Assessment and Status Report on Just Energy Transition in Thailand

Suchart Klaikaew, Valentin Heimes, Klaus Sauerborn, Katharina Hartmann, Lars Blume

May 2024

Just Energy Transition in Coal Regions

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It aims to particularly amplify the voices of workers and communities dependent on coal showing how knowledge can work in practice. It also turns practice into knowledge by bringing local experience into global conversations and advancing just energy transition expertise.

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Abbreviations and Acronyms

AEDP	Alternative Energy Development Plan
APERC	Asia Pacific Energy Research Centre
ADB	Asian Development Bank
BOI	Board of Investment
BGET	Border Green Energy Team
BAU	Business-as-usual
CSO	Civil Society Organisations
CBO	Community-based Organizations
CSIS	The Centre for Strategic and International Studies
CIF	The Climate Investment Funds
DEDE	Department of Alternative Energy Development and Efficiency
EGAT	Electricity Generating Authority of Thailand
EGCO	Electricity Generating Public Company
EEAP	Energy Efficiency Action Plan
EPPO	Energy Policy and Planning Office
EE	Energy Efficiency
ERC	Energy Regulatory Commission
ESCO	Energy Service Company
FiT	Feed-in Tariff
Ft	Fuel adjustment mechanism
GW	Giga watt
GWh	Giga Watt hours
GDP	Gross Domestic Product
GHG	Green House Gas Emissions
IFCT	Industrial Finance Corporation of Thailand

IPP	Independent Power Producer
IKI JET	Innovation Regions for a Just Energy Transition
IMF	International Monetary Fund
INDC	Intended Nationally Determined Contribution
JET	Just Energy Transition
kW	Kilo watt
kWh	Kilo watt hours
Ktoe	Kilotonnes of oil equivalent
IEA	International Energy Agency
IKI JET	Innovation Regions for a Just Energy Transition
IISD	The International Institute for Sustainable Development.
JET	Just Energy Transition
JET-CR Platform	Just Energy Transition in Coal Regions - Interregional Platform
LNG	Liquefied Natural Gas
MEA	Metropolitan Electricity Authority
NAMA	National Appropriate Mitigation Action
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organisation
NEPC	The National Energy and Policy Council
PV	Photovoltaic
PDP	Power Development Plan
PCC	The South Africa Presidential Climate Commission
PEA	The Provincial Electricity Authority
PPA	Power Purchase Agreement
RE	Renewable Energy
REDP	Renewable Energy Development Plan
PEA	Provincial Electricity Authority
RE	Renewable Energy

SPP	Small Power Producer
SME	Small and Medium Enterprise
SOE	State Owned Enterprise
SDG	Sustainable Development Goal
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VSPP	Very Small Power Producer

1 Introduction

1.1 Aim of the assessment of the starting situation and underlying understanding of Just Energy Transition

Goal of the analysis of the starting situation

The project "Innovation Regions for a Just Energy Transition" (IKI JET) aims at supporting and accelerating just energy transitions (JET) away from coal to renewable energy and other sustainable economic activities in the Global South, contributing to a reduction of greenhouse gas (GHG) emissions. The 'Assessment and Status on Just Energy Transition' is meant to prepare the ground for an adequate understanding of the political, societal and economic structures and developments which are key to a JET process on the level of the individual countries with a focus on a selected coal region. In the case of Thailand, the study of the IKI JET coal region Lampang also serves to identify reoccurring themes as a starting point for the definition of potential deep dive areas (as topics for small scale technical assistance).

Common understanding of Just Energy Transitions

A holistic Just Energy Transition process is combining the following six dimensions in a just and balanced way while having a positive climate impact. Support services for just-transition processes should be long-term and flexible including the following cross-cutting issues: leave no one behind, gender equality and non-discrimination. Furthermore, the challenges and opportunities are addressed through supporting regulation and policy frameworks. A regional transition strategy guides choices and actions in the transition, enabling the various stakeholders and decision-makers to align actions to form a coherent and effective approach. Complex transitions need to be governed using a multi-level and multi-actor approach.

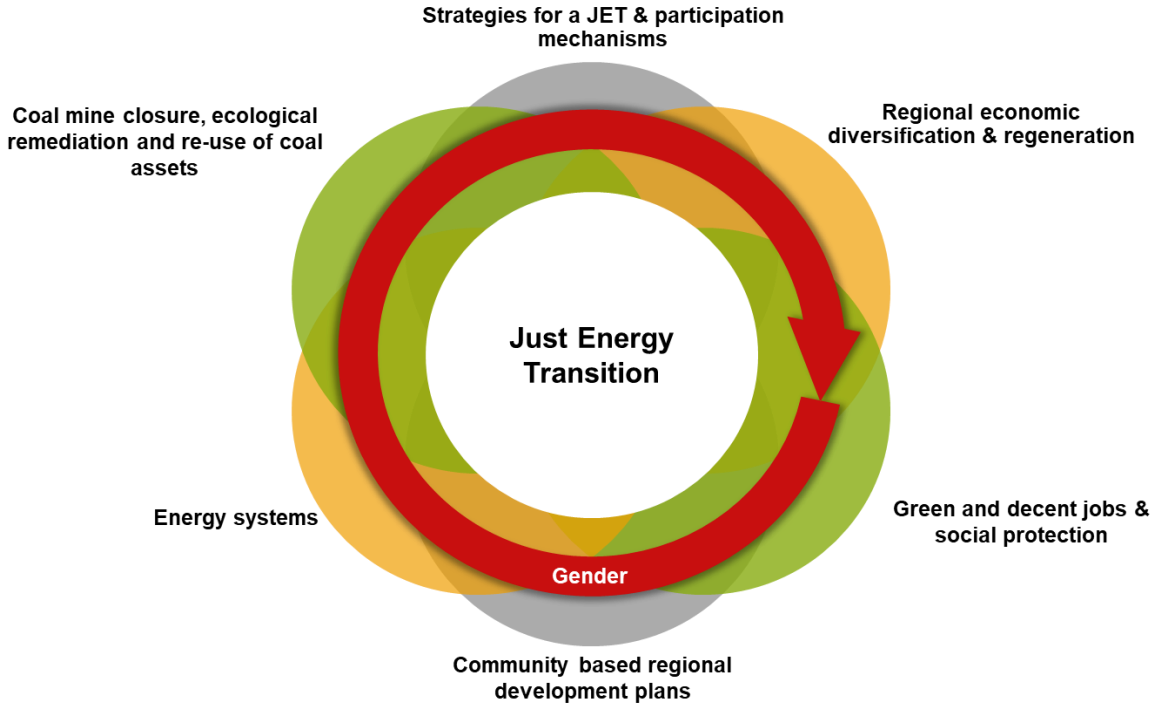

Figure 1. Jet Dimensions
Source: Graphic based on own research

To ensure a just energy transition, exploratory research has been conducted to identify the main areas of operation for the project and support the implementation of IKI JET activities. The project supports the aim of reaching the Paris Agreement of 2015, keeping global warming below 1.5°C. The following list provides an overview of key elements identified:

- Reduce coal related economic activities (mining, energy, chemistry…)
- Foster a sustainable energy mix by supporting all kinds of RE related activities (develop, manufacture, install, run RE facilities)
- Identify all kinds of potentials for developing and fostering green economic diversification, growth and regeneration towards a climate-neutral economy (natural resources such as soil resources, landscapes, woods, other green and blue infrastructures; technological and economic strengths, skilled work-force, cultural assets…) activities
- Focus on coal regions and develop community based regional development plans for a coal phase-out

1.2 Structure and methodology of the assessment framework

Methodology

The assessment and status of the just energy transition in Thailand, with a specific focus on the Lampang district, has been conducted using a mixed-methods approach to collect and analyze the necessary information and data. This approach involved desk research, including the examination of relevant documents and studies, as well as data gathering for statistical indicators. Furthermore, it builds upon the initial findings of the IKI JET mission, which took place in Lampang, Thailand, from June 23rd to June 30th, 2023. The mission aimed to identify key actors and stakeholders, conduct interviews with them, and conduct an on-site visit to the Lampang district with community representatives. In the following chapters, this report will elaborate on these findings and assessments.

- Maps the relevant stakeholders for a JET process at both, national and regional levels (Chapter 2)
- Describes the role of women and marginalized groups in the focus region (Chapter 3)
- Provides description of drivers of climate change, climate impacts and climate relevant policies (Chapter 4)
- Provides a basic description of the societal aspects of the country and the region on which this assessment is focused (Chapter 5)
- Describes the governance and economic context in the country and in the Nalaikh district (Chapters 6 and 7),
- Describes the energy sector both on the national and the regional level (Chapter 8)
- Provides conclusions and recommendations regarding thematic areas of JET (Chapter 9)

1.3 Energy transition and coal region(s) in Thailand

Thailand has set ambitious targets to achieve net-zero carbon emissions between 2065 and 2070. A key element of this commitment is the phase-out of coal in the Lampang region by 2051 (EGAT, 2022). While this represents a significant step towards cleaner energy sources, there is a need for comprehensive strategies to ensure a smooth transition away from coal. The current practices and policies lack adequate consideration for the complexities and challenges associated with such a transition, including the potential impacts on local communities and coal industry workers. In reality, the Ministry of Energy (MOE) in Thailand is pursuing the introduction of four new coal-fired power generators into the energy grid in the Lampang district. The Thai government has

already granted approval for the first two plants, which will each have capacity of 660 megawatts. Construction for these plants is scheduled to begin this year, and they are expected to operate from 2026 to 2050. These plants will be integrated into the existing coal-powered generators at the Mae Moh power plant in Lampang (EGAT, 2023).

In Thailand, coal exploration has a long history, starting with initial activities in the Krabi basin during the 1890s. However, it was not until the establishment of the Electricity Generating Authority Thailand (EGAT) in 1967 that coal production began to increase. According to data from EGAT, as of the end of 2021, Thailand's proven coal reserves totaled to 1,048 Mt. Currently, the Mae Moh coal mine is the sole operational mining facility in Thailand, with an estimated reserve of approximately 198.8 Mt as of the end of 2021. Based on the current and projected mining rate, this reserve could sustain mining activities for the next 25 years.

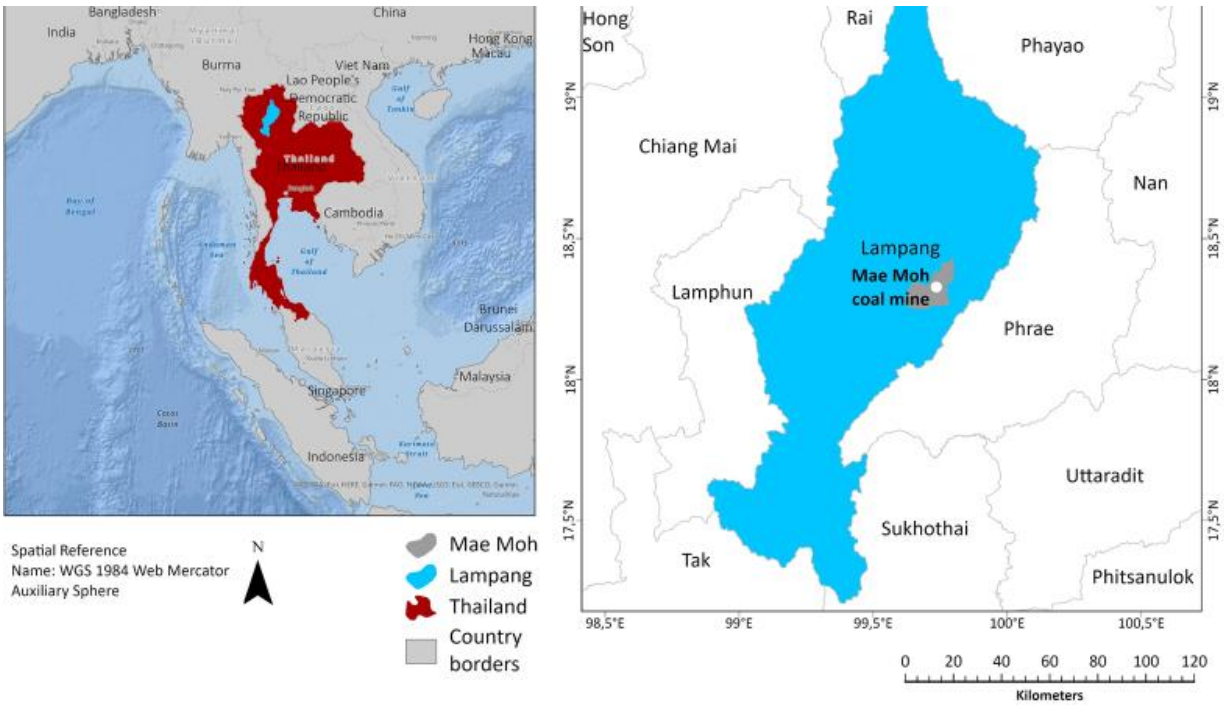

Figure 2. Location of Mae Moh coal mine area, Lampang Province, Thailand
Source: developed by Taurus ECO

Challenges of the Just Energy Transition (JET) in Lampang, Thailand

The Mae Moh mine is the largest source of lignite in Thailand, located in the northern region of the country. In 2000-2010, EGAT's lignite production, which included both the Mae Moh and Krabi mines, averaged around 15.6 Mt and accounted for over 85% of total domestic lignite production. Total coal production in Thailand has steadily declined from 2011 to 2021, with all

14.2 Mt produced in 2021 coming solely from the Mae Moh mine. Mae Moh coal is lignite or brown coal, with the lowest calorific content as compared to other types of coal. By 2030, it is projected to reach around 6.0 Mt aligned with future capacity of Mae Moh Coal power plants (Greenpeace, 2021).

Thailand has had negative experiences from both the Mae Moh lignite mine and coal thermal power plants operation in Lampang. These open-pit lignite mines and thermal power plants have caused direct and indirect adverse environmental impacts, affecting land use, quality of life, forests, wildlife, air quality, and climate. As a result, there has been significant public opposition to coal-fired power plants in Thailand. In Lampang, Thailand, the concept of the Just Energy Transition (JET) is relatively new, resulting in uncertain stakeholder positions primarily due to uncertain national policies and a lack of motivations.

With Thailand committed to phasing out coal, several key actors have emerged as active supporters of the Just Energy Transition (JET). These include EGAT, the Lampang regional government, academic institutions, and civil society, who actively advocate for the transition and align their efforts to support its objectives. However, some national stakeholders such as Energy Policy and Planning Office (EPPO), Energy Regulatory Commission (ERC), and big mining companies have taken opposing positions towards JET. They aim to prolong the operation of existing coal facilities and even propose the addition of four new coal-fired power generators to the grid. Therefore, the complexity of stakeholder perspectives in Thailand emphasizes the challenges in navigating the JET process in Lampang, Thailand. Finding common ground and addressing these divergent viewpoints will be crucial for achieving a successful and sustainable energy transition. In the past 20 years, Thailand has implemented supportive policies and incentives for the adoption of renewable energy (RE), such as feed-in tariffs. The country launched the Renewable Energy Development Plan (REDP) for the period from 2008 to 2022 and has shown interest in decentralized energy systems and community-based projects. Energy storage technologies are being deployed for grid stability. Thailand's favorable environment for transitioning to RE can drive a sustainable and clean energy future for the country.

2 Stakeholder Analysis

This stakeholder analysis reveals a significant divergence of perspectives among stakeholders at both the national and local levels. In Lampang, where the concept of the Just Energy Transition (JET) is relatively new, stakeholder positions remain uncertain primarily due to ambiguous national policies. Despite the goal of phasing out coal, there has been a predominant emphasis on supporting measures without a clear implementation plan, which could potentially hinder the progress of the JET initiative.

At the national level, several challenges contribute to the slow progress. Fragmented authority and capacity limitations, policy uncertainty and discontinuity, lack of coordination between the public and private sectors, and distorted fiscal and regulatory policies hinder the effective implementation of energy conservation measures in Thailand.

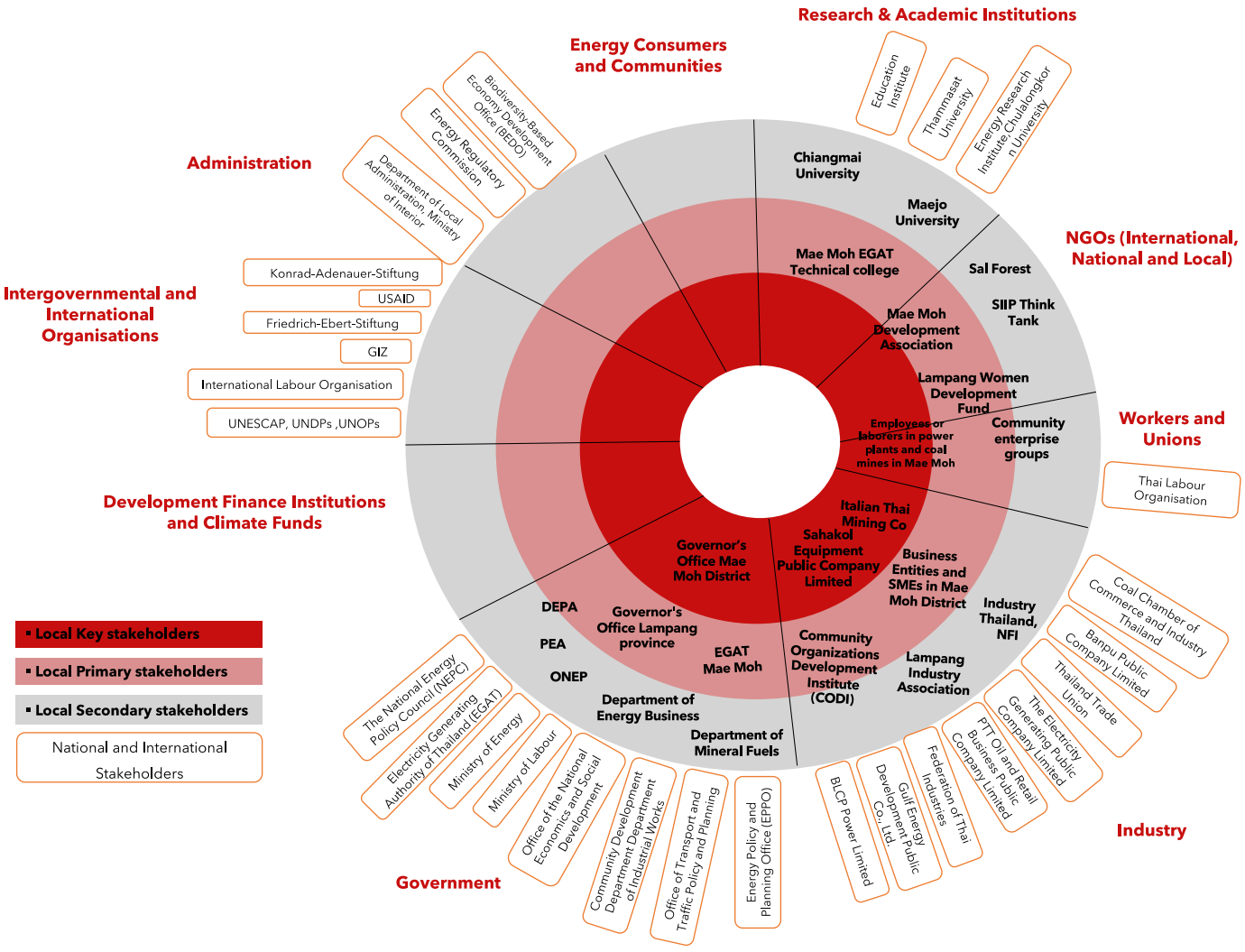

Figure 3. Stakeholder map – National and provincial level

Source: Own research

Within this stakeholder analysis, several key actors have emerged as active proponents of the JET. These include EGAT Mae Moh, academic institutions, and civil society, who are actively advocating for the transition and aligning their efforts to support its objectives. On the other hand, stakeholders such as EPPO, ERC, and mining companies have taken opposing stances towards the JET. These entities seek to extend the retirement time of existing coal facilities and even proposed the addition of four new coal-fired power generators to the grid, of which two power plants have been approved so far. These findings highlight the complex landscape of stakeholder perspectives and underscore the challenges in navigating the JET process in Lampang, Thailand. Addressing these divergent viewpoints and finding common ground will be crucial for achieving a successful and sustainable energy transition.

Further, key highlights from the stakeholder clusters at the national and regional level can be referred to. At the national level, two stakeholder clusters, namely energy consumers and communities, are underrepresented, resulting in a lack of voice from these stakeholders who are directly affected by energy decisions and transitions. The lack of unions' existence in Thailand may contribute to the absence of this group in discussions, not only at the national level but also at the regional level. The absence of unions hampers the representation and advocacy for workers' rights and concerns regarding the energy transition.

To design an effective governance model, it is important to understand the power and influence of certain stakeholders. Figures 4.1 and 4.2 depict the influence-interest position of Lampang stakeholders as seen by GIZ Thailand. The Wuppertal Institute (2022)11 considers three elements as important for an effective governance model : first, the influence that stakeholders have on JET processes, regulations, or overall decisions (x-axis); second, the level of impact that JET would have on stakeholders, and thus on their day to day business models or activities (y-axis), and third, the level of interest that stakeholders have on pushing a JET (red dot size, where smaller dots represent less interest and bigger dots represent higher interest). These three elements are portrayed in Figures 4.1 and 4.2, as perceived by GIZ Thailand.

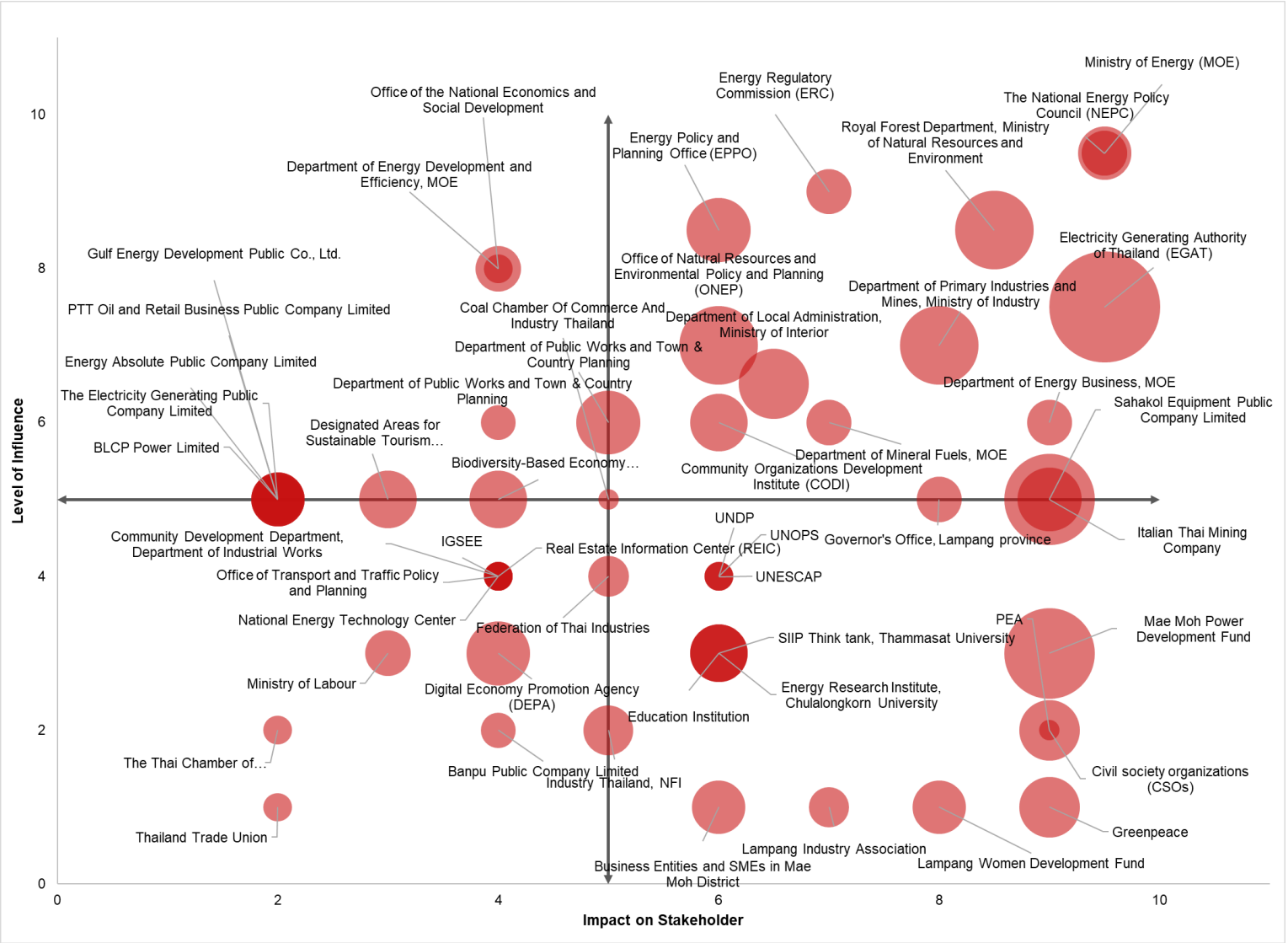

Figure 4.1. Group 1: Influence over Interest stakeholder situation in National Level and Lampang (Top-Down approach)

Source: Own research

Stakeholders with vested interests in decision-making processes can be categorized into two main groups based on their roles and levels of influence.

Figure 4.1 shows group 1 which consists of key stakeholders who hold pivotal positions in policy formulation, thereby adopting a top-down approach. This group includes diverse sub-groups such as 1) National policy-making agencies, 2) National policymakers, 3) Provincial governors and heads of provincial administrative organizations in Lampang, 4) Regional and private sector policy managers in Lampang province, and 5) Local-level administrators and officials. These stakeholders play a critical role in shaping and implementing policies from a top-down perspective.

