

# Ensuring Thailand's Energy Resilience amidst Energy Transition and Global Polarization



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## Introduction

The utmost important conclusion reached at the 21st UN Climate Change Conference (COP21) (UNFCCC, 2016) was the Paris Agreement, which aimed to address global concern towards greenhouse gas emissions. Thereafter, COP26 superseded COP21 to respond to public expectations where countries collectively pledged towards carbon neutrality and net-zero emissions (UNFCCC, 2022). At COP28 (UNFCCC, 2023a, 2023b), the Global Stock take of the activities under Paris Agreement took place to assess the world's collective efforts towards the climate goals, and the global leaders encouraged fast-tracking a just, orderly, and equitable energy transition in order to keep the goal of 1.5 °C in reach. This informs the Nationally Determined Contribution 3.0 (NDC3.0) (UNFCCC, 2024a) to be submitted in 2025 with an expectation for more progressive and ambitious targets. An agreement on the Baku Finance Goal was pursued at COP29 (UNFCCC, 2024b) to allocate \$1.3tn for climate finance in order to accelerate climate actions globally. These movements have intensified the necessity for transition towards clean energy.

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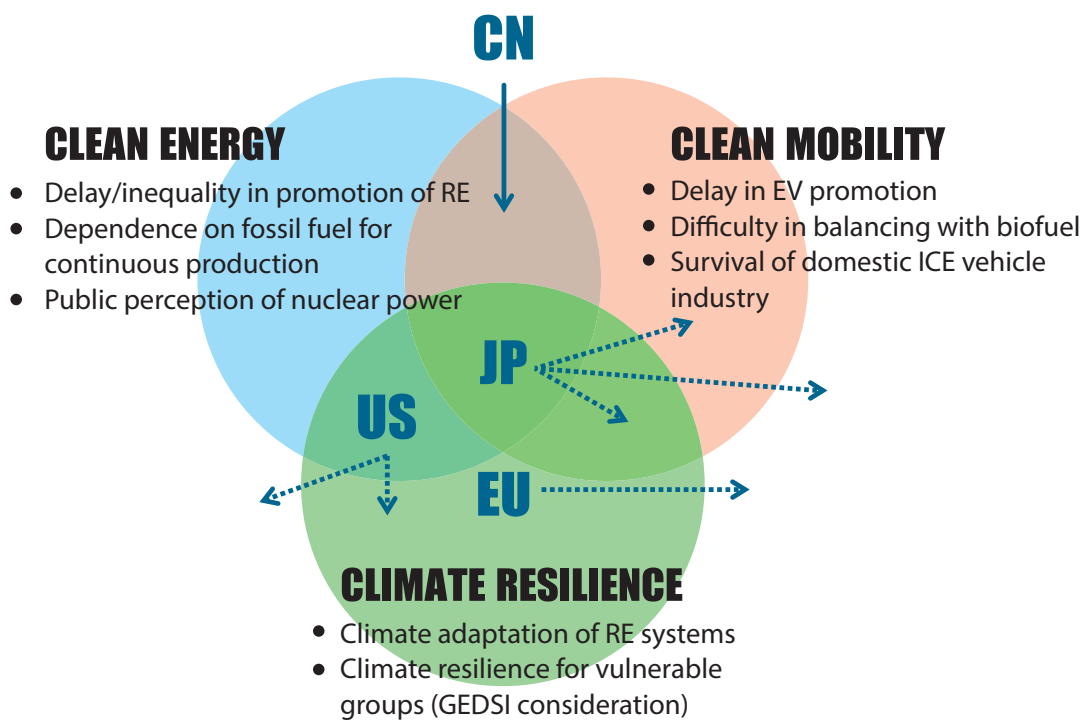
In global lens, the United States has dominated energy industry for decades. However, due to the rapid economic development and technological advancement, the power is gradually shifting from the United States to China. To balance the power, the two giants has strived for strategic partnership and alliance formation to control future energy supply chains, including three clean energies (low-emission electricity, low-emission hydrogen, low-emission synthetic hydrocarbon fuels) and three clean technologies (battery electric vehicles, heat pumps, and fuel cell trucks) (IEA, 2023). These supply chains together are expected to contribute to around half of the cumulative emission reduction in 2025 in net-zero emission scenario. To accelerate emission reduction, economies set forth national legislation, regulations, and mechanisms. The European Union (EU) introduced the Carbon Border Adjustment Mechanism (CBAM) to prevent carbon leakage from the offshoring import of international goods. The United States' government called for nationalization of the fossil fuel industry to combat the climate emergency and considered a similar approach to CBAM to reduce emissions in the country.

