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THAILAND's NET-ZERO EMISSIONS 2050

Bundit Limmeechokchai

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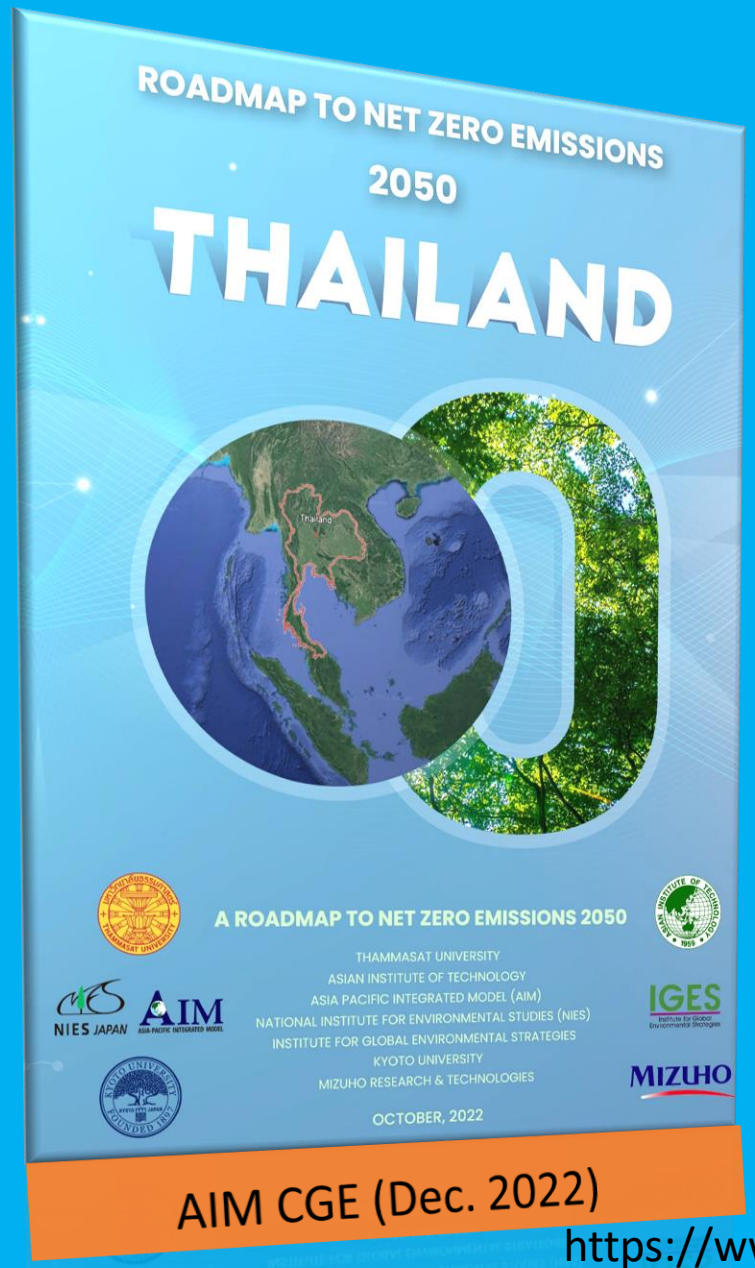
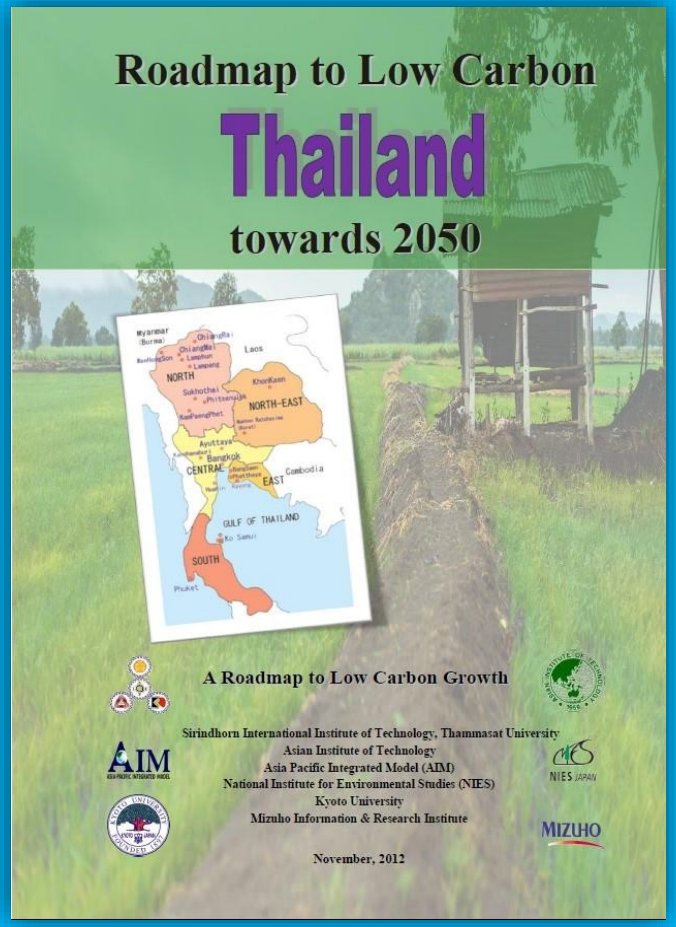
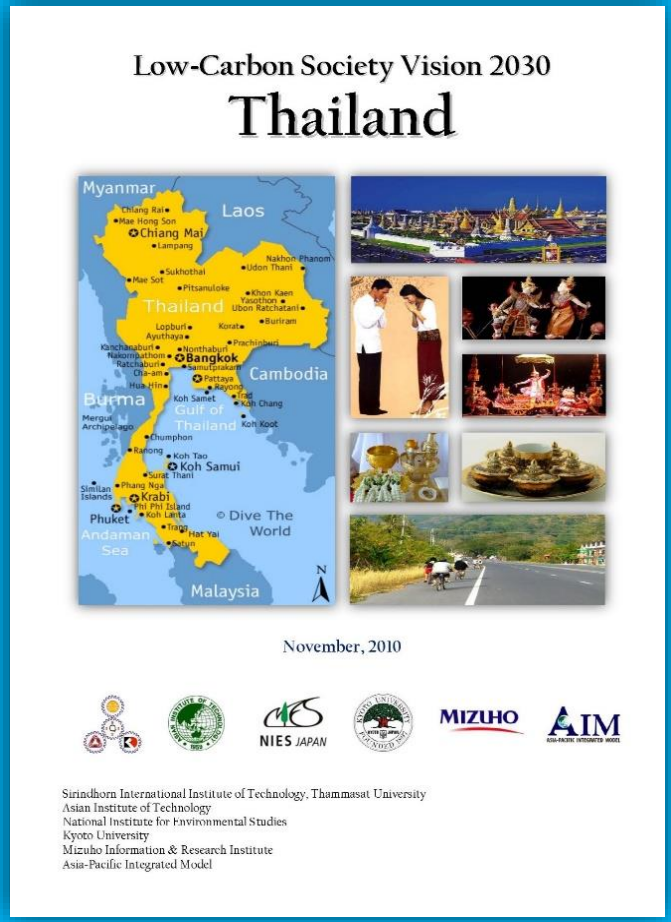
Thailand AIM Brochure



