

Transition to Low Carbon Cities: Lessons Learned and Challenges Being Met for the Case of Thailand

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Abstract

Thailand is facing several sustainability challenges. These include raising the national income, improving livelihood, health, education, and safety; supplying essential infrastructure like power, water, and mobility; and guaranteeing clean air, land, and water. They all compete for scarce financial, human, and intellectual resources, along with a host of others. However, many of these have a direct impact on a city's carbon emissions, and investments in these services may be jeopardized if the causes and consequences of climate change are not addressed. Through lessons learned and obstacles overcome, this article explains Thailand's low-emission development initiatives in order to understand the country's capacity to pursue a low-carbon growth pathway. Governmental systems are becoming more and more integrated with climate change adaptation and mitigation, which is consistent with the growing importance of climate activities on national agendas. In Thailand, interministerial committees have been set up to oversee the development and implementation of climate policies in addition to comprehensive national monitoring, assessment, and reporting mechanisms. Institutional and human capacity limitations persist in all major entities, including those in the public, private, and governmental sectors. Thailand's policy talks have focused mostly on specific concerns like carbon credit trading or afforestation for carbon absorption, with little attention paid to important topics like liberalizing the electric power business and establishing a carbon price. The two possibilities are really a carbon tax system and a cap and trade system, often known as the emission trading system. However, in practice, every technique has advantages and disadvantages.

Keywords: low carbon cities, climate mitigation, climate adaptation, low emission development

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Introduction

All nations are gravely impacted by climate change, which has had an unparalleled global impact. The frequency and intensity of heatwaves have grown, as have heavy precipitation and droughts. Past greenhouse gas (GHG) emissions have also contributed to many other changes in the climate system (Maria et al., 2020). The rate of emissions both now and in the future is anticipated to increase global warming, which will further spur these changes with permanent effects. The Paris Agreement outlines a long-term temperature target and emphasizes the urgency for Parties to achieve a global peak in GHG emissions as soon as possible and then to undertake rapid reductions, on the basis of equity and in the context of sustainable development and poverty eradication, while acknowledging that peaking will take longer for Parties from developing countries (Erickson & Brase, 2019). Many global areas have proposed particular targets for GHG abatement and more stringent environmental laws under this accord (Liobikienė & Butkus, 2017; Sobrinho et al., 2020; Zhou et al., 2021). Nearly 100 nations are discussing achieving net-zero emissions, and more than 30 have made public commitments to do the same, which might serve as an example for other regions looking to more strongly pursue their own climate goals (Wei et al., 2021). Before receiving final Cabinet approval, Thailand's long-term low GHG emission development strategy was created through a collaborative process involving the formation of numerous working groups from all sectors and stakeholders. Thailand's low-emission development strategies (LEDS) outlined specific goals and actions to be taken in order to achieve net zero GHG emissions. Thailand first wants to reach its peak GHG emissions, which will be around 370 MtCO₂eq, in 2030. Second, according to projections, Thailand's net emissions of GHG will be around 200 MtCO₂eq in 2050, which is compatible with the global 2-degree trajectory. Third, post-2050 emissions will be in accordance with the IPCC 2-degree pathways, with Thailand aiming to reach the equilibrium between GHG emissions by sources and removals by sinks as early as practicable within the second half of this century (Minister of Natural Resources and Environment, 2021). The energy and transportation sectors are the primary targets of the GHG mitigation strategies listed in Thailand's LEDS. Energy-related measures include increasing energy efficiency, changing technologies, embracing renewable energy sources, and implementing carbon capture and storage (CCS). Modal shift, increased energy efficiency, and the promotion of new, effective vehicle fleets are a few examples of mitigation strategies used in the transportation sector.

By assessing potential for low carbon development in the country, this article investigates the range of options for urban low emission development (LED) plans in Thailand. The essay is organized as follows. The approach used to analyze energy use and carbon emissions trends, assess the viability of low-carbon investment at the urban scale, and determine possible effects is described in the following section. Then, potential low-carbon investment alternatives are taken into account together with the patterns of current energy use and GHG emissions. By emphasizing the spread of low carbon development potential across sectors, we also emphasize the challenge's cross-sectoral nature. Then, we list some of the obstacles to the widespread use of urban LED. The topic of strategies to enhance cooperation across all levels of governance and to mainstream climate considerations into many policymaking realms is supported by this.

