



Chulalongkorn International
Business Case Competition

CASE B

2023



ACKNOWLEDGEMENTS

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THANKS TO

On behalf of CIBCC 2023, the case writers would like to thank the following people and organizations for their invaluable input throughout the case writing process:

PTT Public Company Limited

The Phuket Provincial Office

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DISCLAIMER

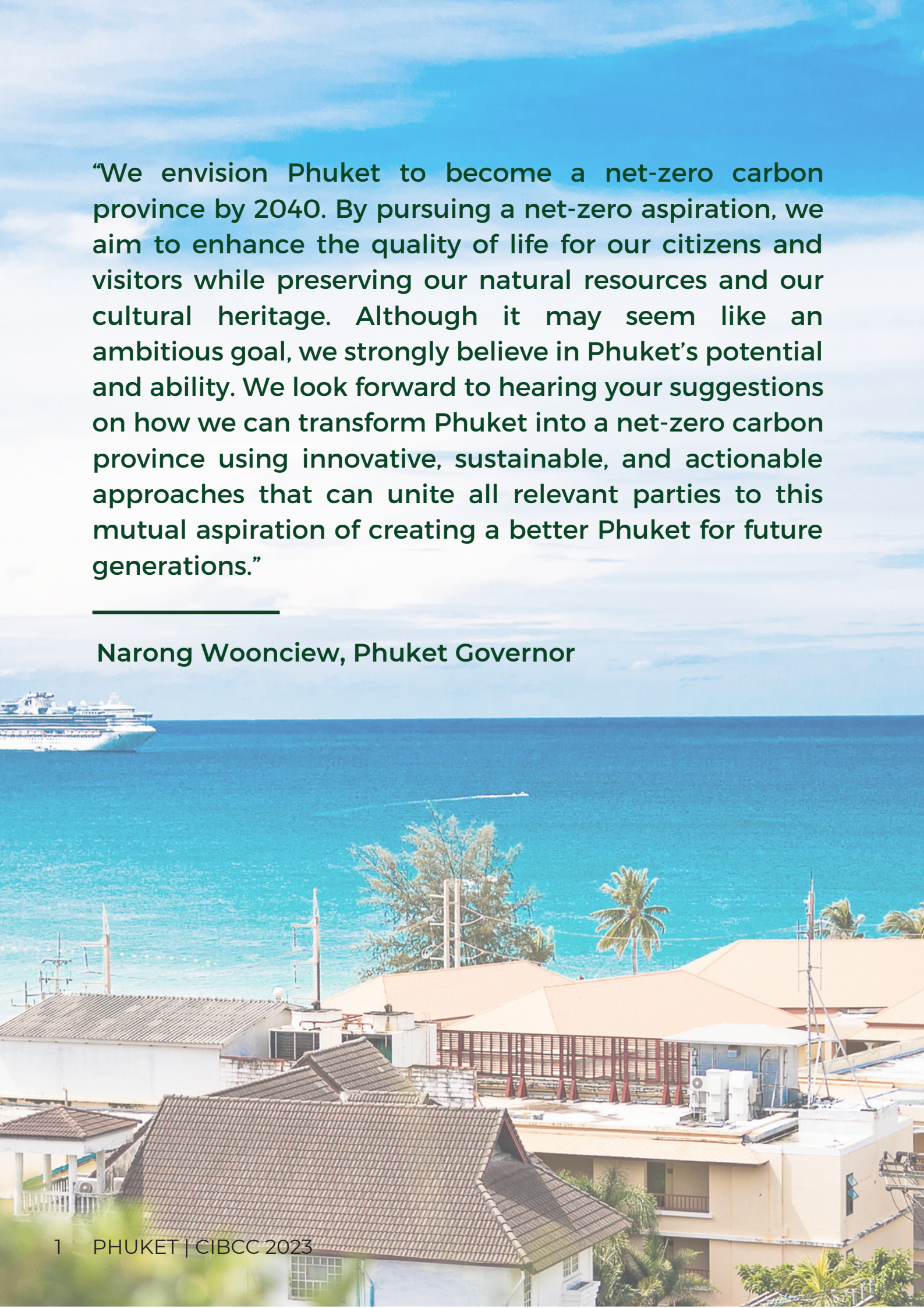
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“We envision Phuket to become a net-zero carbon province by 2040. By pursuing a net-zero aspiration, we aim to enhance the quality of life for our citizens and visitors while preserving our natural resources and our cultural heritage. Although it may seem like an ambitious goal, we strongly believe in Phuket’s potential and ability. We look forward to hearing your suggestions on how we can transform Phuket into a net-zero carbon province using innovative, sustainable, and actionable approaches that can unite all relevant parties to this mutual aspiration of creating a better Phuket for future generations.”

Narong Woonciew, Phuket Governor



INTRODUCTION

Phuket, with a population of 410,000, is a beautiful provincial island located in the Andaman Sea in the southern part of Thailand. It is the largest island in Thailand and is known for its stunning beaches, crystal-clear water, and lush rainforests. With a rich cultural heritage and a unique blend of Thai and Western influences, Phuket has become one of Asia's most popular tourist destinations, with over 5 million international and domestic visitors per month. The island is also known for its vibrant nightlife, shopping, and delicious cuisine, making it a must-visit destination for travelers from all over the world.

Phuket has a vision to become "an international hub for tourism, education, and service innovation through sustainable development". As part of the "sustainable development" approach, Phuket's local government aspires to transform Phuket into a net-zero carbon province by 2040. While the end-stage milestone has been set, the project is still in the nascent stage. To ensure the achievement of the Net-Zero aspiration, the Phuket Government recognizes that it is important to lay out a clear roadmap as well as key initiatives and sub-milestones in each phase of implementation, especially the involvement of necessary stakeholders.

As a team of aspiring international consultants, you are advising the local government on how to embark on the net-zero carbon journey. The Phuket Municipality and the Governor are looking forward to hearing your recommendation on the overall roadmap, key policies, and stakeholder mobilization strategy to help Phuket Province achieve its aspiration by 2040.

CASE QUESTION

How can Phuket Province become a net-zero carbon province by 2040?

1

How would the “masterplan” for Phuket’s Net-Zero Project look like? What are the short-term (2023-25), medium-term (2025-30), and long-term (2030-40) milestones and corresponding initiatives – especially the short-term ones?

2

Who are the key stakeholders (e.g., private sectors, government, government agencies, state enterprises, citizens, etc.) in Phuket's Net-Zero Project? What can be their roles or contributions toward the Net-Zero aspiration? How can the local government mobilize and incentivize them to be part of the Project?

3

How can the Phuket Government secure sufficient funding for all the initiatives? What can be different sources of funds throughout the journey up to 2040 milestone?





TRENDS TOWARD NET-ZERO EMISSIONS

The trend toward sustainability has gained significant momentum in recent years due to the pressing need to tackle the impacts of climate change. According to the United Nations (UN), the global temperature has already risen 1.1°C above the pre-industrial level. To prevent the irreversible damage of global warming on the environment, the UN has announced that the rise of temperature must be limited to no more than 1.5°C above pre-industrial levels. Additionally, the UN has released the 2030 Agenda for Sustainable Development with its 17 goals as the blueprint for a better future with the 13th goal specifically dedicated to Climate Action.



Exhibit A: The 17 UN Sustainable Development Goals

In line with the 13th goal, the Paris Agreement has called for global leaders to take actions toward reaching net-zero emissions by 2050. Likewise, Thailand is also moving towards the same goal, with several milestones to be accomplished as outlined in the National Development Plan. However, despite the ambitious goal, a clear set of immediate actions has yet been defined in many countries. To secure a livable future, it is imperative that countries, corporations, and individuals work together to reduce carbon emissions.

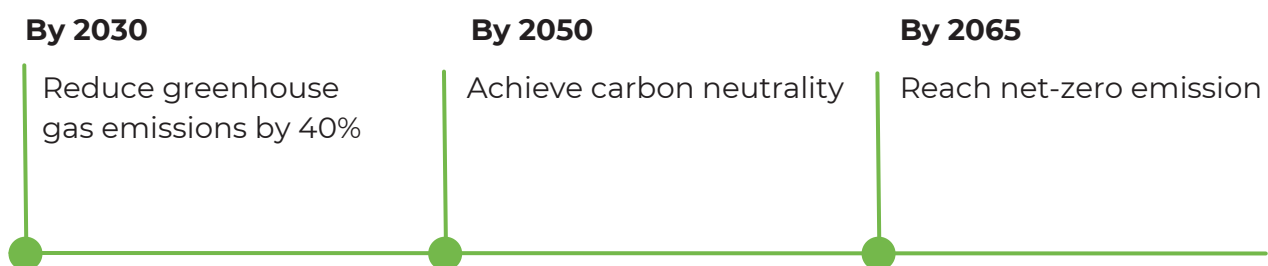


Exhibit B: Roadmap of Thailand's National Development Plan



DEFINING “NET-ZERO CARBON”

There are various terminologies being used to clarify the goal of net-zero pledges. These terms refer to different levels of progress towards reducing the impact of greenhouse gas emissions on the environment, with carbon negative being the most ambitious and carbon neutral being the minimum requirement. There is no singular term that is superior to the others, however, for the purpose of this case, “net-zero carbon” will be the main focus.

CARBON NEUTRALITY

Offsetting the amount of carbon dioxide released to the atmosphere through reducing emissions or compensating by purchasing carbon credits

NET-ZERO CARBON

Reducing carbon dioxide emissions across the entire supply chain and absorbing the remaining carbon dioxide through activities such as forest carbon sequestration

CARBON NEGATIVE

Removing more carbon dioxide from the atmosphere than the amount emitted

DEFINING “NET-ZERO CARBON”

Even within net-zero carbon, there are many definitions put forth by many schools of thought.

"We make the case for researchers and practitioners to consider defining a net-zero carbon city as one that has net-zero carbon infrastructure and food provisioning systems."