AIM CGE (Dec. 2022)



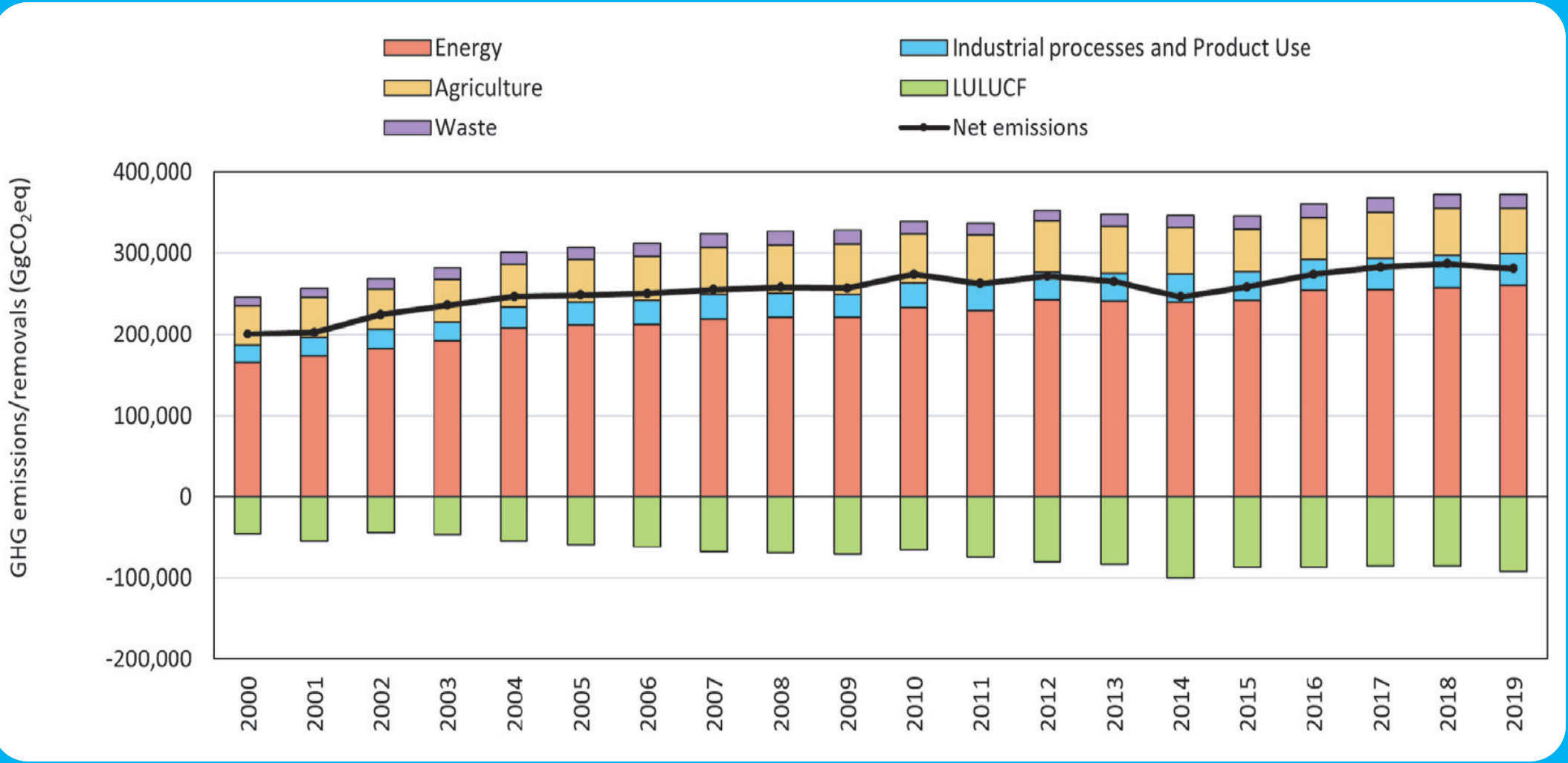
AIM Enduse 2012



AIM ExSS 2010

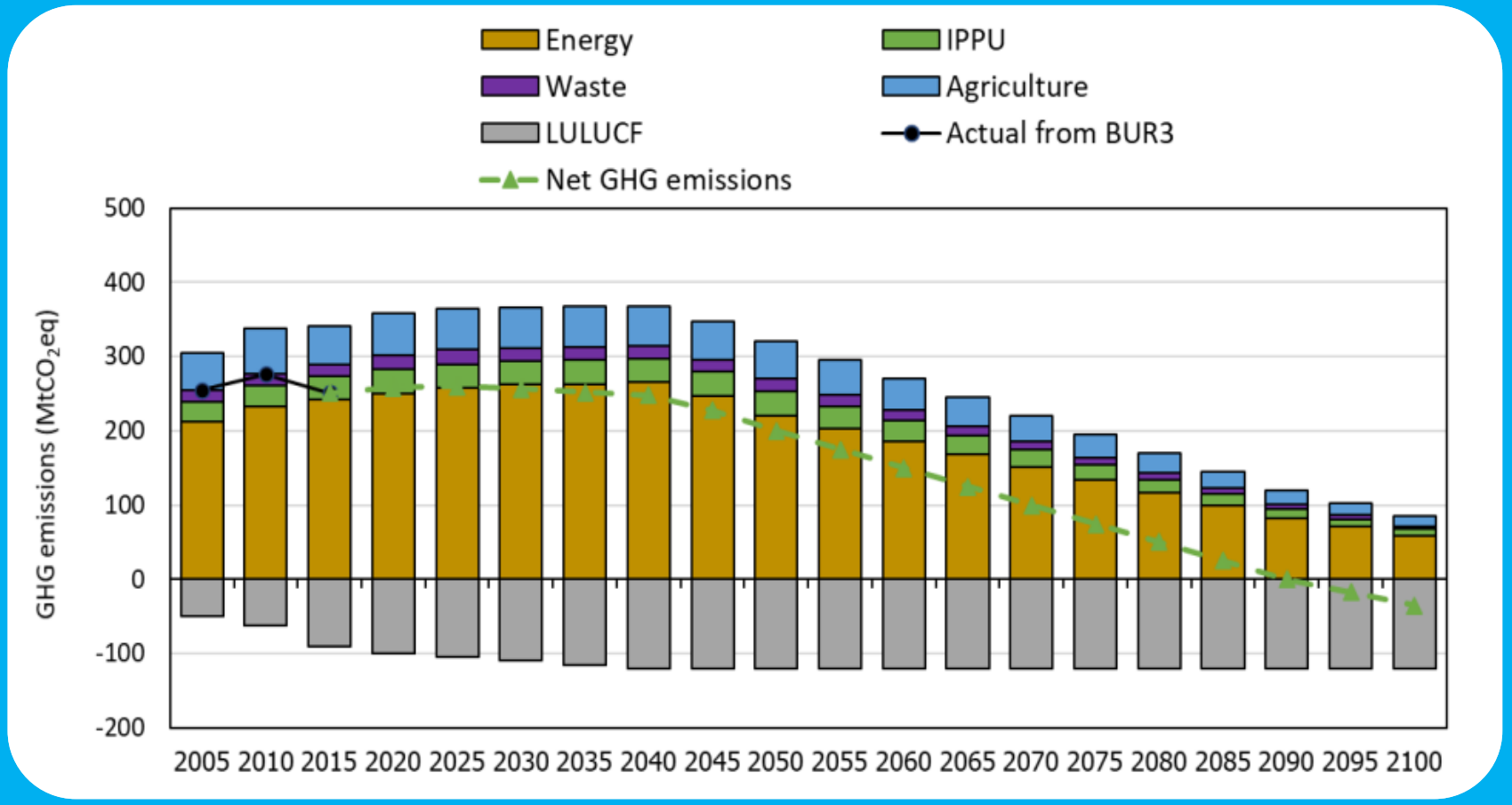
https://www-iam.nies.go.jp/aim/pdf/Thailand_Net_Zero_2050_Roadmap.pdf

Thailand's Greenhouse Gas Emission Situation in BUR4



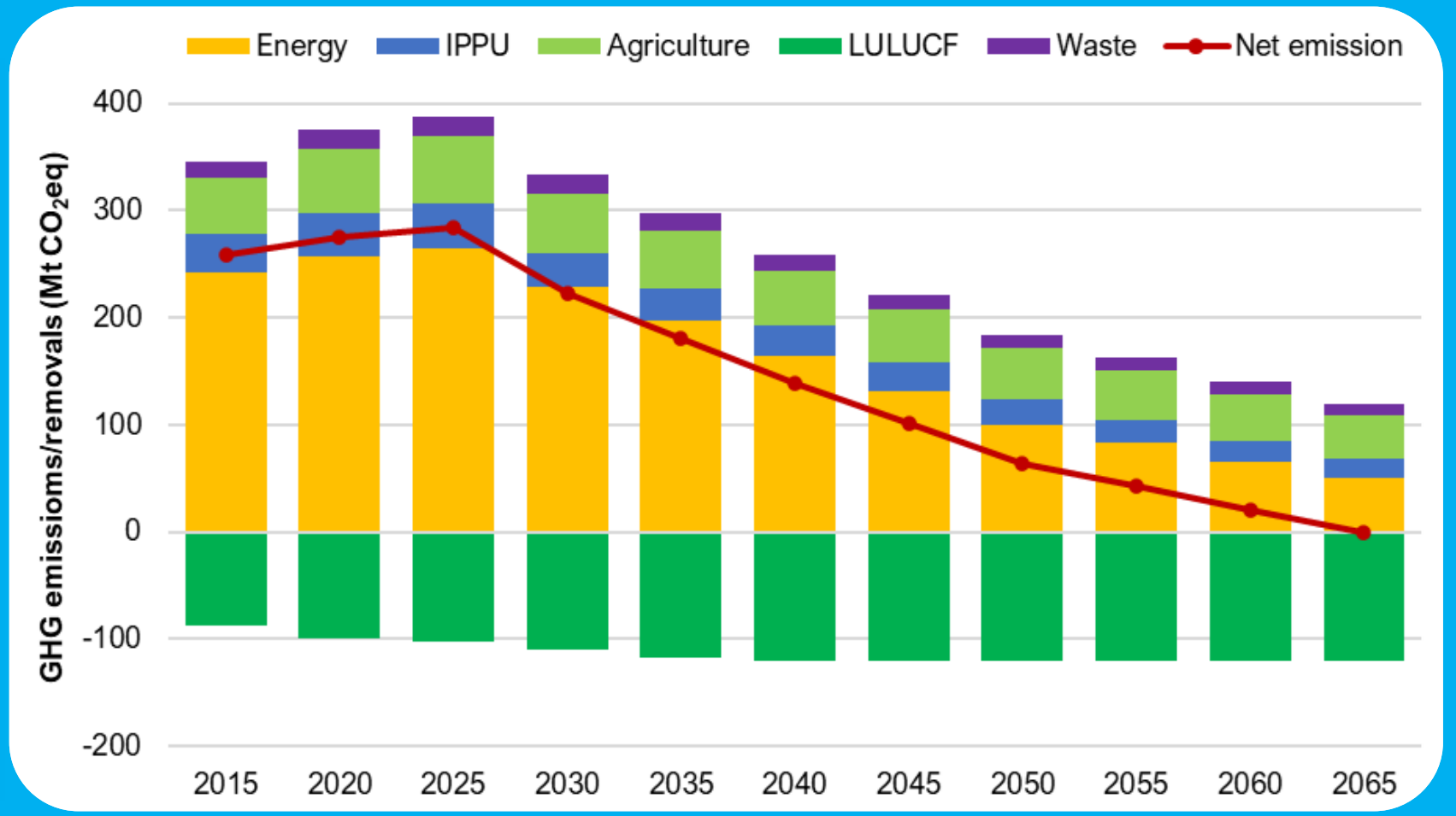
Source: Thailand BUR4 (UNFCCC,2022)

Reaffirmed Baseline Emissions: 2-D pathways



Source: Thailand LT-LEDS (Revised Version)_08Nov2022.pdf (unfccc.int)

Reaffirmed Targets: Net Zero GHG Emission 2065



Source: Thailand LT-LEDS (Revised Version)_08Nov2022.pdf (unfccc.int)

GER-Role of Asia towards a Decarbonized World

Analysis of CO_2 Emission Pathways of Thailand to Achieve Carbon Neutrality 2050 Using AIM Model