Research Method

The article provides a general summary of Thailand's transition to low-carbon cities, including possibilities and obstacles. Present situations are often evaluated through a realist review, which aims to determine what functions for whom, under what circumstances, and in what ways (Pawson, 2005). To start, it is important to understand how energy is used in Thailand.

These are the basic assumptions regarding how a strategy is supposed to operate and what results are anticipated. Then, as we go on, we search for specific evidence to support, refute, or otherwise alter the current blueprints included in Thailand's LEDS assumptions. The conclusions of the review integrate challenges to the widespread use of urban LED with empirical data with a focus on highlighting the connection between the setting in which the strategy is employed, the mechanisms by which it operates, and the results achieved.

Results and Discussion

Overview of Energy Used in Thailand

Due to Thailand's abundant primary energy resources and high final energy production capability, the energy sector has a huge economic impact on the country. Throughout the nation, there are several energy-producing facilities, particularly for coal, crude oil, and natural gas. These components are required for Thailand's power generation, which serves homes with gas and electricity. The market value of all goods and services, including durable objects (such cars, washing machines, and home computers), purchased by households is known as household final consumption expenditure (formerly known as private consumption). Imputed rent for owner-occupied homes is included while home acquisitions are excluded. It also consists of the sums paid as taxes and license and permission fees to the government. Even though they are recorded separately by the nation, household consumption expenditures in this context include the costs incurred by nonprofit organizations that serve households.

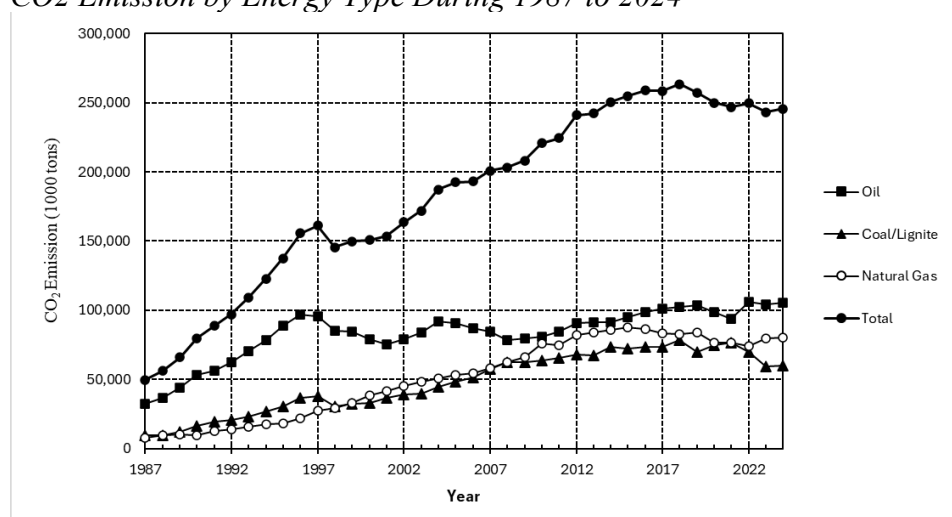
At a projected 129 thousand gigawatt-hours (GWh), natural gas ranked third in Thailand's power generation capacity in 2023, after coal and lignite. During that period, Thailand generated over 223 thousand GWh of power. In Thailand, energy resources are abundant. For example, thirteen natural gas producing facilities are located around the country. However, Thailand has had inconsistent natural gas output; in 2023, 26 billion cubic meters are expected to be produced. Coal and crude oil are important resources for Thailand's energy production in addition to natural gas. Crude oil resources can be found throughout the nation, particularly along the coast and in the north and center. After reaching its high in 2016, Thailand's oil production has been gradually decreasing. The same was true for coal; even with its coal resources, the volume of coal produced has been declining yearly. The Thai government has been pushing for increased production of renewable energy, including solar and hydropower, lately. Energy consumption for enterprises accounted for 81,124 ktoe (+4.00% CAGR) of the energy utilized in 2023, a slide decrease of 3.62% from the previous year (84,178 ktoe in 2022), according to Thailand Energy Industry Report from September, 2024 (Italian Trade Agency, 2024). Among the various energy sources, petroleum products accounted for the largest portion of energy consumption (40,386 ktoe). The amount of electricity consumed that was entirely powered by renewable energy sources like solar, wind, hydro, biomass, biogas, MSW, and geothermal power came in second place with 203,875 GWh as shown in Table 1. In addition to natural gas, coal and crude oil are crucial for Thailand's energy output. Sources of crude oil may be found all throughout the nation, however despite the availability of resources, coal production has been decreasing yearly. Hydropower and solar energy are two examples of renewable energy sources that the Thai government is now encouraging to grow.