Princeton

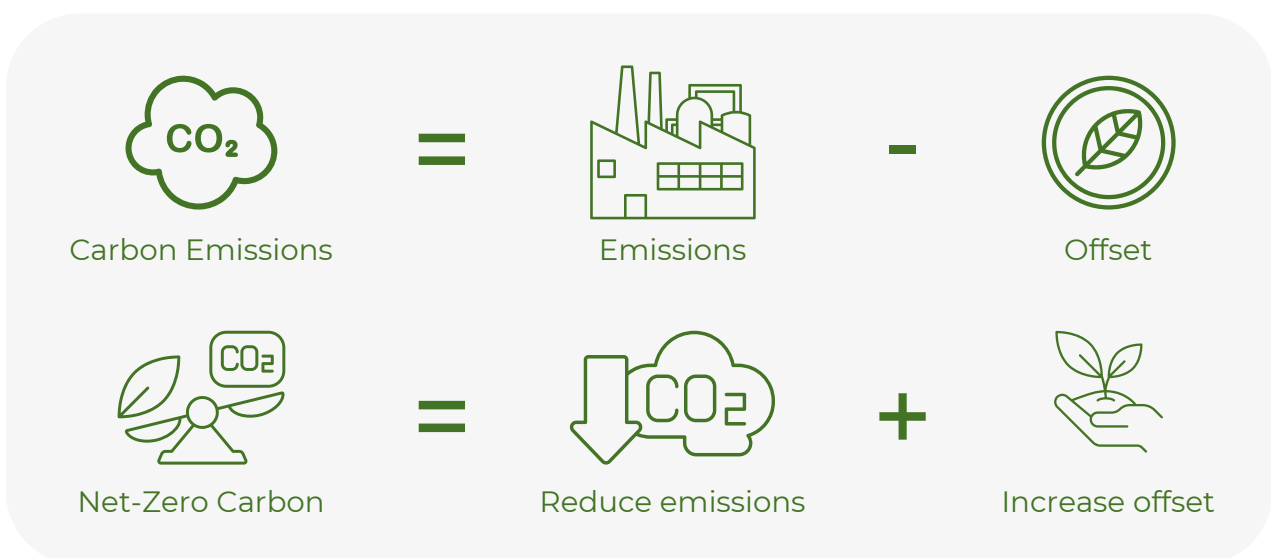
"The [net-zero carbon cities] program aims to do [catalyze urban decarbonization] by fostering public private collaboration to bridge the gap across the energy, built environment and transport sectors"

WEF

"For the uninitiated, carbon net zero means reducing the carbon generated by a company's activities to the point that the amount generated and the amount extracted from the atmosphere are equal"

BBC

However, despite the different nuances in the various definitions mentioned, net-zero carbon can be simply explained as follow:



Net-zero carbon can be achieved by reducing carbon dioxide emissions and increasing carbon dioxide absorption.

BALANCING THE NET-ZERO CARBON EQUATION



REDUCING EMISSIONS

The first component of the equation is the reduction of carbon emissions, which refers to the process of lowering the amount of carbon dioxide emissions released into the atmosphere through various human activities. According to McKinsey & Company, these activities can be categorized into five interconnected areas: building, industry, mobility, power, and agriculture. It is important to note that these areas are not exhaustive and that there may be additional areas depending on the nature of specific cities and provinces. However, for the purpose of this case, these five areas should be regarded as the areas of focus. Case studies of initiatives that different countries or cities have attempted to reduce carbon emission across these areas can be found in Appendix A. Proportion of carbon emissions by areas can be found in Appendix B.

1. BUILDING

Reducing operational and embodied carbons in buildings and construction of buildings

According to the World Economic Forum (WEF), buildings are the biggest contributor to emissions, accounting for up to 70% of city emissions.¹ Around 75% of buildings emissions are categorized as operational emissions while the remaining 25% are in the form of embodied emissions. Operational emission refers to carbon emissions derived from the energy used in operating buildings or infrastructure such as lighting, heating, and cooling. Embodied carbon refers to carbon emissions that are associated with the materials used and the construction processes of buildings and infrastructure. Therefore, the key actions to reduce carbon emissions from building overall may include redesigning buildings to be energy-efficient, using low-carbon building materials, and implementing low-carbon construction technologies.

¹ The statistics provided may be biased towards bigger cities like Bangkok or London. While still significant, carbon emissions from buildings in Phuket may not be as high considering the characteristics of Phuket.

2. INDUSTRY

Reducing carbon emissions in steel and cement production

“Industry-related” carbon emission refers to the emission from industrial or manufacturing processes. Decarbonization of the industrial sector is often considered a difficult task. Steel and cement production is the largest contributor of carbon emissions - accounting for 46% of emissions from the sector. Cement production releases carbon dioxide as a byproduct of chemical reactions and decarbonation, while steel production releases carbon dioxide during iron ore reduction. Other industrial processes such as the production of other goods also contribute significantly to global carbon emissions as it is energy-intensive and powered by fossil fuel combustion. To decarbonize the industry sector, countries must propel the switch to clean-energy-powered processes and encourage adoption of more efficient technologies.

3. MOBILITY

Transforming transport systems to become low-carbon

Transportation accounts for over 27% of total global greenhouse gas emissions and is the main source of air pollution in cities. Mobility, in this context, refers to both human transportation (e.g., automobile, rail, airplane, etc.) and freight for goods (e.g., cargo trucks, ships, etc.). Over the recent years, there have been many new launches of electric vehicles (EVs) as well as growing demand and adoption. This has created positive impact toward the goal of low-carbon mobility. To further increase the adoption of EVs, cities and countries will have to invest or support the investment in infrastructure and ecosystem of EVs (e.g., charging stations, and battery production or imports, etc.). Decarbonization of the mobility sector needs not be limited to incentivizing the switch from fuel-burning vehicles to EVs. Countries can also explore other green or more environmentally friendly mobility initiatives such as developing bicycle-friendly environment, promoting use of public transportation, and incentivizing use of biofuels and more-efficient technologies for freight transport.

4. POWER

Maximizing the production and use of clean and renewable energy²

While the three areas above touch on energy efficiency as a way to reduce carbon emission, the focus of this section is on the source of electricity generation for users. Cities and countries can influence the switch from traditional sources of power generation, such as coal and gas, to renewable sources, such as solar, wind, hydropower, and biomass.

² Clean vs. renewable energy: Although the terms are often used interchangeably, there are still notable differences between the two. According to Utility Dive, renewable energy is derived from sources that can naturally replenish themselves such as the wind or sun, while clean energy encompasses all zero-carbon energy sources.

5. AGRICULTURE

Shifting towards low-carbon farming practices

The relationship between agriculture and climate change is complex. Agriculture contributes significantly to global carbon emissions while also being highly vulnerable to the impacts of climate change itself. This could lead to a domino effect where entire food systems are disrupted. The majority of carbon emissions from the agriculture sector, specifically in Thailand, stems from deforestation and biomass burning. Agricultural deforestation is brought about by the conversion of grasslands or forests to croplands – reducing the green areas for carbon absorption and even creating massive carbon emission through burning. Though primitive, burning serves as a cheaper and faster alternative to mechanized land clearance, allowing farmers with limited capital to prepare land in limited time, hence more yield. However, this practice has been the leading contributor to city smog and air pollution.





INCREASING OFFSETS

The second component of the net-zero carbon equation is an increase in carbon offset, which is as important as a reduction in carbon emissions. Carbon offsetting is a process by which emitted carbon is removed from atmosphere through either natural means or technological solutions. This process can serve as a solution for emissions that are difficult or impossible to reduce.

1. GREEN AREAS

Increasing green spaces to absorb emitted carbon

It is common to see green areas eroding as urbanization approaches and more buildings need to be built to accommodate enlarging population. However, green areas is crucial part of the Net-Zero equation – as the natural absorber of carbon dioxide as well as many other pollutants. Over the recent years, many urban architects and designers have introduced new ideas for urban forestry, on top of public park, in order to introduce more green spaces in increasingly denser cities.

2. TECHNOLOGY

Investing in carbon management technologies

Investing in carbon management technologies such as carbon capture utilization and storage (CCUS) can be an effective way to increase carbon offsetting. CCUS technologies are designed to absorb and store emitted carbon dioxide to prevent the carbon from entering the atmosphere. Captured carbon dioxide can be stored underground in reservoirs or used in the production of chemicals and other products like concrete, plastics, and alcohol.

THAILAND NET-ZERO MOVEMENT

Over the past decades, many countries, including Thailand, have been making strides to reduce their carbon emission. In 2021, Thailand presented the Long-Term Low Emissions Development Strategy (LT-LEDS) at the United Nations Climate Change Conference, which is an annual conference held among the United Nations Framework Convention on Climate Change (UNFCCC) parties. The key milestone of LT-LEDS is to reach carbon neutrality by 2050 and net-zero greenhouse gas (GHG) emissions by 2065. Sub-milestones and key initiatives under LT-LEDS can be found below in Exhibit C.

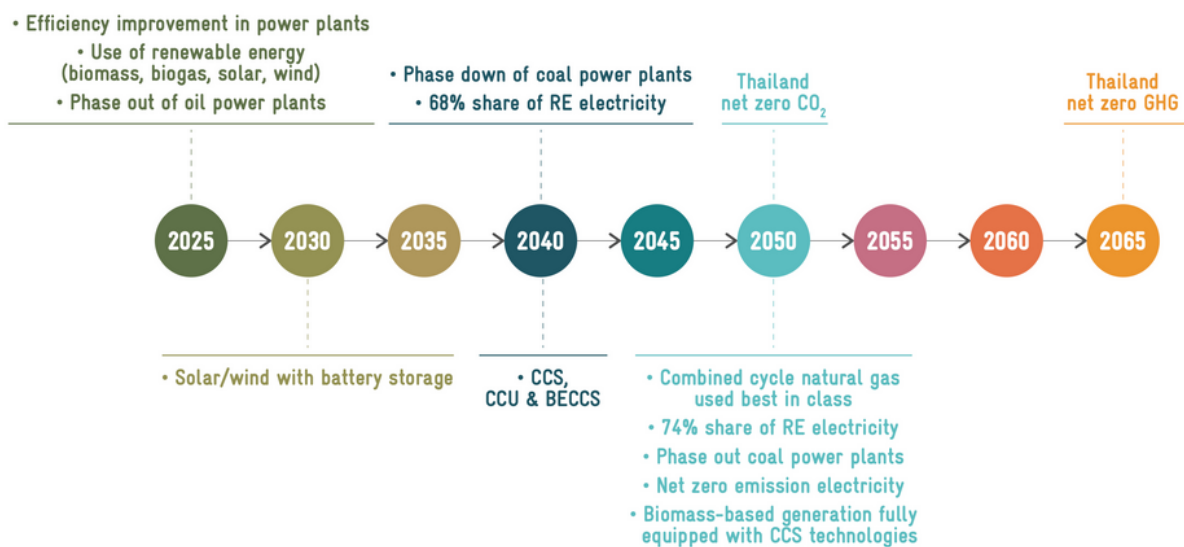


Exhibit C: Thailand's LT-LEDS

RE = Renewable Energy

CCS = Carbon Capture and Storage

CCU = Carbon Capture and Utilization

BECCS = Bio-energy with Carbon Capture and Storage

Over the past years, multiple strategies and initiatives related to “green” and emission reduction have been developed and executed by the Thai government.