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Abstract

The trend of rising greenhouse gas (GHG) emissions in Thailand is a matter of concern, demanding ambitious mitigation efforts beyond 2030 and even before then to contribute towards meeting the long-term goal of the Paris Agreement of staying within a 1.5°C temperature rise. Carbon dioxide (CO_2) emissions form the major part of the total GHG emissions in Thailand. This study aims to explore the energy, environmental and macroeconomic impacts of limiting CO_2 emissions during 2010–2050 for the underlying target of achieving carbon neutrality by 2050. This study has developed a recursive dynamic Asia-Pacific Integrated Model/Computable General Equilibrium (AIM/CGE) model for Thailand which is soft-linked with the AIM/Enduse model. In addition to a business-as-usual (BAU) scenario, the study has formulated two different CO_2-mitigation scenarios, each indicating a carbon-neutrality pathway towards 2050. Results indicate that Thailand should put more effort into mitigation actions to achieve carbon neutrality by 2050. Expansion of renewable-energy-based technologies, improvement of end-use energy efficiency, fuel-switching and deployment of carbon capture and storage (CCS) technologies in both the power and industrial sectors are identified as important mitigation measures for Thailand in curbing CO_2 emissions by 2050. The results show that the introduction of such mitigation measures would provide CO_2 emission reductions, but at the expense of economic losses. The price of CO_2 mitigation was found to vary from 220 to 332 US dollars per ton of CO_2 (tCO_2) in 2050 under the two carbon-neutrality scenarios.

Key words: AIM/CGE, AIM/Enduse, energy efficiency, net zero emissions, renewable energy, Thailand

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http://www.airies.or.jp/ebook/GERv26_2022/index.html#page=1

Climate Policy, 23:2, 168-183,
DOI: 10.1080/14693062.2022.2126813

Scaling up climate ambition post-2030: a long-term GHG mitigation analysis for Thailand

Bundit Limmeechokchai, Salony Rajbhandari, Bijay B. Pradhan, Puttipong Chunark, Achiraya Chaichaloempreecha, Shinichiro Fujimori, Ken Oshiro & Yuki Ochi

ABSTRACT

Thailand's Nationally Determined Contribution (NDC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) aims to reduce 20 to 25% of greenhouse gas (GHG) emissions with respect to the projected reference level of NDC in 2030, respectively, in its unconditional and conditional scenarios. The Intergovernmental Panel on Climate Change (IPCC) states that limiting global temperature rise to 1.5°C would require net zero carbon dioxide emissions globally by around 2050. Thailand's current energy system is highly fossil fuel dependent and requires enormous transformations to achieve more stringent GHG emission reduction targets beyond its NDC. This paper seeks to estimate the level and the intensities of Thailand's energy system and their economy-wide effects post-2030 under the business as usual and 16 GHG emission reduction scenarios ranging from 30 to 100% by 2050. A computable general equilibrium analysis using the AIM/Hub model is employed to estimate the macroeconomic impacts of meeting the unconditional and conditional emission reductions of Thailand's NDC in 2030 along with varying GHG emission reductions in 2050. Results show that renewables – constituting solar, wind, biomass and hydro and carbon capture and storage (CCS) technologies account for more than 95% in the power generation mix by 2050, if 100% GHG emission reduction from the 2010 level is to be achieved. Electricity generation based on biomass both with and without CCS will occupy a major share in the investments by 2050 in all the conditional and unconditional NDC scenarios. A rapid increase in carbon sequestration occurs from 2040 onwards through the deployment of CCS and bioenergy with CCS (BECCS) technologies in all the conditional and unconditional NDC scenarios. Carbon prices lie in the range of 3.4–266.2 US$/tCO$_2$eq during 2025–2050 to achieve 100% GHG emission reductions in 2050. Imposition of early stringent mitigation target lowers the carbon prices in the conditional scenarios towards 2050 when compared to the unconditional scenarios. The rapid uptake of CCS, energy efficiency improvements and electrification of the end-use technologies are identified to be the key measures to transform the energy system of Thailand.

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KEYWORDS
Nationally determined contribution; long-term GHG emissions; Paris Agreement; AIM/Hub model; Thailand

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SPECIAL FEATURE: ORIGINAL ARTICLE

Accelerating Actions for Leveraging a Climate-Neutral, Sustainable Society

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

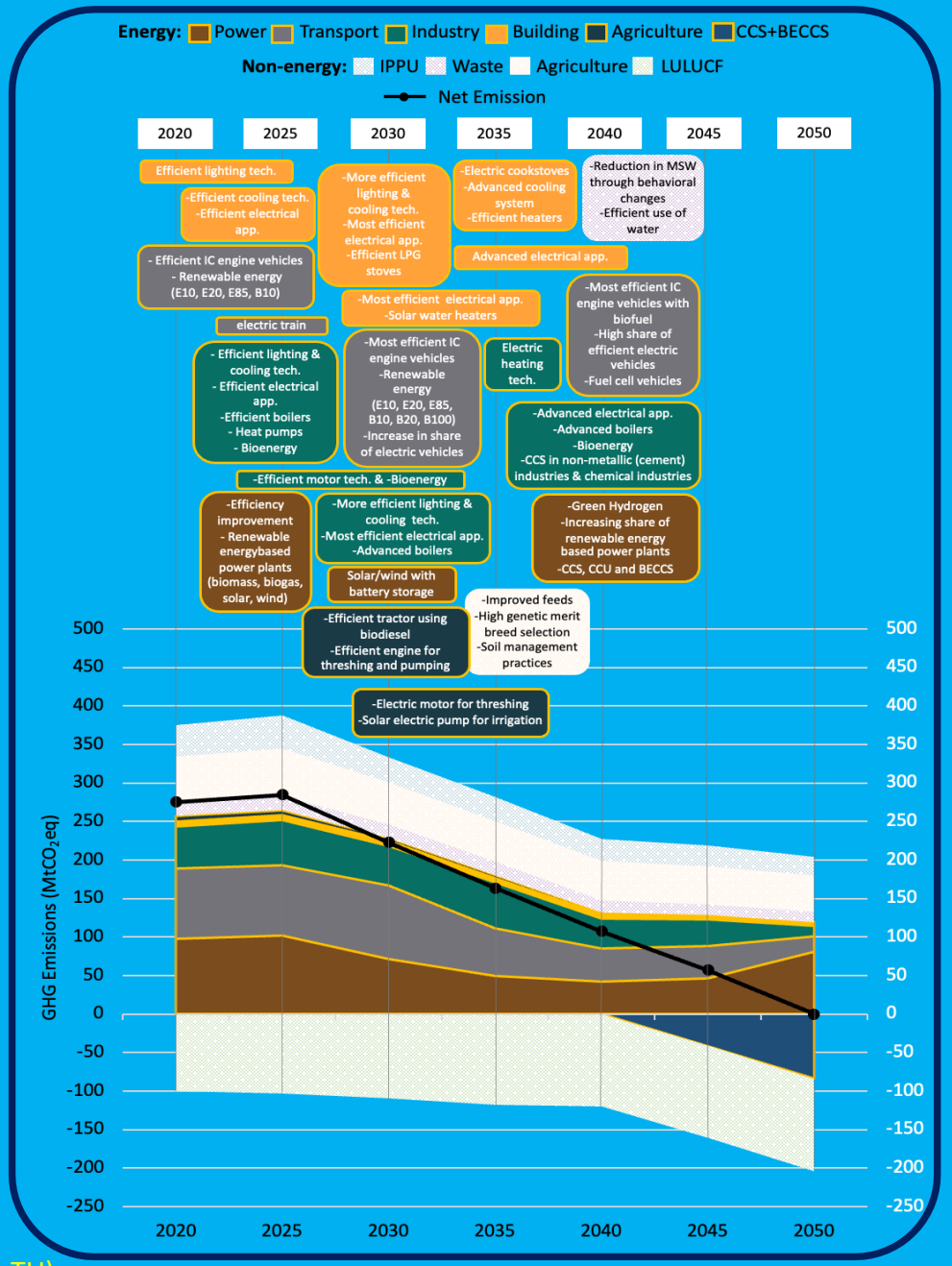
This paper aims at exploring the economy-wide impacts of achieving net-zero greenhouse gas (GHG) emissions by 2050 in Thailand. This study developed a recursive dynamic Asia-Pacific Integrated Model/Computable General Equilibrium (AIM/CGE) model of Thailand for the assessment. The macroeconomic impacts 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

