiency; increasing electrification; expanding renewable energy utilization; deploying green hydrogen; bioenergy; carbon capture, utilization, and storage (CCUS); and behavioral changes are the key identified pillars of decarbonization to drive Thailand towards the pathways of net-zero emissions by 2050. Results show that there is a possibility of attaining net-zero GHG emissions by 2050 at the expense of an economic loss for Thailand. The gross domestic product (GDP) loss would be as high as 8.5% in 2050 to attain net-zero emissions. Lower productivity from the energy intensive industries such as petroleum refineries, coal and lignite mining, manufacturing industries, and transport are the key contributing sectors to the GDP losses. The price of carbon mitigation would shoot up to reach USD 734 per tCO_2eq in 2050 from USD 14 per tCO_2eq in 2025 to attain net-zero emissions in 2050.

Keywords Asia-Pacific Integrated Model (AIM) · Computable General Equilibrium model · Greenhouse gas emissions · Net-zero emissions · Thailand

Source: Rajbhandari, S. (2023). Thailand's net-zero emissions by 2050: analysis of economy-wide impacts. *Sustain Sci*. https://doi.org/10.1007/s11625-023-01319-y

Analysis of green hydrogen technology using AIM/Enduse model

"To examine Thailand's hydrogen and hydrogen-production infrastructure needs, renewable electricity requirements, and investment in electrolysers and clean power generation to achieve net zero GHG emissions by 2050."

Energy Strategy Reviews 51 (2024) 101311

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Role of green hydrogen in the decarbonization of the energy system in Thailand

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ABSTRACT

High dependence on fossil fuels to meet the energy demand is the major source of greenhouse gas (GHG) emissions in Thailand. Decarbonization of the energy system to achieve the pledged climate targets is a challenging task for Thailand. The role of green hydrogen and hydrogen-based technologies in Thailand's energy transition needs to be explored. A bottom-up energy system model developed using AIM/Enduse framework has been used to assess the energy system transformation required with the focus on the role of hydrogen in achieving net zero GHG emissions. A business-as-usual (BAU) scenario and two net zero emissions (NZE) scenarios with low and high-hydrogen use have been assessed. This study finds that GHG emission reduction in the power sector and the transport sector would be the major contributor in achieving net zero emission in 2050 compared to the projected emissions in the BAU level. Energy efficiency improvement in the demand side would lower the electricity consumption compared to the BAU level despite the higher electrification of the end-use technologies. However, the demand to produce green hydrogen in the NZE scenarios would increase the electricity generation in 2050 b y up to 54 % compared to the BAU level. The capacity of electrolyser would reach 50 GW by 2050 in the high hydrogen use scenario. This would require additional solar and wind power capacity of 107 GW and 43 GW, respectively. In addition, it would require 50 million cubic meters of water. Cumulative investments in electrolysers to produce green hydrogen and renewable based power generation during 2031–2050 would be USD 122 billion.

Source: Pradhan et al. (2024). Role of green hydrogen in the decarbonization of the energy system in Thailand. Energy Strategy Reviews, 51, 101311. https://doi.org/10.1016/j.esr.2024.101311

Analysis of Macroeconomic impacts and co-benefits using AIM/Hub

"Policy documents related to NDCs & LT-LEDs neglect the co-benefits of achieving GHG reductions. Incorporating co-benefits in the assessment of emission pathways will significantly improve the outcomes."

Energy, Ecology and Environment
https://doi.org/10.1007/s40974-024-00324-w

Springer

ORIGINAL ARTICLE

Check for updates

Macroeconomic impacts and co-benefits of deep-decarbonization in Thailand

Achiraya Chaichaloempreecha[1,2] · Bijay B. Pradhan[2] · Salony Rajbhandari[1,2] · Puttipong Chunark[3] · Shinichiro Fujimori[1,4,5] · Ken Oshiro[4] · Tatsuya Hanaoka[1] · Bundit Limmeechokchai[2]