BIO-CIRCULAR-GREEN ECONOMIC MODEL OR BCG

In an effort to aid Thailand in achieving its “net-zero” aspiration, the Industrial Estate Authority of Thailand (IEAT) has adopted the Bio-Circular-Green Economic Model as a mean to guide industrial investments and operations.

The term "BCG" refers to three key economic ideas: bioeconomy, circular economy, and green economy. Bioeconomy refers to the production of renewable biological resources and their transformation into value-added products. Circular economy encourages reusing and recycling of resources. Green economy is about maintaining harmony between the economy, society, and environment to promote sustainable development. Practically, the model implies the adoption of new technologies and innovations in the following industry sectors:

FOOD AND AGRICULTURE

Food and agriculture is the largest sector in Thailand by number of employment. However, this sector is still one of the most traditional sectors in terms of processes across the value chains. The government aims to promote the adoption of advanced farming techniques and innovation in food technology to improve the efficiency and quality of food production. Examples of the potential benefits from “Smart Farming” and food tech include new alternative proteins and nutrients, the extension of the shelf life of food products, and an increase in yields for farmers to further alleviate returns for farmers.

MEDICAL AND WELLNESS

Thailand has long been recognized as one of the top destinations for medical tourism. The country is well known for a wide range of healthcare services and alternative therapies. Applied Thai Traditional Medicine is deeply rooted in Thai culture and has been passed down through generations, making this alternative therapy a significant part of Thailand's cultural heritage. This alternative healthcare practice can be considered a part of the bioeconomy for the utilization of natural ingredients such as medicinal herbs and oils. For example, ginger is used to treat digestive issues, and turmeric is used to reduce inflammation.

ENERGY, MATERIAL, AND BIOCHEMICALS

Thailand is a growing economy with growing demand for energy and is the a major producer of biomaterials, such as rubber and silk. In line with the strategic direction toward a green economy, the Thai government has established a target to generate 30% of the nation's total final energy consumption from renewable sources by 2036. To support the growth of renewable energy, the government has implemented new incentives such as feed-in tariffs, tax benefits, and subsidies for renewable energy projects. Furthermore, the government has made investments in innovative technologies aimed at converting biomass and agricultural by-products into valuable materials, such as bioplastics, natural fibers, and active pharmaceutical ingredients.

TOURISM AND CREATIVE ECONOMY

Tourism has been a significant contributor to Thailand's economy for a long time, but it has also created long-lasting negative impacts on the society in different dimensions, such as economic, socio-cultural, and environmental. The Thai government has implemented several initiatives related to tourism and the creative economy. Some of these initiatives aim to address environmental impacts and sustainability concerns, while others focus solely on boosting the national economy. An example of this is the closure of Thailand's Maya Bay and the periodic closure of other islands due to environmental damage caused by tourism in the past.



THAILAND'S CARBON NEUTRALITY PATHWAY

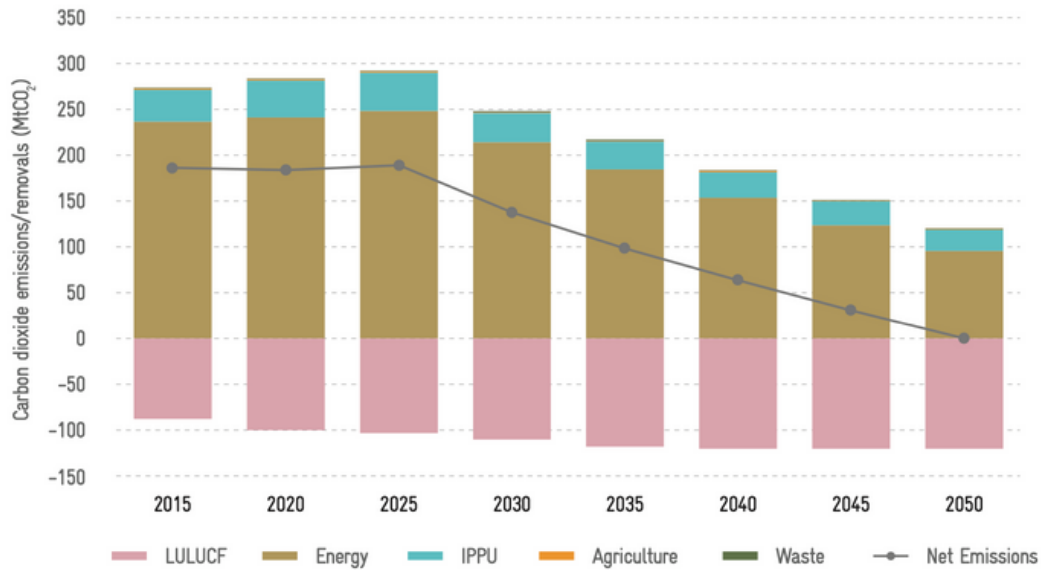


Exhibit D: Thailand's 2050 carbon neutrality pathway
 LULUCF stands for Land Use, Land Use Change and Forestry
 IPPU stands for Industrial Processes and Product Use

The "Thailand's Carbon Neutrality Pathway" is a policy framework launched by the Ministry of Natural Resources and Environment. The purpose of this pathway is to outline a transformative shift towards a clean energy system and ultimately enable Thailand to achieve net-zero carbon emissions by 2050. Exhibit D presents the desired emission targets for various sources of emissions in the envisioned future with core focuses as follows:

- 1 Net-zero carbon dioxide emission by 2050
- 2 Carbon emission from energy, the largest contributor, to be reduced by more than 50% through an increase in the share of renewable energy sources
- 3 Efficiency improvement in the production process and adoption of carbon capture and storage (CSS) to reduce carbon emission from IPPU
- 4 Increase green areas through reforestation and restoration of degraded ecosystems

SMART CITIES

In addition to other carbon reduction plans, Thailand has also embarked on a Smart City development journey. The concept of a smart city in Thailand encompasses seven key areas, including Smart Living, Smart Mobility, Smart Environment, Smart Energy, Smart Governance, Smart Citizen, and Smart Economy. Within these aspects, Smart Living and Smart Mobility are the immediate focus of the Phuket Government, and Smart Environment and Smart Energy have strong relevance to the Net-Zero aspiration.

SMART LIVING

Smart Living aims to enhance livability and quality of life for the city population. Smart Living solutions can range from simple home automation systems, such as smart thermostats and lighting, to more complex systems that integrate various devices and technologies to create a connected and intelligent living environment. Smart Living is not only about convenience and comfort but also about sustainability and efficiency. By using technology to optimize resource consumption and reduce waste, Smart Living can contribute to a more sustainable future. For example, a smart home could include energy-efficient appliances and lighting, water-saving fixtures, and a home energy management system that optimizes energy usage based on user preferences and energy tariffs.



SMART MOBILITY

Smart Mobility is an approach to transportation that aims to reduce congestion and promote sustainable and efficient travel options. This involves the use of big data analytics to optimize traffic conditions and develop intelligent transportation systems – both public and private. Major tools that are typically used to support these systems are a network of sensors, GPS, traffic lights, passenger information panels, and other technologies to manage traffic flow and improve safety, accessibility, and environmental performance. Smart Mobility is another approach that plays a crucial role in achieving net-zero carbon emissions by promoting sustainable transportation options and reducing the carbon footprint of transportation.

SMART ENVIRONMENT

Smart Environment is an approach to minimize the environmental impacts of urban living. This can be achieved through the adoption of modern technology and creative approaches to reduce waste, monitor pollution, manage the use of natural resources, and promote public participation in nature conservation.

SMART ENERGY

Smart Energy is an approach that uses technology and data-driven solutions to optimize energy production, distribution, and consumption. One of the common approaches is the implementation of smart grids which are advanced sensors that allow for better management of energy demand and supply.

For Smart People, Smart Governance and Smart Economy, please refer to Appendix F.



PHUKET



Please click on the following link or scan the QR code above to view the Phuket Introduction video: [LINK](#)

The Phuket Government has developed the Phuket Development Plan which provides local economic development strategy and planned policies to be introduced from 2022- 2027. The objective of the plan is to reduce Phuket’s current reliance on traditional tourism and further diversify into other services where Phuket has strong potential, such as education, healthcare, etc. The vision, as laid out in the plan, is for Phuket to become “an international hub for tourism, education, and service innovation through sustainable development.”

The achievement of the vision is believed to be built upon the following three main pillars.



Develop a value-based economy and high-value services



Develop the infrastructure for sustainable growth



Develop public services and encourage the private sector to improve quality of life in terms of the community, education, and security

As part of the second pillar, Phuket's Net-Zero Project is instrumental in driving sustainable growth by prioritizing environmental stewardship and positioning the province as a leader in sustainability. Furthermore, achieving such aspiration can improve the quality of life for their residents which is in line with the third pillar. To kickstart the project, the Phuket Government has already embarked on its net-zero journey by setting out several strategies at a cost of 425,000 THB (12,370 USD). Ultimately, the long-term target is to achieve net-zero carbon by 2040.



***Phuket Low Carbon City Project
(335,000 THB / 9,750 USD)***

The local government plans to develop a 115-acre area of waste disposal and wastewater treatment center to be a public learning center. This is where incinerator waste disposal, landfill, and wastewater treatment will be studied, developed, and presented to the public.

***Walking and Cycling Route Project
(33,000 THB / 960 USD)***

A walking and cycling route to important locations in Phuket City will be constructed or improved to encourage human-powered transportation. Bicycling will also be promoted through education on bicycle safety to students in municipal schools.

***Organic Compost Project
(30,000 THB / 875 USD)***

This project aims to promote the conversion of organic waste into natural compost through the education of the local population. The Phuket government has a goal to produce organic compost of no less than 300 tons per year.

***2Save Trees and Environment Project
(27,000 THB / 785 USD)***

The local government plans to promote tree planting in public areas during public holidays and to build vertical gardens in municipal offices.

PHUKET GOVERNANCE

Phuket is governed by both the central national government and the local Phuket government, each with different roles and scope of responsibility as shown below.