Available at: https://link.springer.com/article/10.1007/s11625-023-01319-y

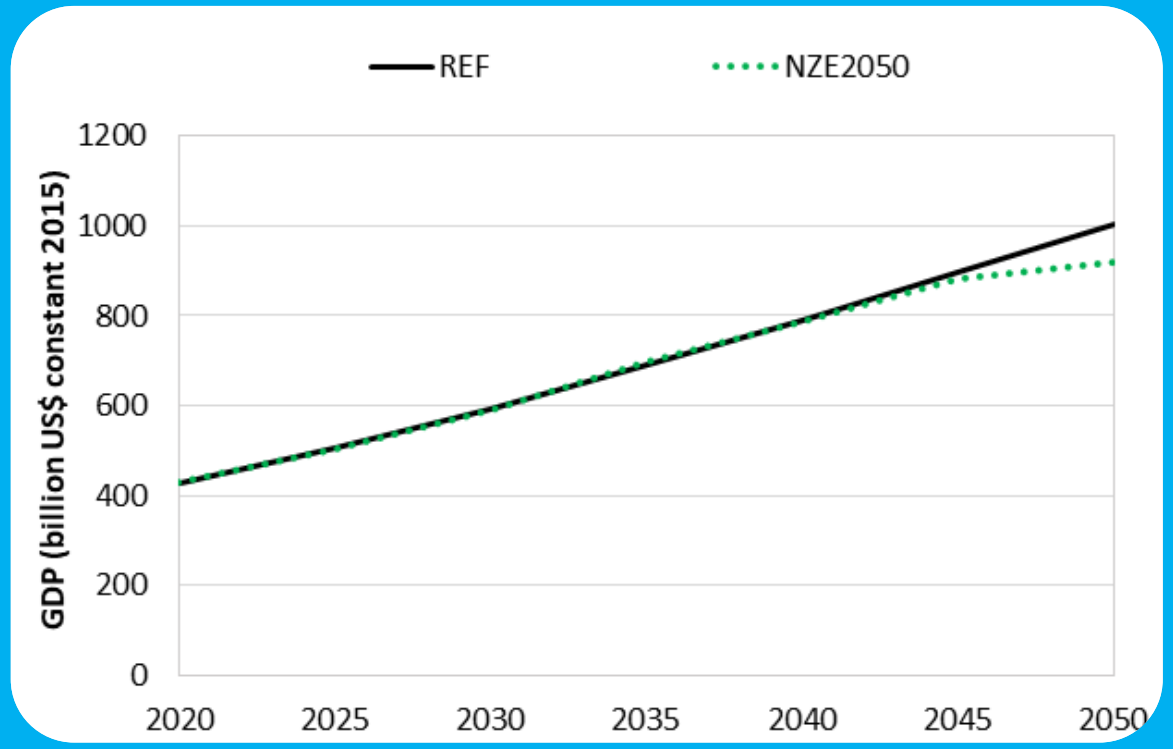
Key Actions to Achieve Net Zero Emissions in 2050 Thailand

- High energy efficiency
- High electrification
- New renewable energy development
- Green hydrogen
- Carbon capture, utilization and storage (CCUS)
- Bioenergy plus CCS
- Behavioral changes