Table 1*Thailand Energy Statistic 2023 (Italian Trade Agency, 2024)*

Thailand Energy Statistic 2023	
Final energy consumption	81,124 ktoe (+4.00% CAGR)
Refined oil consumption	40,386 ktoe (+0.63% CAGR)
Electricity consumption	203,875 GWh (+3.38% CAGR)
Petroleum import value per total import	14% (decrease from 15% in 2022)
Energy import value per total import	19% (decrease from 15% in 2022)
Final energy consumption per person	1.2 toe / person
Electricity consumption per person	3,087 kWh / person (+3.45% CAGR)

National GHG Emissions Profile

Thailand has continued to monitor GHG emissions, of which the UNFCCC mandates that the six primary categories (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) be reported. Figure 1 shows global carbon emissions from fossil fuels from 1987 to 2024, Total carbon emissions increased in 1987 to a peak around 2018, before slightly declining till present. Oil emissions have rapid increased until 1997, then stabilizing with modest fluctuations thereafter. Coal/lignite emissions grew steadily from 1987 to peak in the mid-2010s, then declined to about 60,000 units by 2023. Natural gas emissions show the most consistent growth pattern, rising from about 10,000 to approximately 80,000 units over the period. The data illustrates the overall carbon emissions mix has evolved, with natural gas becoming increasingly significant while coal shows a recent decline. Oil has maintained its position as a major contributor throughout the period. As its economy recovered from the Covid-19 pandemic in 2022, Thailand's emissions of carbon dioxide (CO₂) increased slightly from the previous year to about 247.7 million tons (Ministry of Energy, 2024a).

Figure 1*CO₂ Emission by Energy Type During 1987 to 2024*

The earth warms due to GHG trapping heat. Almost all of the rise in GHG in the atmosphere during the past 150 years can be attributed to human activity. Burning fossil fuels for electricity production, transportation, and industry is Thailand's main human activity-related source of GHG emissions. The largest contributor to CO₂ emissions in 2022—87.91 million tons—came from electricity generation, while the transport industry contributed 79.57 million tons, compared to 13.71 million tons from other sectors. Industry released 66.45 million tons of CO₂

in total as shown in Figure 2. The main source of transportation-related GHG emissions is the burning of fossil fuels in automobiles, trucks, ships, trains, and aircraft. Petroleum-based fuels, mostly gasoline and diesel, account for over 94% of the fuel used in transportation and produce direct emissions. When indirect emissions from the final use of electricity are divided among sectors, the transportation industry is the second-largest source of direct GHG emissions. Although it is an end-use sector for energy, the transportation industry now accounts for a small portion of all electricity use. Electricity-related indirect emissions make up less than 1% of total emissions. The main sources of GHG emissions from industry are the combustion of fossil fuels for energy and specific chemical reactions required to turn raw materials into finished items. The third-largest source of direct emissions is industrial emissions. The industrial end-use sector, which includes the powering of industrial buildings and equipment, is responsible for a far bigger portion of Thailand's GHG emissions than is the case when indirect emissions from electricity use are excluded. When indirect emissions from electricity end-use are taken into account, GHG emissions from the commercial, residential, and industrial sectors rise significantly. This is because a comparatively large portion of electricity is used by buildings for plug-load appliances, lighting, HVAC systems, and air conditioning, as well as for industrial machinery (Ministry of Energy, 2024b).