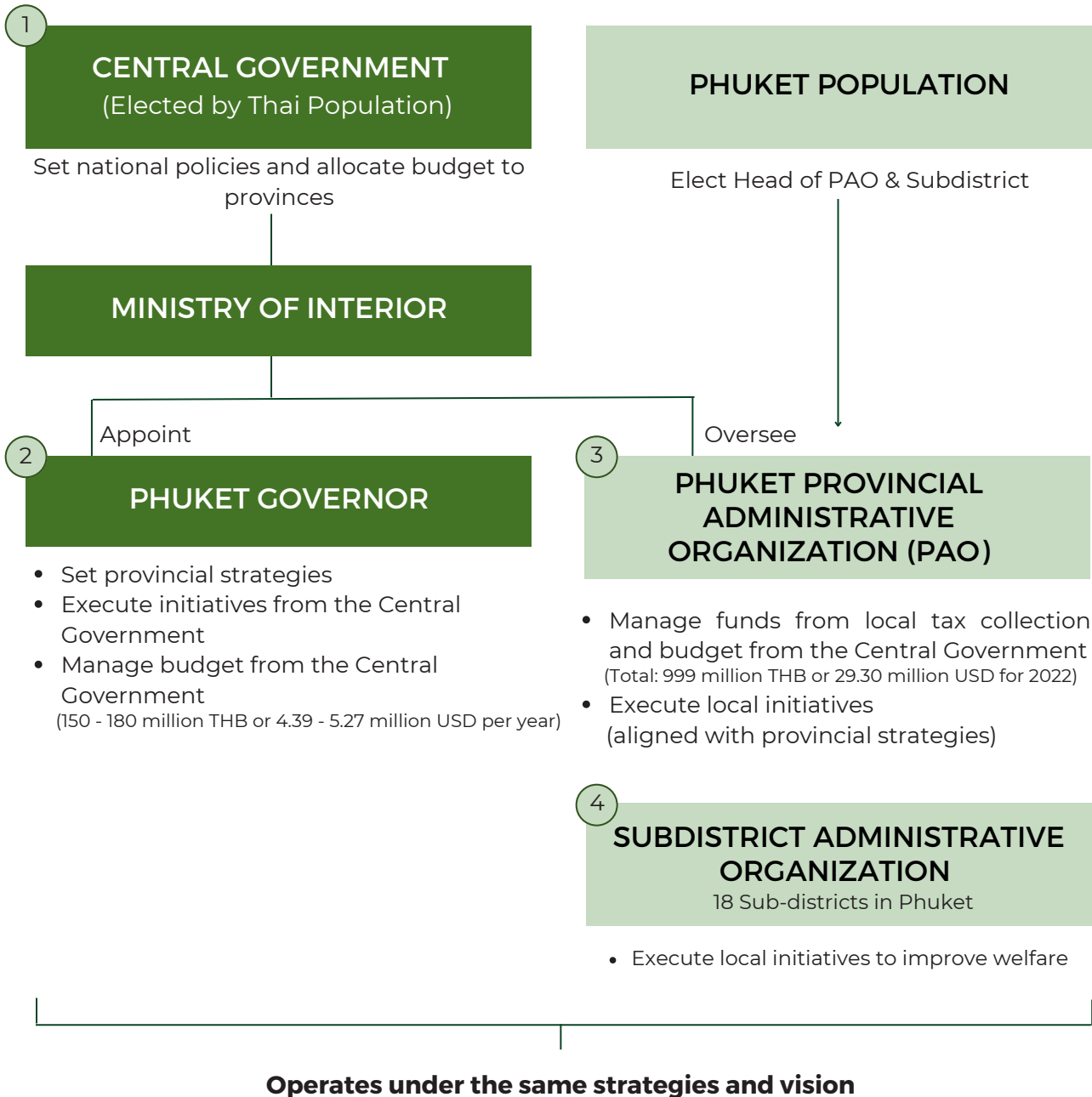


Exhibit E: Phuket Governance

PHUKET GOVERNANCE

1. CENTRAL GOVERNMENT

The Central Government or the National Government governs Phuket through the Ministry of Interior. The Central Government designs the national economic development plan, which outlines general directions which every province would follow. The Central Government also holds the authority to approve any development plans and funding requests submitted by each province in Thailand (usually a 2-year lead time from draft to approval). The cabinet, including the Minister of Interior, is elected every four years.

2. PHUKET GOVERNOR

Phuket Governor is appointed by the Ministry of Interior of the Central Government. The central appointment is to ensure complete alignment with the national strategy by all provinces. The Governor also oversees the operations of all provincial offices of the governmental departments. The Governor's term could last up to four years with an annual evaluation to determine if a change is necessary.

3. PHUKET PROVINCIAL ADMINISTRATIVE ORGANIZATION (PAO)

The PAO is the main governing body of the local provincial government. The organization is led by the Chief Executive elected by the local population of respective provinces every four years. The PAO's main goal is to design and execute local initiatives that serve the needs of the local population. It allocates funds from the Central Government and tax revenues collected from entities and people in the province to finance different local initiatives. For Phuket specifically, the fund managed by the PAO represents the majority of the total provincial budget due to the sheer size of the local economy - being consistently amongst the top 10 in Thailand with the exception of the "COVID years".

While the PAO acts as a separate entity from the Central Government and has the autonomy to allocate funding without additional approval, the initiatives and policies of the PAO need to be aligned with directions and strategy from the Central Government. However, due to the generic nature of the provincial strategy, the local initiatives would generally be aligned with the overall provincial development plan. The Net-Zero Project will largely be funded and executed through the PAO.

4. SUBDISTRICT ADMINISTRATIVE ORGANIZATION (SAO)

In Phuket, there are 18 sub-districts, each with its own Subdistrict Administrative Organization. The SAO is organized and managed in a similar manner to the PAO - with Chief Executives being elected by the population of respective sub-district. The SAO is responsible for carrying out initiatives of respective sub-districts in collaboration with the PAO.

The Net-Zero Project will require corporations from all stakeholders in Phuket and beyond. Due to the dual-governance system of Phuket, the Net-Zero aspiration, while in line with the National Government's direction, will require cooperation from the local governing body to be achievable. Additionally, the scope of solutions space will likely have an impact on private parties, such as local businesses, people of Phuket, etc. Appendix C provides additional details on potential stakeholders that may be relevant to this effort.

The journey to Net-Zero will span nearly two decades, thus sustainability of the plan and execution is a major concern. Both the local and the central governments are elected every four years. This comes with a natural tendency to change strategies and plans. While carbon emission reduction is a common goal for most political parties, there may be operational risks from shifts in budget and policies that may be linked to economic stimuli.



APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



SINGAPORE

Singapore's Green Plan 2030 aims to achieve net-zero emissions by 2050 through five key pillars including Energy Reset which relates to sustainability in the built environment. The Green Building Masterplan outlines a roadmap of initiatives such as the Green Mark Certification Scheme, the Green Buildings Innovation Cluster Program, and Green Financing to support and promote sustainable building practices.

Singapore's Green Plan 2030 serves as a roadmap towards the country's goal to achieve long-term net-zero emissions by 2050. The national agenda outlines five key pillars – Energy Reset, Resilient Future, City in Nature, Sustainable Living, and Green Economy – that are essential to address for the country's successful transition into a net-zero future. Under the Energy Reset pillar, Singapore has set sub-targets related to sustainability in its built environment. The fourth iteration of the Green Building Masterplan outlines three main targets:

- 80% of buildings by Gross Floor Area (GFA) to be green by 2030
- 80% of new developments to be Super Low Energy (SLE) buildings from 2030
- 80% improvement in energy efficiency (compared to 2005 baseline levels) for best-in-class buildings by 2030

KEY ACTIONS:

- **Green Mark Certification Scheme:** To promote environmental sustainability in construction and buildings, the scheme rates buildings based on five criteria; 1. Energy efficiency, 2. Water efficiency, 3. Environmental protection, 4. Indoor environmental quality, and 5. Innovation that contributes to better building performance. Developments that meet the criteria are eligible to receive a Green Mark certification. On the other hand, poor performers are eligible to receive cash incentives to be used for improving energy efficiency in their buildings.
- **Green Buildings Innovation Cluster (GBIC) Program:** The program aims to support the research and development and prototyping of new technologies that would improve energy efficiency in buildings. For innovations that have adoption potential, the program helps to accelerate the commercialization of these solutions.
- **Green Financing:** The Monetary Authority of Singapore (MAS) launched the Green and Sustainability-Linked Loans Grant Scheme (GSLG) which provide loans linked to activities that contribute to sustainable development, improvements to energy efficiency, and construction of green buildings.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



UNITED KINGDOM

The new Bloomberg headquarters, located in London, has earned the highest-ever score of 98.5% on the BREEAM (Building Research Establishment Environmental Assessment Method) sustainability assessment for office development. Using LED lights and an external building design that leverages natural ventilation allows the building to reduce energy consumption by 35%.

With the highest-ever score of 98.5% on the BREEAM sustainability assessment for office development, the new Bloomberg European headquarters has made its mission to push the boundaries of sustainable office design. The external design of the building uses a bronze “breathing” facade that allows for natural ventilation and helps to reduce energy consumption by 35%. The building also includes other energy-efficient features such as LED lights, which use 40% less energy than typical fluorescent lights, and a Combined Heat and Power (CHP) generation center, where waste heat is recycled for cooling and heating. Further, the building has also integrated a smart airflow system to measure carbon dioxide levels in each area of the building and automatically adjusts airflow to save an estimated 600-750 MWh of power per annum.



SINGAPORE

Under the Energy Reset and Sustainable Living pillars of Singapore’s Green Plan are Green Transport and Green Commutes. Green Transport focuses on encouraging the transition to cleaner-energy vehicles, the use of public transport, and active mobility, while Green Commutes outlines a plan to extend Singapore’s rail and cycling network.

The Energy Reset and Sustainable Living pillars aim to promote a greener transportation and commute system in Singapore. To achieve this, the Green Plan has outlined several initiatives, ranging from switching to clean-energy vehicles to expanding the country’s railway and cycling network.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES

KEY ACTIONS:

- Promoting Cleaner Vehicles: After 2020, all new public bus purchases will be either electric or hybrid models. The government has also set regulations in place for 2030 that require all new car and taxi registrations to be of cleaner-energy models.
- Tax Incentives: The government has imposed various tax-related measures to help lower the cost of owning an electric car. This includes a 45% rebate on vehicle registration tax (Additional Registration Fee or ARF) and up to a 34% reduction on road taxes for fully electric vehicles.
- EV Charger Deployment: The Land Transport Authority (LTA) has deployed over 600 EV charging points in more than 200 public parking lots to make charging stations more accessible to EV owners. It is projected that there will be 60,000 charging stations available throughout the island by 2030. Moreover, citizens can use [MyTransport.SG](#) mobile application to search for nearby charging stations.
- Active Mobility: Singapore plans to grow its rail network from 230KM today to 360KM by the early 2030s and expand its cycling network, under its Islandwide Cycling Network (ICN) Program, from 460KM to 1,320KM by 2030. It is also working on repurposing its roads to better support walking and cycling.