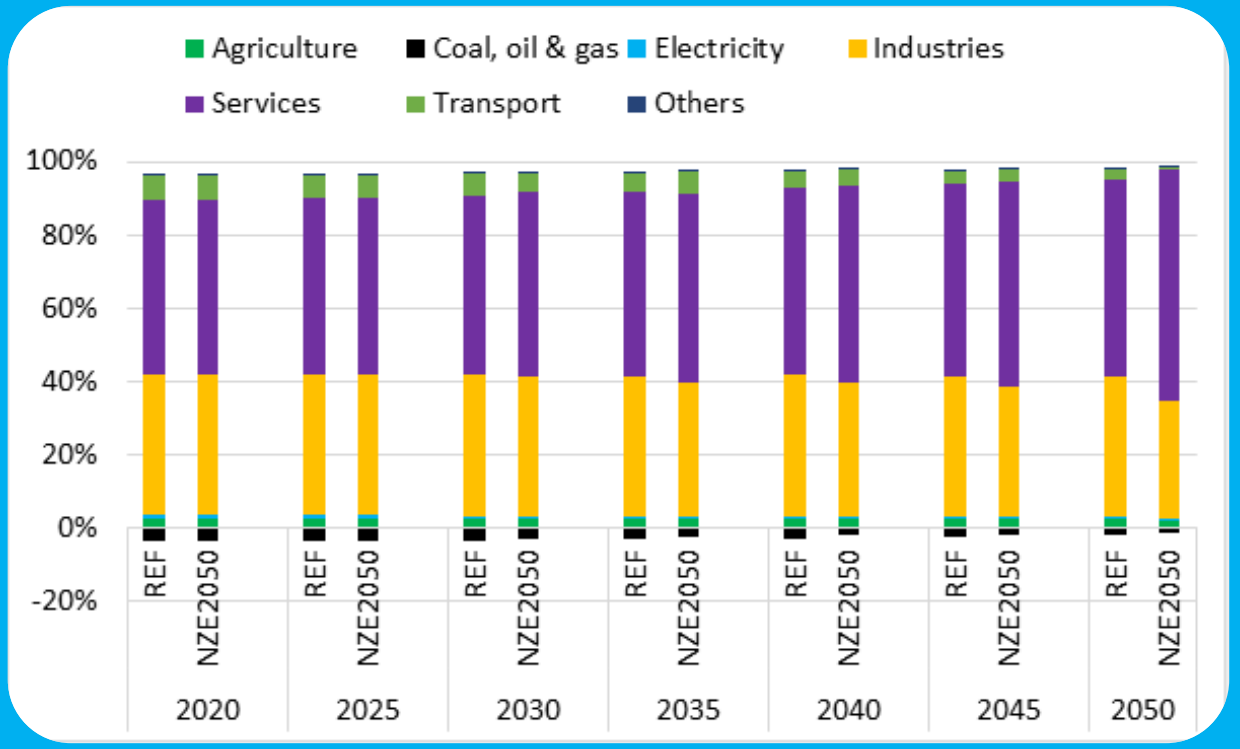


Effect on Macroeconomic Indicators

NZE2050 at the expense of 8.5% economic loss by 2050



Sectoral Share in Total GDP



Increases in productivity lead to higher output from the service sector by 2050

Macroeconomic Implications of Delaying Emissions Peak using AIM/CGE

Thailand's Economy-wide Implications of Delaying Peak Carbon Emissions by 2030

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Highlights

- Aims at exploring the macroeconomic impacts of achieving net zero GHG emissions by 2050 in Thailand with delayed carbon emissions peak occurring in 2030.
- Early introduction of CCS lowers the cumulative GDP losses in net-zero emission scenarios.
- Cumulative GDP losses during 2015-2065 could be lowered by delaying carbon emissions peak from 2025 to 2030.
- It is observed that the carbon prices would be lowered if the CCS technologies are introduced earlier in 2035.

Keywords: AIM/CGE, GHG emissions, Nationally Determined Contributions, Peak carbon emissions, Thailand

AIM/Enduse Modeling & Analyses of Green Hydrogen

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

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Highlights

- Renewable based electricity supply required for green hydrogen production in achieving net zero emissions is quantified.
- Hydrogen production demand and capacity required has been quantified.
- Water demand to produce green hydrogen has been discussed.
- Land area for solar PV has been estimated.
- Co-benefits in terms of local pollutant reduction have been quantified.

Keywords

AIM/Enduse model, Green hydrogen, Renewable energy, Net zero emissions, Thailand

Co-benefits of net zero emissions 2050 by AIM/Hub-Thailand

Macroeconomic impacts and co-benefits of net zero greenhouse gas emission 2050 in Thailand

Achiraya Chaichaloempreecha[1,2], Bijay B. Pradhan[1], Salony Rajbhandari[1,2], Puttipong Chunark[3], Shinichiro Fujimori[4,5], Ken Oishiro[4,5], Edward Byers[5], Volker Krey[5], Tatsuya Hanaoka[2], Bundit Limmeechokchai[6,*]

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Highlights

- Macroeconomic implications and co-benefits of GHG emission reduction in Thailand are analyzed to achieve NDC and net zero emission targets using the top-down computable general equilibrium, AIM/Hub-Thailand model.
- Considering the co-benefits analysis in the policy documents will provide holistic insights on the positive impacts.
- Air pollutant mitigation is from switching to electricity from coal, oil, and natural gas in the demand side sector.
- Its dependence on domestic energy supply will make the country less vulnerable to the international energy market.
- Net zero emission pathway will require effective usage of land area and utilization of domestic energy resources, thereby making the country more energy secure.

Keywords: AIM/Hub-Thailand, Macroeconomic impacts, Co-benefits, Net zero emission

GCAM Modeling & Analyses (2022-2023)

Thailand Carbon Neutrality 2050

TU & PNNL – 1st Stakeholders Meeting (Jan 2023)

U.S. Department of State

US-ASEAN Smart Cities Partnership

Modeling & Analysis

Pacific Northwest NATIONAL LABORATORY

Thammasat University

Stakeholder engagement

การไฟฟ้านครหลวง Metropolitan Electricity Authority

Bangkok Metropolitan Authority

Energy Policy and Planning Office MINISTRY OF ENERGY

Electricity Generating Authority of Thailand

Office of Natural Resources and Environmental Policy and Planning

TU & PNNL - Stakeholders Meeting Aug 2023

GCAM Modeling & Analyses (Sept 2023)

Thailand Carbon Neutrality in 2050

Title: Stakeholder-informed carbon neutral pathways for Thailand and Bangkok

Authors: Taryn Waite[1], Zarrar Khan[1], Leeya Pressburger[1], Meredydd Evans[1], Michael Westphal[1], Bijay Bahadur Pradhan[2], Pornphimol Winyuchakrit[2], Achiraya Chaichaloempreecha[2], Salony Rajbhandari[2], Piti Pita[2], Abdullah Jonvisait[2], Daranee Jareemit[3], and Bundit Limmeechokchai[2,3]

[1]Pacific Northwest National Laboratory; [2]Thammasat University Research Unit in Sustainable Energy & Built Environment; [3]Thammasat Design School, Faculty of Architecture and Planning, Thammasat University, Thailand

Abstract

Thailand has established a target of carbon neutrality by 2050. Reaching carbon neutrality will require coordination and collaboration between stakeholders spanning sectors and scales, including energy system decision makers, land managers, and city planners. Robust decarbonization scenarios incorporating current plans and targets, additional measures needed, and trade-offs between strategies can help stakeholders make informed decisions in the face of uncertainty. Through iterative engagement with decision makers at the city and national levels, we develop and analyze carbon neutral scenarios for Thailand that incorporate Bangkok's role using a global integrated assessment model. We find that Thailand can reach carbon neutrality through power sector decarbonization, energy efficiency improvements, widespread electrification, and advanced technologies including carbon capture and storage (CCS) and hydrogen. Bangkok, as a major population and economic center, contributes significantly to Thailand's energy demand and emissions and can therefore play an important role in national decarbonization efforts. Uncertainty regarding Thailand's potential land carbon sink will have major implications for energy system efforts required both in Bangkok and nationally. These insights can help stakeholders identify priorities and make decisions that will impact Bangkok and Thailand's long-term climate change mitigation potential. This analysis demonstrates how stakeholder engagement in integrated assessment modeling can facilitate and inform multilevel climate governance.