Figure 2

CO₂ Emissions From Several Sectors in 2022

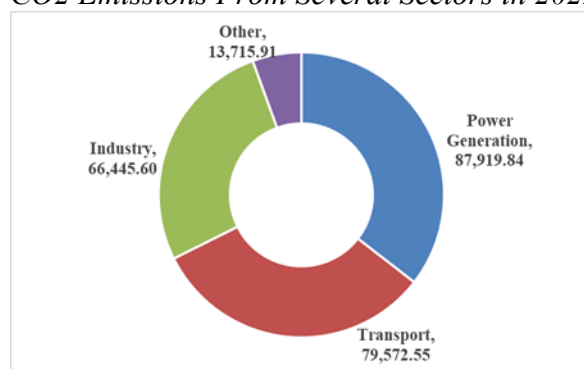
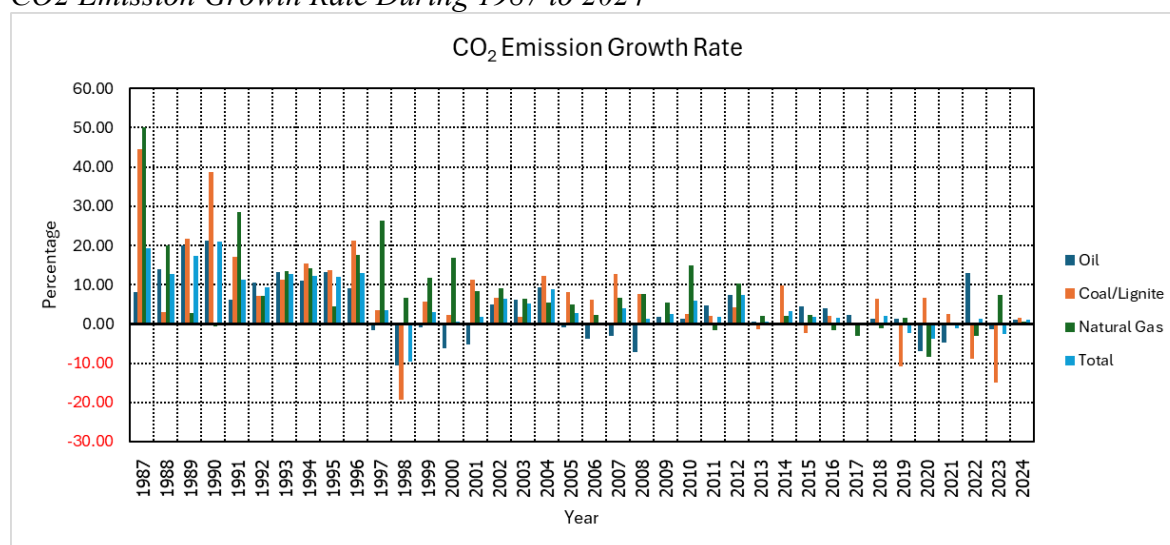


Figure 3 shows the annual percentage growth rate of CO₂ emissions from 1987 to present, broken down by fossil fuel source and total emissions. The highest growth rates occurred in the late 1980s and early 1990s, with some sources showing growth rates of 40-50%. Over time, growth rates have generally decreased, with more modest positive growth in the 2000s and early 2010s, typically below 10%. Recent years (especially after 2015) show a mix of small positive and negative growth rates, indicating periods of both slight increases and decreases in emissions. Coal/lignite emissions show the most volatility, with significant drops in some years. Natural gas generally maintained positive growth rates for longer than other sources, though it shows negative growth in some recent years.

Figure 3
CO₂ Emission Growth Rate During 1987 to 2024



Existing Plans Used in Thailand's LEDS Development

Low-emission development strategies, or LEDS, were initially introduced by the United Nations Framework Convention on Climate Change (UNFCCC) in 2008, and there is ongoing discussion about their potential place in a future climate framework. LEDS are usually used to refer to forward-looking national economic development plans or strategies that encompass low-emission and/or climate-resilient economic growth, even though there isn't a clear definition for the term. While LEDS have several uses, their main goal is to support the advancement of national development and climate change policies in a more planned, cogent, and coordinated way. By offering integrated economic development and climate change planning, an LEDS can add value to the numerous existing strategies and studies connected to development and climate change (Clapp et al., 2010). Thai GHG emissions have been reduced by numerous initiatives, the existing blueprints incorporated into Thailand's LEDS are presented in Table 2.