FINLAND

The CitiCAP project was piloted in 2018 to research the mobility behaviors of citizens of the city of Lahti. Through the mobile application, users were given a weekly carbon budget and were rewarded with virtual credits if they did not use up their budget. The program encouraged citizens to choose more sustainable mobility alternatives like public transportation, cycling, or walking.

The CitiCAP project is a pilot program that was launched in 2018 in the city of Lahti, Finland. The goal of the program is to encourage citizens to adopt more sustainable mobility behaviors by providing them with a weekly carbon budget and incentivizing them to stay within their limits. The mobile application tracks the user's mobility behavior, including their use of public transportation, cycling, walking, and driving. The carbon budget is calculated based on the amount of greenhouse gas emissions that would be produced by their transportation choices. If users stay within their weekly carbon budgets, they will be rewarded with virtual credits to spend on goods and services from local businesses. According to a report from the European Commission, the program resulted in a significant increase in the use of public transportation and a decrease in the use of personal cars.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



DENMARK

Denmark has also recognized the need to address these emissions and has taken steps to transition towards a carbon-neutral freight transport sector. The country is investing in sustainable fuels and adopting new technologies, making Denmark a leader in the effort to reduce emissions from the shipping industry.

Denmark, one of the key maritime players, has launched the Zero-Emission Shipping Mission which will accelerate global innovation efforts across maritime and energy sectors to make a zero-emission fleet a reality by 2030. To address carbon emissions from freight transport, the Danish government has invested in research and development of sustainable fuels such as biofuels and green ammonia. The Danish shipping industry has also been a leader in adopting new technologies, including the use of wind-assisted propulsion and autonomous ships.



UNITED STATES

In response to the urgent need to address climate change, the US has taken significant steps to support the transition to a low-carbon shipping industry. This includes developing a national strategy to reduce greenhouse gas emissions from shipping and investing in research into zero-emission fuels and technologies.

The US has taken steps to support the transition to a low-carbon shipping industry. The Biden administration has announced plans to develop a national strategy to reduce greenhouse gas emissions from the shipping sector, and has committed to implementing international emissions standards for ships. For example, the Environmental Protection Agency (EPA) has proposed new regulations that would require ships operating in US waters to use cleaner-burning fuels and reduce emissions of nitrogen oxide, a key contributor to smog and acid rain. Additionally, the US has provided funding for research into zero-emission fuels and technologies, including hydrogen and battery-electric propulsion.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



GERMANY

With a goal to achieve net-zero greenhouse gas emission by 2050, Germany believes that the steel industry is playing a critical role in meeting this ambition. Multiple strategies have been outlined, including adopting new technologies and promoting circular economy principles

Germany's steel industry is undergoing a transition towards net-zero carbon emissions to achieve the country's climate targets. The steel industry is a key target for emissions reduction efforts as it is one of the most energy-intensive and carbon-intensive industries. One of the strategies for reducing its carbon footprint is using new technologies such as direct reduction of iron (DRI) and hydrogen-based steelmaking.

These technologies are low-carbon alternatives to traditional blast furnace methods of producing iron and steel. By using natural gas or other reducing agents to remove oxygen from iron ore, DRI technology and hydrogen-based steelmaking can produce high-quality iron with significantly lower carbon emissions. Furthermore, the industry is working to promote circular economy principles, such as recycling and reusing steel.



SINGAPORE

Singapore aims to use cleaner energy sources, with solar energy being the most viable option due to its prime geographic location. To meet its target of installing at least 2 gigawatt-peak of solar capacity by 2030, the country has opened a floating solar panel system at Tengeh Reservoir.

The main goal of the Energy Reset pillar is to implement cleaner energy sources across all sectors. According to the Energy Market Authority, solar energy remains the most viable renewable source due to Singapore's geographic location in the tropical sunbelt. Singapore has already achieved a high concentration of solar energy infrastructure and is considered one of the most solar-dense cities in the world. In 2021, Singapore opened a 60-megawatt-peak floating solar panel system at Tengeh Reservoir, in an effort to meet its plan of installing at least 2 gigawatt-peak of solar capacity by 2030.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



SWEDEN

Malmö has aspired to become 100 percent powered by renewable and recycled energy by 2030. Its “Shared Energy is Double Energy” project recycles waste heat from industries and integrates it into the city’s district heating system. Another initiative that has been implemented since 2014 is using food waste to produce biogas, powering the city’s public transport fleets such as buses, garbage trucks, and municipal vehicles.

Currently, around 25% of Malmö’s power production is from renewables. To reach its goal of becoming 100% powered by renewable and recycled energy, the Swedish Governmental Agency for Innovation Systems, also known as Vinnova, established the “Shared Energy is Double Energy” project. This strategy allowed the industry and port to transform its waste energy into usable energy to heat the city. Several districts in Malmö have also signed climate contracts to ensure that a smart grid system for heating, cooling, and power is in place for its residents. In addition to this project, Malmö has also used food waste to produce biogas to fuel the city’s public transportation. Since food waste recycling is mandatory for all households, the initiative has been granted success.



BRAZIL

To promote sustainable farming practices and reduce carbon emissions, the Brazilian government launched the Low-Carbon Agriculture plan to encourage farmers to adopt mixed cropping and crop rotation practices which improve soil quality and minimize carbon emissions from soil decomposition.

Brazil’s agricultural sector is a significant contributor to the country’s GDP, accounting for almost 27%. However, the growth of Brazil’s agribusiness comes at the expense of deforestation. To address this, the Brazilian government has launched the Low-Carbon Agriculture Plan to promote sustainable farming practices using “climate-smart” technologies. To prevent further deforestation and reduce carbon emissions from soil tilling, farmers are encouraged to adopt mixed cropping or crop rotation practices. This is when farmers use different combinations of crops and livestock in order to help maintain soil fertility and health.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



SAINT LUCIA

To tackle inconsistent climate conditions, especially during the dry season, farmers were introduced to ICT tools such as automated irrigation systems controlled via mobile devices. Effective irrigation scheduling can help improve soil, crop, and biomass quality and subsequently reduce greenhouse gas emissions.

As Saint Lucia often experiences drought conditions, its crop production becomes unpredictable, leading to national food insecurity. To tackle such challenges, the Caribbean Agricultural Research and Development Institute (CARDI) launched a project to introduce information and communication technologies to farmers to help with crop irrigation systems. Farmers were able to automate their irrigation systems through their mobile devices using climate data. Soil moisture is the most important factor that affects the amount of greenhouse gas emissions from croplands. Increased irrigation can overstimulate microbial function, causing more carbon dioxide to be released from the soil. During dry seasons, crops are often overwatered, thus, overstimulating soil carbon emissions. Therefore, it is important to have proper irrigation systems to efficiently manage water use and reduce carbon emissions.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



SINGAPORE

To transform into a greener and climate-resilient country, strategies under its City in Nature pillar include the Skyrise Greenery Initiative Scheme to help fund the retrofitting of rooftops and implementation of nature corridors to link existing parks and create a walkable green city.

Singapore has already been named one of the world's greenest cities, with over 46.5% of the country covered in green space. Under its City in Nature pillar are several key strategies to transform Singapore into a greener, more sustainable, and climate-resilient country.

KEY ACTIONS:

- Restore Nature in Urban Areas: The Skyrise Greenery Initiative Scheme (SGIS) provides up to 50% in funding for building owners to retrofit rooftops and vertical surfaces with plants. Skyrise greenery can help reduce the the urban heat island effect and improve the air quality by absorbing harmful pollutants.
- Connect Green Spaces: Through the implementation of "nature corridors", an area that has be revegetated to link two or more existing parks, Singapore is able to create an interconnected eco-hub. While nature corridors enable animals to move safely between habitats, park connector networks, a network of trails linking parks and nature areas, allow for citizens to move across different areas by cycling or jogging. Moving forward, Singapore has an aspirational goal to make every household be within a 10-minute walk from a park.



SPAIN

To improve air quality and combat the heat island effect, Madrid's councilor for the environment and urban development has launched a project to build a green wall around the city. Comprising of indigenous trees that use significantly less water and require less maintenance, the 75-kilometer green wall is expected to absorb up to 175,000 tons of carbon dioxide per year.

The initiative to build a green wall around Madrid is part of a larger effort to combat the negative effects of climate change on the city; improving air quality, reducing temperatures, and increasing the amount of green space in the city. The project is being led by the councilor for the environment and urban development, Mariano Fuentes, and is being supported by the Spanish government and other stakeholders. Indigenous trees will be planted along the highways and main roads around Madrid, covering a total distance of 75 kilometers. This will create a continuous green barrier around the city which will help absorb carbon dioxide and release moisture into the air, cooling down the city.

APPENDIX A

EXAMPLES OF NET-ZERO INITIATIVES



SINGAPORE

Singapore's National Environment Agency (NEA) supports the decarbonization of business and the Energy and Chemicals sector through the Energy Efficiency Fund. Recently, Singapore has also signed a memorandum with Chile and Australia to co-develop and share CCUS technologies.

The Green Economy pillar focuses on enabling the decarbonization of businesses and industries and to do so, the government encourages partnership among players in the Energy and Chemicals sector in developing low-carbon technologies. In support of this initiative, the National Environment Agency (NEA) established the Energy Efficiency Fund (E2F) to finance up to 70% of qualifying costs for adopting energy-efficient technologies. Despite signing a memorandum with Chile and Australia to research, develop, and share CCUS technologies, Singapore faces challenges in executing this initiative due to a lack of suitable geological formations for underground storage of carbon dioxide.