As for Thailand, National Energy Plan (NEP) is expected to pave a clean path for the country's energy transition. Under the NEP, the Power Development Plan 2024 (PDP 2024) (EPPO, 2024) is among the subplans that plays a critical role in the power sector, aiming to increase renewable energy share to 51% of the electricity mix by 2037. Small modular reactors (SMRs) are also introduced in the PDP 2024 as a potential option to strengthen energy security. Fossil fuel phase-out and gradual reduction of subsidization for biofuel are listed as promising measures under Oil Plan 2024. Electrification is listed as one of the key policy directions under the 4D1E initiative (EPPO, 2021) which has led to electric vehicle promotion. Yet, Thailand still needs to maintain biofuel industry in order to make use of plentiful agricultural byproducts. Policy direction should be carefully determined to balance between existing biofuel industry and emerging electric vehicle industry to ensure sustainable and smooth transition for domestic internal combustion engine industry.

In addition, Thailand is facing emerging risks during the energy transition. Escalating severity of climate impacts poses far-reaching consequences to renewable energy infrastructure, affecting surrounding communities. Climate resilience for infrastructure emerges as a key concept to ensure resilient human settlements and give reliable accessibility to energy to vulnerable groups at affordable price.

The objectives of this study are to visualize elements within the energy transition landscape of Thailand and gradually changing power balance, and to perform situation analysis to identify issues affecting energy resilience at national and individual levels from which recommendations are derived.

## Thailand's Energy Transition Landscape



**Figure 1:** Thailand's energy transition landscape and changes in power balance



## Clean Energy



Promotion of renewable energy is not fast enough to meet the target and leads to an issue of inequality.

Alike the majority of the countries in the world, the pace in promoting increase in renewable energy share in Thailand will most likely not meet the energy sector target of 74% (ONEP, 2022) to attain carbon neutrality by 2050. The situation is even worse when it comes to the renewable energy share in the portfolio of power supply for industry which sets the target to achieve carbon neutrality even faster due to the global peer pressure.

The large target of solar power on the draft Power Development Plan (EPPO, 2024), in conjunction with the relaxation of the complicated procedure for industrial solar rooftop (MB, 2024) is expected to dramatically increase the share of solar power in the energy mix, though it will exacerbate the issue on intermittency of the supply (IEA, 2024). There are several ways to address this issue, such as backup power supply which will most likely rely on fossil fuels, or energy storage systems, in terms of both batteries and hydrogen.

**However, these will significantly increase the electricity price, affecting the power accessibility of the vulnerable groups.**

**There is a high chance that a sharp increase in renewable energy share will intensify the issue of unjust energy transition** (Standal et al., 2023).





## Industry still heavily depends on fossil fuels to ensure continuous production.

Industry, particularly heavy industry, largely rely on fossil fuel power plants for steady supply of electricity and high-temperature heat. These are essential for continuous production in many industries, such as steel factories or chemical plants. The majority of renewable energy sources proposed in the draft Power Development Plan (EPPO, 2024), including solar and wind power, will not be able to fulfill these requirements. Therefore, the industry will most probably still require heat and electricity generation from fossil fuels while considering the adoption of carbon capture, utilization, and storage (CCUS) to reduce greenhouse gas (GHG) emissions (IEA, 2022). The other alternative is the introduction of small modular reactors (SMRs), though it will demand tremendous efforts to build public understanding (ACE, 2022).