On the other hand, as figure 4.2 shows, the second group comprises stakeholders who are actively involved in decision-making processes as practitioners and members of the general public, employing a bottom-up approach. This group, consisting of key local stakeholders, is divided into 11 subgroups, including: 1) Community relations groups, volunteer groups, and youth groups, 2) Sub-district managers, 3) Village elders, village heads, and community managers, 4) Community leaders, 5) Youth and young working-age groups, 6) Community enterprise groups, 7) Employees or laborers in power plants and coal mines in Mae Moh, 8) Population who grew up in Mae Moh district, 9) Businesses and entrepreneurs in Mae Moh district, 10) Non-profit organizations in the Mae Moh area, and 11) Ethnic groups in Mae Moh district. These stakeholders represent a diverse range of interests and perspectives at the grassroots level, contributing to decision-making processes from the bottom-up.

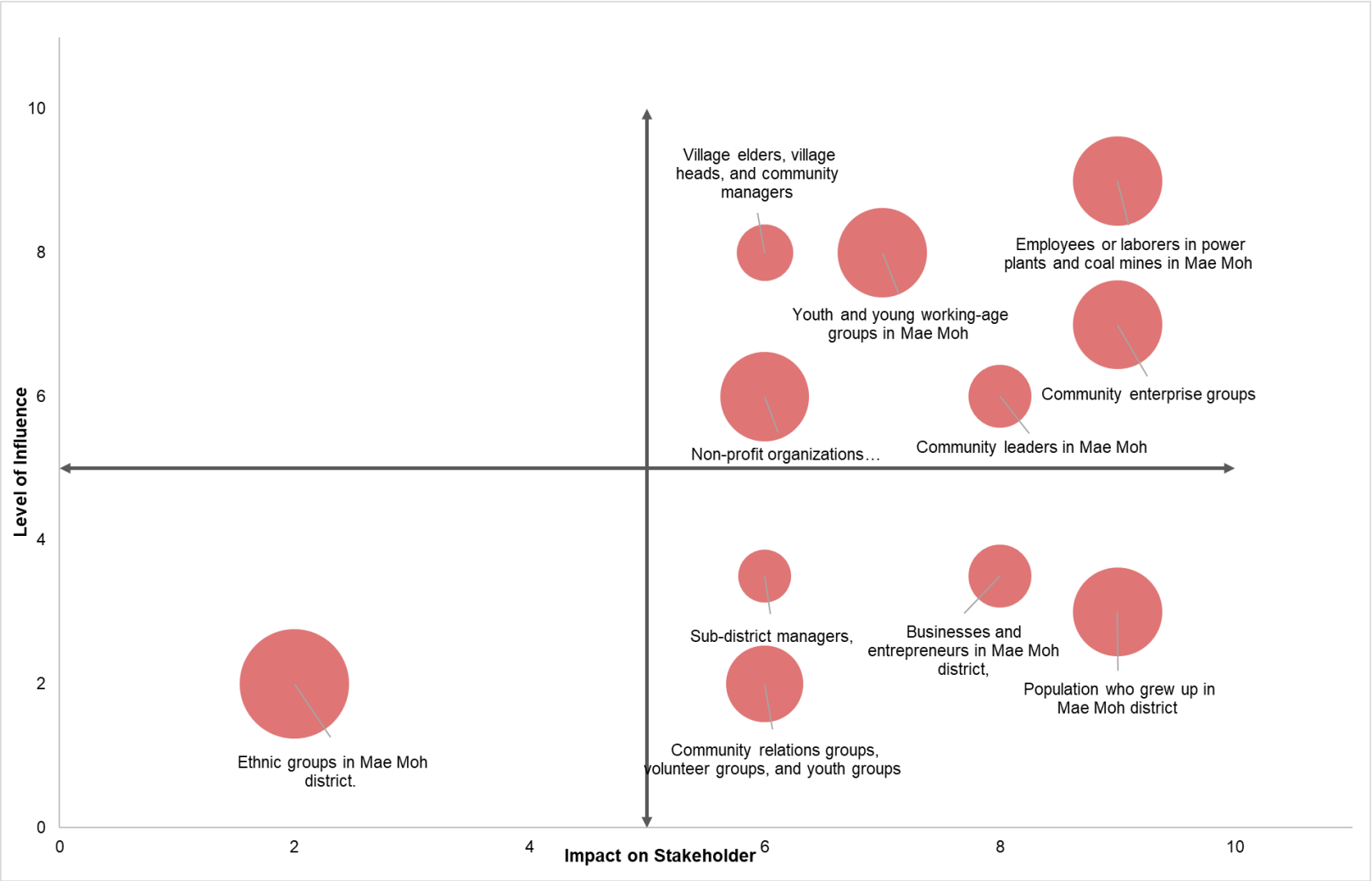

Figure 4.2. Group 2: Influence over Interest stakeholder situation in Mae Moh District, Lampang Province (Bottom-up approach)

Source: Own research

The results of this influence-impact-interest analysis reveal that there is a list of stakeholders who would be affected by the Just Energy Transition (JET), including coal mining companies, local communities, business entities, and SMEs in the Mae Moh district. However, these stakeholders do not have influence over JET-related decisions. Figures 4.1 and 4.2 also illustrate how the EGAT Mae Moh coal mine in Lampang, which would experience the highest impact from JET, has also little interest in pushing the JET while it's influence on decisions is limited.

Considering the stakeholder map that provided an overview of the national and local (Lam-pang) context (Figure 3) and as well as Figure 4.1 and 4.2 (above) on the influence, impact, and interest considerations for stakeholders in Lampang, some positive and negative impacts of JET on different stakeholders should be acknowledged. These enable to anticipate the stance that actors could take once JET processes are in place due to the different impacts that key stakeholders in Lampang can experience amid a JET process. This information is crucial for an efficient JET planning process so that risks and opportunities can be identified in a timely manner and be addressed accordingly.

Furthermore, civil society may lack an adequate format or platform to effectively participate in discussions. At the local level, the identified stakeholders include government authorities, administrative bodies, power utilities, corporations within the coal industry, and NGOs serving as intermediaries for civil society engagement. However, it is important to acknowledge that certain representation gaps exist. In particular, economic actors (e.g., development finance institutions), communities/consumers, local knowledge actors (e.g., research institutions) and workers have not received adequate representation in the stakeholder landscape. This gap primarily stems from a close-knit connection at the local level, resulting in their perspectives being overlooked or marginalized.

Recognizing and addressing the representation gaps identified in this stakeholder analysis is crucial for promoting a more inclusive and effective stakeholder engagement process. Ensuring the meaningful participation of all relevant stakeholders, including those currently underrepresented, will lead to a more comprehensive understanding of the challenges and opportunities associated with the energy transition in Lampang, Thailand. It is evident that Thailand is actively phasing out coal, albeit at a slower pace in Lampang compared to the national level.

Summary

This stakeholder analysis reveals significant divergence of perspectives among stakeholders at the national and local levels in Lampang, Thailand. The concept of the Just Energy Transition (JET) is relatively new in Lampang, and stakeholder positions remain uncertain due to ambiguous national policies.

Challenges at the national level, including fragmented authority, policy uncertainty, and weak governance, hinder the effective implementation of energy conservation measures. Additionally, weak governance in the energy sector, characterized by a lack of independence, transparency, public participation, and accountability, further exacerbates the situation. The absence of transparency and accountability in power planning and development processes has led to public skepticism and mistrust in government decisions, resulting in protests and opposition from civil society organizations (CSOs) against various energy-related issues.

Key actors supporting the JET include EGAT Mae Moh, academic institutions, and civil society, while entities like EPPO, ERC, and mining companies oppose the JET. There are representation gaps at both the national and local levels, particularly for energy consumers, communities, and trade unions. Addressing these gaps and finding common ground is crucial for a successful and sustainable energy transition in Lampang.

3 Role of women and marginalized groups

The role of women and marginalized groups in governance processes has undergone changes throughout Thailand's history. In the past, women of higher economic status could amass wealth and economic power through informal gold and land trading businesses, particularly after the Bowring Treaty during the reign of King Rama IV. The implementation of the first National Economic Development Plan in 1961 fostered economic growth and created opportunities for women to join the labor market, leading to an increased role for women in the economy (Sirasoontorn, 2017). In rural areas, both women and men held vital roles as providers for their families, and the division of labor and power dynamics between genders were flexible. However, with the rise of industrial capitalism and urbanization, power imbalances escalated, and rural women faced worsening conditions due to labor migration away from the agricultural sector. As production shifted from household-based to market-based, women's ability to negotiate and contribute as equal providers diminished, and they became confined to supplementary roles in the production sector.

Only in 1997, with the eighth National Economic and Social Development Plan, were women's rights widely recognized as human rights (Sirasoontorn, 2017). Despite increased inclusion of women in the public sphere, power dynamics continued to prioritize men's economic leadership in areas such as production and income generation. These shifts in gender practices were influenced by global and domestic political trends, with the state playing a significant role in formalizing gender roles and relationships.

The role of women and marginalized groups in governance

At the national level, women's voices and perspectives are being marginalized in decision-making processes regarding coal mining, limiting their participation and representation in governance and policy discussions. Nationally, EGAT and the Ministry of Energy data show that women hold less than 5% of decision-making positions. However, women have a higher level of participation in decision-making at the regional level, primarily through their involvement as community leaders, participation in the Mae Moh smart city project, and membership in the Mae Moh Development Association. Despite this, their influence in high-level decision-making remains limited due to top-down policy implementation. Women's vulnerability to the adverse impacts of coal mining is further exacerbated by their roles as primary caregivers, limited resource access, and marginalization in decision-making processes (EGAT, 2022).

The role of women and marginalized groups in the energy sector, economy and employment of the coal sector

To understand the situation of women in economy and employment in the coal sector, it's crucial to explore how they and marginalized groups contribute significantly to a fair energy transition,

especially in locations like the Mae Moh coal mine in Lampang, Thailand, where the phase-out profoundly affects the community.

In Mae Moh district, women and marginalized groups face significant challenges and inequalities related to the coal sector. Women are underrepresented in the workforce, with less than 20% of mining job opportunities being available to them, while men dominate the industry (EGAT, 2022). This gender disparity not only limits women's access to employment but also perpetuates societal gender inequalities. If coal was to be phased out, women and marginalized groups would be heavily affected, as they often hold low-skilled positions in the coal sector and risk losing their livelihoods. Moreover, women play vital roles in supporting coal mining businesses and the families associated with them, engaging in wholesale and retail sectors and owning small shops and restaurants. It would be crucial to conduct a Social Impact Assessment (SIA) to better understand the specific challenges and impacts faced by women and marginalized groups during the development of a just transition plan. By promoting equal opportunities and addressing gender disparities, the sector can create a more inclusive and equitable environment. Exploring the changing role of men through the Just Energy Transition (JET) process is also necessary to understand how gender dynamics and power relationships may evolve within the energy sector. Additionally, examining informal working arrangements and the forced dependency of women on their husbands, who work directly for EGAT, is necessary as these factors contribute to the overall marginalization of women in coal mining areas. Thailand has formulated a comprehensive plan to phase out the Mae Moh coal mine by 2051, outlining a strategic approach to gradually cease coal mining operations and transition towards sustainable and renewable energy sources. However, the impacts of this phase-out plan on women and marginalized groups, particularly those residing in nearby communities, will vary.

Moreover, pollution from coal mining disproportionately affects women in Lampang, who, as primary caregivers with limited resources, are more vulnerable to its detrimental impacts, particularly on the health of their families. Consequently, they may encounter restricted economic opportunities and face difficulties in accessing essential services like healthcare and education. This constrained access to resources can further worsen the negative impacts of coal mining on their well-being and socio-economic conditions (Buranajaroenkij, 2016).

The coal phase-out plan may cause economic and social hardships for marginalized communities, including indigenous peoples and rural communities dependent on the coal mine. These communities, comprising over 800 families (Greenpeace, 2021), have established traditional land rights and cultural ties to the mining areas. Their involvement in mining activities varies from direct employment to informal work and support services for EGAT. However, it is essential to consider the potential impacts on their rights, well-being, and cultural heritage. Engaging them in decision-making, respecting their rights, and addressing their specific needs are crucial. Similarly, recognizing the differential impacts on women and marginalized groups and developing

strategies that address their concerns and provide alternative livelihood opportunities are key considerations for the plan.

4 Climate Change

4.1 Climate policies / Strategies / NDCs

Due to a combination of political, geographic, and social factors, Thailand is vulnerable to the impacts of climate change, ranking 62nd out of 181 countries in the 2020 ND-GAIN Index ranks 9th in the "extreme risk" category for future climate impacts. Recognizing the significance of this issue, Thailand has actively participated in international efforts to mitigate climate change and address its consequences. In 2016, the nation ratified the Paris Climate Agreement, followed by the release of its third National Communication to the UNFCCC in 2018 and the adoption of its Updated Nationally Determined Contributions (NDC) in 2020.

In November 2022, Thailand submitted its second updated NDCs, which includes several key highlights. One notable change is the increased greenhouse gas (GHG) reduction target, which now stands at 30% by 2030 compared to the business-as-usual scenario. This represents an increase from the previous target of 20%. Additionally, the conditional target has been raised from 25% to 40% reduction with international support, including technology transfers, international cooperation, and financing facilities.

Thailand reaffirms its commitment to achieving carbon neutrality by 2050 and net-zero GHG emissions by 2065. The adaptation components of the NDC remain consistent with the first updated version, focusing on areas such as agriculture, health, human settlements and security, natural resources, tourism, and water. It is important to note that in comparison to the first NDC, Thailand's mitigation targets have been significantly strengthened. However, further efforts are necessary within the energy sector to meet climate targets. Key GHG mitigation measures identified by the government include increasing the proportion of renewable electricity generation, enhancing energy efficiency across all sectors, and adopting emerging technologies like energy storage, hydrogen, and carbon capture, utilization, and storage (CCUS) to further reduce emissions. Thailand aims to boost the adoption of renewable energy and enhance energy production efficiency in the energy sector. However, there is no explicit national commitment to fully phase out coal in the energy production. Nevertheless, EGAT has expressed its intention to phase out coal by 2051 and has decided against constructing new coal power plants beyond 2026.

The preparation of the updated NDC took into account the crucial connection between climate action and national development priorities, including social and economic development and poverty eradication. Integrating the NDC into various national plans and strategies is seen as vital for a successful implementation and contribution (UNFCCC, 2022). Thailand's NDC was developed through stakeholder consultations involving an inter-ministerial working group and steering committee, which included representatives from sectoral agencies, academia, and the private sector. The formulation of the NDC was guided by several plans and policies, such as the National Economic and Social Development Plan, National Energy Plan Framework, Climate

Change Master Plan, Power Development Plan, Smart Grid Development Master Plan, Energy Efficiency Plan, Alternative Energy Development Plan, Sustainable Transport System and Climate Change Mitigation Plan, and Waste Management Roadmap.

Table 1. Overview of NDC mitigation targets 2016 to 2020 (WWF, 2021)

Target	NDC 2016	NDC 2020	Analysis by WWF
Strengthened An economy-wide absolute 2030 target mitigation targets	Thailand intends to reduce its greenhouse gas emissions by 20% from the projected business-as-usual (BAU) level by 2030. The level of contribution could increase up to 25%, if the country receives international support.	Thailand intends to reduce its greenhouse gas emissions by 20% from the projected business-as-usual (BAU) level by 2030. The level of contribution could increase up to 25%, subject to adequate and enhanced access to technology development and transfer, financial resources and capacity building support.	Thailand does not present strengthened mitigation targets. Both NDC present exactly the same reduction emission targets, which could expand from 20% to 25%, if the country receives international support.
An economy-wide absolute 2030 target	Although the NDC refers to an economy-wide 2030 target, it mentions that the inclusion of land use, land-use change and forestry will be decided later.	Economy-wide target (excluding LULUCF) to reduce greenhouse gas emissions by 20% from the projected business-as-usual (BAU) level by 2030.	Both NDC presents the same economy-wide absolute 2030 target.
A 2021-2030 carbon budget aligned to 1.5°C	Not mentioned	Not mentioned.	Not mentioned.
NDC targets aligned to a 2050 or earlier Net-Zero Long-term Strategy	The NDC mentions that Thailand formulated the National Strategic Plan on Climate Change, covering the 2008- 2012 period; and the Climate Change Master Plan, covering the 2015-2050 period, providing a continuous framework for measures and actions in the long-term.	The NDC mentions Thailand is formulating its Long-Term Low Greenhouse Gas Emission Development Strategy (LTLEDS), which will guide the country towards a climate resilient and low greenhouse gas emission development and serve as a basis for enhancing its subsequent NDCs.	The updated NDC mentions that the Long-Term Low Green House Gas Emission Development Strategy (LT-LEDS) is under development. No details on timeline and content are provided.

These plans outline strategies and actions to promote sustainable energy, improve energy efficiency, develop alternative energy sources, manage waste, and mitigate climate change impacts across various sectors. The following are some notable highlights from Thailand's plans:

The Climate Change Master Plan (2015–2050)

Thailand has actively participated in global climate change initiatives, such as the UNFCCC and the Kyoto Protocol. The Climate Change Master Plan (2015-2050) builds on previous strategic plans and provides a comprehensive framework to address climate change at a national level (UNFCCC, 2022). The key purposes of the Master Plan are to promote low carbon growth, establish effective policy mechanisms, guide action plans, and allocate budgets for concrete climate change resolutions. The Master Plan's goals are divided into short-term, medium-term, and long-term phases, with specific targets set for each phase. The short-term goals focus on immediate implementation and capacity building, while the medium-term goals require additional time for implementation and reflect the outcomes of ongoing actions. The long-term goals involve continuous monitoring and actions to be taken over the long term, with the ultimate target year being 2050.

Vision 2050

The vision for 2050 is for Thailand to be resilient to climate change impacts and achieve sustainable low carbon growth. The plan includes developing knowledge and technology for low carbon development, enhancing resilience through integrated approaches, reducing greenhouse gas emissions, and increasing awareness and capacity for implementing climate change policies (UNFCCC, 2022).

A notable gap in Thailand's updated Nationally Determined Contribution (NDC) is the lack of focus on Just Energy Transition processes. This omission hinders the consideration of social equity, job creation, and inclusive development in the transition to a low-carbon economy. By addressing this gap, Thailand can ensure that its climate actions not only mitigate emissions but also promote a fair and equitable transition for all stakeholders involved.

4.2 Causes

National Level

To comprehensively understand the factors influencing climate change, it is crucial to analyze the contributions of all sectors in the economy to greenhouse gas (GHG) emissions. The figure presented below illustrates the Basic Climate Indicators in Thailand, providing valuable insights into the country's emissions profile and key drivers of climate change.

Table 2. Basic climate indicators (World Bank, 2023)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CO2 emissions total (million tonnes)	238.9	256.3	264.7	261.4	268.9	267.9	267.1	264.5	274.4	265.4
CO2 emissions (metric tons per capita)	3.48	3.71	3.80	3.74	3.82	3.79	3.77	3.72	3.85	3.71
CO2 emissions from power generation using coal (million tonnes) (EPPO, 2024)	32.92	36.49	37.86	39.77	36.10	38.53	36.66	36.78	34.96	35.44
GHG emissions total as CO2-equivalents (million tonnes) (Macrotrends, 2024)	361.3	383.6	394.3	389	393.4	406.6	414.7	418.5	432.2	433.8

Table 2 summarizes key climate indicators for the period 2011 to 2020. It provides data on total CO2 emissions in million tonnes, ranging from 238.9 million tonnes in 2011 to 265.4 million tonnes in 2020, which is a slight increase of emissions during the last decade. The CO2 emission per capita have also only risen slightly. Additionally, it presents CO2 emissions from the energy sector from power generation using coal, measured in million tonnes, showing no significant change from 32.92 million tonnes in 2011 to 35.44 million tonnes in 2020.

Looking at greenhouse gas emissions as CO2 equivalents, we see a steady increase from 361.3 Mt in 2011 to 433.8 Mt in 2020, with an average annual growth rate of 2.3%. The energy sector alone represents over two-thirds of total greenhouse gas emissions, with its share rising in recent years.

Notably, Figure 5 considers all GHGs converted into CO2 equivalents. In 2021, the electricity and heat sector emerged as the highest emitting sector, responsible for 102 million tons of CO2

equivalents. The energy sector, as a whole, continues to be the primary source of Thailand's greenhouse gas emissions, with fuel combustion, particularly in grid-connected electricity and heat production, being the leading contributor.

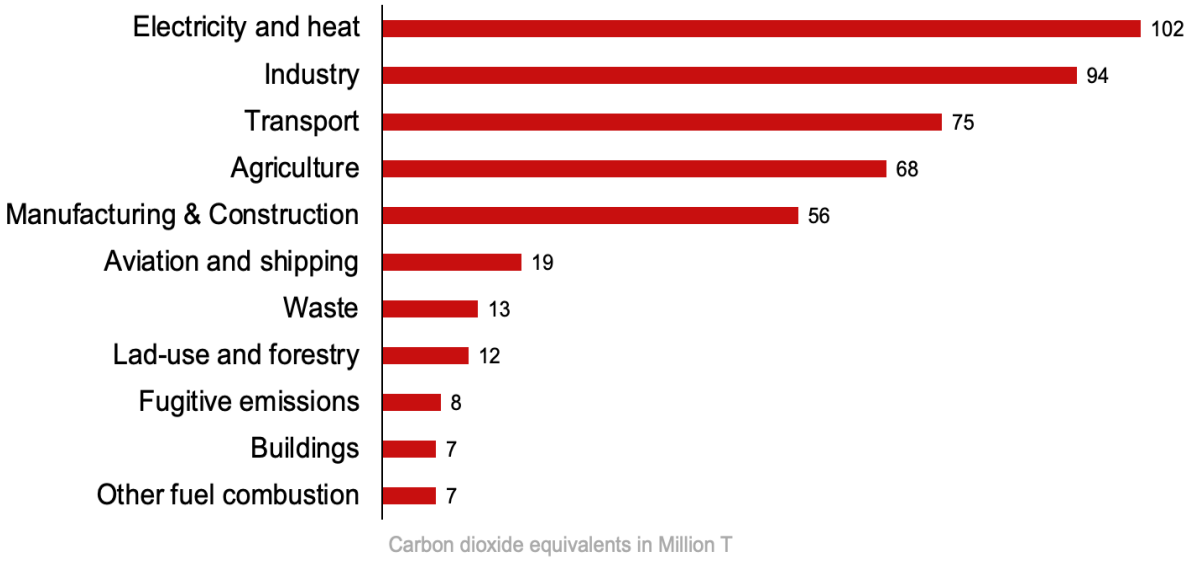

Figure 5. Greenhouse gas emissions by sector in Thailand in 2021

Source: Climate Watch, 2023 – with major processing by Our World in Data.

Industry, transport agriculture as well as manufacturing and construction also play significant roles in GHG emissions. If we were to look only at pure CO_2 emissions, the electricity and heat sector is still by far the sector with the most emissions, followed by the transportation sector. Efforts to reduce emissions in these sectors are crucial for Thailand's overall climate change mitigation strategies and its commitment to international climate agreements.

In Figure 6, the data on CO2 emissions by fuel or industry in Thailand from 1950 to 2021 reveals that oil has consistently been the largest contributor to emissions, peaking at around 121 million tons in 2019. Coal emissions have also increased over the years, reaching 66,8 million tons in 2021, due to more imported coal being consumed by private coal power plants and industries, particularly the cement industry.

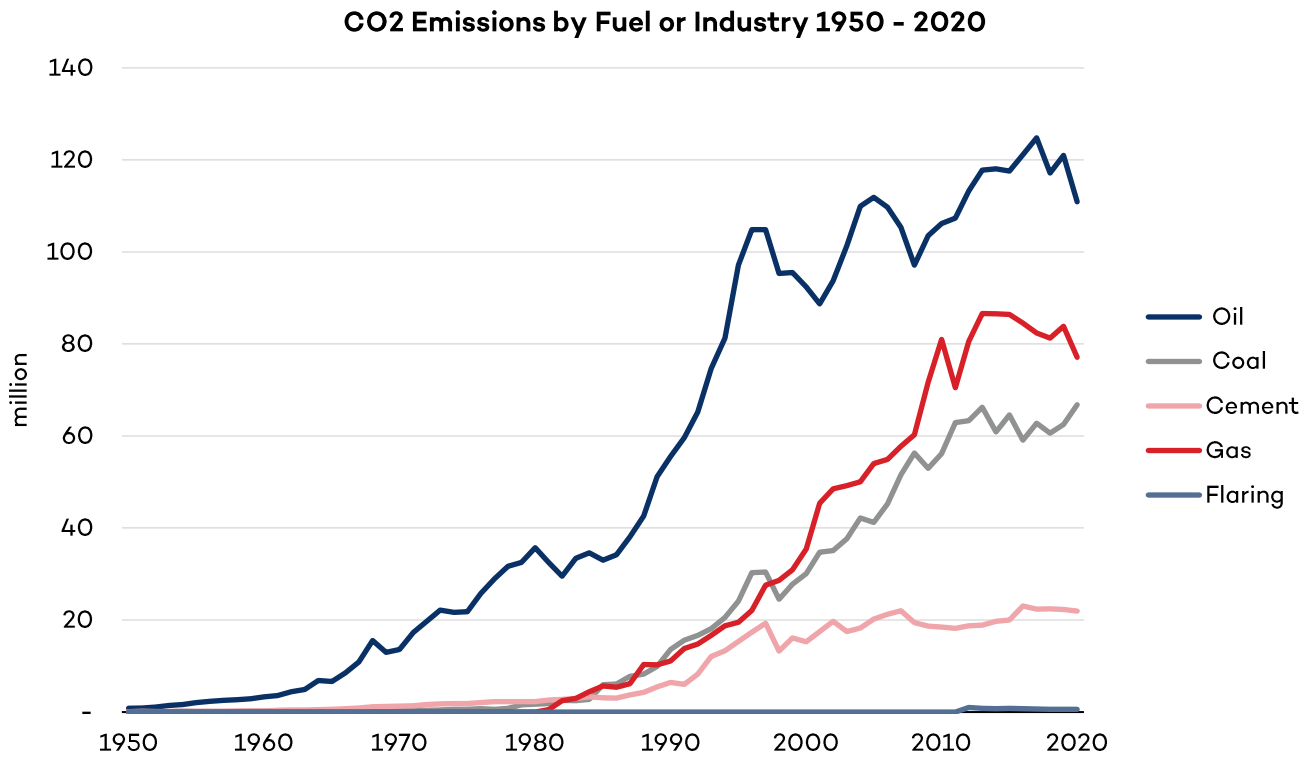

Figure 6. CO2 emissions by fuel or Industry in Thailand from 1950 to 2020

Source: Global Carbon Budget, 2023 – with major processing by Our World in Data.