NORWAY

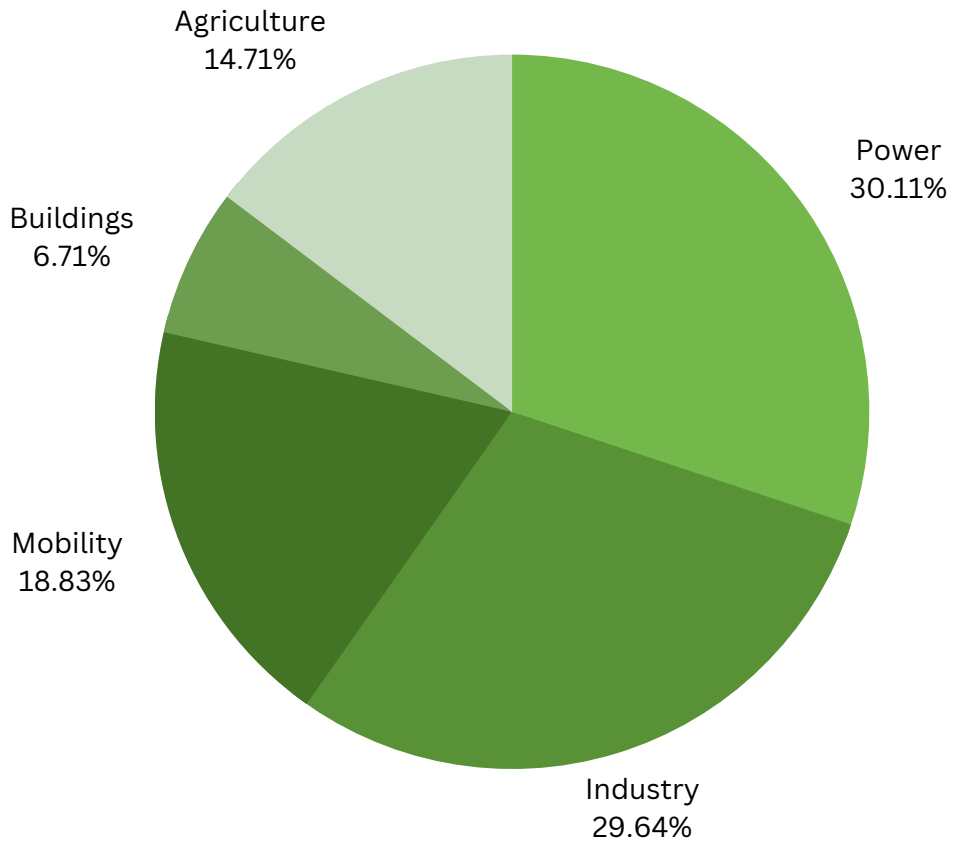
The Norwegian government, in partnership with Equinor, Shell, and Total, recently launched the Northern Lights project, the world's first cross-border carbon transport and storage network. The facility is expected to start its operations by 2024, capturing up to 1.5 million tonnes of carbon emissions per year across the entire European region.

Norway has long been a pioneer in carbon capture and storage technology and has already established a number of successful CCS projects, including the Sleipner project and the Snøhvit project, both of which have been in operation for over a decade. The Northern Lights project is the latest addition to Norway's CCS portfolio, and it has the potential to become one of the largest CCS facilities in the world. This project plans to expand its impact by becoming the first cross-border transport and storage network for the European region. To be launched in 2024, the facility is expected to capture up to 1.5 million tonnes of CO₂ per year initially, with the potential to scale up to 5 million tonnes per year in the future. The captured carbon will be permanently stored in the seabed of the North Sea.

APPENDIX B

PERCENTAGE SHARE OF CARBON EMISSIONS FOR EACH PILLAR

Please note that the following percentages are from levels of emissions globally. The graph below is calculated from the data provided from a McKinsey and Company's report titled "The net-zero transition: What it would cost, what it could bring."



APPENDIX C

STAKEHOLDERS TO BE CONSIDERED

Private Sector	
PKCD	<p>Phuket City Development Co., Ltd. (PKCD) is a social enterprise founded by a group of private businessmen in Phuket. The company currently has 47 shareholders, with a total registered capital of 156 million Baht. PKCD collaborates with government and private entities at all levels to develop Phuket into a world-renowned tourist destination and a leading economic hub. Their projects include smart transit, smart tourism, smart energy, and smart city.</p> <p>One of their projects that have already been implemented is the 'Phuket Smart Bus', which allows users to check the accurate schedules and location of the stations through its website.</p>
Commercial Bank	<p>Financial institutions can play a critical role in providing funding for projects that support sustainable development and reduce carbon emissions. This can involve offering reduced interest rates to sustainable projects or incorporating environmental, social, and governance (ESG) factors into banks' investment decisions.</p> <p>Example: Kasikorn Bank, also known as KBank, is one of the largest commercial banks in Thailand, with a focus on providing a wide range of financial services to individuals and businesses. KBank has announced a Green Banking policy as one of its commitments to achieve a net-zero goal. This policy includes a requirement that borrowers who seek loans for certain types of projects must meet certain environmental and social sustainability standards.</p> <p>Three policies include:</p> <ul style="list-style-type: none">• Green Financing: KBank requires borrowers seeking loans for certain types of projects, such as renewable energy, energy efficiency, and sustainable agriculture, to meet certain environmental and social sustainability standards.• Environmental Risk Management: KBank assesses the environmental and social impact of the projects it finances and provides guidance to borrowers on how to mitigate those impacts.• Stakeholder Engagement: KBank engages with its customers and other stakeholders to promote sustainable practices and provides guidance on how to implement environmentally and socially responsible practices.

APPENDIX C

STAKEHOLDERS TO BE CONSIDERED

Private Sector	
Network Provider	<p>Network providers are responsible for providing telecommunication services and connectivity infrastructure in the area. By this, they can contribute to the reduction of carbon emissions by adopting sustainable practices and implementing green technologies.</p> <p>Example: Advanced Info Service (AIS) is one of the largest mobile network operators in the country. AIS has made a commitment to reduce its carbon emissions by 50% by 2025 and to achieve net-zero carbon emissions by 2030. To achieve these goals, the company has implemented several sustainable practices and initiatives, including:</p> <ul style="list-style-type: none">• Investing in renewable energy: AIS has invested in solar power plants and other renewable energy sources to reduce its reliance on fossil fuels.• Implementing energy-efficient technologies: The company has adopted energy-efficient technologies in its data centers, network infrastructure, and other facilities to reduce energy consumption.• Promoting sustainable behaviors: AIS has launched several public awareness campaigns to promote sustainable behaviors among its customers, including encouraging them to switch off their devices when not in use and use energy-efficient devices.• Supporting the development of smart infrastructure: AIS has partnered with local governments and other stakeholders to develop smart cities and other sustainable infrastructure projects that leverage IoT and other technologies to reduce energy consumption and improve efficiency.
Transportation Service Provider	<p>Transportation Service Providers play an important role in determining the level of emissions, accounting for approximately 14% of global greenhouse gas emissions. Adopting sustainable practices could result in a significant reduction in carbon emissions.</p> <p>Example: Grab is a ride-hailing platform that operates in Southeast Asia, including Phuket, Thailand. It plays an important role in Phuket's transportation by connecting passengers with private cars, motorbikes, and taxis. Grab's services provide an alternative to traditional transport options such as taxis, tuk-tuks, and songthaews, offering a convenient and reliable way for tourists and residents to get around the island.</p> <p>Grab works with governments, automakers, and infrastructure players to build a sustainable and inclusive electrification ecosystem across the region. This also includes supporting partnered drivers' transition to low-emission vehicles such as hybrid cars or EVs.</p>

APPENDIX C

STAKEHOLDERS TO BE CONSIDERED

Private Sector

Retailer

Retailers have significant influence over both their own operations and the behavior of their customers. By adopting sustainable practices and promoting sustainability across their supply chains, retailers can have a huge impact on carbon reductions.

Example: **Central Group** is a Thai conglomerate that operates in the retail, property development and hospitality industries. The company has a significant presence in Phuket, with a range of retail outlets and hotels catering to both local residents and tourists:

- Central Phuket - a large shopping mall located in the heart of the island's tourist district. The mall features a range of international and local brands, as well as a cinema, food court, and other entertainment facilities.
- Porto de Phuket - an air lifestyle retail that focuses on lifestyle stores, restaurants, and the supermarket.
- Top Supermarket & Central Food Hall - Central Group operates more than 5 supermarkets in Phuket island.

All companies within the Central Group have a program to reduce their waste to zero through the implementation of strategies for plastic reduction, waste segregation, and food waste handling. Central Group joins hands with the United Nations Environment Programme (UNEP), inviting customers to take action to reduce environmental impacts from our daily lives through three main themes: Better Living, Better Shopping, and Better Travelling, in order to achieve its environmental goals sustainably.

Example: **C.P. Group** (Charoen Pokphand Group) is another conglomerate with businesses spanning various industries such as agribusiness, food processing, retail, telecommunications, and more.

C.P. Group owns 7-Eleven Thailand, which is the largest convenience store chain in the country. There are currently over 280 7-Eleven stores on Phuket Island.

The Group has set the mission to become a Carbon Neutral Organization by 2030 by focusing on energy management, enhancing energy efficiency, and minimizing environmental impacts for business activities. The Group has made investments in environmental management through a variety of projects, including the development of solar energy, the construction of energy-saving buildings, etc. The following are their past initiatives:

- Solar car park - C.P. Group launched Thailand's largest solar car park under SAIC Motor-CP Co., Ltd., covering an area of 31,000 m² with a total production capacity of 4.88 megawatts.
- For transportation, the group uses the K-Track system, which helps control GHG emissions by monitoring the usage of our vehicles. It records data from each vehicle, including speed and fuel usage, and features a GPS navigation system to help calculate routes and speed, which reduces energy consumption in vehicles.

APPENDIX C

STAKEHOLDERS TO BE CONSIDERED

Government	
Central Government	<p>Responsibility:</p> <ul style="list-style-type: none"> Establishing nationwide policies and overseeing the management of each ministry. <p>Method of selection:</p> <ul style="list-style-type: none"> Elected every four years by the Thai Population. <p>Authority:</p> <ul style="list-style-type: none"> Approve the development plans and funding proposals submitted by each province. For large development projects that require a great amount of funding, the proposal and plan need to be sent to the central administration for approval. Provinces have to submit the plan 2 years in advance before they can receive the funding to proceed. The process involves three sequential steps: firstly, revising and planning the fund; secondly, allocating the fund; and finally, approving the fund.
Phuket Governor	<p>Responsibility:</p> <ul style="list-style-type: none"> Setting policies for Phuket that follow the Central Government's direction. <ul style="list-style-type: none"> e.g., setting up Phuket's development plan to be "an international hub for tourism, education, and service innovation through sustainable development." Oversees the operations of the various government departments and implements government policies at the provincial level. The areas of responsibility include the economy, infrastructure, public services, and the tourism industry. <p>Method of Selection:</p> <ul style="list-style-type: none"> Appointed by the Ministry of Interior (The governor's term could last for up to four years, but the central government will conduct an annual evaluation to determine whether a change is necessary.) <p>Authority:</p> <ul style="list-style-type: none"> Manage the budget from the Central Government <ul style="list-style-type: none"> Usually around 150-180 million THB (4.39 - 5.27 million USD) for Phuket Province.
Phuket Provincial Administrative Organization (PAO)	<p>Responsibility:</p> <ul style="list-style-type: none"> Push and execute local initiatives to improve Phuket (keep in alignment with provincial strategies) <p>Method of Selection:</p> <ul style="list-style-type: none"> Elected every four years by the Phuket Population. <p>Authority:</p> <ul style="list-style-type: none"> Manage resources at the local level as the organization collects its own funding from people in the province (Approximately 999 million THB or 29.3 million USD for 2022). <ul style="list-style-type: none"> The fund can be utilized and allocated without the need for approval from the Central Administration. Thus, projects that aim to use PAO funding can propose to the PAO committee and proceed within a few months.
Subdistrict Administrative Organization	<p>Responsibility:</p> <ul style="list-style-type: none"> Execute initiatives at the district level to improve welfare. <p>Method of Selection:</p> <ul style="list-style-type: none"> The Subdistrict Administrative Organization in each of the 18 sub-districts is elected by the Phuket population every four years.