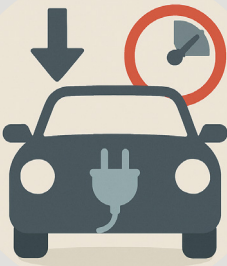


## The introduction of nuclear power requires public understanding and acceptance.

Public perception has been an outstanding issue since the first attempt to introduce nuclear power in Thailand in 1960s (Namwong, 2024). A large portion of the public still links nuclear power to the atomic bombs in Hiroshima and Nagasaki in 1945 and the major nuclear accidents happened in Three-Mile Island, Chernobyl, and Fukushima in 1979, 1986, and 2011, respectively (Vechgama et al., 2023). However, the younger generation has a tendency to be more receptive of the new technologies compared to generation X and Y, and they are alerted by the news of the inclusion of SMRs in the recent draft Power Development Plan (EPPO, 2024). Additionally, the industry is more welcoming for the return of nuclear power due to the abovementioned necessity of continuous power supply. It is desirable to reinvestigate the latest public perception towards nuclear power in order to prepare for the possible introduction of nuclear power.



## Clean Mobility



Electric vehicle adoption is not increasing as fast as expected.

The government launched a program called EV 3.0 and subsequently EV 3.5 to promote electric vehicle adoption in Thailand in 2022 and 2024 (BOI, 2024a). The program includes the subsidization of purchase of various types of electric vehicles, exemption of taxes and duties for various auto parts, and the requirement for the manufacturers to locally produce the electric vehicles according to the sales. The program led to a rapid increase in electric vehicle sales in 2022 and 2023, resulting in 12% of electric vehicle share in the total sales of four-wheelers in 2023 (BOI, 2024b). However, due to significant surplus of supply against demand and public concerns on battery charging infrastructure and safety of electric vehicles, the sales in 2024 do not grow as expected and manufacturers are requesting to delay the enforcement of the manufacturing mandate in order to maintain the balance in demand and supply. Many manufacturers have also significantly discounted the retail price to appeal to the buyers.







The government is striving to balance the promotion between electric vehicles and biofuel.

Southeast Asia, including Thailand, has abundant resources of bioenergy and has relied on biofuel as a substitution to fossil fuels. Thailand was blending 10% of ethanol in gasoline and 10% of biodiesel in diesel. This requires considerable subsidization from the Oil Fuel Fund. Recently, the government decided to gradually lift the subsidy for biofuels and reduce the blending ratio of biodiesel in order to maintain the amount of the Oil Fuel Fund and retain the retail price of diesel which can affect the price of commodities (DOEB, 2024). This called for outrage among biofuel producers as other ASEAN countries are maintaining or increasing the biofuel share in their transport fuels. A comprehensive strategy is needed for the Thai government to harmonize between the promotion of electrification in road transport and the maximization of bioresources in the country to attain the carbon emission reduction goal in transport sector.





## Domestic internal combustion engine vehicle industry needs to adapt to survive.

Thailand has been the hub for the production of internal combustion engine (ICE) vehicles. The industry is the home to nearly a million jobs, scattered in car manufacturing and auto part factories around the country. The rapid emergence of electric vehicle industry is changing the landscape of automotive industry. While the body and the suspension systems are very similar to the ICE vehicles, the engine and many other parts are totally different. The local automotive industry will need to swiftly upskill the labor, otherwise, hundreds of thousands of the employees will be losing their jobs soon. The government will also need to design rules and regulations to facilitate localization of the electric vehicle industry.

## Climate Resilience



Renewable energy systems need to equip themselves with the ability to adapt to climate change.