Table 2
National Development and Climate Change Policies

No	National development and climate change policies	Prepared by	Details
1	National Strategy (2018 – 2037)	The Office of the National Economic and Social Development Board, Prime Minister's Office.	The first national 20-year strategy for Thailand has as its goal the country's transformation into "a developed country with security, prosperity and sustainability in accordance with the sufficiency economy philosophy" and the achievement of happiness and well-being for all Thais by the year 2037.
2	Climate Change Master Plan (2015-2050)	The Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural	By 2050, the master plan wants to steer Thailand toward resilient climate change, low carbon growth, and sustainable development. The following are the four main objectives: (i) enhancing climate

No	National development and climate change policies	Prepared by	Details
		Resources and Environment.	resilience by integrating policies and measures across all sectors; (ii) developing mechanisms to reduce GHG emissions, resulting in sustainable low carbon growth; (iii) enhancing stakeholder capacity and awareness; and (iv) developing a database, knowledge, and technology to support climate change adaptation and mitigation.
3	Thailand's NDC Roadmap (2021-2030)	The Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment.	This roadmap outlines mitigation strategies for the energy, IPPU, and waste sectors. For the energy sector, these strategies include renewable electricity and energy efficiency. For the IPPU sector, these strategies include the replacement of raw materials in cement manufacturing. By 2030, it is anticipated that actions taken under the NDC pathway could cut GHG emissions by 113 MtCO ₂ eq.
4	NDC Action Plan in the energy sector, 2021 – 2030	The Energy Policy and Planning Office, Ministry of Energy.	The Energy Efficiency Plan (EEP2018), the Alternative Energy Development Plan (AEDP2018), and the Power Development Plan (PDP2018) were all integrated into this action plan, which is expected to reduce GHG emissions by 117.66 MtCO ₂ eq by 2030.
5	NDC Action Plan in the transport sector, 2021 – 2030	The Office of Transport and Traffic Policy and Planning, Ministry of Transport.	This plan outlines strategies for efficient, environmentally friendly, and accessible transportation, and it is anticipated to help reduce GHG emissions by 35.42 MtCO ₂ eq in 2030.
6	NDC Action Plan in the industrial processes and product use including industrial wastewater sector, 2021 – 2030	The Department of Industrial Works, Ministry of Industry.	This action plan identifies ways to reduce GHG emissions, such as changing the refrigerant and clinker used in industrial production processes, as well as increasing the production of biogas from industrial wastewater by recycling methane gas. The actions outlined in this action plan are anticipated to reduce GHG emissions by 2.25 MtCO ₂ eq in 2030.
7	NDC Action Plan in municipal waste management sector, 2021 – 2030	The Pollution Control Department, Ministry of Natural Resources and Environment.	This action plan consists of work plans/activities on municipal solid waste management and municipal wastewater management that have the potential to reduce GHG emissions. These measures is expected to contribute to the GHG emission reduction of 2 MtCO ₂ eq in 2030.

No	National development and climate change policies	Prepared by	Details
8	Energy Efficiency Plan 2018 – 2037 (EEP2018)	Department of Alternative Energy Development and Efficiency, Ministry of Energy.	It aims to lower energy intensity by 30% by 2037 compared to 2010 levels. Energy savings targets of 17,682 ktoe, 21,137 ktoe, 6,418 ktoe, 3,300 ktoe, and 527 ktoe by 2037 have been set for the priority sectors of transportation, industry, commercial/government buildings, residences, and agricultural, respectively.
9	Alternative Energy Development Plan 2018 – 2037 (AEDP2018)	The Department of Alternative Energy Development and Efficiency, Ministry of Energy.	It plans to raise the share of renewable energy generation from 17.29% in 2019 to 30% of the total amount of power needed in 2037, or 29,358 MW.
10	Power Development Plan 2018 – 2037 (PDP2018)	The Energy Policy and Planning Office, Ministry of Energy.	It aims to increase energy security and efficiency in Thailand, concentrating on the following aspects: (1) energy security to meet the country's growing electricity demand while taking fuel diversification into account, (2) economy to maintain competitive power prices over the long term, and (3) environment to cut CO ₂ emissions from power generation and emphasize renewable energy sources.
11	Master Plan for Sustainable Transport Development and Climate Change Mitigation and the transport system development	the Office of Transport and Traffic Policy and Planning, Ministry of Transport.	This strategy intends to boost good governance, quality of life, equity, and green growth while also enhancing economic security, competitiveness, and capability. The major topics include (i) integrated transportation systems, (ii) enhanced transportation services, (iii) rules and institutions, (iv) development of human resources, and (v) innovation and technological techniques. Reducing GHG emissions in the transportation industry is predicted to contribute about 36.3% of Thailand's NDC Roadmap in 2030.
12	National Industrial Development Master Plan 2012 – 2031	The Office of Industrial Economics, Ministry of Industry.	By fostering an environmentally responsible approach, this plan highlights global climate change as one of the four fundamental essential elements for national industrial development.
13	Thailand Industrial development strategy 4.0 (2017 – 2036)	The Office of Industrial Economics, Ministry of Industry.	The approach seeks to transform industries into smart ones and lessen industrial waste and carbon emissions.
14	Thailand's Forest Reference Emission Level	the Technical Working Group on	The preparation of this document and its annexes was done in accordance