AIM/Enduse Analyses of Discount Rate in Thailand (2021)

Carbon taxes needed to achieve the 2-D pathways (USD/t-CO_2)			
Technology	DR 10%	DR 6%	DR 3%
Wind	95.0 - 122.8	64.5 - 90.8	42.1 - 69.7
Solar PV	70.9 - 88.4	41.8 - 59.1	21.7 - 39.9
BECCS	66.1 - 86.2	50.2 - 71.0	39.2 - 61.0
Biogas	0 - 9.7	0 - 2.5	0
Waste to energy	-	-	-

AIM/Enduse Analyses of CCS in Thailand CN2050 (2022)

CURRENT POLICY (PDP)

Power technology	Reduction potential ($MtCO_2$)	CO_2 avoided cost (USD/tCO_2)	Incremental cost (USD/tCO_2)
SPC with CCS	313.83	42.77	69
BE with CCS	39.65	178.62	158
FBPC with CCS	26.78	25.41	76
USPC with CCS	12.51	42.77	107
STPL with CCS	7.91	58.90	126
SPC with CCU	3.64	34.79 – 380.79	52 – 407
FBPC with CCU	3.64	16.43 – 362.43	58 – 413
USPC with CCU	1.06	29.21 – 375.21	84 – 439
STPL with CCU	0.08	44.80 – 390.80	101 – 456
TOTAL	**409.10**		

RE50% SHARE

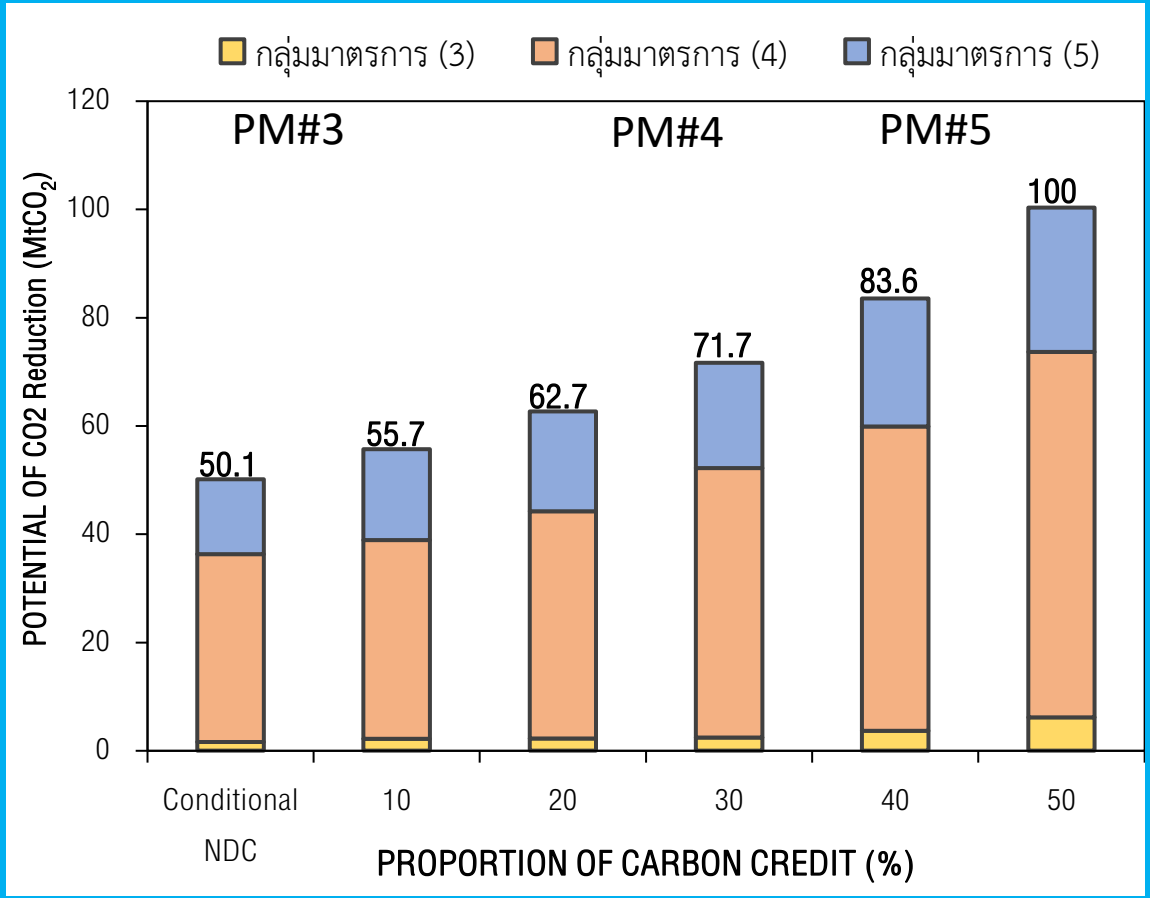
Power technology	Reduction potential ($MtCO_2$)	CO_2 avoided cost (USD/tCO_2)	Incremental cost (USD/tCO_2)
SPC with CCS	80.54	50.77	77
IGCCPC with CCS	29.03	15.39	62
FBPC with CCS	23.66	33.41	84
BE with CCS	18.46	178.62	166
SPC with CCU	1.11	42.79 – 388.79	60 – 415
FBPC with CCU	1.11	24.43 – 370.43	66 – 421
IGCCPC with CCU	0.29	9.75 – 355.75	47 – 402
USPC with CCU	0.24	37.21 – 383.21	92 – 447
TOTAL	**154.44**		

NOTE:
FBPC = Fluidized-bed pulverized coal
USPC = Ultra-supercritical pulverized coal
STPL = Steam thermal pulverized lignite
SPC = Supercritical pulverized coal
BE = Bioenergy
IGCCPC = Integrated gasification combined cycle pulverized coal

AIM/Enduse Analyses of JCM in Thailand (2023)