Cement-related emissions have slowly grown, while gas emissions have also significantly increased since 1980. Flaring emissions have remained negligible. This data underscores the need for transitioning to cleaner energy sources and reducing reliance on oil and coal to mitigate climate change in Thailand.

There is a pressing need to prioritize the enhancement of energy efficiency in response to the evolving economic landscape. Economic growth has been linked to a rise in energy consumption, leading to increased CO2 emissions, despite advancements in energy efficiency. Recent trends further emphasize this problem showing a surge in CO2 emissions. This is evident from the data depicted in the accompanying figure 7, emphasizing the importance of redirecting efforts towards achieving a more sustainable and environmentally friendly approach to economic development.

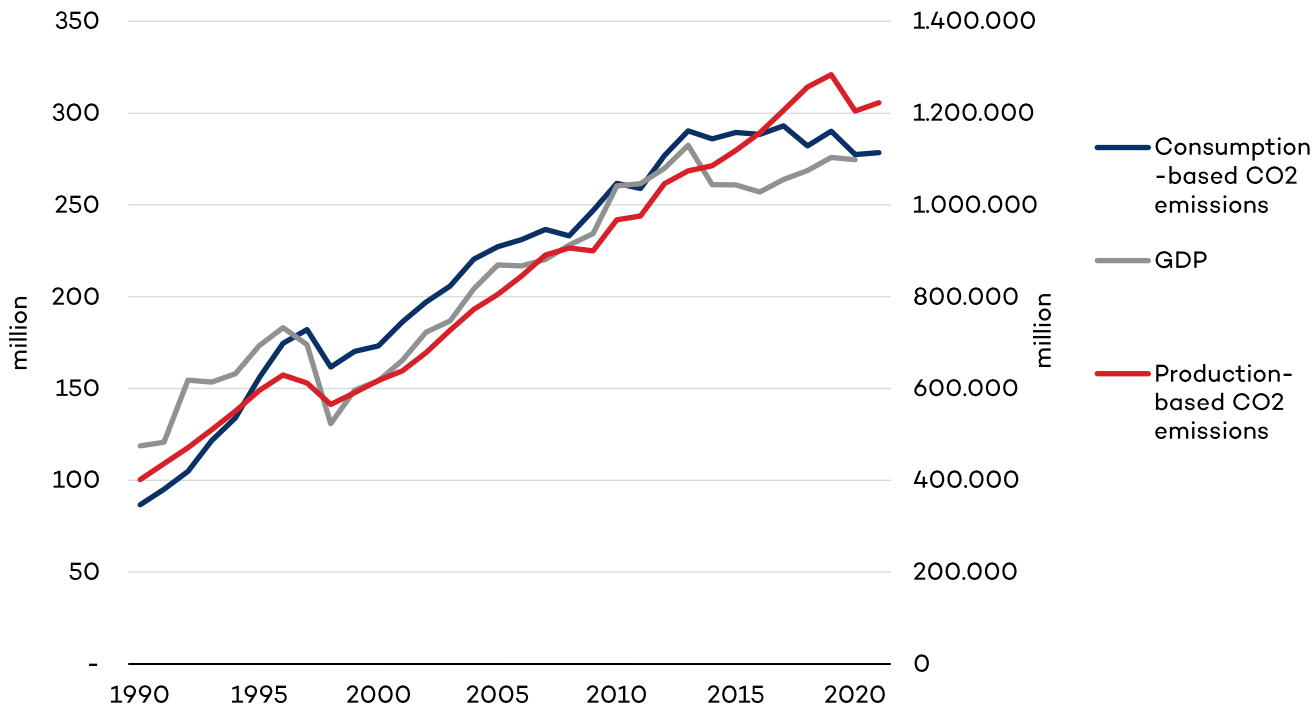

Figure 7. Change in CO2 emissions and GDP in Thailand

Source: World Bank, 2023 – with minor processing by Our World in Data.

Regional Level

The Mae Moh District in Lampang Province, northern Thailand, is home to a prominent coal-fired power plant and the largest lignite coal mine in Southeast Asia (EGAT, 2020). Unfortunately, these facilities significantly contribute to atmospheric pollution by releasing pollutants like SO2, CO, and NO2, leading to public health concerns (Asian Development Bank, 2002). The combustion of lignite coal emits harmful substances into the air, affecting over 30,000 local residents in the past, causing respiratory illnesses, displacement, and crop damage. Efforts have been made to mitigate these impacts, including the installation of pollution control devices such as flue gas desulfurization and ionizing wet scrubbers, resulting in a substantial decrease in atmospheric SO2 levels (Sangram et al., 2016).

The Mae Moh District experiences two distinct monsoon seasons: the southwest monsoon brings hot and wet weather between March and September, while the northeast monsoon brings cooler and drier conditions from October to February. During the dry season, high atmospheric pressure in the area leads to the rapid accumulation of SO2 concentrations, causing severe immediate health effects among the local population. The Pollution Control Department monitors the air quality in the region through the Air Quality Index (AQI), which typically ranges between 10 and 20 in Mae Moh. Although levels of pollutants like SO2, NOX, CO, and O3 are relatively low, there remains concern regarding the concentrations of PM2.5 and PM10, highlighting the need for

continued attention to address air quality issues effectively. Therefore, the region faces two key contributors to climate issues: EGAT as a major source of emissions due to burning of coal and biomass burning, primarily for agricultural purposes, as another significant source of emissions.

4.2 Impacts and risks

Thailand, as a developing nation, is highly susceptible to the adverse effects of climate change and ranks 9th in the “extreme risk” category for future climate impacts over the next three decades. Thailand’s energy sector remains the primary source, accounting for 69.06% of total emissions in 2019, as stated in the country’s 4th National Communication.

At the national level, Thailand experiences significant direct climate impacts and indirect effects on society, the economy, and the energy sector. Based on data from the World Bank’s Climate Knowledge Portal, several key findings highlight the consequences of climate change in Thailand. Rising temperatures have led to increased heatwaves and heat stress, particularly in urban areas, posing detrimental effects on human health, agricultural productivity, and energy consumption. The frequency and severity of drought events have also intensified due to climate change, impacting agriculture, water resources, and hydropower generation, resulting in water scarcity, crop failure, and economic losses.

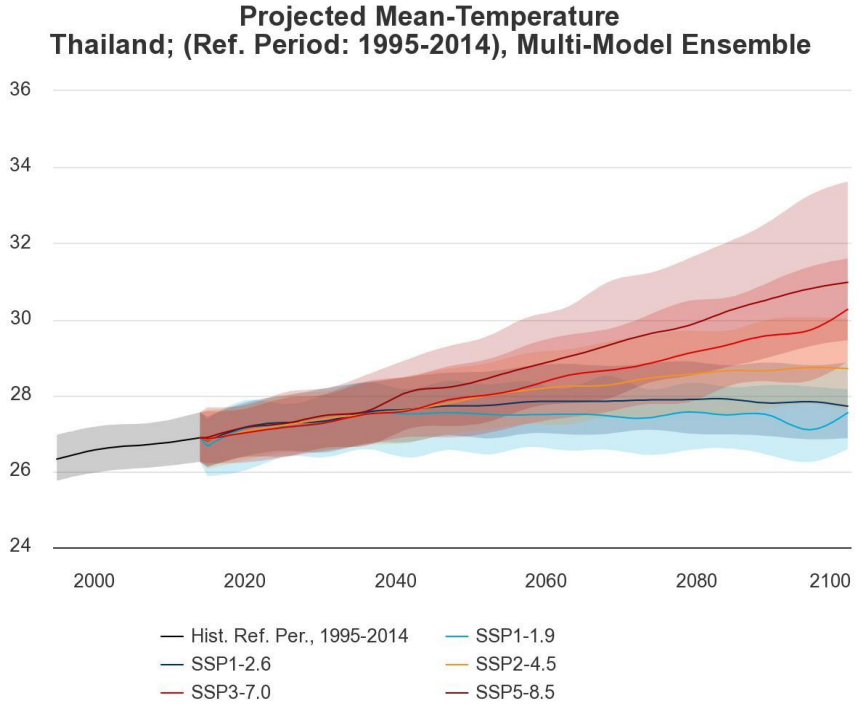

Figure 8. Projected Mean-Temperature Thailand

Source: Climate Change Knowledge Portal, 2024.

According to the data from the World Bank's Climate Knowledge Portal, mean temperature projections for Thailand indicate an upward trend from the year 2000 to 2100. The projections suggest that temperatures will continue to rise throughout the century, posing significant challenges for the country. This warming trend has implications for various sectors, including agriculture, human health, and energy consumption and will make extreme weather events more likely. It underscores the critical need for Thailand to implement effective climate mitigation and adaptation strategies to address the adverse impacts of rising temperatures and ensure a sustainable and resilient future.

Regional Level

At the reginal level, climate change has altered rainfall patterns in Thailand, with projected changes in both timing and intensity. This alteration poses challenges for water management, affecting agriculture, water supply, and hydropower generation. Lampang's vulnerability to floods is exacerbated by climate change, as increased rainfall intensity leads to more frequent and severe flooding events, causing displacement, infrastructure damage, and economic losses. Additionally, tropical storms and cyclones pose a significant threat to the region, with the potential for climate change to increase their intensity and frequency, resulting in widespread destruction, loss of life, and impacts on infrastructure, agriculture, and the overall economy. The indirect effects of these direct climate impacts are far-reaching, encompassing disruptions to food production, increased pressure on water resources, damage to infrastructure, displacement of communities, and negative impacts on tourism, agriculture, and the energy sector. These consequences hinder economic development, increase vulnerability, and necessitate substantial resources for adaptation and recovery efforts. While Lampang district recognizes the urgency of addressing climate change impacts and has taken steps to mitigate and adapt to these challenges at the regional level, continued efforts are necessary to build resilience, promote sustainable development, and reduce vulnerability to climate change at both the regional and national levels.

5 Society

5.1 Socio-cultural context

National Level

Thailand, officially known as the Kingdom of Thailand, is a Southeast Asian nation situated at the center of the Indochinese Peninsula. With a land area of 513,120 square kilometers and a population exceeding 71.7 million people (World Bank, 2022), Thailand ranks as the world's 50th-largest country by land area and the 22nd most populous. Bangkok, a special administrative area, serves as its capital and largest city. Surrounded by Myanmar, Laos, Cambodia, Malaysia, and the Andaman Sea, Thailand operates as a constitutional monarchy and parliamentary democracy. However, it has faced political instability, including multiple coups and periods of military rule (World Bank, 2022).

During the era of Western imperialism in Asia, Thailand, then known as Siam, notably avoided colonization by foreign powers while making territorial and trade concessions through unequal treaties. Under the reign of King Chulalongkorn, from 1868 to 1910 Siam experienced a centralization process, transitioning into a modern, unitary, and absolute monarchy. Siam's alignment with the Allies during the First World War further strengthened its international engagement. In 1932, a bloodless revolution took place, leading to the establishment of a constitutional monarchy and the adoption of the name "Thailand". However, Thailand's political landscape has been marked by volatility since the 2000s, with alternating periods of democracy and military rule. This period has been characterized by a prolonged and divisive conflict between supporters and opponents of Prime Minister Thaksin Shinawatra, resulting in two coups and ongoing calls for reform. Recent political demonstrations, primarily centered in Bangkok, have urged changes to the monarchy and the government (Haile/Devasahayam, 2021).

Thailand emerged as a significant ally of the United States in the late 1950s and played a crucial role in anti-communist efforts as a member of the Southeast Asia Treaty Organization (SEATO). Additionally, Thailand holds the distinction of being a founding member of the Association of Southeast Asian Nations (ASEAN), established in 1967. The country has achieved notable human development levels and possesses the second-largest economy in Southeast Asia. Its economic growth is driven by robust manufacturing, agriculture, and tourism sectors (Haile/Devasahayam, 2021).

While progress has been achieved, addressing regional disparities, improving social inclusivity, and safeguarding human rights for all citizens continue to be key priorities for Thailand's future growth and development.

Examining demographics, poverty, inequality, and human rights on a national level using World Bank data, Thailand has made substantial progress in reducing poverty over the years. The poverty rate declined from 67.2% in 1986 to 6,8% in 2020, an impressive achievement. Furthermore, the table below shows that Thailand could improve its Gini inequality index during the last decade from 0,37 in 2011 to 0,33 in 2021.

Table 3. Basic demographic indicators (Our World in Data, n.d.)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Population (million people)	68,71	69,16	69,58	69,96	70,27	70,61	70,9	71,13	71,31	71,48	71,6
Poverty (% of population) [1]	13,2	12,6	10,9	10,5	7,2	8,6	7,9	9,8	6,2	6,8	6.8
Gini Inequality Index	0,37	0,36	0,36	0,42	0,42	0,41	0,42	0,41	0,34	0,34	0,33

However, challenges persist, particularly in addressing pockets of extreme poverty and income disparities between different regions and population groups. Thailand's demographic profile reflects a diverse population with varying socio-economic conditions. Urban areas, especially Bangkok, experience higher levels of development and economic opportunities, attracting a significant share of the population. However, rural areas, particularly in the north and northeast, face higher poverty rates and limited access to essential services and infrastructure.

Efforts to address poverty and inequality have been accompanied by a focus on enhancing human rights in Thailand. The country has made notable strides in promoting gender equality, improving education and healthcare systems, and strengthening social protection programs. However, challenges remain in ensuring equal access to justice, protecting the rights of marginalized groups, and tackling issues related to freedom of expression and assembly.

Regional Level

Lampang District, situated in the northern region of Thailand with a population of ca. 740.000 (2019), exhibits a diverse demographic makeup characterized by a blend of ethnic groups, including the Thai majority and various hill tribes such as the Karen, Hmong, and Lahu. The

1 Share of population living below national poverty lines.

district's population is predominantly rural, with agriculture serving as a significant livelihood source for many residents. However, Lampang District, like numerous other rural areas in Thailand, grapples with challenges associated with poverty and inequality. Lampang District contains pockets of poverty, particularly among marginalized communities and ethnic minorities at Mae Sann area such as three indigenous groups – Mlabri, Kaw (Umpi) and Bisu (Open Development Thailand, 2021), which face constrained access to education, healthcare, and economic opportunities, thereby perpetuating poverty and inequality.

Notably, Lampang District is renowned for its coal mining operations, primarily concentrated in the Mae Moh area. The extraction and combustion of coal bear profound implications for human rights. Coal mining activities contribute to environmental degradation, encompassing air and water pollution, adversely affecting the health and well-being of local communities. Consequently, conflicts have arisen within the context of coal mining, involving mining companies, local communities, and indigenous groups. These conflicts often revolve around contentious issues such as land rights, displacement, and environmental concerns. Consequently, human rights violations have emerged, encompassing the infringement of the right to a healthy environment, land and natural resources, and cultural identity. Instances of physical and structural violence have been reported in early 2000, whereby physical violence manifests through clashes between local communities and mining companies, as well as authorities employing force to suppress protests or demonstrations. Structural violence manifests through the deprivation of rights and access to resources, alongside the imposition of policies and regulations disproportionately affecting marginalized communities. These acts of violence and human rights violations predominantly impact the rights to a healthy environment, land and natural resources, and cultural identity. Various actors contribute to these violations, including mining companies, government agencies responsible for mining licenses and oversight, and law enforcement agencies engaged in maintaining order during conflicts (World Bank, 2022; World Bank Climate Change Knowledge Portal, n.d.).

Furthermore, Lampang District accommodates diverse ethnic minority groups, as mentioned above, especially in Mae Sann village. These indigenous communities possess distinct cultural traditions, land tenure systems, and customary practices deeply intertwined with their natural surroundings. The impact of coal mining activities on these indigenous groups can be particularly severe, as they confront the loss of ancestral lands, disruption of traditional livelihoods, and erosion of cultural heritage. In sum, the coal mining operations in Lampang District engender concerns regarding human rights violations, particularly pertaining to environmental degradation, land rights, and cultural identity.

With the aim of lessening the impacts of coal mining and burning for the local population, the government has established a social relief impact fund called The Power Development Fund, earmarked for areas affected by power plant operations and managed by EGAT and ERC in designated regions, encompassing 790 entities across 77 provinces in Thailand, including 59 large

and medium-sized funds and 731 small funds. The Mae Moh Power Development Fund, the largest in the country, specifically serves 5 subdistricts in the Mae Moh district. Financial allocation criteria involve 50,000 baht per megawatt annually during construction or a minimum of 50,000 baht per year, with an additional consideration of 1-2 satang per unit of electricity generated during operation, depending on the fuel type. The money goes to the local community surrounding the power plants. The fund is managed by the ERC, with local community representatives elected by people from each district to form a committee that oversees the fund for a term of 4 years. One-third of this committee consists of local government representatives, while two-thirds are from the local community. The allocated funds are then meant to be redistributed through community development initiatives around power plants which should cover one or several of seven dimensions: Health, Education, Local Economy, Environment, Utility, and Energy. It provides more than three hundred million baht annually for the local community in Mae Moh, Lampang. However, transparency issues in the project funding selection process, a lack of success indicators for projects, and mismanagement of funds by provincially and locally appointed committees have resulted in the unsuccessful development of project funded by power development fund over the last 10 years, as these past projects has not actually benefitted the local community.

5.2 Discourses, narratives and visions on coal and just transition

National Level

Energy plays a pivotal role in facilitating economic and social progress. In Thailand, significant efforts have been made to expand electricity generation capacity to meet the growing demand. Narratives and visions on coal and just transition have played a vital role in shaping the local responses to proposed coal-fired power plants. For example, in Krabi, a Southern province of Thailand, the planned facility faced vehement opposition from residents due to environmental concerns and the growing acknowledgment of renewable energy alternatives. Similarly, in Mae Moh, the community's rejection of the coal plant aligns with a shift towards embracing renewable energy solutions for a sustainable future. This resistance reflects historical movements globally where communities have united against environmentally harmful projects. The proactive involvement of civil society groups, notably including women and marginalized populations, has been fundamental in mobilizing opposition and successfully thwarting the construction of the coal plant in Krabi.

Furthermore, the planning for diversifying to renewable energy has been suboptimal, resulting in a heavy reliance on natural gas and coal as the primary fuels for electricity generation. The preference for gas in Thailand is primarily driven by its perceived environmental benefits, lower capital expenditure, shorter implementation timeline, and the improved efficiency offered by gas-based power plants, which is advertised by ERC. Yet, the narratives around coal in Thailand vary,

with some emphasizing its economic benefits and role in driving growth and meeting energy demand, while others focus on the negative environmental and social impacts such as air pollution, deforestation, and climate change. Traditionally, the dominant narrative in Thailand has centered around the economic benefits of coal, highlighting its affordability and energy security advantages. However, in recent years, a marginalized narrative has emerged, emphasizing the need to prioritize renewable energy sources and reduce dependence on coal to address environmental concerns.

Regarding the impact of the prevailing perception of coal, individuals who perceive EGAT as the primary emitter of pollutants tend to exhibit higher levels of concern compared to those who do not hold this perception. Conversely, individuals who perceive other entities as the main contributors to emissions tend to display lower levels of concern. This perception is largely influenced by the negative consequences experienced in Thailand due to the operation of Mae Moh's lignite mine-mouth thermal power plants, which have caused significant environmental impacts such as land degradation, deforestation, air pollution, and climate change. Consequently, there has been strong public opposition to coal-fired power plants in Thailand.

The concept of a just transition of the coal sector in Thailand has gained traction in recent years, aiming to address the social and economic implications for affected communities and workers during the transition away from coal. The government's approach considers the balance between energy security, economic growth, and environmental sustainability. It promotes renewable energy sources as alternatives and acknowledges the importance of social and economic factors in the transition. While there may not be specific outlined visions for society after the phase-out of coal, there is a broader recognition of the importance of transitioning to a more sustainable and low-carbon energy system. EGAT aims to achieve energy security and EGAT Carbon Neutrality by 2050 through reducing greenhouse gas emissions, increasing renewable energy sources, co-creating carbon sinks, and promoting public participation in greenhouse gas reduction. In Chapter 9, the plans for diversifying the energy system will be discussed, including a more detailed explanation of the Triple S Strategy. These initiatives align with Thailand's goals of climatic sustainability and drive sustainable practices in the energy sector (EGAT, 2022).

Regional Level

In Lampang, the narratives concerning coal align with the national-level narratives described above, sharing similar principles and perspectives. The dominant narrative in Lampang has traditionally revolved around the economic benefits of coal, supported by the government and industry sectors. Approximately 47% of district population is directly or indirectly involved in coal mining, emphasizing its significance for job creation and regional economic development. However, an alternative narrative from civil society highlights the importance of prioritizing public health and the environment by phasing out coal and transitioning to renewable energy

sources. This alternative narrative often encounters challenges in gaining widespread acceptance and support.

Lampang's Current Situation: Assessing the Dependency on Coal in the Region

Coal mining in the Mae Moh coal basin in Lampang province started in 1955, when the EGAT was established to meet the country's growing demand for electricity. The Mae Moh mine is one of the largest and oldest coal mines in Thailand, with proven coal reserves of around 1 billion tons. Over the years, the mine has expanded to cover an area of approximately 13,000 hectares and has become a major source of fuel for the Mae Moh power plant (2,455 MW). The mine has undergone several phases of development, with the latest expansion project completed in 2012. EGAT has stated that the Mae Moh mine is expected to continue operating until 2051, although the organization has also recognized the need to transition towards cleaner and more sustainable sources of energy in the future.

Stages of phasing out coal in Lampang

There are overall visions for the region of Lampang after the phase-out of coal. Organizations like Greenpeace advocate for a transition towards renewable energy sources, such as solar and wind power, to replace coal-fired power plants. The vision includes the establishment of a clean energy industry in the region, creating new job opportunities, reducing pollution, and improving the health and well-being of the local population. This vision aligns with the goal of achieving a sustainable and environmentally friendly energy system in Lampang. The historic development of the coal industry in Lampang is displayed by the following figure.

Contextual & historic development

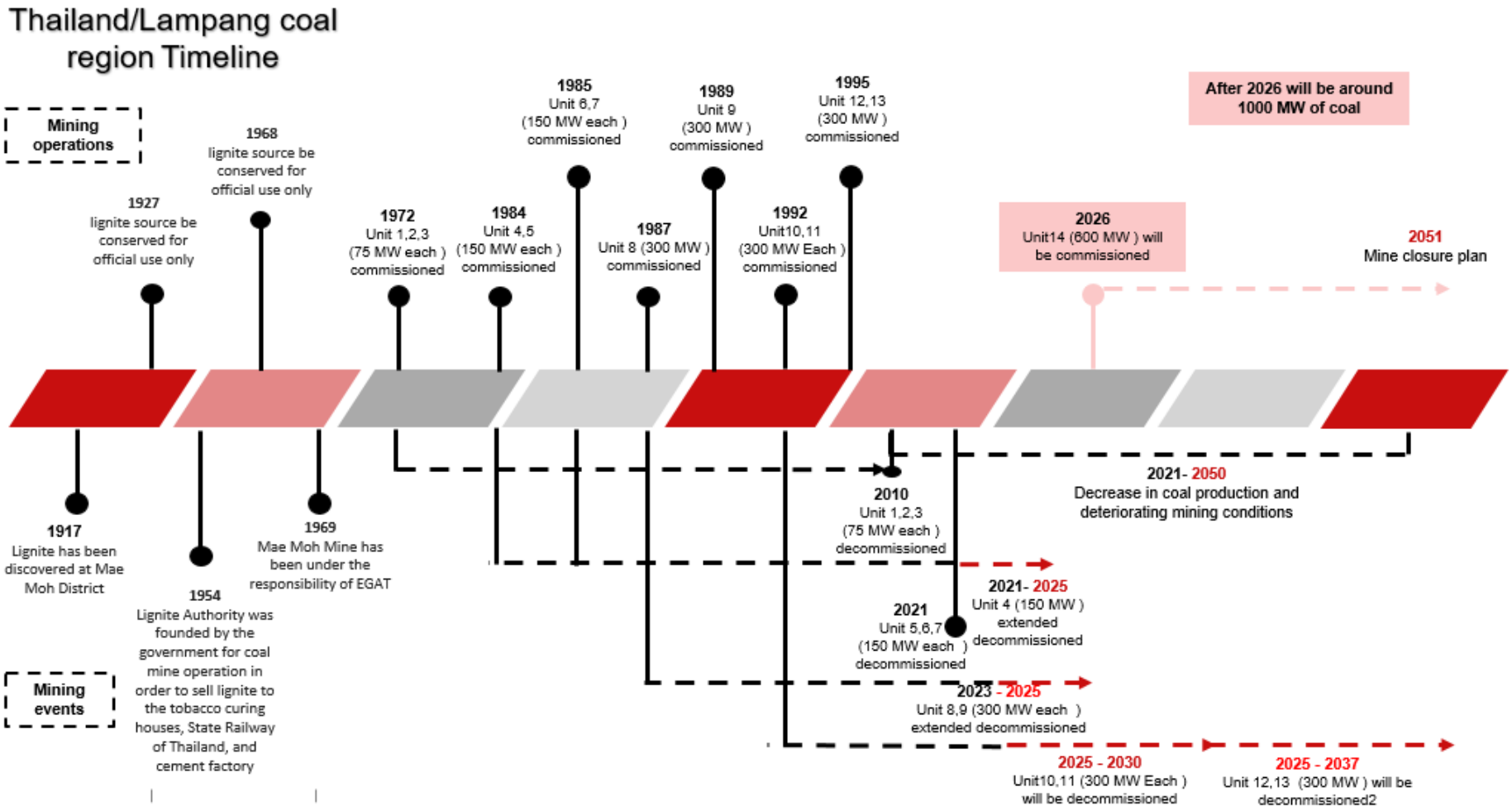

Figure 9. Timeline on coal development in Lampang

Source: Own research

Lampang is already undergoing a significant economic transformation away from coal mining since the introduction of the Mae Moh Green Model roadmap (see Chapter 6 regional level), which includes the development of new green industries. As a result, the economic situation and need for energy transition in Lampang is very different from other districts and the national level. While the national economic plans and political strategies are focused on increasing renewable energy usage, Lampang has already decoupled from the risks associated with the ongoing global energy transition by planning to replace coal power plants with a large-scale solar capacity of 2400 MW in the coming decades (EGAT, 2022). However, from a microeconomic perspective, this transformation has resulted in a decline in income for former mining families, with the number of families involved in mining decreasing from over 2,000 families in the period from 1972 until 2010 to around 800 families in 2022.