The greenhouse gas emission reduction target of the energy sector results in rapid increase of unconventional power sources. In particular, solar and wind power, which occupy a large share of the power capacity in the draft Power Development Plan (EPPO, 2024), rely heavily on natural conditions, resulting in a different set of climate risks compared to conventional fossil fuel power plants. It is necessary to perform a climate risk assessment for these renewable energy systems with the consideration of the local context. In addition, as climate change will increase the probability and intensity of disasters and climatic events, Foresight of future disruptions is crucial for the assurance of climate adaptability of these power sources.



Vulnerable groups have always been more severely affected by climate change.

During normal operation, it is already difficult for the vulnerable groups to assure accessibility to power supply (Dugan et al., 2023) the human catastrophe that can potentially unfold due to the failure of essential services can far outweigh the financial damages incurred. Furthermore, power outages do not impact individuals equally, and access to proper resources (or lack thereof. This will be even worse during emergencies, e.g., disasters or severe climatic events. Given the intermittent nature of solar and wind power of which the quality of power production will be heavily affected by climate change (IEA, 2024), increasing their shares in electricity mix may increase the frequency and severity of power outage. Since the vulnerable groups are highly unlikely to have access to emergency power supply, the possibility of being affected by power outages is going to dramatically rise along the transition towards cleaner power sources.

## Power Balance



China is entering the power and automotive businesses in Thailand and will probably dominate the market soon.

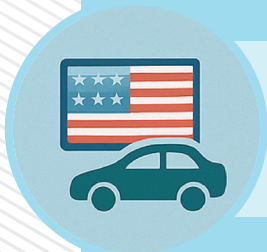
China is the top producer and distributor of solar panel and solar power equipment. The majority of solar panels installed in Thailand are made in China. This trend is expected to continue during the remarkable increase in solar power in future power mix. The same tendency is observed in automotive industry where most electric vehicle brands are from China. Unlike Japan, China brings in the auto parts rather than ordering them from domestic manufacturers (Kohli, 2024). Without strategic moves by the government or other domestic players, domination of Chinese brands in power and automotive industries is foreseen in near future.





Japan has been a great ally of Thailand in energy, transport, and climate arenas, though it may lose market share to China.

Japan has helped Thai industry in greening the energy supply through Clean Development Mechanism (CDM). Japan has also been using Thailand as its regional hub to support its automotive businesses. While the global trend is shifting towards electric vehicle, Japan has tried to maintain its strength in ICE vehicles by promoting hybrid and fuel cell vehicles (NEV, 2018). Depending on the strategies of Thai government towards the entrance of Chinese companies during energy transition, Japan may maintain its position in Thailand in all sectors, shift some of the productions to other countries, or lose its ground to China.



The United States has been an important player in the energy sector while the future is still unclear.

Things happening to Japan in Thailand is happening to the United States at the global scale. Through the fossil fuel industry, The United States has been indirectly supporting power and fuel production in Thailand and Southeast Asia. The United States has also been supporting many climate mitigation and adaptation projects in the region. While the United States is trying to maintain its energy-related supply chains (Schäpe, 2024), it is still unclear whether the new administration will remain supportive to climate-related activities.





The European Union strives to maintain its bargaining power through carbon border adjustment mechanism.

The European Union has always played a crucial role in the climate arena across the globe, including in Southeast Asia. It tries to convince, support, or indirectly impose climate-related initiatives in other countries. The recent movement is the enforcement of carbon border adjustment mechanism (CBAM) (EU, 2023) which urged heavy industries in Thailand to set greenhouse gas emission reduction targets and find strategies to meet them. However, with the increasing influence of China in the region, there is still a possibility of power shift in this sector.