No	National development and climate change policies	Prepared by	Details
	and Forest Reference Level for REDD+ under the UNFCCC	REDD+ of Thailand, Department of National Parks, Wildlife and Plant Conservation, Ministry of Natural Resources and Environment.	with the procedures and rules outlined in decision 12/CP.17 Section II, the decision's annex, as well as the Intergovernmental Panel on Climate Change's Guidelines for National Greenhouse Gas Inventories. The contribution follows the TACCC ³ guidelines and includes all data and methodologies in a clear, thorough, and precise manner.
15	20-year Forest Strategic Plan (2017-2036)	The Royal Forest Department, Ministry of Natural Resources and Environment.	With the assistance of the local community, this strategic plan seeks to expand forest coverage by up to 40%, particularly in upstream basin and mangrove forests. It would enhance the reduction of GHG from forest-related activities.

Challenges to the Widespread Use of Urban LED

It is obvious that the effort to cut GHG emissions should involve organizations responsible for social and economic development in addition to the environment. The campaign must place equal emphasis on the energy and transportation sectors, particularly with relation to the production of electricity and the burning of fuel in the transportation sector. A significant source of GHG emissions is the use of energy from fuel burning and industrial power use, including at the household level. The foundation for many forms of development, including improving low-carbon manufacturing industries and services, modifying economic structures to be more environmentally friendly, and building sustainable low-carbon cities, among others, is provided by the energy and transportation sectors. To assure low carbon emissions and environmental friendliness in the near future, it is crucial to regulate the structure of the energy and transportation industries. Otherwise, the implementation of the modifications and their long-term effects on the nation's GHG emissions would take a lot of time. The energy and transportation sectors are major sources of emissions because of the methodical reporting and data collection practices. The public should benefit from the long-term plans in reducing GHG emissions by, for instance, fostering stability in the energy sector, enhancing convenience and saving time in travel, and lowering air pollution to promote public health.

It is the duty of the Subcommittee on Climate Change Policy and Planning Integration to make suggestions and recommendations regarding the formulation and integration of climate change policies, strategies, and plans in relation to both mitigation and adaptation; to make recommendations regarding mechanisms and measures, such as statutory provisions and financial safeguards; and to advance a comprehensive system for allocating budgetary resources to address climate change. The working group on national GHG reduction policy and plan integration has integrated pertinent information from the ministerial agencies and academic institutes related to climate change to formulate mid-century low GHG emissions, and this subcommittee considers and offers suggestions on the draft document in the development of Thailand's LEDS.

Opportunities for Transition to Low Carbon Cities and Support Needs

In keeping with the rising prominence of climate activities on national agendas, climate change adaptation and mitigation are becoming increasingly firmly ingrained in governmental systems. Inter-ministerial committees have been established in Thailand to supervise the creation and application of climate policies, as well as extensive national monitoring, evaluation, and reporting systems. All key agencies, including those in the public, commercial, and government sectors, still have deficiencies in their institutional and individual capacities.

To achieve mitigation and adaptation goals and raise ambition, it is crucial to offer assistance and cooperation on climate measures. During the development of the NDC and NAP, a number of difficulties were found, including the unknowns around climate change and its effects. Lack of instruments and methods to enable implementation, lack of data and research on coping mechanisms and vulnerabilities in sectors and the local region, and numerous institutional impediments to cross sectoral and political boundaries. Additionally, the way individuals go about their daily lives is gravely endangered by the global new coronavirus outbreak (COVID-19). Many social and economic activities will change when the so-called “New Normal” follows the epidemic. In order to better restore an ecosystem and economy that supports climate-resilient and sustainable development, particularly through the adoption of NDC, as Thailand plots its recovery from this pandemic, we want to take advantage of this opportunity. The effective and practical implementation of Thailand’s NDC depends heavily on the following assistance, including financial, technological development and transfer, and capacity building.