Results from the fact-finding mission reveal that while the concept of JET is familiar to key decision-makers at the international level, it is not widely known or implemented within Lampang. This lack of awareness extends to the workers and unions in the region. While union decision-makers possess some knowledge about JET through global exchanges, they have not yet taken an active role or recognized the importance of unions in the JET process. There is a need to enhance awareness and knowledge about the concept of just transition in Lampang to promote its understanding and implementation in the region. Recently, the Mae Moh Development Association has established an education fund for the coal mine community, enabling their families to access higher education. This initiative demonstrates how Lampang benefits from a well-organized community of former mine workers utilizing the power development fund in the region.

To effectively introduce the JET in Lampang, it is essential to align with the region's existing climate change commitments, particularly focusing on the reduction of greenhouse gas emissions through the complete shutdown of the coal-fired power plant by 2050. These targets reflect the region‘s commitment to transitioning towards cleaner and more sustainable energy sources as part of the JET initiative. By aligning JET initiatives with Lampang's climate change goals, it becomes possible to engage decision-makers, workers, and unions in a meaningful manner. This approach acknowledges the need to address the broader environmental challenges while ensuring a just transition for affected communities and workers.

The role of coal-based electricity generation in the Lampang region of Thailand is coming under increasing scrutiny, which primarily comes from various stakeholders, including government entities, environmental organizations, local communities, and concerned citizens. Despite the potential environmental and health impacts of coal mining and power generation, coal remains a major source of electricity for the region and an important employer in local communities. However, phasing out coal-based electricity generation in Lampang could be challenging due to economic, political, and technical barriers that must be addressed. A comprehensive SWOT analysis that considers the social, economic, and environmental factors driving the energy

transition in Lampang is essential to identifying opportunities for transitioning to more sustainable sources of power and overcoming these barriers.

5.3 JET related SWOT (society)

Table 4. JET related SWOT on Society

Strengths:	**Weaknesses:**
National: The presence of a democratic political system and active civil society can act as an advantage for the implementation of a JET process. Regional: The "Mae Moh Green Model" initiative by EGAT: The comprehensive programs and initiatives under the "Mae Moh Green Model" showcase EGAT's commitment to ensuring a just transition away from coal in Lampang. These initiatives include job training programs, support for small businesses, community development efforts, and social safety nets, all aimed at mitigating the social impacts of the transition. Opposition to coal-fired power plants: Some local communities in Lampang have expressed opposition to coal-fired power plants, highlighting the need for alternative, cleaner energy sources. This opposition emphasizes the importance of involving communities in decision-making processes and considering their concerns and preferences.	National: Limited social inclusivity and human rights concerns: addressing country disparities and improving social inclusivity remain priorities. Coal mining poses human rights challenges for marginalized communities and indigenous groups, affecting their access to a healthy environment, land, resources, and cultural identity. Regional: Human rights violations in coal mining areas: Coal mining in Lampang District poses significant human rights challenges, particularly for marginalized communities and indigenous groups. Violations include the right to a healthy environment, land, natural resources, and cultural identity. These violations must be addressed and mitigated during the transition process.
Opportunities:	**Threats:**
National: Diversification to renewable energy sources: Thailand's reliance on coal for electricity generation faces concerns about declining supply and increased reliance on costly imports. Diversifying to renewable energy	National: One drawback is that the integration and development of the Just Energy Transition (JET) approach into the national and local development strategy papers is still in progress.

sources presents an opportunity to mitigate negative environmental impacts and reduce dependence on coal.

Regional:

Lampang benefits from a well-organized community of former miner workers through the Mae Moh Development Association. This group could prove to be a valuable asset in the implementation of a Just Energy Transition (JET) approach in the district.

Collaboration in the "Mae Moh Smart City" project: The collaboration among EGAT, the Mae Moh District community, and related agencies in the "Mae Moh Smart City" project aims to promote sustainable development and long-term self-reliance. This project focuses on Smart Energy, Smart Economy, and Smart Environment, offering opportunities for compre-hensive and holistic development.

While the existing social protection programs in Lampang do not have a specific focus on addressing the needs of former miners, there are ongoing efforts to establish a social support program. This is of particular significance in light of the new policy direction of the upcoming government, which is placing a priority on the phase-out of coal.

Balancing energy demand and conservation efforts: Thai people prioritize stable and affordable energy prices, but also express concerns about environmental issues related to coal. Balancing the demand for personal comfort with energy conservation efforts is a challenge, as excessive use of cooling systems without considering energy efficiency remains prevalent. This balance must be struck to ensure a sustainable transition.

Regional:

Uncertain Transition Pathways: Identifying and im-plementing viable pathways to alternative energy sources in Lampang faces uncertainties in technology readiness, policy support, and financial constraints.

Main driver:

Environmental concerns: Coal-based electricity generation is a significant contributor to air and water pollution, as well as greenhouse gas emissions that contribute to climate change. This can lead to public health concerns and environmental degradation, which could present significant barriers to the continued use of coal by local communities.

Main barrier:

Coal is still the major source of electricity generation for EGAT.

6 Governance

6.1 Political-economic context

National Level

This chapter aims to provide an overview of the energy transition in Thailand, focusing on the main institutions, policies, and stakeholders involved in the low-carbon society concept. This chapter also aims to identify and describe the key institutions, instruments, policies, plans, and laws relevant to JET at both the national and regional levels. The chapter begins by tracing the initial steps taken in the 1990s when Thailand prioritized energy conservation through the Energy Conservation Promotion Law. However, the implementation of energy conservation measures was not fully utilized, and it was later transferred to the EGAT. In 2002, the Ministry of Energy was established to consolidate various government agencies and state-owned enterprises involved in energy planning. Despite slow progress, Thailand has embraced the concept of a low-carbon society and incorporated targets and policies for renewable energy and energy efficiency. Achieving the energy transition requires collective efforts from government agencies, the private sector, local communities, and civil society organizations.

The governance and regulatory framework for Thailand's energy sector is comprised of several key agencies and bodies that are instrumental in facilitating the phase-out of coal. Key political institutions relevant for the JET as following:

Table 5. Regulatory framework roles and function of governmental entities

Governmental entities	Role and responsibilities of the institution
ERC	The ERC is a regulatory agency set up separately from the Ministry of Energy and other government departments but work within the policy framework of the National Energy Policy Council. ERC has legal authority to set rules and regulate the implementation of power policies including drafting the Power Development Plan (PDP), the investment plan in the electricity industry, gas procurement.
NEPC	the National Energy Policy Council (NEPC), along with the Ministry of Energy, has a main responsibility to provide recommendations on national energy policy and development plan to the cabinet, with the goal to develop energy policy. It sets frameworks and rules for the energy sector, and facilitates coordination between government agencies, state enterprise and private sector participants.

Governmental entities	Role and responsibilities of the institution
MOE	The Ministry of Energy is the administrator of the Thai energy sector. It oversees the operation of the Energy Policy and Planning Office (EPPO) and the Department of Alternative Energy Development and Efficiency (DEDE), which are tasked with designing and promoting alternative energy policies, respectively.
EPPO	EPPO is responsible for designing the Thai energy policy, regulating electricity price and conducting research on energy policy. Its main policy document is the Power Development Plan (PDP).
DEDE	DEDE is responsible for promoting alternative energy, energy conservation and energy efficiency. This is done through issuance of the Alternative Energy Development Plan, a policy guideline on alternative energy.
EGAT	The Electricity Generating Authority of Thailand (EGAT) is the single buyer, transmission operator, and owner of key power plants (Mae Moh Coal Mining). EGAT is wholly owned by the government of Thailand and is the counterparty for most PPAs in the country.

These agencies and bodies play a crucial role in shaping Thailand's energy sector and driving the transition towards a more sustainable and renewable energy future by reducing the country's reliance on coal.

Key Instruments relevant for JET

Thailand's energy policy is shaped by key agencies, with several instruments and plans supporting JET processes. At the national level, the Energy Conservation Promotion Law promotes energy efficiency, while the Power Development Plan (PDP) and Alternative Energy Development Plan (AEDP) guide renewable energy development. The Feed-in Tariff (FiT) scheme and Small Power Producer (SPP) program support renewable energy projects. The revision of the National Energy Plan is necessary to align with JET objectives, including decarbonization targets and phasing out coal. Overarching documents such as the PDP, AEDP, EEDP, and Low Carbon City Framework outline strategies for renewable energy, energy efficiency, and carbon reduction. The Energy Efficiency Development Plan and Climate Change Master Plan provide roadmaps for transitioning to a low-carbon economy and phasing out coal. Instruments for promoting renewable energy include the Energy Conservation Act, Building Energy Code, financial incentives, and the FiT scheme. The Energy Efficiency Development Plan aims to decrease energy intensity, while the PDP sets a target of 30% renewable energy by 2037.

Decision-making processes on the coal sector in Thailand have been criticized for not being inclusive of all local populations affected by it. The government has been accused of not

adequately consulting with local communities and not taking their concerns into account when making decisions on coal projects. Lessons can be learned from the experiences of other countries which implemented successful steps of a coal transition policy that includes a just transition for affected communities. To improve decision-making processes on the coal sector in Thailand, there needs to be greater transparency, accountability, and participation of local communities in the decision-making process. The government could also consider implementing a just transition policy to ensure that affected communities are not left behind in the transition to a low-carbon economy.

The involvement of citizens and local people in decision-making processes related to JET varies. While there are efforts to promote public participation through public hearings and consultations, the level of engagement and influence on decision-making processes may vary across different projects and regions. There is a need to strengthen mechanisms for meaningful participation and ensure that the voices of local communities are heard and taken into account. In the context of JET-related processes, there have been concerns about corrupt, clientelist, and patronage-based structures and practices. It is important to address and mitigate these challenges to ensure transparency, accountability, and the fair allocation of resources in JET initiatives.

Finally, the Thai government is making progress in replacing coal-fired generation with renewable energy sources. A new National Energy Plan is set to be released in late 2023, providing further details on the government's strategy to fulfill climate change commitments and the just energy transition plan. However, the coal mining industry is expected to persist and may impede the transition, potentially leading to corrupt practices. Stakeholders involved in shaping these measures include EGAT's coal phase-out plans, the PDP, mining company contracts, specific business associations, and associations representing coal mining companies.

Regional level

The current practices and policies lack adequate consideration for the complexities and challenges associated with such a transition, including the potential impacts on local communities and coal industry workers at the regional level. For example, the MOE is pursuing the introduction of four new coal-fired power generators into the energy grid. The Thai cabinet has already granted approval for the first two plants, which will have a combined capacity of 660 megawatts. Construction for these plants is scheduled to begin this year, and they are expected to operate from 2026 to 2050 (Praiwan, 2023). These plants will be integrated into the existing coal-powered generators at the Mae Moh power plant.

Moreover, the Power Development Plan (PDP) plays a critical role in the phase-out of coal in Lampang. As EGAT follows the government's intentions and expectations outlined in the PDP, it becomes the most important factor in driving the transition.

Recent revisions to the PDP demonstrate a substantial increase in solar, hydro, biomass and wind generation capacity, aligning with Thailand's commitment to carbon neutrality and net-zero

emissions. The energy target of achieving 30% of total final energy consumption from renewable sources by 2037 is based on the 2018 PDP Rev.1. The successful implementation of these plans and policies outlined in the PDP is crucial for ensuring a smooth and effective transition away from coal in the Lampang (MOE/IRENA, 2021).

NEPC and MOE in their recent terms are also crucial government agencies involved in the coal phase-out policy at both the national and regional levels. They play vital roles in supporting renewable energy and coal phase-out initiatives. This is exemplified by the recent announcement that the construction of the 660 MW coal generator in Mae Moh will be the last unit to be built in Thailand (EGAT, 2022). Their active involvement underscores the government's commitment to transitioning towards renewable energy sources and phasing out coal, aiming to foster a more sustainable and environmentally friendly energy sector in Thailand.

In the context of the Mae Moh coal mine in Lampang, the decision-making processes have not effectively included all local populations affected by the mining operations. Local communities and stakeholders, who bear the direct impacts of the coal mine, have often been excluded from participating in the decision-making processes. This exclusion means that their concerns, perspectives, and interests are not adequately represented or considered when decisions are being made about the operations and future of the coal mine. GIZ observations indicate that this conflict has led to decisions that do not adequately consider the social, economic, and environmental impacts on the local populations. Consequently, the exclusion of the local community has generated feelings of powerlessness, frustration, and distrust among those affected.

Lessons learned from previous experiences when EGAT started their operation in the Mae Moh mine from the late 1970s to the 2020s highlight the importance of early and continuous engagement with affected communities. These included the repercussions of limited interaction with the local community, fostering misunderstandings and conflicts. Additionally, insufficient inclusive planning activities between EGAT and the community resulted in discord and resistance. The shift towards a more inclusive, community-centric approach emphasized the significance of bottom-up engagement, ensuring successful operations and fostering community acceptance. Transparent and accessible information sharing is vital, as is the integration of local knowledge and expertise into decision-making processes. Recognizing and respecting the rights and aspirations of local communities is crucial, and involving them as partners in the transition process is key for EGAT and the Lampang government in further implementing the coal transition project in line with the Green Mae Moh Model.

Grassroots activism and community empowerment hold great importance within the Mae Moh coal mine context. Local communities have united through civil associations, community spokespersons, and NGOs to voice their concerns and demands. These groups play a vital role in advocating for the rights and well-being of affected communities, increasing awareness about the environmental and social impacts of the coal mine, and advocating for more inclusive and sustainable energy policies. Concerns have arisen regarding corrupt, clientelistic, and patronage-

based structures and practices in relation to the Just Energy Transition (JET) processes in Thailand, including the Mae Moh coal mine.

Mae Moh Green Model Road Map and its Driving Forces for JET

Figure 10. Driving Forces of the Mae Moh Green Model
Source: EGAT

The primary instrument relevant for JET at the regional level is the Mae Moh Green Model Road Map, which considers the key driving forces of the Mae Moh Green Model. The "Mae Moh Green Model" in Lampang comprises comprehensive programs and initiatives aimed at facilitating the transition away from coal dependency. and it demonstrates EGAT's commitment to ensuring a just and sustainable transition away from coal in Lampang.

The implementation of the "Mae Moh Green Model" is driven by four key factors. Firstly, the region benefits from abundant RE resources, making it a significant RE capacity hub with approximately 5,405 MW available from sources such as solar farms, biomass plants, and pumped storage. This availability of RE resources provides a strong foundation for the development of green power in the area. As part of the Mae Moh Green Model, EGAT plans to establish various green power initiatives including biomass plants, solar farms, Carbon Capture and Storage (CCS) technology, pumped storage systems, and hydrogen fuel sources. These initiatives are specifically designed to attract investments in green industries, drive innovation in sustainable practices, create opportunities for green logistics, and foster the development of a skilled green workforce in the region. These green industries encompass solar panel manufacturing and installation firms, organic farming ventures specializing in agricultural product processing. Concurrently, sustainable tourism initiatives are gaining traction, promoting eco-friendly accommodations and

activities. Moreover, the city is experiencing growth in electric vehicle charging station infrastructure, green concrete business, waste management, pellet woods, and recycling facilities, all playing integral roles in advancing Lampang's green industry evolution.

Secondly, the strategic location of Mae Moh as a transportation hub offers advantageous connectivity. Situated along the main railway connecting central and northern Thailand, Mae Moh provides convenient transportation access not only within the country but also for international distribution and export of green energy products and services.

The third driving force is the community mindset and social cohesion in Mae Moh. The local community's openness and willingness to embrace green initiatives and sustainable practices create an enabling environment for the successful implementation of the Mae Moh Green Model. This supportive community mindset plays a crucial role in fostering the growth of green industries, promoting innovation, facilitating logistics, and developing a skilled green workforce.

Lastly, the presence of robust infrastructure, including road networks, rail connections, and access to land and water resources, provides a solid foundation for the effective implementation of the Mae Moh Green Model. These infrastructure elements facilitate the efficient operation and expansion of green energy projects, making Mae Moh an attractive destination for the development of green industries.

Within the context of the "Mae Moh Green Model," there is a sub-project called Lampang's "Mae Moh Smart City" project, which emphasizes collaboration among EGAT, the Mae Moh District community, and related agencies. This project aims to develop and support the community in achieving long-term self-reliance, while also promoting the development of the energy sector, economy, society, and environment suitable for sustainable living after the decommissioning of the Mae Moh Mine and Power Plant in 2051. The project focuses on three dimensions: Smart Energy, Smart Economy, and Smart Environment, ensuring a holistic approach to sustainable development in Lampang.

These programs encompass a range of initiatives designed to mitigate the effects of the transition, including but not limited to:

1. Job training and re-skilling programs: These programs aim to provide new skills and training to former coal miners and other workers who will be affected by the phase-out of coal. The training is designed to help them transition to new industries and jobs, such as in renewable energy, agriculture, and tourism.

2. Small business support: To encourage the growth of new businesses in Lampang, the government has established a variety of support programs, including access to financing, business planning assistance, and marketing support.

3. Community development programs: These programs aim to support the development of new community-based enterprises and organizations. This could include the

establishment of cooperatives, community-based tourism initiatives, and other initiatives focused on sustainable development.

4. Infrastructure development: The government is investing in infrastructure projects to support the development of new economic activities in Lampang. This includes the construction of new roads, bridges, and other infrastructure to improve transportation and access to markets.

5. Social safety nets: To support those who have been most affected by the coal phase-out, the government has established social safety net programs, such as cash transfers and food assistance programs, to help them meet their basic needs during the transition period.

6.2 JET related SWOT (governance)

Table 6. JET related SWOT on Governance

Strengths:	**Weaknesses:**
National: Mae Moh coal Phase out plan by 2051 Instruments such as the Energy Conservation Promotion Law, PDP, and AEDP support JET processes. Overarching documents like the PDP, AEDP, EEDP, and Low Carbon City Framework outline strategies for renewable energy, energy efficiency, and carbon reduction. Key government agencies, such as the MOE, NEPC, and ERC, actively support renewable energy and coal phase-out initiatives, showing a dedication to a more sustainable energy sector. Regional: The Power Development Plan (PDP) plays a critical role in the phase-out of coal by reducing the capacity of the Mae Moh coal power plant from 2,455 MW in 2023 to 0 MW in 2050, ultimately leading to a complete elimination of coal in 2051 or before.	National: The reliance on coal-fired generation and the lack of comprehensive strategies and consideration for a just transition away from coal are weaknesses. Regional: Construction of new coal power plants is counter-productive to coal phase-out Decision-making processes related to the coal sector have not effectively included all local populations affected by mining operations, leading to exclusion and a disconnect between decisions and community needs. The lack of inclusivity and community participation in decision-making processes has generated feelings of powerlessness, frustration, and distrust among affected communities.
Opportunities:	**Threats:**

National: Thailand has opportunities to expand renewable energy capacity, strengthen decision-making pro-cesses, and enhance energy efficiency measures. Regional: Mae Moh Green Model roadmap. Mae Moh Smart City Project. The implementation of mechanisms that promote meaningful community participation can address the lack of inclusivity in decision-making processes and ensure that the concerns and interests of affected communities are adequately considered. Early and continuous engagement with affected communities, transparent information sharing, and integration of local knowledge can improve decision-making processes and facilitate a smoother transition away from coal. Grassroots activism and community empowerment provide an opportunity for affected communities to advocate for their rights, increase awareness about the impacts of the coal mine, and push for more inclusive and sustainable energy policies.	National: Slow progress in transitioning away from coal, potential negative impacts on local communities, and external factors such as global energy market changes pose threats to Thailand's sustainable energy goals. Regional: Trust between EGAT and Local community. The exclusion of local communities from decision-making processes poses a threat to the successful implementation of the coal phase-out plans and policies. Corrupt, clientelistic, and patronage-based structures and practices in the Just Energy Transition processes can undermine the transition efforts, including those related to the Mae Moh coal mine. The lack of community involvement and unresolved concerns can lead to increased social unrest, protests, and legal challenges, posing a threat to the operation of the coal mine and the overall energy transition goals.

Main drivers:

1. Government targets and commitment to climate action: Thailand's recent targets to achieve net-zero carbon emissions and phase out coal are key drivers for the transition towards renewable energy sources.

2. Growing awareness and demand for sustainable energy: There is an increasing national awareness of the environmental and social impacts of fossil fuel-based energy sources, including coal. This awareness has led to a growing demand for clean and sustainable energy solutions.

Main barriers:

1. Even though Thailand has comprehensive strategies and ambitious targets for renewable energy deployment and coal phase-out, there is a crucial need for concrete action, detailed implementation plans.

2. Challenges in inclusive decision-making: The exclusion of local communities from decision-making processes, as observed in the case of the Mae Moh coal mine, presents

a significant barrier. Failing to include the perspectives and concerns of affected communities can lead to opposition, protests, and legal challenges, creating delays and obstacles in the transition away from coal.

7 Economy and Employment

7.1 The role of coal mining and coal trade

National Level

The economic performance of a country is often assessed using indicators such as GDP, GDP per capita, and economic growth rate. These indicators provide valuable insights into the patterns and changes in a nation's economy over time. In the context of Thailand, the provided data from 2010 to 2022 reveals its economic trajectory.

Table 7. Data from 2010-2022 for the following indicators: GDP; GDP per Capita; economic growth in Thailand

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
GDP (Billion US$)	370.82	397.56	420.33	407.34	401.3	413.37	456.36	506.75	543.98	500.46
GDP per capita (US$)	5,396.6	5,748.6	6,041.1	5,822.4	5,708.8	5,845.5	6,436.8	7,124.6	7,628.6	7,001.8
Economic growth (the rate of change of real GDP in %)	0.8	7.2	2.7	1.0	3.1	3.4	4.2	4.2	2.1	-6.1

Source: World Bank 2021.

The analysis of the GDP figures demonstrates a steady growth trend, with an GDP increase from $370.82 billion in 2011 to $543.98 billion in 2019. However, a decline to $500.46 billion occurred in 2020 due to the global economic impact of the COVID-19 pandemic. Similarly, the GDP per capita exhibited consistent growth, rising from $5,396.6 in 2011 to $7,628.6 in 2019, followed by a decline to $7,001.8 in 2020. The economic growth rate fluctuated, reaching a peak of 7.2% in 2012, and subsequent years displayed more moderate rates ranging from 0.8% to 4.2%. However, a negative growth rate of -6.1% was recorded in 2020, reflecting the adverse effects of the pandemic. These findings underscore the resilience and vulnerability of Thailand's economy, emphasizing the need for effective policies to address external shocks and ensure sustained growth (World bank, 2021).

The key characteristics of the coal sector at national level

Thailand coal supply analysis and forecast.

Approximately 99% of coal found in Thailand is low-quality lignite. Some subbituminous and bituminous coals are also scarcely found. A small number of anthracite coals can be found in Na Duang coal mines in Loei province and Na Klang coal mines in Udon Thani province. The largest lignite source comes from Mae Moh mine in northern Thailand. Lignite production of EGAT (Mae Moh and Krabi mines) averaged around 15.6 Mt in 2000-2010 and accounted for more than 85% of total domestic lignite production. From 2011, production of other private mines rapidly declined. Total domestic coal production reached 14.2 Mt per year in 2021 – all came from the Mae Moh mine. Mae Moh coal is lignite or brown coal, with the lowest calorific content as compared to other types of coal. Since Thailand is aiming to reduce the capacity of coal-fired power plants (PDP, 2022), domestic lignite production is expected to gradually decrease in 2023-2030, reaching around 6.0 Mt per year by 2030.

Thailand coal demand analysis and forecast.

Thailand's coal demand increased rapidly from 22 Mt in 2000 to 39.3 Mt in 2014. In the same period, coal demand for industry almost tripled and accounted for 35% of total coal consumption in 2014. Coal demand for power generations saw an increase at 3% during the period, reaching a peak of 25.6 Mt in 2014, in which Small power producer (SPPs) consumption remained stable over the same period, while IPPs (Independent power producers) quadrupled their consumption since 2006. (EPPO, 2022) In 2015-2021, coal demand was relatively stable, totalling around 37-39 Mt per year. Coal demand for power generations showed a decline of -1.1% in the period and accounted for only 53.8% of total consumption. Meanwhile, coal demand for industry climbed steadily by 4.1% and accounted for the remaining 46.2% of total coal demand.

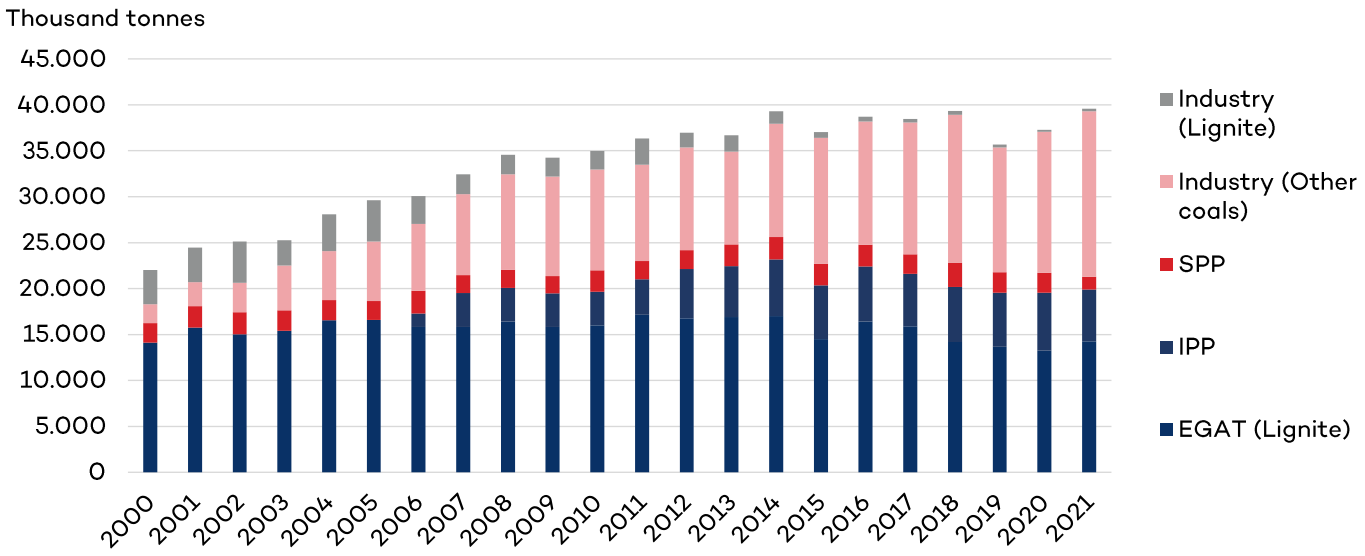

Figure 11. Thailand's Coal Demand 2010-2021

Source: EPPO, 2022.