APPENDIX C

STAKEHOLDERS TO BE CONSIDERED

National Government Agencies

Ministry of Energy

Responsibility: The Ministry of Energy is responsible for the formulation and implementation of policies related to energy development, promotion, and conservation. It has 2 state enterprises under the ministry; EGAT and PTT Public Company Limited. Its main goal is to ensure a secure, affordable, and sustainable energy supply for Thailand's economic and social development.

The Ministry is responsible for overseeing and regulating the production, distribution, and consumption of energy in Thailand, including electricity, natural gas, oil, and renewable energy sources such as solar, wind, and biomass. It also promotes energy conservation and efficiency through various initiatives and programs, such as the Energy Conservation Promotion Fund and the Energy for All program.

Ministry of Transport

The Ministry is responsible for overseeing and regulating various modes of transportation in Thailand, including road, rail, air, and sea. It also promotes the development of transportation infrastructure and services, such as highways, airports, seaports, and public transportation systems.

The Ministry of Transport works closely with other government agencies, private sector organizations, and international partners to develop and implement transportation policies and projects. For example, the Ministry collaborates with the Ministry of Energy to promote the use of alternative fuels in the transportation sector, and with the Ministry of Tourism and Sports to promote tourism-related transportation services.

State Enterprises

EGAT (Electricity Generating Authority of Thailand)

The Electricity Generating Authority of Thailand operates its main business in generating and distributing electricity to Metropolitan Electricity Authority (MEA), Provincial Electricity Authority (PEA), electric users, nearby countries, and other electricity businesses.

EGAT generates electricity from its 50 power plants located in all regions in Thailand with a total generating capacity of 15,789.58 megawatts. EGAT power plants consist of 3 thermal power plants, 6 combined cycle power plants, 27 renewable energy power plants (hydropower), 9 renewable power plants (wind, solar, geothermal), and 4 diesel power plants.

APPENDIX C

STAKEHOLDERS TO BE CONSIDERED

State Enterprises

PEA (Provincial Electricity Authority)

Provincial Electricity Authority is a leading organization in the region that focuses on providing efficient and reliable electricity services. The enterprise electrifies over 99 percent of Thailand in 74 provinces, serving 21 million customers.

In its strategy development, the focus is on transforming PEA into an entity of sustainable development, guided by international best practices, including UN SDGs. It advocates efficient energy consumption by actively driving energy saving in all sectors; including energy saving in industrial works, which represent power-intensive customers.

Apart from the core business of supply and distribution of electricity to customers in 74 provinces, PEA also has several supplementary businesses including:

- Electrical Power System Construction and Installation - facilitates installation of communication tools and connection of power grids.
- Energy Management - provides energy management services to third parties, such as the energy efficiency enhancement project in the public sector and solar rooftop installation service for residences.
- New businesses concerning electricity service - These businesses may be developed solely by PEA or in collaboration with partners in both public and private sectors in response to electricity industry restructuring. These businesses should also add value to the portfolios of PEA and affiliates, including those involving electric vehicles (EV network operator and EV data roaming), power sales and purchases on an energy-trading platform, energy storage, and digital businesses involving data analytics.

APPENDIX C

STAKEHOLDERS TO BE CONSIDERED

State Enterprises

PTT Public Company Limited

PTT Public Company Limited is the leading energy company in Thailand. The company is currently expanding into new businesses including renewable energy, EV Chain, and Life Sciences, as an attempt to drive the business toward sustainability. Leveraging its extensive network and resources, PTT Public Company Limited is collaborating with various development projects to drive sustainability and innovation.

In April 2022, PTT Public Company Limited entered into a Memorandum of Understanding with Phuket City Municipality to collaborate on the development of education and innovation in the field of energy, specifically smart energy and public utility management in Phuket City. The partnership aims to continue the progress of innovative energy projects, including water resource management, power generation from solar energy, and the development of energy storage systems. In addition, the project will focus on promoting tourism through the use of electric vehicles, while also transforming Phuket City into a smart city and a model for clean energy. The ultimate goal is to position Phuket City as a world-class destination for both tourism and living while being recognized as an international leader in sustainable energy.

In addition to the collaboration with Phuket City Municipality, PTT Public Company Limited is also involved in numerous other initiatives, including

1. Wangchan Valley Project

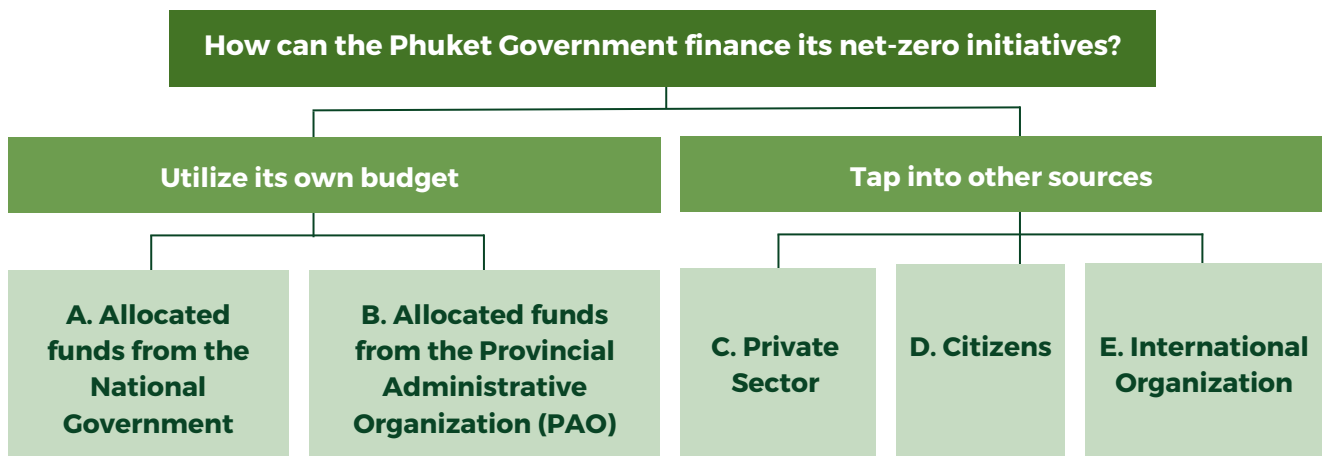
Wangchan Valley, also known as the Eastern Economic Corridor of Innovation Project, is a pilot initiative of PTT Pcl and the National Science and Technology Development Agency on 553 hectares of land in Rayong province since early 2021. The project aims to be a pilot smart city that helps convert Thailand's traditional industry into the new target industry, or new S-Curve. Through the use of seven smart city concepts certified by Depa, they aim to develop the city as one of the best smart cities offering an innovation ecosystem in Southeast Asia.

2. PTT ExpreSo

PTT ExpreSo unit was established to invest in and support startups that work on energy innovations and decarbonization. By supporting startups working on these issues, PTT ExpreSo can help accelerate the development and adoption of new technologies and solutions that can reduce greenhouse gas emissions and contribute to a more sustainable future.

APPENDIX D

POSSIBLE FUNDING STRATEGIES



Some of the ways that the Phuket government supports the financing of its net-zero project are illustrated below. Though it is important to note that this list is not exhaustive.

A. ALLOCATED FUNDS FROM THE NATIONAL GOVERNMENT

The Phuket Government can use the allocated funds from its budget to support net-zero projects in Phuket. The budget is determined by the national government, and the process is highly bureaucratic, often taking longer than two years for approval. Furthermore, the annual budget is typically only around 150 - 180 million THB (4.39 - 5.27 million USD), and the budget needs to be spent on other areas as well such as infrastructure maintenance and government officers' salaries.

B. ALLOCATED FUNDS FROM THE PROVINCIAL ADMINISTRATIVE ORGANIZATION (PAO)

The PAO has its own budget from collecting taxes and receiving an allocated budget from the National Government, and the approval process is more streamlined. It typically takes three to five months to get approval. The total budget for 2022 is approximately 999 million THB (29.30 million USD). Similar to the funds from the National Government, the budget is a common pool and has to be shared with other initiatives as well.

APPENDIX D

POSSIBLE FUNDING STRATEGIES

C. PRIVATE SECTOR

The Phuket Government can partner with private companies and investors to finance net-zero projects in Phuket. This involves leveraging private capital to fund sustainable development projects and sharing the risks and rewards of these investments. Public-private partnership can be in the form of pure CSR as well. As an example, the government partnered with PJT Technology in 2012 to launch the Phuket Waste To Energy Plant. PJT funded all the initial costs and owned the technology. The Phuket Municipality is responsible for collecting and transporting waste to the disposal complex for processing. All the revenue generated from the power plant goes to PJT.

D. CITIZENS

While not ideal, public crowdfunding can be utilized as well. To initiate a fundraising campaign from the citizens, approval and cooperation from the PAO will be required. Donations will likely be the only form of funding feasible, as green securities such as green bonds have not been issued in Thailand.

E. INTERNATIONAL ORGANIZATION

Organizations such as the Asian Development Bank (ADB), the United Nations, and other donor agencies can provide funding to support net-zero projects in Phuket. These funds are often targeted at specific sectors, such as renewable energy or sustainable transportation. This method is considerably difficult though not impossible. For instance, the Northeast Thailand Wind Power Project located in the Chaiyaphum province is being funded by a loan of 157 million USD from ADB. To reach out to these organizations, support from the PAO or the National Government will be crucial.

APPENDIX E

EXAMPLES OF INITIATIVES TO ACHIEVE GOALS IN THAILAND'S CARBON NEUTRALITY PATHWAY

HYDRO-FLOATING SOLAR HYBRID PROJECT AT KHON KAEN

The 24 MW hydro-floating solar hybrid project at Ubol Ratana Dam in Khon Kaen province is in development after the success of the Sirindhorn Dam Hydro-Floating Solar Hybrid Project in Ubon Ratchathani province to support the government's goal of carbon neutrality. This project will generate electricity through the combination of solar power and hydropower from the dam. Moreover, it will be equipped with a battery energy storage system (BESS) to enhance the efficiency and continuity of power generation.

