CHALLENGES TO THE FUTURE OF THAILAND'S BLUE ECONOMY

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INTRODUCTION

As the world population increases, states are seeking more resources and other sources of wealth to meet the needs of their people. For many countries, land-based resources are one of the main sources of wealth. However, this reliance has generated problems, such physical overuse resulting in poor regeneration or has proven overly costly to gather and transport. Therefore, there has been, or will be, a desire to use sea-based resources as either a supplement or replacement for land-based resources. Hence, in the future it is reasonable to assume states will seek to power a greater share of their economies from the sea.

The ocean is vastly more important than we appreciate. The following figures show how crucial it is to the world: the value of the world marine economy is about US$2.5 trillion per year according to World Wildlife Fund report in 2023. Marine tourism is worth US$1.6 billion a year. Roughly, 80% of global trade is transported via the seas, 350 million jobs are employed in the fishing sector, and by 2025, it is estimated that 34% of crude oil production will be sourced from offshore sites. If the ocean were a country it would have the seventh largest economy in the world, when the first to the sixth are as follow: USA, China, Japan, Germany, France, and UK.

The blue economy was first introduced as a concept at the "United Nations Conference on Sustainable Development" conference in 2012. Blue economy is an approach to economic development of using marine and coastal resources such as: fisheries, transportation, tourism and energy. It is a way to drive economic growth in a way that is sustainable to the maritime ecosystem. To do this, states invest in capabilities that aim to stop IUU fishing and reduce marine pollution while committing to practices that boost the utilization of resources and the sustainability of ecotourism.[1] The blue economy is important to developing countries with territories adjacent to the sea because marine resources can be used to add value and create benefits for the country. It also focuses on management and increase productivity in line with the social landscape of that community and does not cause damage or destroy natural resources. Additionally, it aligns with the United Nations Sustainable Development Goal 14th: life below water.[2]

According to the United Nations Convention on Law of the Sea 1982 (UNCLOS), Thailand has a maritime zone of about 320,000 square kilometers representing about 60 percent of the land territory (about 530,000 square kilometers). The length of the coastline is over 3,219 kilometers and there are 21 coastal provinces.[2] In 2016 it was found that the share of Thailand's maritime revenues was worth 21.517 trillion baht in 2016, details in Table 1.[2] Thailand had a sea benefit values of 24 trillion baht in 2020, details in Table 2.[5] Thai marine economy is worth 15-20% of the overall GDP.

No.	Item	Trillion baht	Australian million dollar (AUD)*
1.	Import-export by sea	14.483	629,695.65
2.	Industries related to petrochemicals – plastics	3.000	130,434.78
3.	Import-export of crude oil, finished oil, gas, fuels	1.087	47,260.87
4.	Maritime logistics services industry	0.794	34,521.74
5.	Marine tourism	0.669	29,086.96
6.	Crude oil-gas drilling in the Gulf of Thailand	0.620	26,956.52
7	Industry related to canned and processed seafood	0.277	12,043.48
8.	Petroleum procurement	0.198	8,608.70
9.	Fisheries	0.123	5,347.83
10.	Tax revenue from the Customs Department	0.119	5,173.91
11.	Coastal aquaculture industry	0.091	3,956.52
12.	Shipyard and ship repair industry income	0.045	1,956.52
13.	Revenue from the Port Authority of Thailand	0.011	478.26
	Total	21.517	935,521.74

* 1 AUD = 23 baht

Table 1: Value of annual marine revenues in Thailand in 2016[2]

Benefit value	million baht	Australian million dollar (AUD)
1. Living resources	100,300	4,360.87
2. inanimate resources	1,005,100	43,700.00
3. Logistics	20,500,200	893,704.35
4. continuous industry	450,100	19,569.57
5. Tourism	1,540,600	66,982.61
6. Etc.	403,700	17,552.17
Total	24,000,000	1,043,478,27

* 1 AUD = 23 baht

Table 2: Sea benefit value of Thailand in 2020[5]

Research Question

For the research purpose, we should be able to answer all these questions: How does the blue economy relate to a more land-centric approach to economic growth? Do the challenges present in both carry the same weight of importance? Do the non-traditional threats Thailand faces come mostly from or via the sea? Do all these challenges affect the blue economy?