Notably, there has been a transition from state-run power plants to privately-owned facilities, with the Mae Moh plant's share of coal use for electricity dropping to 61-63% between 2019 and 2021. Furthermore, the majority of coal consumed by IPPs and SPPs is imported.

Coal Demand forecast

According to Thailand's PDP 2018 and the recent National Energy Plan 2022 (draft version), Thailand is aiming to decarbonize its energy sector which will involve retiring inefficient coal-fired power plants. Therefore, coal demand for power generations is expected to fall gradually. Recently, EGAT proceeded with the Mae Moh power plant replacement project. A new thermal plant with an installed capacity of 660 MW (Unit 14) will be built to replace the existing units 8-9 (600 MW), which will be decommissioned. The objective of the project is to maintain security of the electricity system in the North and the Northeast and stability of the electricity system of the country. The use of lignite from Mae Moh Mine as fuel, combined with advanced pollution control technology, ensures that the emissions are within or even better than the environmental standards. This means that the pollution levels are kept at a level that meets or exceeds the required environmental standards, ensuring a cleaner and more sustainable energy production process. The new power plant is planned to start its commercial operation in 2026 (EGAT, 2022).

Total coal demand for power is projected to fall in 2021-2030, reaching 14.3 Mt in 2030, of which lignite is 6.0 Mt and bituminous/sub-bituminous is 8.3 Mt. In the cement industry, prominent manufacturers such as the Siam Cement group are strategically working towards achieving a 50% reduction in fossil fuel consumption by 2022 across their plants in Thailand, Vietnam, Laos, Cambodia, and Indonesia. They aim to accomplish this by transitioning to electricity generated

from renewable sources, but they have not yet published their results. However, this proactive approach demonstrates a noteworthy commitment and sets a commendable example for other private companies within the same sector. Additionally, biomass is being considered as an alternative to coal usage, as seen with Ajinomoto's implementation of a rice husk cogeneration system. Consequently, the demand for coal for industrial purposes is expected to decline steadily from 2022 to 2025 and then remain steady until 2030, which is also valid for total coal demand, as illustrated in the figure below.

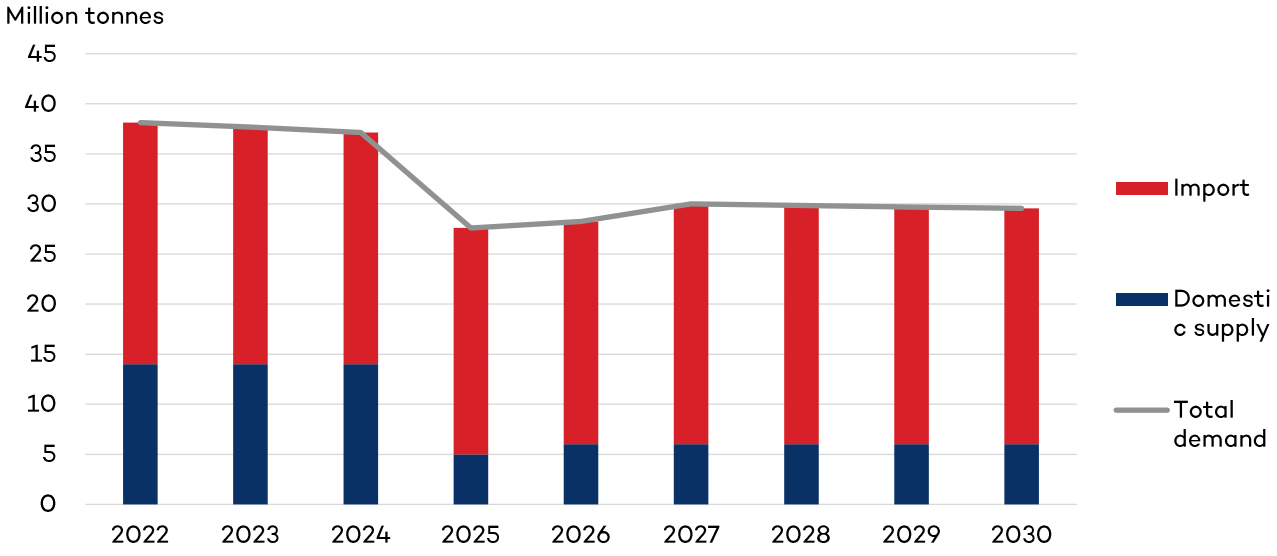

Figure 12. Forecast of coal demand in Thailand
Source: PDP, 2018.

Thailand coal trade situation analysis

Thailand is not a big market, yet there are a lot of coal traders, thus, the market competition is extremely intense. Most of the coal used in the private sector was imported coal as the volume of domestically produced coal by the private sector is quite small because of limited coal reserves. Between 2000 and 2021, coal imports increased sixfold, as the next figure shows.

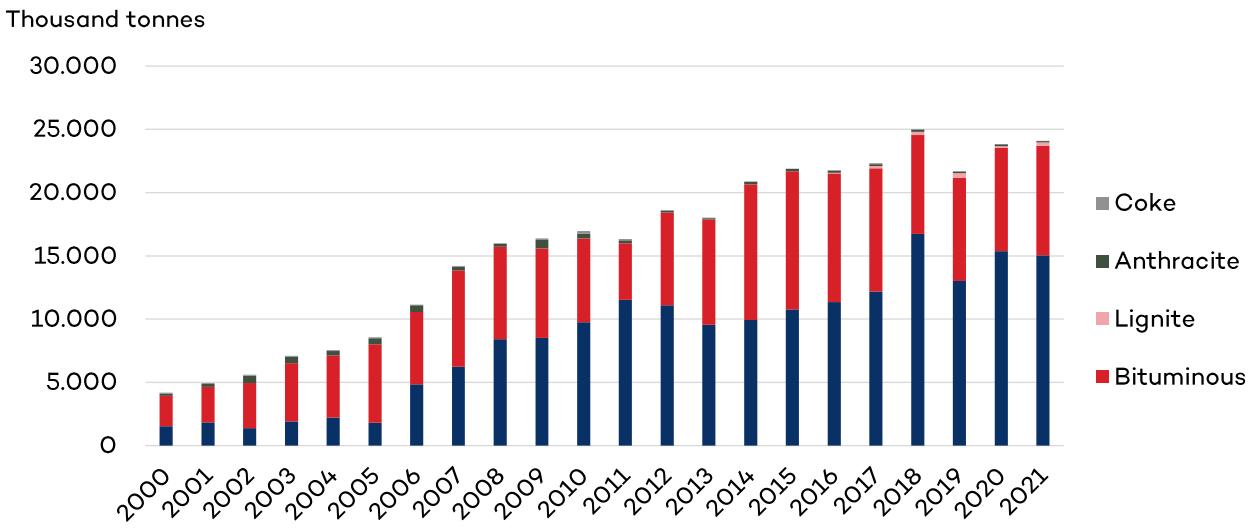

Figure 13. Coal imports to Thailand by type
Source: EPPO, 2022.

In 2021, Thailand imported 24.1 Mt of coal and countered the downward trend in 2019-2020 due to the COVID-19 pandemic. Approximately 22-25% of imported coal was consumed by independent power producers with long-term purchase contracts with foreign coal producers. As this supply did not enter the spot market, less than 20 Mt remained for coal importers to compete, making the market highly competitive. There are various factors influencing the rise of coal imports in the last decades. Firstly, with domestic production decreasing since the mid-2000s, itself of low-quality lignite, it is unsurprising that Thai consumers have turned to the international coal market. In particular, the proximity of Indonesia, and the richness of its reserves, is a clear attraction for coal supply to Thailand.

Moreover, the economics of coal imports also counts in their favor as coal is cheap compared to other fuel types. Transportation costs are relatively low per unit, even if a large amount of coal is needed for electricity generation.

The tax regime around coal is also very favourable. From 1987-2014, a tax ceiling of 25% was placed on coal imported to Thailand, but in practice, only 1% was charged, and 7% Value-Added Tax (VAT) is placed on top. Since 2014, import tax has been fully exempted so that only the VAT remains. Furthermore, excise tax is placed on diesel, petroleum, and natural gas to raise revenue and limit usage as they are considered environmentally harmful products, but there is no such tax on coal. Up to the mid-2000s, oil was still the preferred power source for factories in Thailand. However, as oil prices increased, and higher import tax rates, many factories shifted to the relatively cheaper coal, and larger companies took an active role in mining, shipping, and distribution of coal. The top three exporting countries included Indonesia, Australia and Russia.

Further exporters include the Philippines, Colombia, Laos and Vietnam, of which Laos is the major source of imported lignite and Vietnam is the main exporter of anthracite. Figure 14 shows the split of imports between industry, IPPs and SPPs. Since imports started picking up 20 years ago, industrial consumption has consistently accounted for 50% share, standing at 62.7% in 2021 (EPPO,2022).

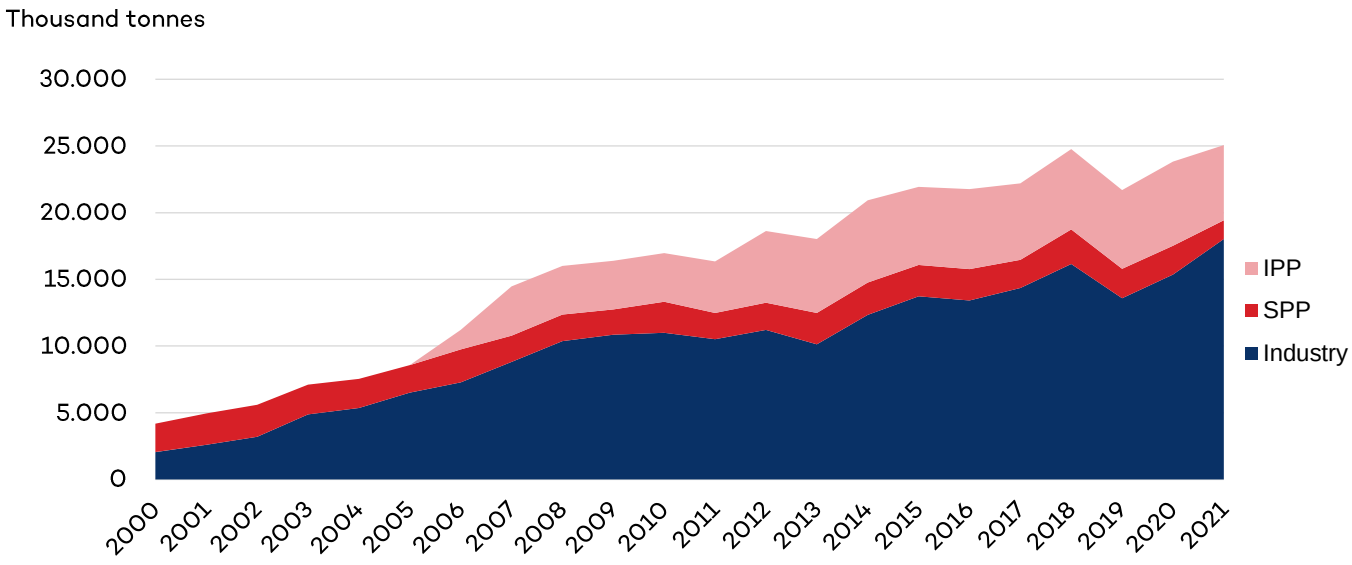

Figure 14. Coal imports to Thailand by end-user
Source: EPPO, 2022.

Coal imports mainly serve demand from the private sector (IPPs/SPPs and industrial users). Some companies and entrepreneurs engage in short-term bidding contracts or from the spot market. Other are more deeply positioned in the value chain, whether owning shares in mines abroad (for example, Banpu in Indonesia and Australia, SCG in Indonesia), coal shipping companies, or local distribution firms (Greenpeace, 2021).

Work force in the mining sector as of end 2020

According to data from 2020, the coal mining sector employed over 9,000 individuals in Mae Moh coal mine in Lampang. Coal extraction is mainly concentrated in the northern provinces of Lampang and Mae Hong Son, as well as the central province of Saraburi. However, despite its historical significance, the coal mining industry in Thailand has been on the decline, partly due to the government's push towards renewable energy sources. The majority of coal mining activities in Thailand are conducted by private companies rather than government-owned enterprises. It is likely that most jobs in the coal mining sector are manual labour positions, such as excavation, hauling, and processing of coal. The mining and quarrying sector is an important component of economic development (2,55 % of GDP in 2018 (NESDC, 2018)), providing employment opportunities and contributing to overall growth. Within this sector, the coal industry holds

significant importance as a source of energy. As of 2021, Thailand witnessed a slight decrease in the number of active mines compared to the previous year, with a total of 502 active mines. Over the years, the number of active mines in the country has gradually declined, peaking in 2017.

Thailand's mining and quarrying operations encompass a wide range of resources, including coal (lignite), zinc, gypsum, fluorite, tungsten, limestone, and marble. Additionally, along the east coast of the peninsula, mining activities are focused on the extraction of precious gemstones such as rubies and sapphires. The country's industrial expansion has resulted in an increased demand for electricity and fossil fuels, further emphasizing the significance of the mining and quarrying sector.

Regional Level

The key characteristics of the coal sector in the region

The majority of lignite produced from the Mae Moh mine is used to fuel the nearby Mae Moh thermal power plant operated by EGAT. In line with Thailand's goal to reduce the capacity of coal-fired power plants, as stated in the draft PDP 2022, domestic lignite production is expected to gradually decrease from 2021 to 2030. By 2030, it is projected to reach around 6.0 Mt aligned with future capacity of Mae Moh Coal power plants (EPPO, 2022).

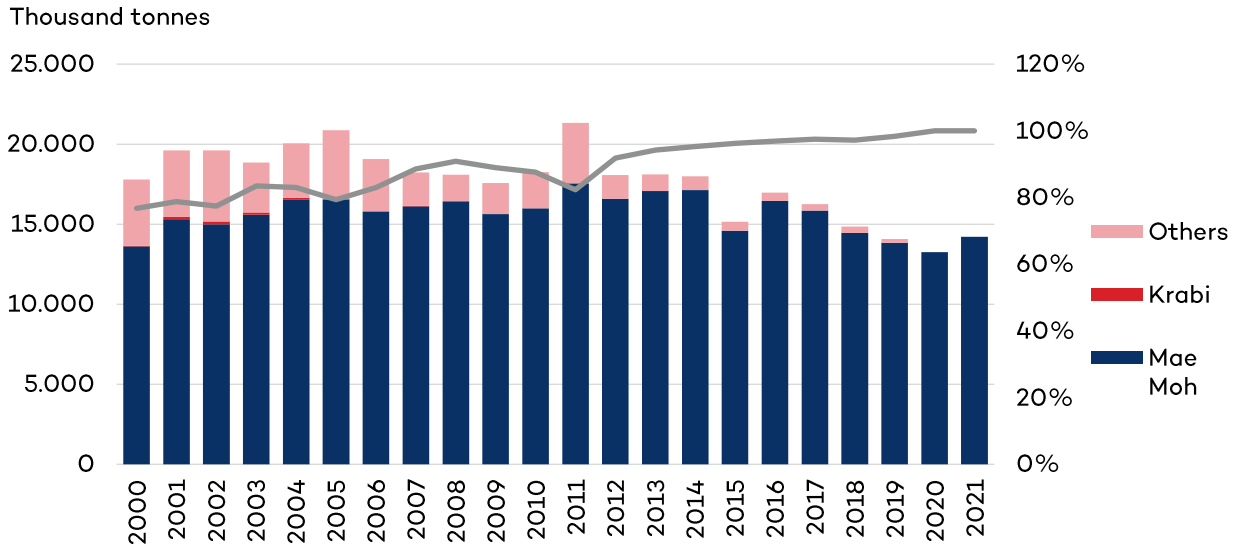

Figure 15. Domestic production of lignite in Thailand
Source: EPPO, 2022; Analysis from EGAT data

As the figure above shows, the domestic production of lignite coal shows a decreasing trend during the past two decades and since 2020 lignite coal is only mined at the Mae Moh mine.

Ecological regeneration and future opportunities for Mae Moh coal region

Efforts are currently underway to explore ecological regeneration and future opportunities for the coal region, particularly through initiatives such as the Mae Moh Green Model roadmap (see Chapter 6 regional level). The aim is to transform the area into a sustainable and innovative urban center, showcasing renewable energy, green technologies, and eco-friendly practices, thus paving the way for a transition from coal mining to a more environmentally conscious and economically diverse future (Mae Moh Smart City, 2024).

In the short term, quick wins for ecological regeneration in the coal region, such as the Mae Moh project, involve implementing immediate measures to mitigate environmental impacts of coal mining. This includes activities such as reclaiming and rehabilitating mined-out areas, restoring degraded ecosystems, and implementing effective waste management practices. Collaboration with environmental organizations and experts is key to developing and implementing sustainable land-use plans and practices, ensuring that the land is restored and repurposed for beneficial uses such as agriculture, forestry, or renewable energy installations. Additionally, promoting community engagement and participation in environmental conservation efforts helps create awareness and foster a sense of responsibility among local residents.

In the medium term, efforts focus on diversifying the local economy by attracting investments in renewable energy projects and industries that align with the region's natural resources and potential. This involves leveraging the existing infrastructure and expertise in the coal sector to transition towards cleaner energy sources, such as solar, wind, and biomass. Encouraging the development of renewable energy parks and promoting research and development in green technologies creates job opportunities and stimulates economic growth. Furthermore, supporting the establishment of eco-tourism initiatives that highlight the region's natural beauty and unique ecosystems contributes to the diversification of the local economy.

In the long term, a comprehensive and sustainable transition plan is being formulated to guide the coal region towards a more resilient and environmentally friendly future. The plan involves establishing green industrial zones, where environmentally friendly industries and businesses are encouraged to set up operations, creating a sustainable economic base. Investments in education and training programs equip the local workforce with the skills needed in emerging green industries. Additionally, fostering innovation and research in sustainable technologies and practices positions the coal region as a hub for green innovation and attracts investments in clean energy and environmental solutions. Overall, the long-term vision prioritizes sustainability, economic diversification, and community well-being, paving the way for a brighter and greener future for the coal region. The implementation of these transition activities is very important, because it is predicted that if no such activities take place in the area, it is projected that Lampang province will experience a 22% loss in Gross Regional and Provincial Product (GPP) by the year 2050 (EGAT, 2022). This would result in a degradation of the province's GPP ranking from 41 to 48 (out of 77 provinces) in Thailand, demonstrating the significant consequences of not

addressing the situation. Vulnerable populations, including low-income households, women, and marginalized groups, may then experience even more severe consequences due to their existing social and economic challenges.

7.2 Employment situation

National Level

At the national level in Thailand, the unemployment rate has experienced fluctuations from 2013 to 2022, as indicated by data obtained from the World Bank in Table 8. Over this period, the unemployment rate ranged from 0.5% in 2013 to 1.10% in 2020, before slightly decreasing to 0.86% in 2022. The unemployment rate for males followed a similar pattern, with a peak of 1.11% in 2020, while the unemployment rate for females reached its highest point of 1.09% in the same year. The youth unemployment rate, focusing on individuals aged 15-24, remained relatively stable at around 3% from 2013 to 2015, subsequently increasing to 5.31% in 2020 before declining to 4.47% in 2022.

Table 8. Unemployment rates in Thailand

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Unemployment rate	0.4	0.54	0.60	0.69	0.83	0.77	0.72	1.10	0.99	0.86
Unemployment rate for males	0.54	0.55	0.59	0.67	0.82	0.79	0.71	1.11	0.96	0.83
Unemployment rate for females	0.54	0.55	0.61	0.71	0.84	0.75	0.74	1.09	1.03	0.90
Youth unemployment, ages 15-24	3.0	3.15	3.15	3.80	4.47	4.14	4.34	5.31	4.95	4.47

Source: World Bank, 2024.

Projections suggest that the unemployment rate is expected to continue fluctuating in the coming years. However, there is a lack of publicly accessible data regarding employment figures within the energy sector, specifically in areas like renewables and the coal industry. Nevertheless, job loss is a significant apprehension in Thailand when undergoing energy reforms, such as the

transition from fossil energy to RE. The opposition from state-owned enterprises (SOE) employees towards restructuring the energy sector and privatizing three SOEs reflects their worries about potential unemployment, job security, and loss of benefits.

Research conducted by ADB has indicated that as countries shift towards a low-carbon economy, investments in clean and sustainable energy can generate multiple advantages, such as job creation and fostering green growth. It has been observed that fossil fuel technologies require significant capital investments, resulting in a net decrease in employment opportunities. Conversely, renewable energy and energy efficiency projects tend to be more labor-intensive, offering the potential to generate more jobs and cultivate a highly skilled workforce and local economy. Despite these positive prospects, concerns about job security persist in Thailand, particularly among those employed in SOEs.

Regional Level

This section explores various aspects of the just energy transition, including its impacts on employment, social dialogue, skills development, and labor rights. Additionally, it examines the potential future opportunities in terms of job creation and green initiatives at the regional level.

Since the beginning of coal mining in the Mae Moh area in the late 1970s, lignite coal has been extracted from Phase 1 to Phase 8 over the past 50 years. The mining operation will commence a new phase (phase 9) in 2025. Currently, approximately one-third of the contract workers in the Mae Moh district are involved in coal mining operations, with two major coal companies operating in the area: Sahakol Equipment Co., Ltd and Italian-Thai Development PLC (ITD) in phase 8. These companies have not yet provided concrete plans for preparing for the mine closure, especially with the expansion of phase 9 of the Mae Moh mine in 2025 (ULMA, 2024). On the other hand, reskilling and training programs are being considered as EGAT prepares to reduce production capacity by half by 2026 and eventually shut down the Mae Moh mine by 2050 (EGAT, 2022; ULMA 2024).

As mentioned above, there is a lack of publicly accessible data regarding employment figures within the energy sector, including the Mae Moh coal mine in Lampang Province, where job loss due to the expected mine closure is a significant apprehension. Similarly to the national level, SOE employees oppose restructuring the energy sector due to worries about potential unemployment, job security, and loss of benefits. This perception continues to persist, highlighting the importance of addressing employment impacts and ensuring social dialogue during the transition process on the regional level in the Mae Moh coal mine project.

The closure of the Mae Moh coal mine in Lampang Province will have significant direct and indirect implications for employment in the region. Currently, there are 5 sub-districts, 44 villages, and approximately 40,000 people residing in the area. With 47 percent of the workforce employed by EGAT and related companies, with 9,000 job positions, two-thirds with EGAT and

one-third with mine contracts, the closure of the mine will undoubtedly lead to job losses, primarily in the mining sector and informal workers.

In the process of transitioning away from coal mining in the Mae Moh area, ensuring meaningful employee engagement through dialogue and consultations is essential to address their concerns and implement relevant training and skill development programs. EGAT's Mae Moh Green Model (see Chapter 7) includes such activities, namely: job training programs to equip affected workers with the necessary skills for new industries, support programs for small businesses to develop sustainable ventures aligned with clean energy goals, community development efforts focusing on infrastructure improvement and social well-being, and social safety nets to provide necessary support to those most affected during the transition period. Further investigation is needed to assess the level of employee engagement in these consultations and the implementation of associated measures.

In Mae Moh, the First Mae Moh Foresight Workshop, organized by The Office of National Higher Education Science Research and Innovation Policy Council (NXPO) in collaboration with the APEC Center for Technology Foresight (APEC CTF) and EGAT, serves as a platform for representatives from the affected employees, relevant stakeholders, and government agencies to engage in meaningful dialogue and decision-making. This workshop has been instrumental in discussing and developing plans for training and skills development programs, such as providing vocational courses in renewable energy technologies or supporting entrepreneurship in sustainable industries. The Mae Moh Foresight Project has collected information and inputs from stakeholders to devise action plans for Mae Moh city to end coal-fired power generation by 2050 (NXPO, 2023). While social protection and security measures in Mae Moh are in the preparing phase by EGAT under the CSR team and EGAT Environmental Department to mitigate the adverse effects on social groups, one initiative led by the Mae Moh Development Association has created a financial support program and set up job placement services (so far only pilot measures) to assist affected workers in finding alternative employment opportunities in one of the subdistricts. However, it is important to assess if these instruments currently exist and identify any gaps that need to be addressed to ensure a just and smooth transition for all stakeholders involved, particularly at the regional level (EGAT, 2022). To mitigate the adverse effects on the social groups in Mae Moh, several measures can be taken. This includes establishing skills development and training programs to help affected workers transition into new industries and occupations.

Furthermore, implementing social protection measures such as financial support, unemployment benefits, or income assistance can provide temporary relief to affected individuals and households during the transition period. Currently, the Mae Moh Development Association, supported by the Power Development Fund under the ERC, allows for community development initiatives that promote economic diversification, entrepreneurship, and sustainable industries, which can create

new job opportunities and support local economies. These initiatives are also part of the broader plans for Mae Moh, such as the Mae Moh Green Model and Mae Moh Smart City project.

Future Opportunities and Green Job Creation

The transition from coal mining in the Mae Moh area opens up significant opportunities for the creation of green and decent jobs. Lampang Province has the potential to attract investments in renewable energy projects, infrastructure development, and sustainable industries (see Chapter 6.2). By leveraging the existing expertise in the coal sector, workers can be upskilled and trained for new roles in emerging green sectors. Furthermore, initiatives focusing on eco-tourism, sustainable agriculture, and research and development can contribute to job creation and economic diversification in the region.