Received: 12 January 2024 / Revised: 5 March 2024 / Accepted: 1 April 2024

Abstract
The updated Nationally Determined Contributions (NDC) in 2022 of Thailand includes an aggressive GHG emission reduction target of 40% in 2030 from its baseline emissions. However, the macroeconomic impacts and co-benefits associated with reducing GHG emissions are not addressed. This study analyzes the macroeconomic implications and co-benefits of GHG emission reduction in Thailand to achieve the NDC and net zero emission (NZE) targets by 2050 using the AIM/Hub-Thailand model. This paper provides co-benefits for Thailand on ambitious long-term GHG emission reduction targets. Considering the co-benefit analysis in the policy documents will provide holistic insights on the positive impacts of GHG mitigation. Results show that Thailand would have to bear a GDP loss of 7.7% in 2050 compared to the BAU level if the net zero emissions need to be achieved. Fuel switching from fossil fuel to electricity in the demand side and improvement of technologies in the power sector also reduces air pollutant emissions. The increasing dependence on domestic energy supply in the NZE scenario will make the country less vulnerable to the fluctuating prices in the international energy market. In terms of trade-offs, the land use for sustainable biomass in both the NDC and NZE scenarios will be larger than in the BAU scenario. Results show better land use for biomass production and higher yields in agricultural production. Moreover, the achievement of NZE pathway will require effective usage of land area and better use of energy resources, thereby making the country more energy secure.

Keywords AIM/Hub model · Net zero emissions · Macroeconomic impacts · Co-benefits of GHG mitigation · Thailand

Source: Chaichaloempreecha et al. (2024). Macroeconomic impacts and co-benefits of deep-decarbonization in Thailand. Energ. Ecol. Environ. https://doi.org/10.1007/s40974-024-00324-w

ICUE 2024

International Conference on sUstainable Energy

ENERGY TRANSITION and NET-ZERO CLIMATE FUTURE

21 - 23 October 2024 / Pattaya City, Thailand

Role of Discount Rate and Social Cost of Carbon for Carbon Capture Utilization and Storage Technologies in Thailand's Low Emissions Pathways

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***Abstract*— To achieve Thailand's carbon neutrality by 2050 (CN2050), CCUS and BECCS technologies are proposed to be used in the electricity generation sector. Using low discount rates and the social cost of carbon (SCC) is recommended for climate projects. In this study, the AIM/Enduse, developed by the National Institute for Environmental Studies (NIES) Japan, is employed to assess the appropriate discount rate, and estimate the SCC in terms of carbon price of electricity generation with CCUS and BECCS technologies. The results indicate that, with a constant discount of three, SCC starts at 63 USD/tCO2 for the CN2050 target. In the case of a declined discount rate, the 6 percent discount rate is employed in the assessment before 2037 and then the 3 percent discount rate is applied after 2037 to the end of the CN2050 target. Results indicate that SCC starts at 21 USD/tCO2 when the 6 percent discount rate is applied before 2037 then SCC starts at 63 USD/tCO2 after 2037 when the 3 percent discount rate is applied.**

***Index Terms*-- AIM/Enduse, CCS, BECCS, Social cost of carbon, Thailand**

zero greenhouse gas emissions by 2065 (NZE2065). Both targets have greenhouse gas emissions (GHG) levels consistent with keeping a global temperature within 1.5°C [3].

To achieve CN2050 and NZE2065 targets, Carbon Capture, Utilization and Storage (CCUS) and Bioenergy with Carbon Capture and Storage (BECCS) technologies are proposed to be used in the power sector. The implementation of CCUS and BECCS technologies will start by 2040. CCUS and BECCS technologies are well known as GHG mitigation technologies or climate projects but both technologies are still expensive. When the project developer analyzed the cost-effectiveness of CCUS and BECCS technologies, it was inappropriate for the implementation of both technologies. The discount rate is one of the factors and assumptions used in analysis. Thailand and other developing countries use business-perspective discount rates of 10 percent. However, The Intergovernmental Panel on Climate Change (IPCC) recommends using discount rates of 5 and 2 percent for short and long-term climate projects, respectively [4]. Changes in

Low discount rates employed in AIM/Enduse result in selection of low carbon technologies such as CCUS and BECCS. These technologies are competitive with conventional technologies.