Energy, IPPU, and Transportation:

- In the short-term period, Thailand urgently needs assistance with the transition to renewable energy sources, with a particular emphasis on advanced energy storage systems (EES) and demand-side management strategies, renewable energy technologies (such as solar and wind), the development of electric vehicles (EV), batteries, and infrastructure, and increased grid modernization, smart energy management, and Independent Power Supply (IPS).
- In a mid-term period, Thailand need assistance to increase the potential usage of carbon capture and storage (CCS), carbon capture, utilization, and storage (CCUS), and bioenergy with CCS (BECCS) technologies.
- In a long-term period, assistance is required for Thailand to develop other technologies (such as green hydrogen or bio-hydrogenated diesel) in order to reduce GHG emissions and attain a net-zero economy.

Agriculture and Waste:

- In the short-term period, funding is required for advancing GHG reduction technologies in the agriculture and waste sectors, such as methane reduction in rice farming, wastewater treatment, and waste-to-energy technology.
- In a mid-term period, Thailand requires assistance in developing technology for managing soil and manure as well as reducing and circulating water use.

Policy Implementation:

- Increasing the capacity of the public and commercial sectors to incorporate climate initiatives into their respective plans or companies.
- Increasing public and relevant stakeholder understanding of climate change, Thailand’s LT-LEDS, and NDCs.

Instruments and Mechanisms:

- Approaches, processes, financial tools, and incentives to encourage the private sector to make the switch to green investments.
- Exchanging information and best practices on legislative frameworks and procedures to aid Thailand's implementation of the LT-LEDS and NDC.

Policy Recommendations

Thailand clearly has to boost its GHG reduction efforts and meet its present national targets. Given the increasing global pressures to tackle climate change is critical. At the same time, Thailand should use this chance to accelerate the creation of a “green economy” as a new economic growth engine. This will also provide well-paying jobs for Thai workers while reducing health impacts, particularly from air pollutants such as PM 2.5, which frequently accompany GHG emissions. As the speech from Dr. Somkiat Tangkitvanich (2023) who is the president of the Thailand Development Research Institute (TDRI) in the topic “Transforming Thailand into a Low-Carbon Economy and Society”, he said the government should examine the following seven policy actions to attain these objectives (Tangkitvanich, 2023):

- 1. Transitioning to the Green Economy:** As its principal policy objective, set the transition aim to a “green economy” capable of creating many high-paying “green jobs” for Thai workers. When countries have the capacity to do so, concentrate on underdeveloped sectors (in terms of technology or policy framework coverage); government agencies should also be responsible for developing transformative policy frameworks for those sectors since they can spur corresponding global climate action.
- 2. Implementing Carbon Tax:** Reduce and gradually remove fossil fuel subsidies over the next five years, and use the funds to establish a Transition and Adaptation Fund. This money will help to cut GHG emissions and adapt to shifting weather patterns. Long term, the country's excise tax should be converted into a carbon tax.
- 3. Creating a Well-Functioning Carbon Credit Market:** Accelerate the creation of a voluntary carbon credit market on both the demand and supply sides. The emphasis should be on lowering verification costs and raising demand for carbon credits in the commercial sector.
- 4. Reforming the Electricity Market:** Restructure the country’s electrical market, which is currently a bottleneck in the country’s transition to a green economy. By liberalizing power generation, enabling third-party access to the grid at a cost-based price, and permitting direct peer-to-peer electricity trading, the new market structure should support the expansion of renewable energy.
- 5. Implementing Complementary Measures:** Promote “green products” with various incentives, such as government procurement regulations. Green product standards should be created, as well as expenditures in critical infrastructure, particularly efficient mass transit systems in big cities.
- 6. Implementing Large-scale Greenhouse Gas Reduction Initiatives:** Implement “sandbox” projects to reduce GHG emissions on a broad scale. For example, the “Saraburi Sandbox” collaborative initiative in Saraburi province involves corporate sectors, the government, academia, and professional groups, with the goal of creating Thailand’s first low-carbon prototype city. The planned “Government Management Modernization Act” should be used to modernize and institutionalize the sandbox effort. The lessons learnt from this sandbox should be applied across the country, and other structural reforms should be implemented.