THAI RICE NAMA PROJECT, FUNDED BY THE NAMA FACILITY

The Thai Rice NAMA is a pilot mitigation project that aims to reduce greenhouse gas emissions from rice production in the agricultural sector. This sector accounts for nearly 55% of emissions, and the project seeks to transform the Thai rice sector into low methane emission rice production. The project covers a harvested rice area of 0.91 million hectares across 6 provinces in the central region. Several mitigation technologies are being implemented, such as land laser leveling technology, alternative wetting and drying (AWD), and site-specific soil and nutrient management.

LOW CARBON CITY PILOT AT RAYONG

Muangklang, a small-sized municipality located in Rayong, is a pioneer Low Carbon City. This is the city where a process to help localities work towards becoming a low-carbon city is practiced. The goal is to offer lessons learned and a model for customization and replication in other small cities across Thailand.

APPENDIX F

OTHER THREE ELEMENTS IN SMART CITIES

SMART ECONOMY

Smart Economy is an approach that focuses on using digital technology to increase efficiency in business operations and create added value for the economy. The main goals of Smart Economy are to enhance its business climate, attract startups, investors, and highly skilled talent, and promote sustainable economic growth for increased competitiveness.

SMART CITIZEN OR SMART PEOPLE

Smart Citizen or Smart People is an approach to facilitate lifelong learning opportunities for residents by encouraging them to be more creative and stay current with evolving technologies. To achieve that, the government needs to create digital inclusion or digital equality as it is an important prerequisite.

SMART GOVERNANCE OR SMART GOVERNMENT MANAGEMENT

Smart Governance or Smart Government Management refers to the use of technology and data-driven approaches to improve the efficiency, transparency, and responsiveness of government services in Smart Cities. The main goal of Smart Governance is to empower citizens, increase citizen participation, and enhance the delivery of public services by leveraging digital technologies.

APPENDIX G

EXAMPLE OF SMART LIVING AND SMART MOBILITY

FUKUOKA CITY, JAPAN

Fukuoka, the largest city on the island of Kyushu in Japan, has adopted several Smart Living initiatives to enhance the quality of life of its citizens. These projects include energy-efficient technology like smart meters and energy storage systems, and sustainable transportation choices like electric buses, bike-sharing programs, and intelligent traffic systems. In addition, Fukuoka has developed a smart waste management system that makes use of sensors to streamline garbage collection routes and lower costs. Other initiatives are a smartphone application for tourists that provides details on nearby sights and activities and a smart disaster protection system that employs sensors to monitor seismic activity and notify citizens in the case of an earthquake or other natural catastrophe.

SINGAPORE

As one of the countries that have land constraints and a growing population, one of the key national priorities is to develop Smart Mobility. The goal of Singapore's Smart Mobility policy is to provide a more effective, environmentally friendly, and open transportation network for all citizens. This is accomplished through programs like Intelligent Transport Systems, which optimize traffic flow and improve public transportation services using sensors, data analytics, and automation. To decrease the number of vehicles on the road and enhance last-mile connection, shared mobility alternatives like car- and bike-sharing are supported. Moreover, incentives, infrastructure development, and research and development are used to promote the use of electric vehicles. The city also prioritizes active mobility by creating a more walkable and bike-friendly environment with pedestrian-friendly streets, dedicated cycling paths, and safe cycling networks.



APPENDIX H

EMPLOYMENT IN PHUKET

Phuket's total registered population in 2020: 414,471 (according to Ministry of Interior)

Employment by Status	Population Number
Private firm employees	192,636
Freelance	65,430
Public sector employee	18,774
Work for family business	16,043
Employer/ Business owner	13,325

Employment by Industry	Population Number
Food and Hospitality	81,557
Retail	62,354
Manufacturing	20,731
Construction	24,955
Agricultural	8,201
Management	21,672

APPENDIX I

PHUKET GROSS PROVINCIAL PRODUCT

Phuket GPP by Category (2021)

Category	GPP 2021 (Million THB)	GPP 2021 (Million USD)
Agriculture Total	7,054	205
Agriculture, forestry and fishing	7,054	205
Industrial Total	6,022	175
Manufacturing	3,632	105
Electricity, gas, steam and air conditioning supply	2,033	59.28
Water supply; sewerage, waste management and remediation activities	357	10.42
Services Total	86,469	2522
Construction	4,211	123
Wholesale and retail trade and repair of motor vehicles and motorcycle	7,630	223
Transportation and storage	18,664	545
Accommodation and food service activities	16,847	491
Information and communication	2,845	83.37
Financial and insurance activities	9,992	291
Real estate activities	5,901	172
Professional, scientific and technical activities	570	16.63
Administrative and support service activities	993	28.98
Public administration and defense; compulsory social security	8,925	260
Education	2,368	69.09
Human health and social work activities	5,391	157
Arts, entertainment and recreation	498	14.54
Other service activities	1,631	47

APPENDIX J

PHUKET LAND USE (UPDATED 2015)



Phuket Land Use (Updated 2015)

- Low density Residential Area
- Medium density Residential Area
- High density Commercial and Residential Area
- Industrial and warehouse Area
- Agricultural Area
- Forest Conservation Area
- Marine Conservation area
- Transportation Infrastructure

APPENDIX K

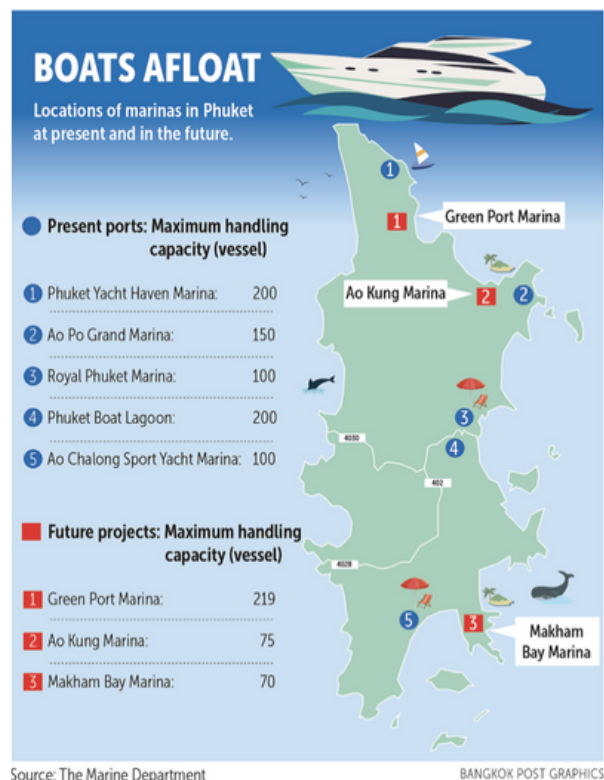
TRANSPORTATION IN PHUKET

MARINA

Phuket has five marinas, which welcome 2,000 boats per year. The marinas are very popular as a stopover when sailing between the South China Sea and the Andaman Sea through the Malacca Strait.

AIRPORT

There is one international Airport, located in the north of Phuket Island, about 32 kilometers from the city center. Phuket International Airport is the second-busiest airport in Thailand, after Bangkok's Suvarnabhumi Airport. It offers direct flights to many international destinations, including Australia, China, Hong Kong, Singapore, and Russia, as well as domestic flights to several cities in Thailand.



APPENDIX K

TRANSPORTATION IN PHUKET

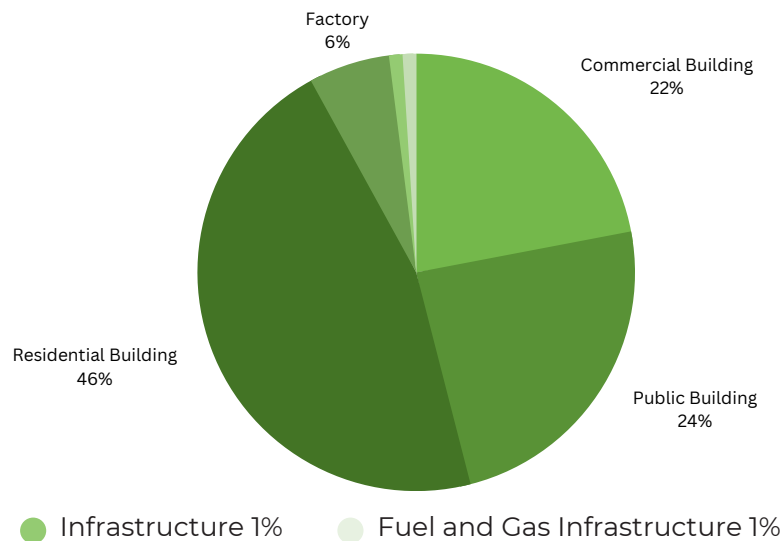
PUBLIC TRANSPORTATION:

Phuket does not have a train system or station. Currently, buses are the main means of public transportation. The most recent bus service called 'Phuket Smart Bus' was launched in 2022, by the collaboration of the Phuket government and the private sector. Phuket Smart Bus project is an attempt to increase the ease of public transportation for tourists, operating the route from the airport to six beach destinations at a flat rate fare of 100 THB.



APPENDIX L

PHUKET CONSTRUCTION AND REAL ESTATE UTILIZATION (APPROXIMATED)

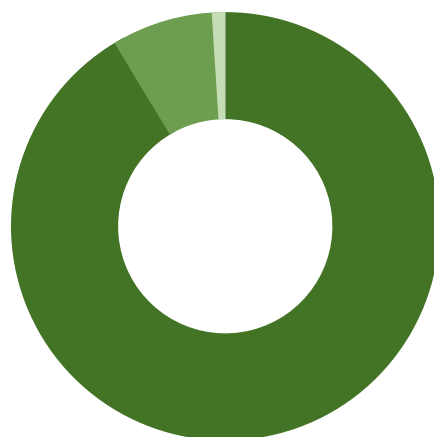


APPENDIX M

PHUKET BUDGET ALLOCATION FOR 2022

In 2022, Phuket received a total budget of 119 Million THB (3.53 Million USD) from the National Government. This budget has been allocated as shown below.

- Tourism Development - 108.70M (91.31%)
- Quality of Life Improvement - 1.20M (1.04%)
- Stability and Safety Development - 9.10M (7.65%)



The government resource allocation in Phuket appears to be incongruous when compared to the significant gross provincial product (GPP) generated by the province. In 2021, Phuket's GPP amounted to 99.54 billion THB (2.95 billion USD), ranking it seventh among Thailand's 77 provinces. However, budget allocation is determined by population and size, and Phuket's registered population is considerably smaller than provinces such as Nakhon Ratchasima, Ubon Ratchathani, and Chiang Mai, which have five times more residents.

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