Labor Rights and Compliance

The Ministry of Labour of Thailand and Department of Labor Protection and Welfare, including partner institutions, plays a crucial role in implementing core labor standards and labor-related human rights, as outlined by the International Labour Organization (ILO). However, further investigation is needed to determine the extent to which these agencies are willing and able to implement these standards in the Mae Moh region. As mentioned in the previous chapter, EGAT is currently decommissioning its lignite coal mine in the Mae Moh district of Lampang province. This transition presents an opportunity for EGAT to prioritize compliance with labor standards and human rights, ensuring that workers' rights are respected and protected during the decommissioning process. It is crucial for EGAT to provide appropriate support, training, and alternative employment opportunities for affected workers to mitigate any negative impacts on their livelihoods.

While the ILO provides a framework for labor rights at the national level, the available information does not directly address the situation at the regional level. Only specific data related to labor rights in some cases from local NGOs such as Enlaw and Greenpeace Thailand exist. However, there are concerns raised by the local NGO, Enlaw, regarding the legal proceedings and the rights of the affected communities. For instance, The Supreme Administrative Court has taken more than 11 years to return a verdict on the two cases related to the Mae Moh coal mine and power plant, which involved the resettlement group and respiratory group affected by the mining operation.

This prolonged legal process has resulted in a significant wait for justice for the affected communities and contract informal workers. Moreover, during this extended period, more than 30 individuals from the affected communities have passed away (EnLaw, 2019). These circumstances highlight the importance of learning from the court's verdict and incorporating its lessons into future energy policies and practices related to coal mining, in order to prevent further tragedies like the one in Mae Moh. It is crucial not to forget that there are still many people living in the vicinity of the project who have not participated in the legal proceedings and have not

received justice, while being exposed to the same issues of low labor standards and human rights." Therefore, a comprehensive assessment is necessary to evaluate the commitment and capacity of state agencies and partner institutions in Mae Moh to uphold core labor standards, including the prohibition of child labor (especially exploitative forms), forced labor, discrimination in occupation and employment, and the promotion of freedom of association and the right to collective bargaining. Furthermore, other labor-related rights such as wages, working hours, occupational health and safety, and maternity leave could also be considered in the evaluation process. To gain a comprehensive understanding of the implementation of core labor standards and labor-related human rights, it is crucial for EGAT and related organizations to explore specific measures, policies, and enforcement mechanisms in place to address labor rights issues in the Mae Moh region. By examining these sources, the commitment and effectiveness of state agencies and partner institutions in upholding labor rights can be assessed, ensuring that appropriate measures are in place to protect workers and promote decent work opportunities.

Establishing a functioning labor inspectorate, which is currently not in place, is essential for monitoring compliance and imposing sanctions in case of violations. Regular inspections and rigorous enforcement are necessary to protect workers' rights and ensure their well-being throughout the transition.

The transition of the Mae Moh coal mine in Lampang Province presents both challenges and opportunities. While job losses are expected in the coal mining sector, the shift towards green industries offers potential for job creation and economic diversification. Ensuring social dialogue, skills development, and compliance with labor rights are crucial components of a successful transition. By embracing these aspects, Lampang Province can pave the way for a sustainable and inclusive future, benefiting both the environment and the local workforce.

7.3 JET related SWOT (economy and employment)

Table 9. JET related SWOT on Economy and Employment

Strengths:	**Weaknesses:**
National: Thailand's positive socio-economic development in recent decades and the country's pledge to become climate-neutral by 2050 are good prerequisites for green economic growth and job creation. Regional:	National: There is a lack of publicly accessible data regarding employment figures within the energy sector, specifically in renewables and the coal industry. This hinders a comprehensive assessment of the employment impacts of a JET. Regional:

Existing expertise: The coal mining sector in Lampang Province has a pool of skilled workers with experience in the energy industry, from which the potentially growing RE sector could benefit.	Prolonged Legal Proceedings and Delayed Justice: The prolonged legal process regarding the Mae Moh coal mine and power plant cases has resulted in a significant wait for justice for affected communities and contract informal workers. Failure to address this weakness can erode trust and undermine the rights of affected communities.
Opportunities:	**Threats:**
National: Potential for green job creation: The transition from coal mining presents opportunities for the creation of green and decent jobs in renewable energy, sustainable industries, and eco-tourism Aligning with the Northern Economic Corridor for Thailand's development plan in Lampang, the focus is on green job creation. This transition offers an opportunity to draw investments in renewable energy projects, infrastructure development, and sustainable industries, thereby fostering the generation of new jobs. Regional: Upskilling and training: Leveraging the existing expertise in the coal sector, workers can be upskilled and trained for new roles in emerging green sectors, ensuring a smooth transition and minimizing un-employment.	National: Violations of Labor Standards and Human Rights: Ensuring compliance with core labor standards and labor-related human rights is crucial during the transition process in Thailand. Failure to establish a functioning labor inspectorate and enforce regulations can lead to violations such as child labor, forced labor, and discrimination. Neglecting this aspect can result in negative impacts on workers and damage the reputation of the project and stakeholders involved. Regional: Job loss concerns: The closure of the Mae Moh coal mine raises apprehensions about potential job losses, particularly among state-owned enterprise employees. The opposition to restructuring and privatization reflects worries about unemployment, job security, and loss of benefits.

Main Drivers:

1. Renewable Energy Transition: The main driver for the Mae Moh coal mine closure is the transition towards renewable energy sources driven by global commitments to reduce greenhouse gas emissions and combat climate change.
2. Economic Diversification: Another main driver is the opportunity for economic diversification in Lampang Province that goes hand in hand with the closure of the coal mine.
3. Economic considerations and cost competitiveness for Mae Moh Region: The declining costs of technologies such as solar power, coupled with the potential for long-term cost savings, make renewable energy increasingly attractive from an economic standpoint.

Main Barriers:

1. Job Losses and Employee Concerns: The closure of the Mae Moh coal mine raises concerns about potential job losses, particularly among employees of the state-owned enterprise.
2. Lack of Employment Data and Planning: Another barrier is the lack of publicly accessible employment data within the energy sector, specifically in renewables and the coal industry. The absence of comprehensive information hampers effective planning and decision-making regarding job transition, skills development, and social dialogue initiatives.

8 Energy

8.1 Description of the Energy sector

National Level

Thailand's electricity sector is facing increasing pressure to transition away from coal-based electricity generation due to its environmental and health impacts. An exploration in the Gulf of Thailand revealed substantial reserves of natural gas and in the 1980s, the government made the decision to utilize domestic natural gas for power generation to mitigate the negative environmental and health impacts associated with power generation by coal. Since then, the use of natural gas in Thailand has been prominent. EGAT currently serves as the sole buyer, transmission operator, and owner of key power plants in the country's single buyer market structure. While some privatization and liberalization efforts have been made in the past, it is unlikely that there will be further moves towards privatizing EGAT or other state-owned entities in the near to medium-term. This presents challenges for transitioning to more sustainable sources of power, as the government will need to find ways to integrate renewable energy sources into the existing energy infrastructure while balancing economic, political, and technical considerations. Therefore, a comprehensive understanding of Thailand's energy sector is vital to identify opportunities and challenges in transitioning to sustainable power, enabling policymakers and stakeholders to develop strategies that overcome barriers, reduce reliance on coal, and achieve a low-carbon energy future.

Generation capacities

Thailand’s energy sector is still heavily reliant on fossil fuels, with coal as the second most important energy source after natural gas. In 2022, 30,9 GW (65,4%) of the 47,2 GW of installed power generation capacity was natural gas, 4,6 GW (9,8%) was coal and 10,3 GW (21,8%) renewable energies, including hydropower. Compared to shares of installed power generation capacity of 71,9% for natural gas and 18,1% for coal in 2010, a shift away from fossil fuels is recognizable. From 2010 to 2022, the share of renewable energy in total energy generation excluding imported electricity has increased substantially from 8,75 TWh (5,3%) to 28,4 TWh (13,2%) and this trend is projected to continue in the near future (EPPO, 2024).

Electricity production and its sources

In 2021, Thailand's total electricity generation amounted to 209,684 GWh. The majority of this was produced by natural gas, generating 113,113 GWh. Following closely behind was coal, with a generation volume of 36,065 GWh, and imported electricity (essentially hydro generated in Laos) at 33,365 GWh. The relative shares of natural gas and coal have fallen steadily, while the shares of renewable energy sources and imported energy have grown (EPPO, 2024).

Thailand has been actively expanding its renewable energy portfolio by integrating biogas, municipal solid waste, and energy crops. Biomass plants dominate the renewable generation landscape, accounting for 63%, followed by hydro at 18%, solar PV at 16%, and wind at 10%. The breakdown of power generation by plant type in Thailand from 2000 to 2021 is detailed in Figure 16.

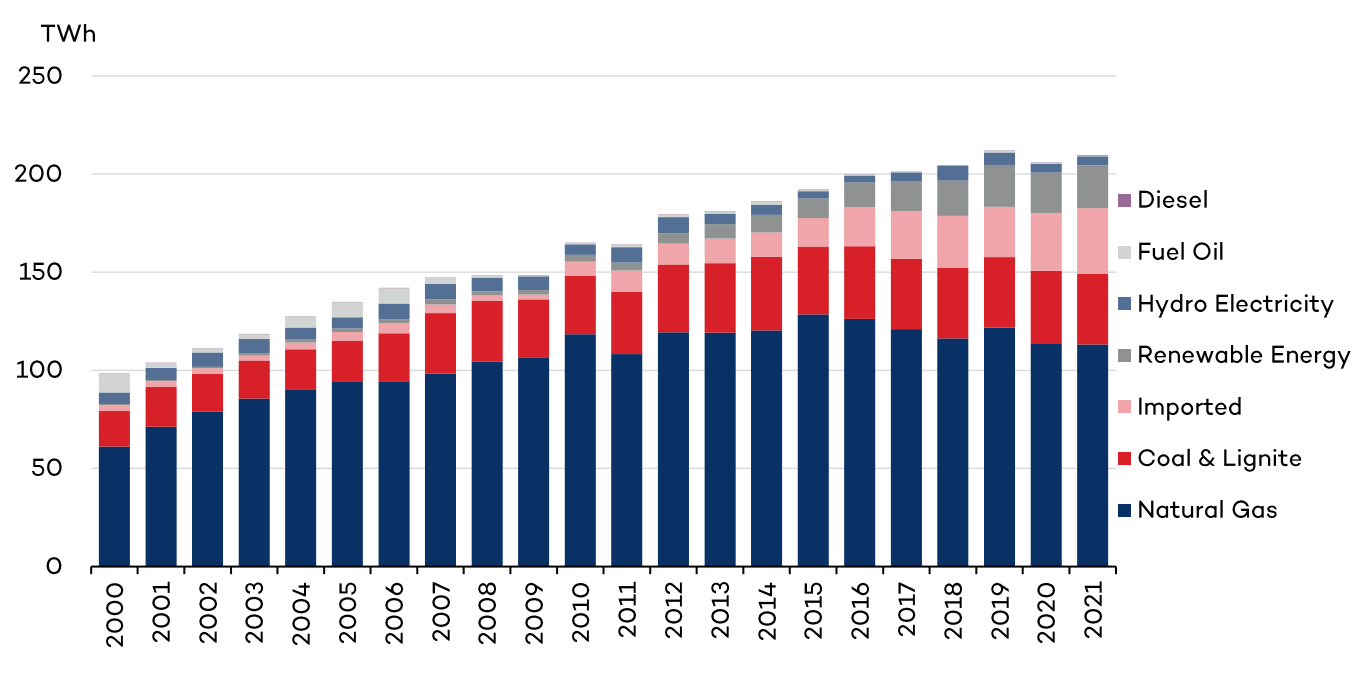

Figure 16. Electricity Generation by source (2001-2021)

Source: EGAT/EPPO, 2024.

The next chart shows the electricity generation capacities broken down by producer.

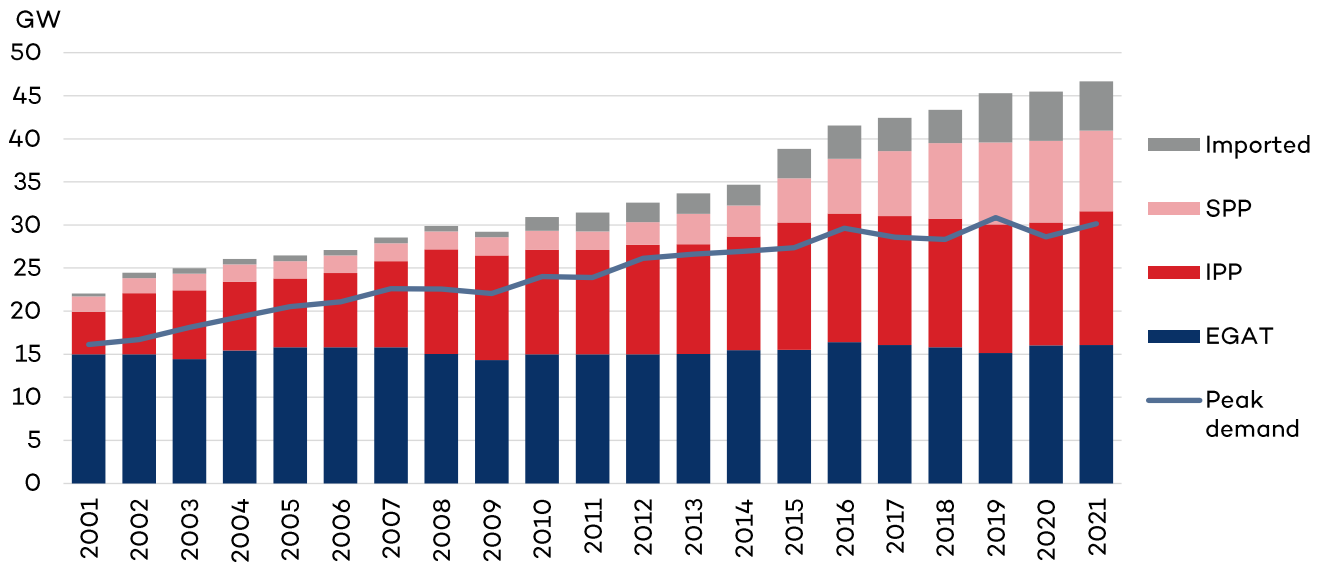

Figure 17. Generation Capacity by producer (2001-2021)
Source: EGAT, 2024.

As of the end of 2021, EGAT, which operates a significant portfolio of coal, Combined Cycle Gas Turbine (CCGT) and hydro plants, owned the largest share of the installed capacity. EGAT currently accounts for roughly one-third of Thailand's total electricity generation, a proportion that has remained largely consistent over the past five years. This represents a slight decline compared to the preceding five-year period. The share of generation from independent power producers (IPPs) has declined slightly over the past five years, while the shares from small power producers (SPPs) with capacities of 10-50 MW and imported generation have increased.

Energy consumption

As of 2022, the energy consumption in Thailand was distributed across different sectors. The residential sector accounted for 53,747 ktoe (29.1% of the total), followed by the business sector with 46,097 ktoe (22.2%). The industrial sector had the highest energy consumption at 88,574 ktoe (46.3%), while the government and non-profit sector consumed 216 ktoe (0.11%). The agriculture sector utilized 335 ktoe (0.2%), and other sectors accounted for 4,219 ktoe (2.1%). Overall, the total energy consumption across all sectors amounted to 193,189 ktoe (EPPO, 2024).

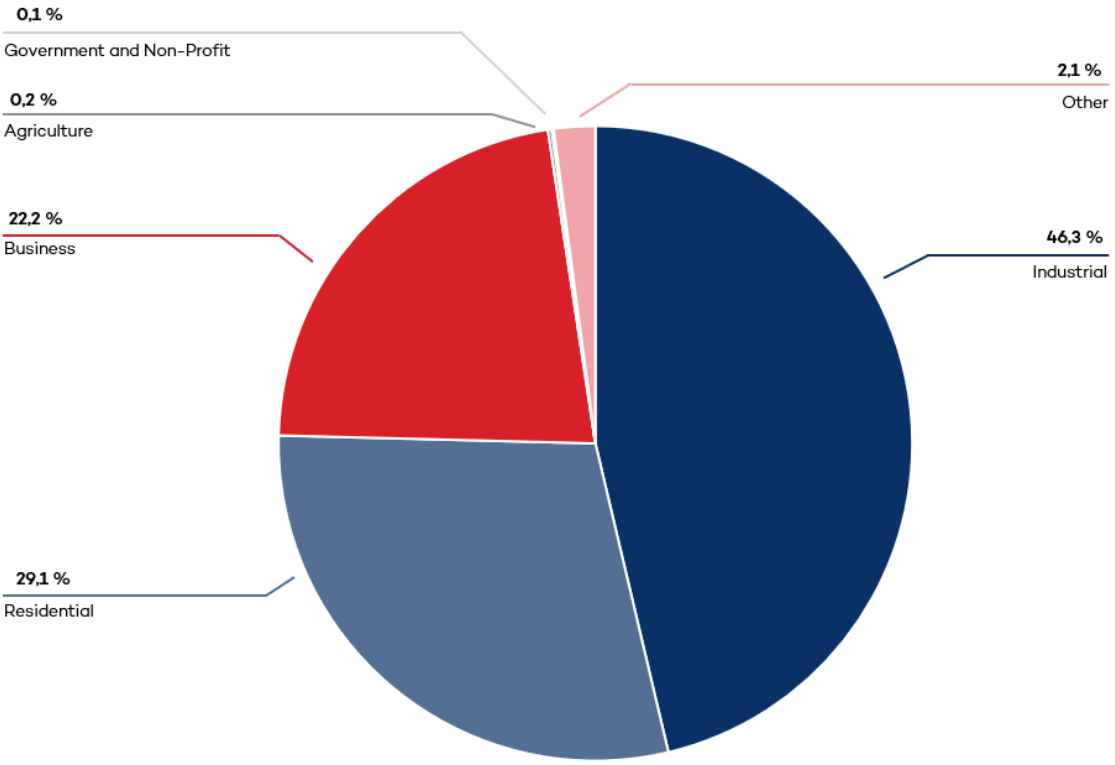

Figure 18. Energy Consumption per Sector 2022

Source: EPPO, 2024.

Power grid system

Electricity distribution in Thailand is mainly overseen by two entities: the Metropolitan Electricity Authority (MEA) in Bangkok and the Provincial Electricity Authority (PEA) in other regions. PEA manages two-thirds of electricity sales, while MEA handles the rest. The transmission network, run EGAT, spans 37,545 kilometers with various voltage lines.

Currently, the grid capacity in Thailand to manage fluctuating renewable energy (RE) power is crucial and requires appropriate infrastructure like energy storage systems and grid management technologies. Robust forecasting tools and grid flexibility measures are also necessary to ensure a stable power supply during the transition to higher levels of renewable energy. Overcoming these challenges is essential to maximize the potential of RE and secure a sustainable energy future for Thailand. It is crucial to highlight that there is currently a lack of clear policies in place to empower the grid infrastructure. Therefore, it is imperative for the government to establish comprehensive and well-defined policies that prioritize the strengthening and modernization of the grid system. By doing so, the potential of renewable energy can be fully realized, enabling a sustainable and resilient energy landscape in Thailand.

Furthermore, as Thailand integrates more renewable energy, opening access to third-party resources can reduce costs, accelerate RE development, and enhance system diversity. While this approach may increase planning complexity and competition, Thailand's limited involvement in third-party access at the domestic level shows a step towards embracing this model. Thailand's participation in cross-border initiatives like the ASEAN Power Grid and others aims to enhance regional energy cooperation, manage fluctuating RE power, and promote sustainable energy transitions across borders. The benefits of a fully integrated ASEAN Power Grid with Multi-National Power Trading could help country reach net-zero targets faster and reducing electricity costs.

Therefore, acknowledging the growing need for grids and infrastructure as the energy transition advances. To enhance Thailand grid capacity, the country should move beyond limited bilateral trading to fully benefit from connectivity. Focus should be on enabling more multilateral power trading, developing grid infrastructure, aligning with sustainable development goals, and strengthening institutions to support ASEAN Power Grid development. Creating new institutions could further facilitate regional energy network integration and development.

Thailand's transmission network, on the other hand, is owned and operated exclusively by EGAT. As of February 2022, the transmission network spans approximately 37,545 kilometers and includes 14,420 kilometers of 115 kV lines, 15,805 kilometers of 230 kV lines, and 7,269 kilometers of 500 kV lines.

There are currently 232 operational substations in Thailand, with a combined transformer capacity of 130,381 MVA. The lower voltage distribution network, which includes systems operating at 115 kV and below, is owned by MEA and PEA. These distribution entities have a monopoly on retailing electricity to consumers in their respective areas.

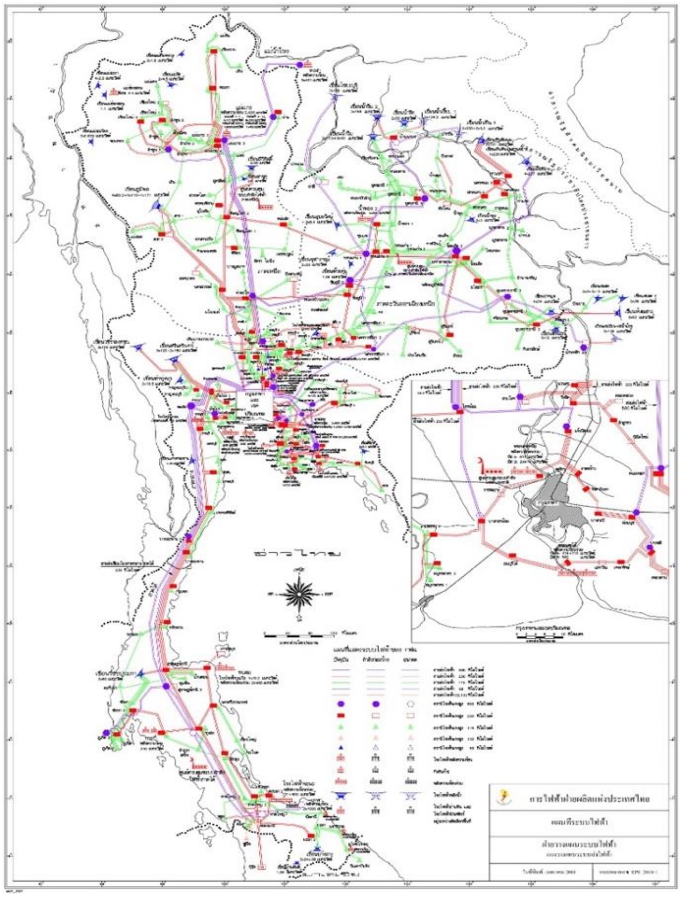

Figure 19. Transmission network in Thailand
Source: EGAT

Thailand is currently expanding its transmission network to establish connections with neighboring countries such as Laos and Cambodia. Some parts of the network are already operational, allowing for the import of electricity from hydro and coal plants in Laos. These plants are partially owned by Thai companies and have long-term power purchase agreements (PPAs) with EGAT. Further details on the transmission can be found in the future expansions, which are anticipated to link Thailand's network with power plants in Cambodia and Myanmar to facilitate the import of electricity into Thailand.

In addition, there is an existing interconnector in the south with the Tenaga Nasional Berhad (TNB) of Malaysia, although the import contract is limited to emergency purposes. The transmission system also plays a critical role in supplying electricity to the Bangkok area, which has a capacity deficit. The 500 kV line, highlighted in purple in Figure 19, serves as the backbone of the transmission network, connecting the border with Laos in the north and north-east to the central plain area, Bangkok, and the southern region. Another important 500 kV line is located in the south-eastern part of the central plain, transmitting electricity from coal- and gas-fired plants, such as those in Rayong and Chacheongsao, through the Wang Noi substation in the north of

Bangkok and the Bang Pakong substation in the east. The 230 kV line, depicted in red, interconnects with several large hydro plants in the west and north of Thailand, while the 115 kV lines are indicated.

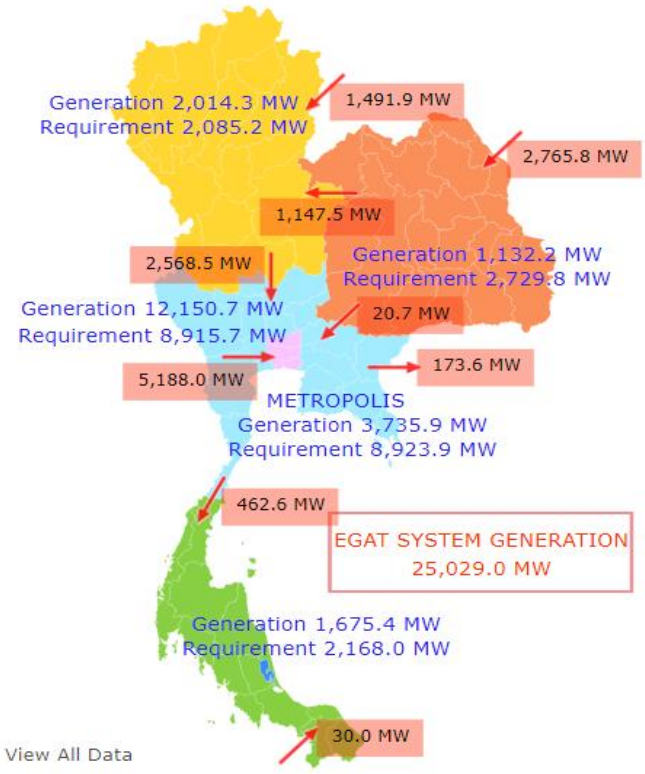

Figure 20. Thailand´s power system
Source: EGAT

An example of electricity flows on 25 March 2022, based on the latest available data, is illustrated in Figure 20. Typically, the electricity transmission in Thailand follows a pattern of flowing from outer provinces to the Bangkok area, where the majority of demand is concentrated. The northern transmission network receives electricity imports from Laos, which are then channeled to the capital area. Similarly, the north-eastern grid handles the southward flow of electricity from Laos to Bangkok.