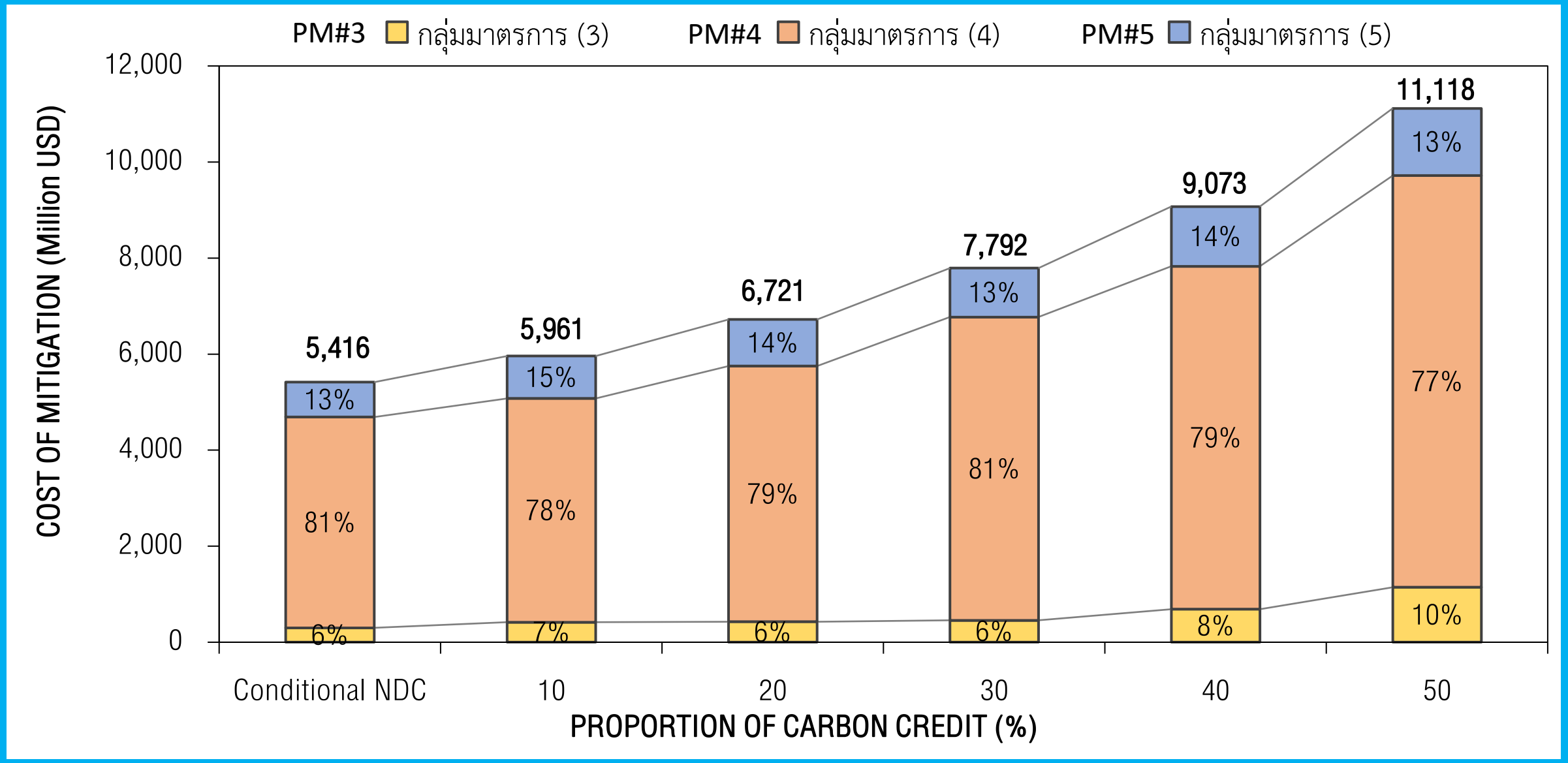
Policy & Measure (PM)	Low Carbon Technology
(1) Energy Efficiency	Power: การทำงานของระบบผลิตไฟฟ้า และเทคโนโลยีโรงไฟฟ้าพลังงานความร้อนร่วมด้วยเชื้อเพลิงก๊าซธรรมชาติ Transport: เครื่องยนต์สันดาปภายใน ยานยนต์ไฟฟ้า และการปรับเปลี่ยนรูปแบบการเดินทางมาใช้ขนส่งสาธารณะ Manufacturing: แสงสว่าง ทำความเย็น/ปรับอากาศ มอเตอร์ หม้อไอน้ำ เตาเผาอุตสาหกรรม และปั๊มความร้อน Buildings: แสงสว่าง เครื่องปรับอากาศ/เครื่องทำความเย็น เตาไฟฟ้า อุปกรณ์สำนักงาน และเตา LPG Agriculture: รถแทรกเตอร์ ปั๊มน้ำ และอุปกรณ์ทางการเกษตรอื่น ๆ
(2) Renewable Energy	Power & Industries: พลังงานแสงอาทิตย์ พลังงานลม พลังงานชีวมวล และก๊าซชีวภาพ Transport: เชื้อเพลิงชีวภาพ ได้แก่ E10, E20, E85, B10 และ B20 Buildings: เครื่องทำน้ำร้อนพลังงานแสงอาทิตย์ Agriculture: ปั๊มน้ำพลังงานแสงอาทิตย์ และเชื้อเพลิงชีวภาพ (B10 และ B20)
(3) Advanced Electric Devices	Manufacturing industries: แสงสว่าง ระบบทำความเย็น มอเตอร์ และปั๊มความร้อน Buildings: ระบบแสงสว่าง เครื่องปรับอากาศ และเตาไฟฟ้า
(4) Advanced Thermal Devices	Manufacturing Industries: หม้อไอน้ำ และเตาเผาอุตสาหกรรม Buildings: เตา LPG สำหรับประกอบอาหาร
(5) CCUS, Bio & Green Energy	Power: Solar with battery เทคโนโลยี CCS/CCU และเทคโนโลยี BECCS Transport: เชื้อเพลิงชีวภาพ (E100 และ B100) และยานยนต์ไฟฟ้าเซลล์เชื้อเพลิง Manufacturing Industries: Green hydrogen

AIM/Enduse Analyses of JCM in Thailand (2023)



Policy & Measure (PM)	Potential of CO_2 Reduction ($MtCO_2$)					
	Conditional NDC	Proportion of Carbon Credit				
		10%	20%	30%	40%	50%
1. Energy Efficiency	Unconditional NDC					
2. Renewable Energy						
3. Advanced Electric Devices	1.6	2.2	2.3	2.5	3.7	6.2
4. Advanced Thermal Devices	34.7	36.7	41.9	49.8	56.2	67.5
5. CCUS, Bio & Green Energy	13.8	16.8	18.5	19.4	23.7	26.6
TOTAL	50.1	55.7	62.7	71.7	83.6	100

AIM/Enduse Analyses of JCM in Thailand (2023)



THANK YOU

谢谢　ขอบใจ　TERIMA KASIH　どうもありがとう