## Bioenergy

TITLE-ABS-KEY ( Bioenergy )  
2015-2020  
8,888 Scopus records

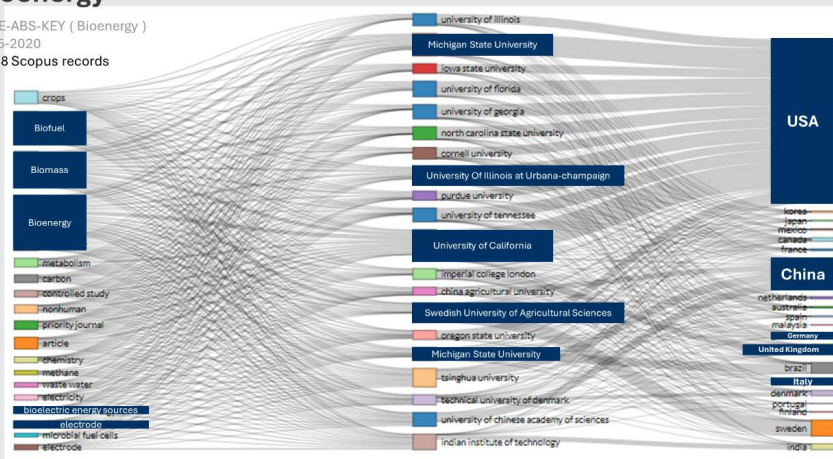


Figure 2: Three-field plot for bioenergy (keywords, institutes, countries) (TYSA, 2022)

From an academic perspective, the United States and its allies remain influential.

While China is increasing its presence in Thailand, Southeast Asia, and other regions, the United States still dominates the academic landscape. Taking bioenergy as an example, the bibliometric analysis shows that the United States is superior to China in terms of the number of publications, the top affiliations, and the top citations. Though China surpasses the United States in terms of the number of publications in some fields, the top citations are still from the United States, European countries, Japan, and Australia.

## Challenges in Ensuring Energy Resilience at National Level

From the situational analysis of the energy transition landscape and the changing power balance in Thailand, the issues affecting the resilience of energy supply from the national point of view can be summarized as follows.

### Tension between the United States and China in clean technologies inadvertently affects Thailand and Southeast Asia.

Both countries are forming alliances to localize all energy-related supply chains, and technology users are indirectly forced to take side. There is a chance that supporting any part of these supply chains will result in benefits or incentives to address other challenges in the country, and vice versa.







## Carbon border adjustment mechanism has become a new trade barrier.

While the carbon border adjustment mechanism can be justified as a mechanism to promote climate consideration, it can also impede export activities of countries with financial difficulties to access to climate technologies. It also indirectly forces the companies of which the foreign headquarters made an ambitious carbon neutrality commitment to increase renewable energy share in their power mix, increasing their financial burden.



## Introduction of small modular reactors will further complicate the landscape.

The United States and China are not the only players in the nuclear power market. Many promising small modular reactor designs are owned by Russia and South Korea. The two countries are reaching out to Southeast Asia to explore the possibility of adopting their technologies. They might emerge as new players along the energy transition pathway of Thailand.

## Challenges in Ensuring Energy Resilience at Individual Level

There are also several outstanding issues that may affect energy security at an individual level which can be summarized as follows.



## Potentially higher energy expenditure will decrease the accessibility of vulnerable groups to quality power.

Hasten large-scale introduction of variable renewable energy will likely increase the electricity unit price. Besides, many vulnerable households do not own an electricity meter and are paying higher price per unit to the mediators. Higher reliance on renewable energy will most probably fuel the increase in the share of energy-related expenses among lower-income households.