Inter-regional power flows exhibit seasonal variations. During the winter period, there is generally less electricity consumption in the Bangkok area, resulting in reduced incoming flows from the provinces and across the borders. Conversely, during the dry season, hydro plants in the west, north, and Laos do not operate at full capacity, leading to lower electricity flows from these regions. In contrast, during the summer, demand in the central region exceeds the generation capacity in the area, necessitating higher power flows into the region from outside.

Potential and policies for renewable energies

Thailand has implemented policies aimed at diversifying its energy system and transitioning to cleaner and more sustainable energy sources, including renewable energy and energy efficiency measures. Thailand has set a target of increasing the share of renewable energy in its power mix to 30% by 2037, which suggests that it may reduce its reliance on coal over time and shift towards cleaner energy sources.

Power Development Plan

The Energy Regulatory Commission released the updated version of the Power Development Plan (PDP) in 2018, with projections up to 2037, which was officially approved in the second quarter of 2019. In 2020, a revision of the PDP 2018 (PDP 2018 Rev.1) was announced to align the targeted renewable energy with the Alternative Energy Development Plan 2018 and the new community power plant policy. The PDP 2018 focuses on ensuring security, adequate capacity for system stability, and economic competitiveness of the economy in the long term. Compared to the previous version, the PDP 2015, the PDP 2018 reflects a slight downward adjustment in projected peak demand and generation, and a greater role for gas-fired generation in the capacity mix over the 20-year outlook period. The projections were based on economic growth projections, population growth, energy efficiency, economic activity, and infrastructure development needs.

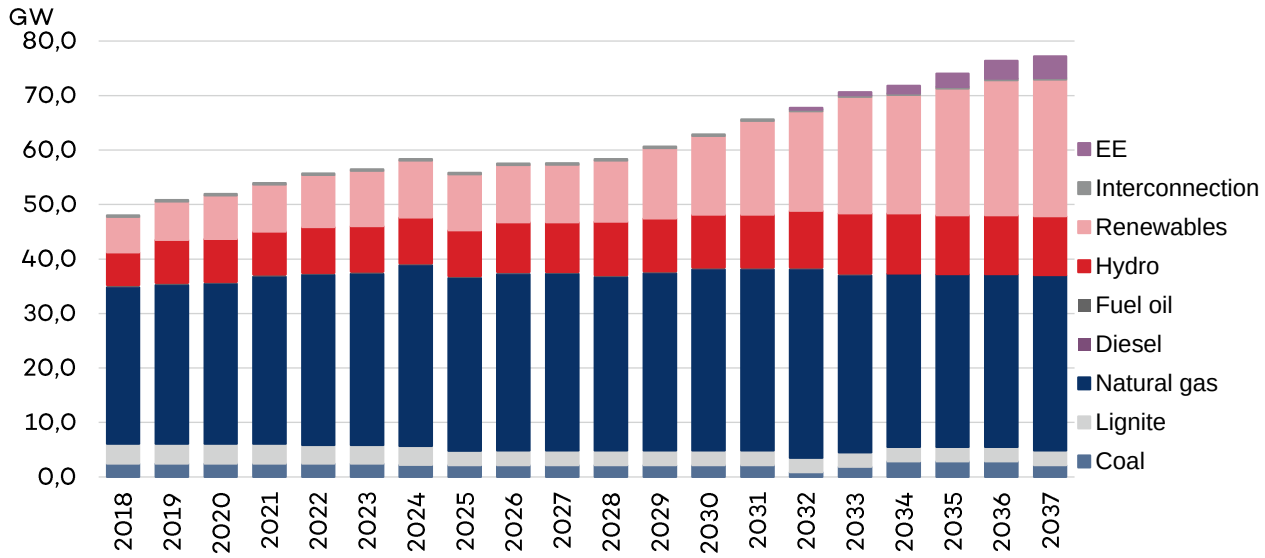

Figure 21. Proposed capacity mix in Thailand

Source: PDP 2018 Rev.1

The PDP underwent significant updates in November 2021 to adjust the renewable generation capacity projections between 2021 - 2037. Notable changes include an increase in projected wind capacity by 1,230 MW, resulting in a revised projection of 1,500 MW. Additionally, the projected hydro capacity, imported from Laos, was raised by 1,366 MW to reach a revised projection of

2,766 MW. Conversely, the projected solar capacity was reduced by 740 MW to 4,455 MW because of grid integration and curtailment issues, and the projected biomass and biogas capacity experienced a decrease of 1,083 MW, leading to a revised projection of 820 MW, which can be viewed critically. Furthermore, there was an increase in the capacity derived from industrial and community waste, with an additional 200 MW, resulting in a new projection of 600 MW. These adjustments reflect both the dynamic nature of renewable energy sources and Thailand's commitment to achieving its renewable energy goal.

In addition to the current efforts, it is worth mentioning that a new version of the Power Development Plan (PDP) is currently being developed in Thailand. This updated PDP is expected to include more ambitious targets for the expansion of renewable energy (RE) sources. The aim is to further accelerate the transition towards a sustainable and low-carbon energy future.

Looking towards the long term, the IRENA roadmap for Thailand projects a total renewable generation capacity increase from 9,000 MW in 2015 to 19,900 MW in 2037, in accordance with the PDP. This capacity will comprise various renewable sources, including 3,300 MW from hydropower, 3,000 MW from wind power, 7,400 MW from biomass, and 6,000 MW from solar PV (IRENA, 2017). These long-term projections not only highlight Thailand's commitment to expanding renewable energy sources but also underscore the country's determination to achieve a more sustainable and environmentally friendly energy landscape. The upcoming revision of the PDP with more ambitious RE expansion targets will play a pivotal role in driving this transition and ensuring a cleaner and greener energy sector for Thailand.

Thailand's commitment to sustainable energy is evident through its National Determined Contributions (NDCs) under the Paris Agreement, which were updated in November 2022. These NDCs outline measurable goals and targets for reducing greenhouse gas emissions by 30% by 2030 and increasing the share of renewable energy in the overall energy mix up to 30% by 2037 (UNDP, 2023).

Thailand has made significant strides in promoting renewable energy through a range of fiscal and non-fiscal policies. As a result, the country's renewable power market has witnessed impressive growth in recent years.

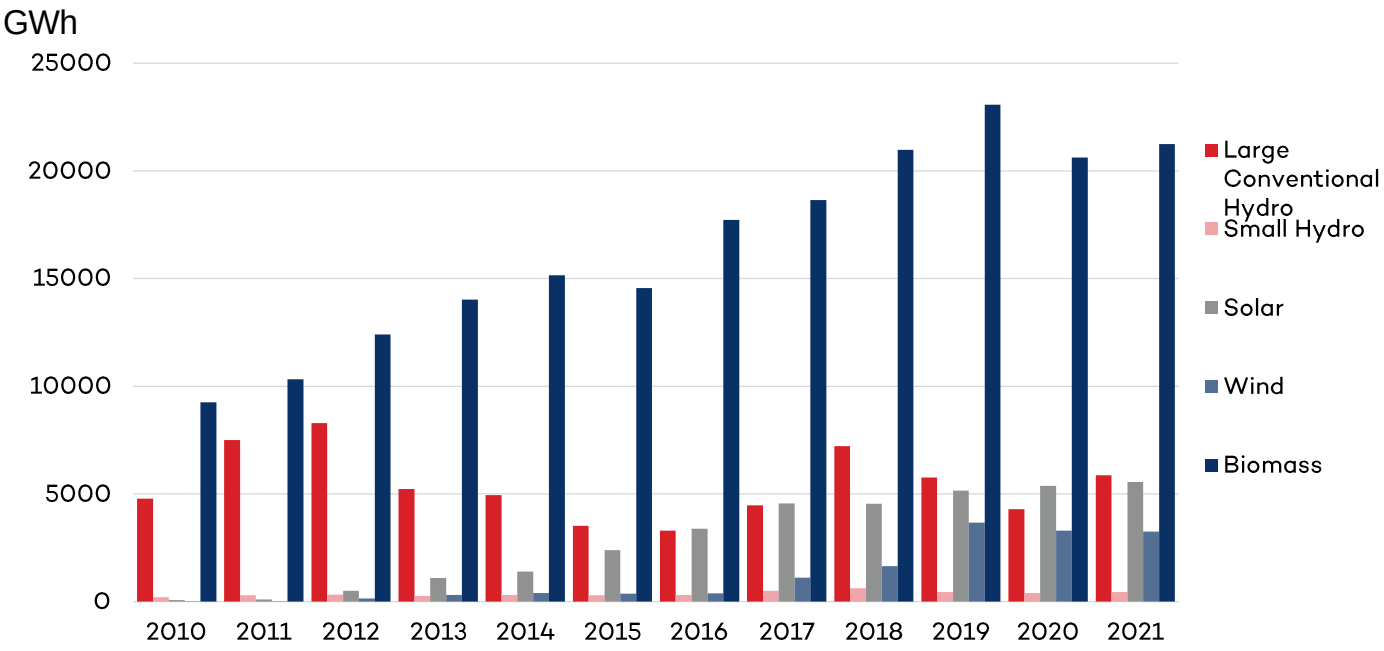

Figure 22. Historical Renewable Growth (2010-2021)

Source: EPPO, 2024.

Among the different renewable sources, biomass leads the way with 21,2 TWh of produced power as of 2021, up from 9,2 TWh in 2010. Solar power has also seen considerable development, with an increase from 64 GWh in 2010 up to 5,5 TWh in 2021. Thailand increased its total installed solar photovoltaic (PV) generating capacity tenfold over the past decade. This progress can be attributed to the incentives offered under various power purchase schemes.

Thailand's solar PV installations are expected to continue to grow in the coming years, driven by a robust pipeline of projects, potential new rounds of tendering for SPPs and Very Small Power Producers (VSPPs), ambitious government targets, and the ongoing reduction in costs, including savings from simplified administrative procedures. The rooftop solar PV market is also expected to remain active, further boosting solar capacity. As a result, it is anticipated that Thailand's solar capacity could reach 8,000 MW over the next decade. This growth in solar power will play a critical role in transitioning to a more sustainable and low-carbon energy future in Thailand. Thailand exhibits promising prospects for generating renewable energy, particularly through solar sources in the central northern regions, as evidenced by the solar capacity potential indicated by irradiation intensity, which is shown in the following figure.

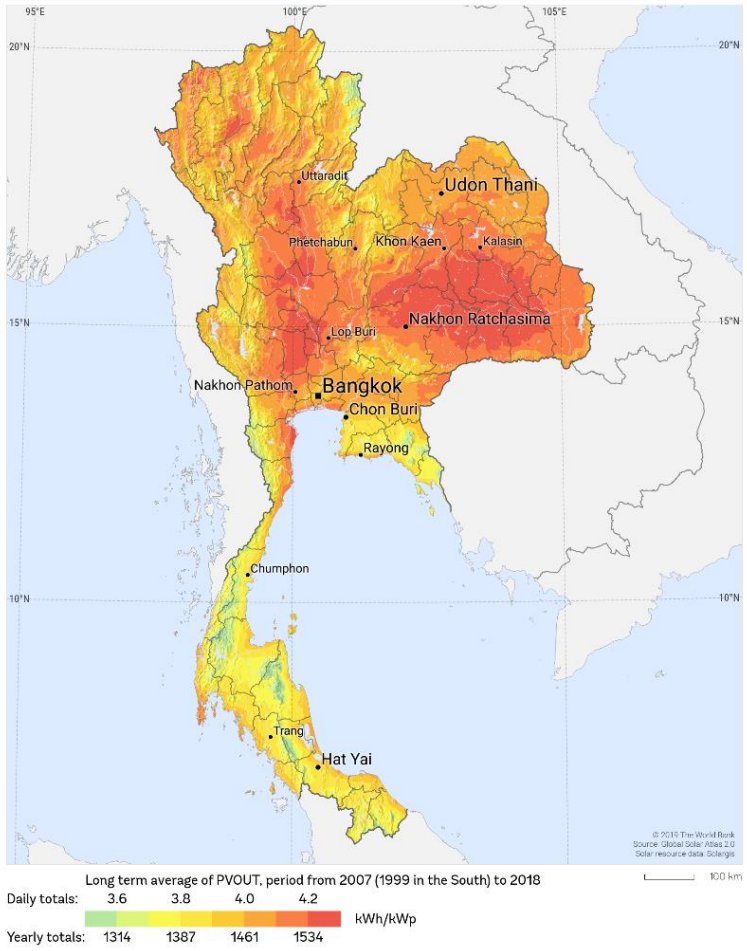

Figure 23. Photovoltaic Power Potential Thailand

Source: Global Solar Atlas, 2019.

However, it is crucial to acknowledge that the economically exploitable capacities of solar energy will be influenced by various factors such as terrain conditions, land use issues, and grid connectivity.

Regarding wind potential, Thailand possesses moderate wind resources, with certain areas in the northeast and south suitable for economically viable wind turbine technology. The electricity generation capacity from these wind resources depends on the efficiency of the wind turbines used to harness the energy. Present and future wind farms situated in the northeast are expected to support the power demand in the Bangkok area, where importing electricity from neighboring load regions is often necessary. Conversely, wind farms in the south aim to meet the local power demand in an area that experiences a chronic capacity deficit, partially due to constrained transmission capacity between southern Thailand and the central and northern regions.

The short-term projections for Thailand's renewable energy sector were formulated considering several factors, including the National Economic and Social Development Board's long-term economic growth projection of 3.8%. These projections encompassed population growth, energy efficiency, economic activity, and infrastructure development needs.

Nevertheless, there are some major obstacles to the development of renewable energy in Thailand:

1. Policy issue

One major obstacle to the development of renewable energy in Thailand is the lack of policy coherence and uncertainties among government agencies responsible for implementing policies, despite the existence of the Alternative Energy Development Plan (AEDP) and its near and long-term targets. This gap in mechanism, measurement, and policy support needs to be addressed to ensure that the transition away from coal is successful and that no one is left behind.

Another obstacle is the regulatory framework, which has primarily been designed to support a centralized electricity system and does not allow for electricity buyback for Commercial and Industrial customer (C&I customers) or direct purchase of renewable energy. This framework hinders the penetration of decentralized renewable energy sources like solar, wind, and biomass energy. However, new rules and regulations are being discussed to make the electricity system fit for decentralized generation like renewable energy. The latest development is the plan to allow direct PPA, where customers can purchase electricity through the transmission and distribution network, and pay wheeling charges to relevant authorities that own and operate the transmission network.

Furthermore, there is a challenge for further development of renewable energy projects as the regulation remains unclear concerning future application tender rounds for FiT. Without clear regulations, the scope for renewable energy projects in Thailand has been relatively quiet, hindering the growth of renewable energy in the country.

2. Technical Issue

It is necessary to address the challenges that hinder the growth and adoption of renewable energy in Thailand. One of the critical obstacles is the inflexible grid code, which is not designed to support distributed generation characterized by small-scale and intermittent generators like solar energy. The current structure of the Thai market design framework is a centralized electricity system, which could cause difficulties in system operation and management with high penetration of solar-based electricity generation in the power grid.

To address this issue, the government needs to implement market design reform to support distributed generation and promote the integration of renewable energy into the grid. The government could consider introducing new regulations and policies that support distributed generation and encourage the development of microgrids in local communities. This approach

can help to reduce the burden on the centralized grid system and promote the growth of renewable energy in Thailand.

Another significant issue is the distance between supply (utility-scale or rooftop plants) and demand, where C&I customers want to invest in or purchase solar generation but have no space while some plants have filled their roof space with the installation and can generate electricity exceeding their demand. To address this issue, the government could consider allowing purchases across areas, which can promote more solar energy generation and provide more opportunities for C&I customers to invest in renewable energy.

Regarding the household rooftop solar purchase scheme, only a small percentage passed the criteria to reach the stage of receiving approval for buyback or net metering schemes. One of the standing issues is the typical installation standard that does not meet the government standard, resulting in some residential households failing at the permitting stage. To address this issue, the government needs to better publicize the installation standards and promote the adoption of equipment that meets the required standards.

3. Financial issue

It is imperative to address the obstacles that impede the phase out of coal and growth and adoption of renewable energy in Thailand. One major challenge is the substantial upfront capital required for related renewable energy projects, specifically for grid infrastructure, grid operation, and the integration of renewable energy. These aspects, which must be owned by state-owned companies like EGAT, MEA, and PEA, face financial constraints that further complicate the situation.

Another challenge is the lack of an affordable transmission system for renewable energy projects, particularly for solar ventures. While private entities can construct transmission systems for certain projects such as cogeneration plants or floating solar facilities, building an exclusive transmission system for solar projects proves to be economically unfeasible. The cost of such a system significantly outweighs the limited operational hours of solar energy, resulting in a diminished economic return from rooftop projects. Hence, the problem lies in the absence of a cost-effective transmission system rather than solely the lack of grid connection and net-metering.

EGAT's Triple S Strategy: Paving the Way for Climatic Sustainability in the Energy Transition Period

EGAT has declared its intention to drive towards energy security and EGAT Carbon Neutrality by 2050. First, under the **Sources Transformation** aspect, EGAT aims to reduce greenhouse gas emissions in electricity generation and transmission. This involves increasing the proportion of renewable energy sources in the electricity mix, upgrading power plants and the electricity system with advanced technology to enhance flexibility in renewable energy generation, and

implementing energy storage systems like pumped-storage hydropower plants, Battery Energy Storage Systems (BESS), and Hydrogen Energy Storage Systems (HESS).

The **Sink Co-creation component** focuses on carbon dioxide absorption. EGAT plans to collaborate with partners to reforest an area of 1 million rai (160,000 hectares) by 2031. Additionally, EGAT is exploring the deployment of Carbon Capture, Utilization, and Storage (CCUS) technology in its power plants to further offset carbon emissions.

Lastly, the **Support Measures Mechanism** aims to promote public participation in greenhouse gas reduction. EGAT places a strong emphasis on power-saving initiatives, such as the No.5 Energy-Saving Label Project, and actively promotes electric vehicles through the development of EV Business Solutions. This includes implementing EleX by EGAT charging stations, the EleXA Application, EGAT Wallbox home chargers, and the BackEN management system. Additionally, EGAT undertakes various other initiatives, including the Green Classroom Project, promoting the Bio-Circular-Green (BCG) Economy, managing waste electrical and electronic equipment, and implementing the Mae Moh Green Model.

Through these comprehensive initiatives, EGAT is actively working towards achieving EGAT Carbon Neutrality by 2050. The Triple S Strategy encompasses the transformation of energy sources, co-creation of carbon sinks, and support measures to drive sustainable and environmentally friendly practices in Thailand's energy sector (EGAT, 2022).

Regional level

As of 2021, the capacity of the Mae Moh coal power plant is 2,455 MW. However, according to the PDP, by the year 2025, there is a target to decrease the capacity by ca. 50%, bringing it down to 1,255 MW. Ultimately, the plan aims for a complete phase-out of coal power generation, with zero capacity by the year 2050. MOE in Thailand is pursuing the introduction of four new coal-fired power generators into the energy grid in the Lampang district. Recently, EGAT proceeded with the Mae Moh power plant replacement project. A new thermal plant with an installed capacity of 660 MW (Unit 14) will be built to replace the existing units 8-9 (600 MW), which will be decommissioned. Construction is scheduled to begin this year, and they are expected to operate from 2026 to 2050 (EGAT, 2023).

In pursuit of the goal to boost solar energy capacity to 4.455 GW by 2037, outlined in the PDP from 2018 rev.1, a substantial portion is to be situated in the Northern Region of Thailand, potentially reaching an impressive range of 2400-5000 MW. The solar power sector is anticipated to experience significant growth, fostered by favorable feed-in tariffs and the decreasing costs of solar PV systems (EPPO, 2021). This strategic combination of local government initiatives and regional market dynamics sets the stage for a promising future for solar energy in the Northern region.

Concerning JET strategies on the regional level, one example of a strategy relevant to a coal phase-out transition is the Mae Moh closing plan, which sets a goal of phasing out coal-based power generation by 2050. The plan encompasses various initiatives, including investments in renewable energy infrastructure, particularly in solar power, battery technologies, and pumped hydro storage in the Mae Moh area. These strategies exemplify Thailand's dedication to reducing its dependence on coal and fostering a transition towards a more sustainable and resilient energy system. The regional government in Lampang is actively exploring policies to promote the adoption of solar PV technology, with a particular focus on smaller-scale applications in the commercial and residential sectors, as highlighted in the Mae Moh Green roadmap. Although there is currently a dearth of solar rooftop purchase schemes for commercial and industrial users, the growing inclination towards a more sustainable economy is generating significant interest in these applications. The northern part of Thailand is also witnessing the launch of one of the world's largest floating hydro-solar hybrid projects, (EGAT, 2022) and there are plans to invest in similar projects at other dams in the region. Moreover, private companies are actively planning to construct floating solar plants within industrial estates to generate clean energy for internal consumption.

At the regional level, the convergence of technology, government policy and social awareness is driving the widespread adoption of solar energy in the northern region of Thailand. The integration of innovative technologies and digitalization has enabled businesses and residents in the region to buy and sell electricity among themselves, including through peer-to-peer trading programs and access to third-party suppliers, facilitating direct energy exchange between individual consumers.

Additionally, the implementation of third-party access ensures equal grid access for independent market participants, facilitating energy trading with consumers and other players in the market.

Financial mechanisms at national and regional levels

The development of green financing policies is crucial. To achieve a just transition, policymakers should collaborate with central banks, regulatory authorities, and investors to develop a green finance policy, explore options like green bonds, and employ de-risking and direct incentives to reduce high financing costs associated with renewable energy technologies in developing countries, as outlined in the United Nations Development Programme's guide on de-risking renewable energy investment. There are various types of finance available for solar projects in Thailand, including:

1. Commercial loans: This is the most common form of finance for solar projects in Thailand. Commercial banks offer loans at competitive interest rates, with repayment periods ranging from 5 to 20 years.

2. Green bonds: Green bonds are a type of fixed-income instrument that are used to fund environmentally friendly projects. In Thailand, the government has issued green bonds to finance renewable energy projects, including solar.
3. Crowdfunding: Crowdfunding is becoming increasingly popular in Thailand, with several platforms offering investment opportunities in solar projects.
4. Government subsidies: The Thai government offers various subsidies and incentives for renewable energy projects, including solar. These include feed-in tariffs, tax incentives, and grants.
5. Power purchase agreements (PPAs): PPAs are contracts between solar developers and energy consumers, where the consumer agrees to purchase the electricity generated by the solar project at a predetermined price.

The finance requirements for solar projects in Thailand depend on the size and scope of the project, with small-scale projects typically requiring a few thousand dollars and larger utility-scale projects necessitating investments in the millions. The main costs associated with solar projects in Thailand include equipment and installation costs, land acquisition, and maintenance expenses. While it is common for international public banks like ADB or the World Bank to support renewable energy projects globally, their specific involvement in the solar sector in Thailand is not explicitly mentioned. The availability of funds for further expansion of solar projects in Thailand is an important factor to consider, and the willingness of financial institutions to finance such projects and the overall investment landscape play a crucial role. The potential scarcity of capital as a bottleneck requires further examination, as factors like government incentives, investor confidence, and the interest of financial institutions can influence the availability of finance for solar projects in Thailand.

8.2 Jet related SWOT (energy)

Table 10. JET related SWOT on Energy

Strengths:	**Weaknesses:**
National: Implementation of favorable renewable energy policies and regulations, which create a conducive environment for the growth of the sector The availability of incentives, subsidies, and tax benefits further encourage investment in renewable energy projects. The support for	National: The regulatory framework in Thailand's energy market, operating under the enhanced single buyer model, exhibits weaknesses that include limited competition, lack of market flexibility, and potential inefficiencies. Conflicts between state-owned energy enterprises' focus on maximizing electricity sales

research and development in renewable technologies fosters innovation and technological advancements in the sector. Regional: Lampang benefits from abundant solar resources due to its favorable geographic location. This, coupled with the falling costs of solar photovoltaic (PV) systems, presents a significant opportunity for the expansion of solar energy generation. Lampang has access to biomass resources, which can be utilized for bioenergy production, contributing to the diversification of renewable energy sources and reducing reliance on fossil fuels.	and promoting energy conservation, along with mismanagement and inadequate incentives, hinder Thailand's achievement of renewable energy targets, except for successful solar power initiatives by private operators. Policy uncertainty and discontinuity in Thailand's energy sector create challenges and hinder the development of a stable and long-term investment environment for sustainable energy projects. The inflexible grid code in Thailand's energy sector hinders the seamless integration of renewable energy sources and emerging technologies, requiring an update to enable grid flexibility and ensure reliable electricity transmission and distribution. Lack of capital for RE investments. Regional: The distance between supply (utility-scale or rooftop plants) and demand Lack of coordination between public and private sectors Limited Grid Capacity as upgrading and expanding the grid infrastructure to support increased renewable energy generation may require significant investments and time.
Opportunities:	**Threats:**
National: Emerging Technologies and Digitalization, e.g. peer-to-peer trading programs. Increasing Energy Demand and Market Potential Rising public awareness and demand for clean and sustainable energy sources. Regional: Regional Collaboration and Integration: Opportunities for regional collaboration with neighboring countries to develop cross-border renewable energy projects.	National: Distorted fiscal and regulatory policy. Regulatory and Policy Challenges as diverse regulatory frameworks and policies among neighboring countries could pose challenges to harmonizing renewable energy regulations and standards at the regional level. Regional: Fragmented authority and capacity limitations for regional stakeholders. Grid Infrastructure Limitations: Insufficient grid infrastructure and interconnection capabilities between countries may hinder the transmission

Integration of cross-border energy markets in South-east Asia to facilitate the sharing and trading of renewable energy resources. Attraction of foreign direct investment in renewable energy projects, leveraging Lampang's strategic location and supportive investment climate.	and integration of renewable energy at the regional level. Inadequate investment in grid upgrades and modernization could limit the effective distribution and utilization of renewable energy resources.

Main drivers:

1. Government Policies and Investment Incentives promoting alternative energy development
2. Abundant solar resources and falling costs of solar PV systems.
3. Emerging technologies and digitalization such as peer-to-peer trading programs and third-party access are expected to further sustain the uptake of solar power in the country.

Main barriers:

1. The regulatory framework of the power sector, which has primarily been designed to support a centralized electricity system, hinders the penetration of decentralized renewable energy sources like solar, wind, and biomass energy.
2. The inflexible grid code, which is not designed to support distributed generation characterized by small-scale and intermittent generators like solar energy.
3. The absence of a cost-effective transmission system for solar energy is hampering its large-scale expansion.
4. The lack of substantial upfront capital required for related renewable energy projects, specifically for grid infrastructure, grid operation, and the integration of renewable energy.