An investigation of Internationally Transferred Mitigation Outcomes (ITMOs) on GHG emissions reduction in Thailand's NDC

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ICUE 2024
International Conference on sUstainable Energy
ENERGY TRANSITION and NET-ZERO CLIMATE FUTURE
21 - 23 October 2024 / Pattaya City, Thailand

***Abstract*--Thailand has pledged its climate commitment and targets on the Carbon Neutrality by 2050 and the net-zero GHG emissions by 2065, including greenhouse gas (GHG) emissions reduction of 30% in its Nationally Determined Contributions (NDC) by 2030 with domestic contribution, called "Unconditional NDC", and up to 40% with supports from international cooperation, called "Conditional NDC". The assessment found that Thailand's estimated greenhouse gas emissions at that time would be at 555 $MtCO_2eq$. Due to Article 6.2 of the Paris Agreement, Thailand has encountered to achieve the additional 10% of GHG emissions reduction of 55.5 $MtCO_2eq$.**

This study examines the potential for GHG emissions reduction in Thailand's energy sector within the framework of international cooperation such as the Joint Crediting Mechanism (JCM). However, results of transferring amount must be accounted and reported in the NDC tracking under Article 13 of both Parties to avoid double counting. In the investigation, the AIM/EndUse model, developed by National Institute for Environmental Studies Japan, is employed.

The results indicate that, according to the international cooperation framework, Thailand must reduce GHG emissions more than the target specified in the conditional NDC. Moreover, the abatement cost shows that the amount of Internationally Transferred Mitigation Outcomes (ITMOs) should not be higher than 42.8% of conditional NDC target for investment proportion from international cooperation of 30%.

***Keywords*-- AIM/EndUse, Internationally Transferred Mitigation Outcomes (ITMOs), Nationally Determine Contribution (NDC), Paris Agreement, Thailand**

Article 6 of the Paris Agreement allows countries to engage in voluntary cooperation to meet their national GHG emission reduction targets by transferring GHG emission reduction quantity. Specifically, Article 6.2 permits countries to transfer ITMOs, measured in tons of carbon dioxide equivalent (tCO_2eq), to help other countries achieve their emission reduction goals. This mechanism supports sustainable development and ensures environmental benefits while requiring rigorous accounting and reporting to prevent double counting. Compliance with international standards, as defined by the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC), is mandatory for measuring, reporting, and verifying (MRV). Avoiding double counting is crucial to ensure that global net GHG emissions do not increase. Double counting can occur in various forms, such as double issuance, double claiming, double use, and double purpose. The use of ITMOs and Corresponding Adjustments (CA) is vital in preventing double counting and claiming of GHG reductions under the Paris Agreement. ITMOs adjustments are made once after their first transfer, with reductions counted towards the implementing country's GHG targets, while the host country's reductions are correspondingly decreased or increased.

The projection of Thailand's GHG emission level under the Business as Usual (BAU) scenario is expected to be 555 $MtCO_2eq$ in 2030. On one hand, according to the NDC target, domestic GHG emission reduction, called unconditional

AIM/Enduse was employed to investigate appropriate proportion of carbon credits under Article 6 of Paris Agreement. Proportion of 30-50% credit sharing is recommended for JCM projects in Thailand.

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Analysis of Transport demand and modal shift on emissions using AIM/Enduse

"Integrated transport model to analyze effect of modal shift on long-term pathways of energy consumption and emissions"

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Changes in Transport Demand and Modal Shift on GHG Emissions in Thailand

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***Abstract*— Thailand's economic success relies heavily on its transportation infrastructure, which is a major contributor to GHG emissions. To address these challenges, Thailand has developed transportation infrastructure plan focused on enhancing its transport system, promoting mass transit, and adopting advanced technologies to reduce energy consumption and GHG emissions. This study developed a transport demand model for Thailand to estimate future demand and to assess the impact of behavioral changes on modal shifts, considering mode-specific costs. The transport demand model was then linked with the AIM/Enduse to analyze long-term energy consumption and GHG emissions pathways. Scenarios, including reference, COVID, and transport modal shift policy, estimate significant impacts from changes in behavior and a shift to mass transit on energy use and GHG emissions. By prioritizing public transport infrastructure, Thailand will substantially increase its transport demand, however, energy consumption and GHG emissions will decrease by 16.6% and 17.2% in 2060 compared to reference scenario.**

***Index Terms*-- Transport demand model; Transport mode choice; Behavioral change; AIM/Enduse; GHG mitigation.**

transport infrastructure is essential for Thailand's economic stability and future success [3], [4].