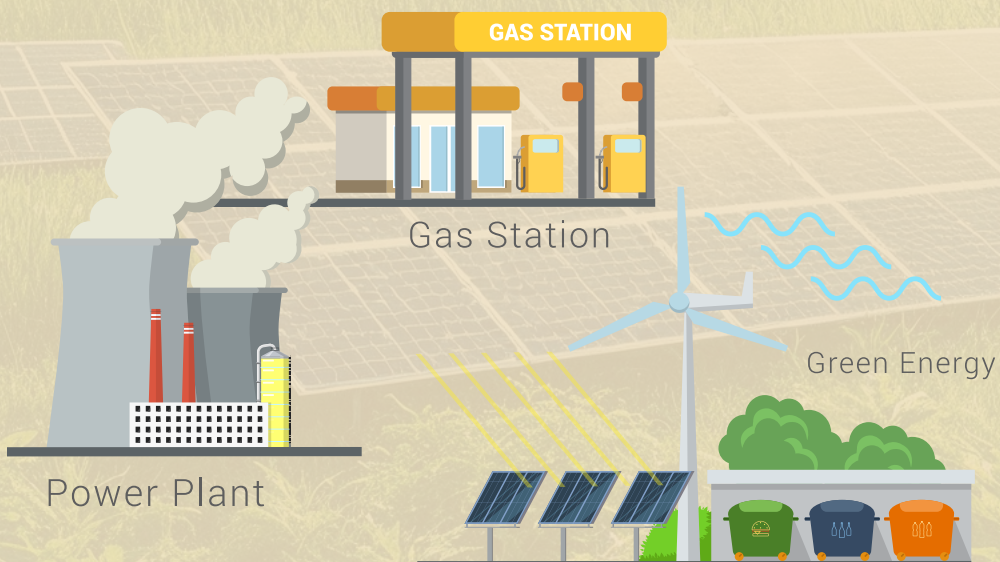
Vulnerable groups will be among the initial sufferers from higher blackout risk.

Renewable energy sources without proper design for backup power or energy storage will increase the blackout risk in terms of both frequency and impact. More frequent and severe disasters due to climate change will further intensify the risk of renewable energy systems. Lower-income households that have no budget for an emergency power system or an energy storage system or a smart grid service will suffer higher blackout risk in the near future.



No one wants an unfamiliar power plant in their backyard.

The Not-In-My-Back-Yard (NIMBY) spirit found in past introductions of nuclear and fossil fuel power plants seems to be highly applicable to small modular reactors. Laypersons have very limited knowledge of nuclear power, and they can still link it to the past devastating accidents. It is not unusual that people fear it, and thus, the power utility will need to make efforts in creating accurate public understanding.





## Recommendations



Thailand should make effort to continue the harmonization of diplomatic relations among key players.

The energy sector of Southeast Asia has been closely tied to western countries and their allies, especially Japan. However, the location is also preferable for China to expand its energy and automobile markets. While the countries will be forced to take sides sooner or later, it is still considered a smart move to maintain good relationships with existing parties while welcoming new players to some extent.



Thailand should strategically localize energy-related industry and make use of local resources.

The business model of China is very different from that of Japan with which the Thai industries are familiar. Without well-designed rules and regulations, the role of Thailand might be limited to just only the provision of sites for factories and outlets. Conditions imposed on electric vehicle companies can serve as a good example for future interventions. Additionally, capacity building programs should be designed for local industry to be able to catch up with new clean technologies.



## Thailand should mainstream infrastructure adaptation in its National Adaptation Plan.

It is undeniable that climate change has become one of the important issues on the global agenda. People tend to link only mitigation of climate change, i.e., greenhouse gas emission reduction to the energy sector. However, it is becoming more obvious that the rapid increase in renewable energy share is making the energy infrastructure more susceptible to climate risks, and thus, it is a sensible decision to include strengthening adaptability of critical infrastructure in the National Adaptation Plan.



## National and human security agencies should be aware of their roles in ensuring sustainable, resilient, and just energy transition.

At first glance, energy transition may seem to be irrelevant to assurance of national and human security. Yet it was clear from the landscape and situational analysis above that the nation should be able to secure steady power supply, and the people should be able to maintain their quality of life during the transition towards clean energy and consequently carbon neutrality. It is necessary that the responsible agencies are made aware of their roles in order to start working with the Ministry of Energy, Ministry of Transport, Ministry of Natural Resources and Environment, and Ministry of Industry.



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