9 Results from the analysis and recommendations for the JET process

In order to prepare the ground for developing fact-based ideas for the support of a coal phase-out and a JET process in Thailand, key areas were analysed. In the following, the major results as well as the conclusions and recommendations deducted from the analysis are presented.

9.1 On the national level of Thailand

Governance

In 2016, Thailand ratified the Paris Climate Agreement. In the NDCs from 2022, the increased greenhouse gas (GHG) reduction target was raised by 20% to 30% by 2030 compared to the business-as-usual scenario. The conditional target to be achieved with international support was raised from 25% to 40% reduction. Thailand reaffirms its commitment to achieving carbon neutrality by 2050 and net-zero GHG emissions by 2065. Key GHG mitigation measures identified by the government include increasing the proportion of renewable electricity generation, enhancing energy efficiency across all sectors, and adopting emerging technologies like energy storage, hydrogen, and carbon capture, utilization, and storage (CCUS) to further reduce emissions. Thailand's key strategic instruments which support JET processes are the Power Development Plan (PDP) and Alternative Energy Development Plan (AEDP) guiding renewable energy development, while the Energy Conservation Promotion Law promotes energy efficiency.

Although Thailand has established numerous plans and policies with relevance for a JET[2] and even a Climate Change Master Plan, there is no explicit commitment to fully phase out coal in energy production on the national level and to focus on a just energy transition. Nevertheless, EGAT has expressed its intention to phase out coal by 2051 and has decided against constructing new coal power plants beyond 2026. Key government agencies, such as MOEN, NEPC, and ERC actively support renewable energy and coal phase-out initiatives. However, decision-making processes on the coal sector in Thailand have been criticized for not being inclusive of all local populations affected by it. The government has been accused of not adequately consulting with local communities and not taking their concerns into account when making decisions on coal projects.

2 e.g. National Energy Plan Framework, Power Development Plan, Smart Grid Development Master Plan, Energy Efficiency Plan, Alternative Energy Development Plan, Sustainable Transport System and Climate Change Mitigation Plan

Conclusions and recommendations:

Integrate and develop a coal phase-out and JET strategy into all relevant strategies and plans as regards the energy transition, climate change mitigation and adaptation as well as economic and social development.

As features of the JET strategy, the government should

- Adopt transformative policies and establish targets to prioritize renewable energy over coal and gas.
- Promote the development of community-based regional plans in coal energy regions, ensuring proper closure and ecological regeneration of coal mines and promoting sustainable and inclusive growth with meaningful inclusion and participation of affected groups, in particular of women and marginalized groups.
- Provide social protection for affected mine and coal power plant workers.

This should include effective governance practices, participation, transparency, and efficient transition management, with a focus on the Lampang region and affected sectors.

Coal and energy sector

As shown above, Thailand's energy sector is still heavily relying on fossil fuels for power generation (gas and coal accounted for 75% of installed power generation capacity in 2022). The country aims at achieving carbon neutrality by 2050 and net-zero GHG emissions by 2065 (UNFCCC, 2022) and after a gradual decrease, the complete phase-out of coal-fired power generation by EGAT is only scheduled for 2051. A building block for this is EGAT's Triple S Strategy, under which EGAT aims i) to reduce its GHG emissions through the expansion of renewable energy and storage systems, ii) to capture CO2 through reforestation and the use of Carbon Capture, Utilization, and Storage (CCUS) technology, and iii) to increase public participation in the transformation process through electricity conservation initiatives, promotion of electric vehicles, awareness raising and other soft measures. The intended goal is EGAT's carbon neutrality by 2050.

The total installed capacity of RE as of 2022 is 10.3 GW (21.8 %), including hydropower. Thailand exhibits promising prospects for generating renewable energy, particularly through solar sources in the central regions, as evidenced by the solar capacity potential indicated by irradiation intensity. However, the economically exploitable capacities of solar energy will be influenced by

various factors such as terrain and weather conditions, land use and purchase issues, and grid connectivity. Looking towards the long term, the IRENA roadmap of MOE for Thailand projects a total renewable generation capacity increase from 10.3 GW in 2022 to 19.9 GW in 2037, which would correspond to a share of only 32%, in accordance with Thailand's Power Development Plan (PDP). This capacity will comprise various renewable sources, including 3,300 MW from hydropower, 3,000 MW from wind power, 7,400 MW from biomass, and 6,000 MW from solar PV (IRENA, 2017). The regulatory framework of the power sector, which has primarily been designed to support a centralized electricity system, hinders the penetration of decentralized renewable energy sources like solar, wind, and biomass energy. Another critical obstacle, that hinders the growth and adoption of RE in Thailand, is the inflexible grid code, which is not designed to support distributed generation characterized by small-scale and intermittent generators like solar energy. Furthermore, the absence of a cost-effective transmission system for solar energy is hampering its large-scale expansion as well as the substantial upfront capital required for related renewable energy projects, specifically for grid infrastructure, grid operation, and the integration of renewable energy.

Conclusions and recommendations:

At the time of writing, plans to phase-out coal-fired power generation only in 2051 and a foreseen RE power capacity share of only 32% in 2036 will contribute to continuously high CO2-emissions and consequently to sustained negative environmental impacts. The coal phase-out should be brought forward and the expansion targets for renewable energies should be increased in order to exploit the country's large RE potential.

- Scrutinize the framework conditions (natural conditions, regulatory framework, power market design) to establish adequate policies to strengthen the transition to RE, in particular as regards to the analysis of the influence of changing weather conditions on RE capacities.
- Improve the T grid system , including the adjustment of grid codes to integrate higher proportions of de-centralized and fluctuating RE into the grid and the establishment of a cost-effective transmission system.
- Develop and integrate storage capacities into the power grid.
- Design feed-in tariffs that stimulate investments without generating more profits than necessary.
- Provide land policy for establishing RE facilities.
- Push for the phasing out of fossil fuel subsidies .

The government should establish financial incentives in the form of investment subsidies and soft loans for potential investors of RE projects.

Society

Thailand has achieved notable human development levels and possesses the second-largest economy in Southeast Asia. Its economic growth is driven by manufacturing, agriculture, and tourism sectors. It has made substantial progress in reducing poverty over the years. The poverty rate declined from 67.2% in 1986 to 6.8% in 2020. However, challenges persist, particularly in addressing pockets of extreme poverty and income disparities between different regions and population groups. The country has made notable strides in promoting gender equality, improving education and healthcare systems, and strengthening social protection programs. However, challenges remain in ensuring equal access to justice, protecting the rights of marginalized groups, and tackling issues related to freedom of expression and assembly.

The **narratives** around coal in Thailand vary, with some emphasizing its economic benefits and role in driving growth and meeting energy demand, while others focus on the negative environmental and social impacts such as air pollution, deforestation, and climate change. Traditionally, the dominant narrative in Thailand has focused on the economic benefits of coal, highlighting its affordability and energy security advantages. In recent years, however, a new narrative has emerged that remains marginal for the time being. It emphasizes the need to prioritize renewable energy sources and reduce the dependence on coal in order to address environmental and health concerns. This perception is largely influenced by the negative consequences experienced due to the operation of Mae Moh's lignite thermal power plants, which have caused significant environmental impacts such as land degradation, deforestation, air pollution as well as health deterioration. Consequently, there has been strong public opposition to coal-fired power plants in Thailand. The proposed coal-fired power plant in Krabi (in the South of Thailand) faced strong opposition from locals, the situation in Mae Moh is similar. The proactive efforts from civil society, including women and marginalized groups, played a crucial role in mobilizing opposition and ultimately preventing the construction of the coal-fired power plant in Krabi. The population seems to become more and more reluctant to coal power plants. The concept of a just transition of the coal sector in Thailand has gained some traction in recent years, aiming to address the social and economic implications for affected communities and workers during the transition away from coal. This is also reflected by the government and has led to the energy sources transformation in EGAT's Triple S Strategy to achieve carbon neutrality by 2050.

Conclusions and recommendations:

Amongst the competing narratives on coal, the one on coal phase out and just energy transition needs backing. A JET process can build upon on a certain reluctance against coal mining and coal power although the predominant narrative is still rather pro coal. Activities for fostering the awareness of the need and the benefits of a JET narrative should be strengthened, stakeholders in favour of a JET process should be supported and empowered.

As regards topics of the JET narrative, the country's commitment to economic development, poverty reduction and environmental objectives should be taken into account and built upon. In particular, human rights challenges for marginalized communities and indigenous groups, affecting their access to a healthy environment, land, resources, and cultural identity deserve particular attention. The dialogue with political institutions in charge of energy policy and regional development of the coal regions should be strengthened.

The participation of local communities, including women and marginalized groups, in the development of regional plans for sustainable and inclusive growth should be facilitated.

Economy and Employment

The coal industry does not play a critical role in Thailand's economy (2.55 % of GDP), national production is declining, domestic coal produced is not an export product, and projections for the country's coal demand also show a downward trend, which will also be associated with a decline in the workforce in this sector. On the other hand, the RE sector in Thailand employs more and more people. According to ILO estimations, more than 17,000 employees were working directly in RE in 2016 and there is potential for a quick growth as well as for the generation of indirect jobs in installation and maintenance. However, the lack of differentiated and disaggregated publicly accessible employment data, including in the energy sector, specifically in renewables and the coal industry, remains a barrier for managing the change on the labour market. It hampers effective planning and decision-making regarding job transition, skills development, and social dialogue initiatives.

Conclusions and recommendations:

The potential for viable alternative economic diversification and development paths in context of a JET process should be explored in more detail, taking into account the views of stakeholders.

Engaging the private sector through partnerships, initiatives, and clear benchmarks is crucial for accelerating investment in renewable energy and facilitating the phase-out of coal power plants. This can be achieved by promoting private-public partnerships, creating favorable investment conditions, providing incentives, and streamlining regulatory processes to attract private sector participation.

Needs for social protection of affected workers in coal mines and power plants as well as for reskilling and job placement should be examined thoroughly. Based on the results, support schemes are to be developed.

Extensive data surveys and analysis regarding employment figures within the energy sectorshould be carried out to make a comprehensive assessment of the employment impacts of a JET.

9.2 On the regional level of the Lampang region

The phase-out of coal in the Lampang region by 2051 – for mining as well as for power generation - is key to Thailand’s target to achieve carbon neutrality by 2050, net-zero carbon emissions by 2065.

Coal and energy

The Mae Moh coal basin in Lampang province, located in the northwest of Thailand, is the last operating coal mining area of the country and is the largest source of lignite (brown coal) in Thailand. Mining started in 1955 and over the years, an area of approximately 13,000 hectares was covered. In line with Thailand's goal to reduce the capacity of coal-fired power plants, as stated in the draft PDP 2022, domestic lignite production is expected to gradually decrease from 2021 to 2030. In 2021, 14.2 Mt have been produced and by 2030, it is projected to reach around 6.0 Mt aligned with future capacity of Mae Moh Coal power plant. The majority of lignite produced from the Mae Moh mine is used to fuel the nearby Mae Moh thermal power plant operated by EGAT. As of 2021, the capacity of the Mae Moh power plant is 2,455 MW, it is the largest thermal power plant in the country. It provides 50% of electricity to the north, 30% to the central region, and 20% to the northeast. According to the PDP, by the year 2025, there is a target to decrease the capacity by around 50%, bringing it down to 1,255 MW. Ultimately, the plan aims for a

complete phase-out of coal power generation, with zero capacity by the year 2051. Nevertheless, four new coal-fired power generators are foreseen in the Lampang district. The Thai cabinet has already granted approval for the first two plants, which will have a combined capacity of 660 megawatts. Construction for these plants is scheduled to begin this year, and they are expected to operate from 2026 to 2050. These plants will be integrated into the existing coal-powered generators at the Mae Moh power plant. The Mae Moh closing plan, a coal phase out plan on the regional level, sets a goal of phasing-out coal-based power generation by 2050. The plan encompasses various initiatives, including investments in renewable energy infrastructure, particularly in solar power, battery technologies, and pumped hydro storage in the Mae Moh area.

Thailand's northern region has abundant potentials for RE expansions, especially for solar PV, which is a clear strength that could drive the JET process. According to the Mae Moh Green Model roadmap, the area is to be developed into a RE generation hub, with a capacity of approximately 5,405 MW coming from solar farms, biomass plants and pumped storage. On the other hand, there are weaknesses that hinder the exploitation of this strength, namely the non-capable power grid and the uncomprehensive regulatory framework for the expansion and grid integration of higher RE shares.

Conclusions and recommendations:

Develop a comprehensive plan or expand the Mae Moh closing plan for the closure of the EGAT Mae Moh Coal mine to ecological regeneration through land rehabilitation, reforestation, and ecosystem restoration. If necessary, with collaboration among environmental experts, local communities, and government agencies to ensure effective implementation.

Improvingthe framework conditions (natural conditions, regulatory framework, power market design) for a JET process on the national level is crucial for progressing in Lampang; see for details recommendations in energy/coal section on national level.

Expand the exploitation of the Lampang region's enormous potential for photovoltaics and biomass as sources of renewable energy.

Society and Governance

In Lampang, basically we find the same pro-and con-narratives about coal as on the national level. Several key actors have emerged as active supporters of JET including EGAT, the Lampang regional government, academic institutions, and civil society, who actively advocate for JET and align their efforts to support its objectives. However, some national stakeholders such as EPPO, ERC, and big mining companies have taken opposing positions towards a JET. They aim to

prolong the operation of existing coal facilities and even propose the addition of four new coal-fired power generators to the grid. In general, the understanding of just energy transition in Lampang remains low. This lack of awareness extends to the workers and unions in the region.

Lampang District exhibits a diverse demographic makeup characterized by a blend of ethnic groups, including the Thai majority and various hill tribes such as the Karen, Hmong, and Lahu. Lampang District contains pockets of poverty, particularly among marginalized communities and ethnic minorities such as three indigenous groups, the Mlabri, Kaw (Umpi) and Bisu, which face constrained access to education, healthcare, and economic opportunities. Coal mining activities contribute to environmental degradation, encompassing air and water pollution, adversely affecting the health and well-being of local communities. Consequently, conflicts have arisen within the context of coal mining, involving mining companies, local communities, and indigenous groups. These conflicts often revolve around contentious issues such as land rights, displacement, and environmental concerns. Human rights violations have emerged, encompassing the infringement of the right to a healthy environment, land and natural resources, and cultural identity. Various actors contribute to these violations, including mining companies, government agencies responsible for mining licenses and oversight, and law enforcement agencies engaged in maintaining order during conflicts (World Bank Climate Change Knowledge Portal, 2022). In the context of the Mae Moh coal mine in Lampang, local communities and stakeholders, who bear the direct impacts of the coal mine, have often been excluded from participating in the decision-making processes. Up to 30,000 people have been displaced during the construction of the power plant. In Lampang, there has been a lack of inclusivity in decision-making between EGAT and the local community. GIZ observations indicate that this conflict has led to decisions that do not adequately consider the social, economic, and environmental impacts on the local populations. Grassroot activism and community empowerment hold great importance within the Mae Moh coal mine context. Local communities have united through civil associations, community spokespersons, and NGOs to voice their concerns and demands. Consequently, the exclusion of the local community has generated feelings of powerlessness, frustration, and distrust among those affected. In addition, concerns have arisen regarding corrupt, clientelist and patronage-based structures and practices in relation to the JET processes in Thailand, including the Mae Moh coal mine.

The primary instrument relevant for JET at the regional level is the Mae Moh Green Model Road Map (see below), which considers the key driving forces of the Mae Moh Green Model. Thai government has established The Power Development Fund to alleviate the impacts of coal mining and burning on local communities. Managed by EGAT and ERC, the fund covers 790 entities across 77 provinces in Thailand, including the Mae Moh Power Development Fund, the country's largest, serving 5 subdistricts in the Mae Moh district. Funding criteria involve 50,000 baht per megawatt annually during construction, with an additional consideration of 2 satang per unit of electricity generated during coal operation. It provides more than three hundred million baht annually for the local community in Mae Moh. However, challenges such as transparency issues,

lack of success indicators, and mismanagement by appointed committees have hindered the fund's effectiveness over the past decade, failing to deliver tangible benefits to the local community.

Conclusions and recommendations:

The implementation of mechanisms that promote meaningful community participation is crucial. Initiatives such as public consultations, community engagement forums, and the establishment of platforms for dialogue between decision-makers and affected communities can facilitate this. By actively incorporating the voices of the local populations, policies related to the coal sector can be shaped to adequately consider their concerns and interests.

Actively engage in dialogue with government and regional authorities as well as private companies on how to avoid future infringements of human rights such as access to land and natural resources, a healthy environment and cultural identity, in particular as regards marginalized communities and indigenous groups.

Make deliberations and decision-making processes as regards to a JET more transparent, in particular as regards to interests of stakeholders and flows of money.

Economy and Employment

In the Mae Moh area, coal is of huge importance to the regional economy, providing 9,000 job positions and accounting for 18.1% of GRDP of Lampang province. The transition from coal mining and gradually from coal-based energy generation in Mae Moh presents an opportunity to attract investments in renewable energy projects, sustainable agriculture and industries, eco-tourism and infrastructure development, leading to the creation of new jobs. The shift from coal to renewable energy is driven by global commitments to reduce greenhouse gas emissions and combat climate change, but also by cost decreases and increasing competitiveness of RE. The closure of the Mae Moh coal mine raises concerns about potential job losses, particularly among employees of the state-owned enterprise. Resistance to restructuring and privatization reflects worries about unemployment, job security, and loss of benefits.

For Lampang, planning for phasing-out coal mining and power generation has already led to concrete approaches such as the Mae Moh Green model roadmap and the Mae Moh smart city project. Key components of the Mae Moh Green model include job training programs to equip affected workers with the necessary skills for new industries, support programs for small businesses to develop sustainable ventures aligned with clean energy goals, community development efforts focusing on infrastructure improvement and social well-being, and social

safety nets to provide necessary support to those most affected during the transition period. The approach is underpinned by some small-scale pilot projects in the areas of job placement services, women empowerment and financial support to most affected groups. But it presently lacks a systematic implementation plan, a long-term perspective and adequate financial resources which would allow for a proper scaling-up of required activities. EGAT has proposed those approaches, but although they are technically interesting and in principle eligible for a JET process, they have been developed without participation of the affected groups, civil society, regional government, private investors and other regional stakeholders. Meanwhile, activities for a better inclusion of regional stakeholders such as the First Mae Moh Foresight Workshop as well as an initiative led by the Mae Moh Development Association to establish a financial support program and set up job placement services have taken place.

The exploration of alternative viable economic development paths in Lampang is underway, as for example the Mae Moh Green Model and first pilot project prove. The coal mining and energy sectors in Lampang Province have a pool of skilled workers with experience in the energy industry which can be upskilled and trained for new roles in emerging green sectors. For establishing a broad transformative development vision, a comprehensive and participatory approach is required. The above mentioned first Mae Moh Foresight Workshop, organized by The Office of National Higher Education Science Research and Innovation Policy Council (NXPO) in collaboration with the APEC Center for Technology Foresight (APEC CTF) and EGAT, serves as a platform for representatives from the affected employees, relevant stakeholders, and government agencies to engage in meaningful dialogue and decision-making. This workshop has been instrumental in discussing and developing plans for training and skills development programs, such as providing vocational courses in renewable energy technologies or supporting entrepreneurship in sustainable industries.

Thailand is committed to core labour standards and labour-related human rights such as non-discrimination in occupation and employment, and the promotion of freedom of association, the right to collective bargaining, adequate wages, working hours, occupational health and safety and maternity leave. Delayed case law proves that there are deficits in law-enforcement in Lampang. Further, estimated two thirds of all coal workers are informal workers who are assumed not to have the same rights as the formal workers.

Conclusions and recommendations:

Revise JET related development models like the Mae Moh green model and further develop it to a community-based action plan

- on the bases of a broad regional participation of all relevant stakeholders.
- by assigning a leading role to the regional Energy Regulatory Commission (ERC).

- by taking a long-term perspective and establishing a systematic implementation plan.
- by providing adequate financial resources which would allow for a proper scaling-up of required activities.
- By letting key regional authorities and stakeholders (such as the Governor's office of Lampang Province, ERC Lampang Province, EGAT Mae Moh, the Provincial Administration Organization) organize the future participatory JET process in Lampang; taking into account key strategies and development plans (e.g. Provincial Energy Development Plan, Local Climate Action Plan).

Explore the situation of the coal workers as regards to labour standards and labour-related human rights in Lampang and develop specific measures, policies and enforcement mechanisms in place to address labour rights issues where necessary.

Assess the effectiveness and coverage of existing instruments in Mae Moh, identify any gaps, and address them through policy reforms, resource allocation, and collaborative efforts.

Support affected groups to strengthen their capacities in articulation of their views and interests and to enhance their awareness and knowledge about the concept of just transition in Lampang.

Establish comprehensive social protection measures to support affected workers during the coal mine closure process. This includes providing financial assistance, retraining programs, and access to healthcare services and the creation of green and decent jobs.

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Annex

Table 11. Summary of the transmission system in Thailand

Voltage Level (kV)	As of June 2022,					
	Line Length (Circuit-Kilometres)	%	Number of Substations	%	Transformer Capacity (MVA)	%
500	7,269.23	19.27	23	9.91	44,949.66	34.47
300	23.07	0.06	-	-	388.02	0.30
230	15,804.64	41.90	84	36.21	69,400.01	53.23
132	8.71	0.03	-	-	133.4	0.10
115	14,420.13	38.69	125	53.88	15,510.66	11.90
69	18.80	0.05	-	-	-	-
Total	37,544.57	100.00	232	100.00	130,381.75	

Source: EGAT.

Table 12. Detailed list of coal generator capacity across Thailand

Name	Operation	Location	Owner	Capacity (MW)
State-owned plants				
Mae Moh	1972	Lampang	EGAT	2,400
Electricity imported from foreign coal mine				
Hongsa	1972	Xayaburi Province, Laos Hongsa	PCL (HPC)	1,473
Independent Power Producer (IPP)				
BLCP	2006	MTP Industrial Estate, Rayong	Banpu PCL; EGCO Group (50:50 share)	1,434
GHECO-One	2012	MTP Industrial Estate, Rayong	Glow Energy PCL; WHA Energy 2 Co., Ltd	660
Small Power Producer (SPP)				
Glow SPP 2/ Glow SPP 3	2000	MTP Industrial Estate, Rayong	Glow Energy PCL	513
Glow Energy CFB 3	2010	MTP Industrial Estate, Rayong	Glow Energy PCL	85
National Power Supply (NPS)	1999	304 Industrial Park, Prachinburi	National Power Supply PCL (Double A Power)	328
IRPC	2015	IRPC Industrial Zone, Rayong	IRPC PCL	240
TPT	1995	MTP Industrial Estate, Rayong	TPT Petrochemicals PCL	55

Source: EPPO, 2024.

Table 13.1. Coal-fired power plants in Thailand and Laos under contracts with EGAT

Name	Operation	Location	Owner	Capacity (MW)
State-owned plants				
Mae Moh	1972	Lampang	EGAT	2,400
Electricity imported from foreign coal mine				
Hongsa	1972	Xayaburi Province, Laos Hongsa	PCL (HPC)	1,473
Independent Power Producer (IPP)				
BLCP	2006	MTP Industrial Estate, Rayong	Banpu PCL; EGCO Group (50:50 share)	1,434
GHECO-One	2012	MTP Industrial Estate, Rayong	Glow Energy PCL; WHA Energy 2 Co., Ltd	660
Small Power Producer (SPP)				
Glow SPP 2/ Glow SPP 3	2000	MTP Industrial Estate, Rayong	Glow Energy PCL	513
Glow Energy CFB 3	2010	MTP Industrial Estate, Rayong	Glow Energy PCL	85
National Power Supply (NPS)	1999	304 Industrial Park, Prachinburi	National Power Supply PCL (Double A Power)	328
IRPC	2015	IRPC Industrial Zone, Rayong	IRPC PCL	240
TPT	1995	MTP Industrial Estate, Rayong	TPT Petrochemicals PCL	55

Source: EGAT.

Table 13.2. List of cement plans in Thailand

No.	Plant Name	Location	Owner	Remark
1	Lampang plant	Lampang	Siam Cement Group (SCG)	
2	Siam White Cement plant	Saraburi	Siam Cement Group (SCG)	Produce white cement
3	Khao Wong plant	Saraburi	Siam Cement Group (SCG)	
4	Kaeng Khoi plant	Saraburi	Siam Cement Group (SCG)	
5	Ta Luang plant	Saraburi	Siam Cement Group (SCG)	
6	Thung Song plant	Thung Song	Siam Cement Group (SCG)	
7	Takli plant	Takli	HeidelbergCement AG	
8	Cha-am plant	Cha-am	HeidelbergCement AG	
9	Pukrang plant	Pukrang	HeidelbergCement AG	
10	SCC Factory 1	Saraburi	Siam City Cement, PLC	
11	SCC Factory 2	Saraburi	Siam City Cement, PLC	
12	SCC Factory 3	Saraburi	Siam City Cement, PLC	
13	Nakhon Ratchasima plant	Nakhon Ratchasima	Sumukee Cement Co.	Grinding plant
14	Hinson plant	Saraburi	Thai Pride Cement Co., Ltd.	
15	TPI Cement Factory	Saraburi	TPI Polene Public Company Ltd.	Coal used in the nearby VSPP to generate electricity for cement plant

No.	Plant Name	Location	Owner	Remark
16	Kaeng Khoi plant	Saraburi	Chememan	

Source: Cemnet, 2024.

Table 13.3 Coal imports to Thailand in 2020 by origin and type of coal, in thousand tonnes

	Anthracite	Bituminous	Sub-bituminous	Lignite
Indonesia	17	3,834	13,961	-
Australia	0	3,414	232	-
Russia	25	893	722	-
Philippines	-	-	233	-
Colombia	-	1	173	-
Laos	-	-	-	148
Viet Nam	111	-	-	-
Others	1	7	59	-
Total	154	8,149	15,379	148

Source: EPPO.

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