- 7. Mobilising External Fundings to Speed up the Mitigation Efforts:** Create programs to minimize GHG emissions and raise international funds to help Thailand meet its target sooner.

Conclusions

Thailand also lacks a comprehensive plan for lowering GHG emissions. While there are initiatives to reduce emissions in the energy and transportation sectors, there is no overarching plan for the entire economy. Thailand's policy debates are primarily focused on specific topics such as carbon credit trading or afforestation for carbon absorption, while other key measures such as liberalizing the electric power sector and instituting a “carbon tax” have received little attention. In fact, two alternatives are available: a “carbon tax” system and a “cap and trade” system, often known as the ETS. However, in actuality, each strategy has advantages and disadvantages. Emissions trading schemes provide certainty in carbon emission reduction, making it easier for countries to meet their national emission reduction targets and facilitating cross-border carbon trade. A carbon tax, on the other hand, helps firms make investment decisions since they know exactly how much it costs to emit each ton of carbon based on the tax rate. It also allows governments to readily forecast tax income. In practice, adopting a carbon tax is frequently easier since it may use existing tax collection methods, particularly excise tax collection. Meanwhile, implementing an ETS demands the creation of new infrastructure, such as primary and secondary markets for carbon trading with adequate liquidity, which may be challenging to build in developing countries that are just starting to reduce their carbon emissions.

References

- Clapp, C., Briner, G., & Karousakis, K. (2010). Low-emission development strategies (LEDS): Technical, institutional and policy lessons.
- Erickson, L. E., & Brase, G. (2019). Paris agreement on climate change. In *Reducing Greenhouse Gas Emissions and Improving Air Quality* (pp. 11–22): CRC Press.
- Italian Trade Agency. (2024). Thailand Energy Industry Report.
<https://www.ice.it/en/sites/default/files/inline-files/thailand-energy-industry-2024.pdf>
- Liobikienė, G., & Butkus, M. (2017). The European Union possibilities to achieve targets of Europe 2020 and Paris agreement climate policy. *Renewable Energy*, 106, 298–309.
- Maria, C., Góis, J., & Leitão, A. (2020). Challenges and perspectives of greenhouse gases emissions from municipal solid waste management in Angola. *Energy Reports*, 6, 364–369.
- Minister of Natural Resources and Environment. (2021). *Mid-century, Long-term Low Greenhouse Gas Emission Development Strategy*.
https://unfccc.int/sites/default/files/resource/Thailand_LTS1.pdf
- Ministry of Energy. (2024a). *CO₂ Emission by Energy Type and Sector*.
<https://www.eppo.go.th/index.php/en/en-energystatistics/co2-statistic> (in Thai)
- Ministry of Energy. (2024b). *Energy Statistics*. <https://energy.go.th/en/home> (in Thai)
- Pawson, R., Greenhalgh, T., Harvey, G., & Walshe, K. (2005). Realist review-a new method of systematic review designed for complex policy interventions. *Journal of health services research & policy*, 10(1_suppl), 21–34.
- Sobrinho, V. G., Lagutov, V., & Baran, S. (2020). Green with savvy? Brazil's climate pledge to the Paris Agreement and its transition to the green economy. *Energy and Climate Change*, 1, 100015.
- Tangkitvanich, S. (2023). Transforming Thailand into a Low-Carbon Economy and Society.
<https://tdri.or.th/en/2023/10/transforming-thailand-into-a-low-carbon-economy-and-society/>
- Wei, T., Wu, J., & Chen, S. (2021). Keeping track of greenhouse gas emission reduction progress and targets in 167 cities worldwide. *Frontiers in Sustainable Cities*, 3, 696381.
- Zhou, S., Tong, Q., Pan, X., Cao, M., Wang, H., Gao, J., & Ou, X. (2021). Research on low-carbon energy transformation of China necessary to achieve the Paris agreement goals: A global perspective. *Energy Economics*, 95, 105137.

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