In Thailand, the transport sector was the largest final energy consuming sector, increasing from 23.49 Mtoe in 2005 to 30.92 Mtoe in 2022, with an annual average growth rate (AAGR) of 1.63%. It accounted for 40% of Thailand's total energy consumption in 2022 [5]. Road transport has been a major transportation mode and contributed almost 80 percent of energy consumption in the transport sector. In the emission aspect, the transport sector was the second largest emission source within the energy sector. GHG emissions from the transport sector were 76.92 MtCO_2eq in 2018, accounting for 29.5% of total GHG emissions in the energy sector [6]. Road transport is the biggest cause and responsible for 97% of Thailand's transport emissions. Additionally, the number of vehicles on the road is increasing, putting upward on the emissions [7].

To address these challenges, the Thai Government launched the 20-Years Thailand Transport System Development Strategy (2018-2037). The plan aims to enhance the country's competitiveness by upgrading its transport and

Source: Chaichaloempreecha et al. Change in Transport Demand and Modal Shift on GHG Emissions in Thailand. ICUE2024. (under preparation for publication)

Decarbonization of Power Sector in Thailand to Achieve Carbon Neutrality by 2050

“To analyze the economy-wide impacts of decarbonizing Thailand’s power sector in the pursuit of carbon neutrality and supporting the goal of achieving net-zero emissions”

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Source: Rajbhandari et al (2024) Decarbonization of Power Sector in Thailand to Achieve Carbon Neutrality by 2050. ICUE2024. *(under preparation for publication)*

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Decarbonization of Power Sector in Thailand to Achieve Carbon Neutrality by 2050

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***Abstract*—Thailand has significantly raised its emissions reductions goals, aiming for carbon neutrality by 2050 and setting a net-zero greenhouse gas (GHG) emissions target for 2065. The power sector is the largest contributor to carbon dioxide (CO_2) emissions and plays a pivotal role in decarbonizing other sectors. As such, a comprehensive reform and decarbonization of the power sector are imperative for Thailand to successfully achieve the carbon neutrality and net-zero GHG emissions goals. This study hence develops a recursive dynamic Asia-Pacific Integrated Model/Computable General Equilibrium (AIM/CGE) model to analyze the economy-wide impacts of decarbonization pathways focusing on the Thai power sector. In doing so, this study disaggregates the electricity generation sector into various renewable and fossil-based sources when evaluating the responses to decarbonization policies. Simulations indicate that considering disaggregation in electricity production is important for accurately quantifying the economic impacts of carbon mitigation.**

***Index Terms*--AIM/CGE, Carbon neutrality, Decarbonization, Power sector, Thailand**

decarbonization strategy, since the sector accounted for 36% of energy sector carbon emissions and 22% of the total emissions by sources in 2019 [3]. Further electrification will be essential for reducing emissions from the industries, transport and building sectors. Therefore, a fundamental reform and decarbonization of the power sector are imperative for Thailand to successfully realize its commitment to carbon neutrality by 2050 and net-zero GHG emissions by 2065. This illustrates the importance of disaggregating the electricity generation sector into various renewable and fossil-based generation when considering the responses to such decarbonization policies.

Many studies have highlighted the significance of disaggregating electricity generation when evaluating responses to energy and environmental policies [4], [5], [6], [7]. The electricity sector in most decarbonization studies using the computable general equilibrium (CGE) models in Thailand is highly aggregated, making it unsuitable for effectively analyzing the impacts of climate change or energy policies on this sector [8], [9], [10]. The study conducted by [9] developed a CGE model for Thailand to analyze carbon neutrality pathway towards 2050. But the study treated the electricity generating sector as an aggregate sector assuming

Disaggregation of Electricity Sector in I/O Table

- Total value of each commodity is allocated in proportion to the electricity generation share by technology

	GWh	Share in Total Generation, %
Coal & Lignite	36697	19.90%
Natural Gas	125723	68.16%
Oil	1329	0.72%
Biomass	12513	6.78%
Hydro	3878	2.10%
Solar	2378	1.29%
Wind	329	0.18%
Others (MSW, Biogas, Geothermal)	1602	0.87%
	184450	100.00%

- Annualized capacity cost is used for disaggregating the operating surplus & depreciation among the various electricity generation technologies

	Capacity (MW)	Capacity x Annualized Cost (1000 USD)	Share (%)
Coal	4,565	485,278	11%
Natural Gas	25,975	2,252,242	53%
Oil	341	29,421	1%
Biomass	2,727	447,471	11%
Hydro	3,079	712,749	17%
Solar	1,420	139,192	3%
Wind	234	48,912	1%
Others (MSW, Biogas, Geothermal)	505	121,992	3%
Total	38,844	4,237,256	100%

THANK YOU