A. PURPOSE

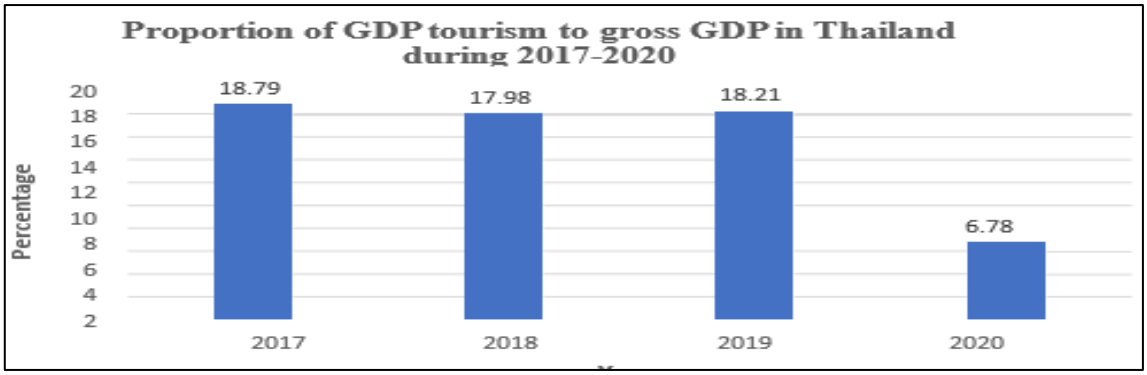
The purpose of the study is to prioritize the non-traditional challenges that Thailand's blue economy faces. From there, they can be prioritized and calibrated can be set aside for each challenge.

Case study: Quantitative Solution Types of Blue Economy

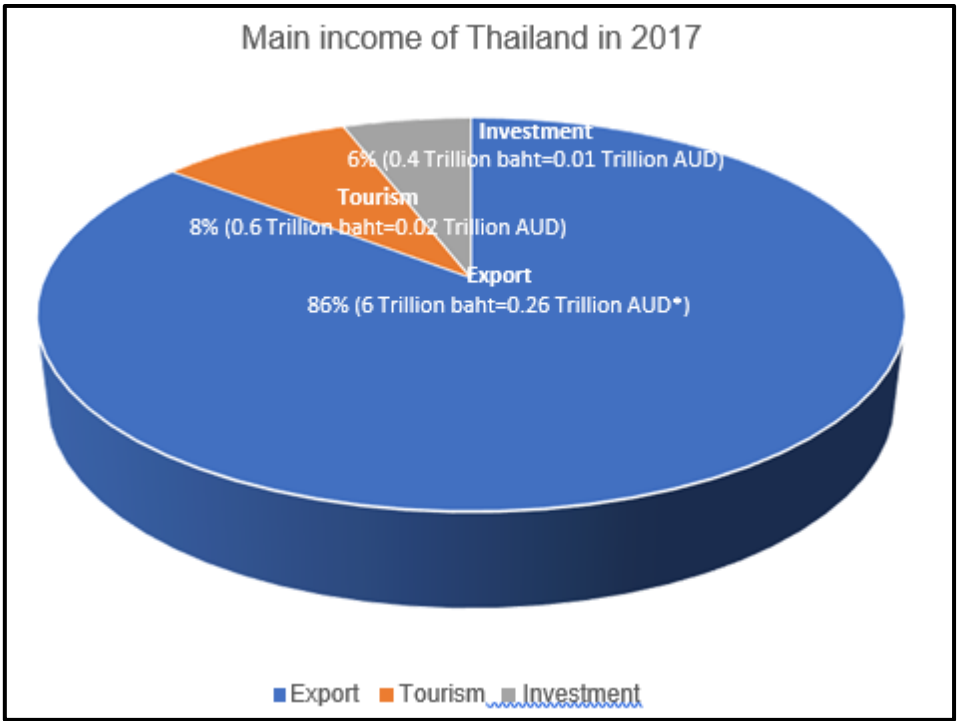
The blue economy can be divided into 12 categories: tourism, fisheries, marine waste management, shipyard, aquaculture near the sea, energy, logistics, renewable energy from the sea, desalination, pharmaceutical industry, minerals under the sea, and ports and can be explained in the following sections.

Tourism

The tourism sector is comprised of many different elements. Hotels, restaurants and transportation have historically been the major drivers of the Thai economy. The reasons why Thailand is a tourist destination for people is: delicious food, cheap cost of living, beautiful tourist attractions and the friendliness of the Thai people. There was some decline during the 2020-2023 COVID pandemic. Today, the tourism economy is improving. A trace of being the country's main income can be seen in the following graph. In Thailand, the proportion of GDP in tourism to gross GDP in 2017 was 18.79% and 17.98%, 18.21% and 6.78% in 2018, 2019 and 2020 respectively, seen in Graph 1.[22] The tourism industry is the country's second highest income earner, seen in Graph 2.[3]



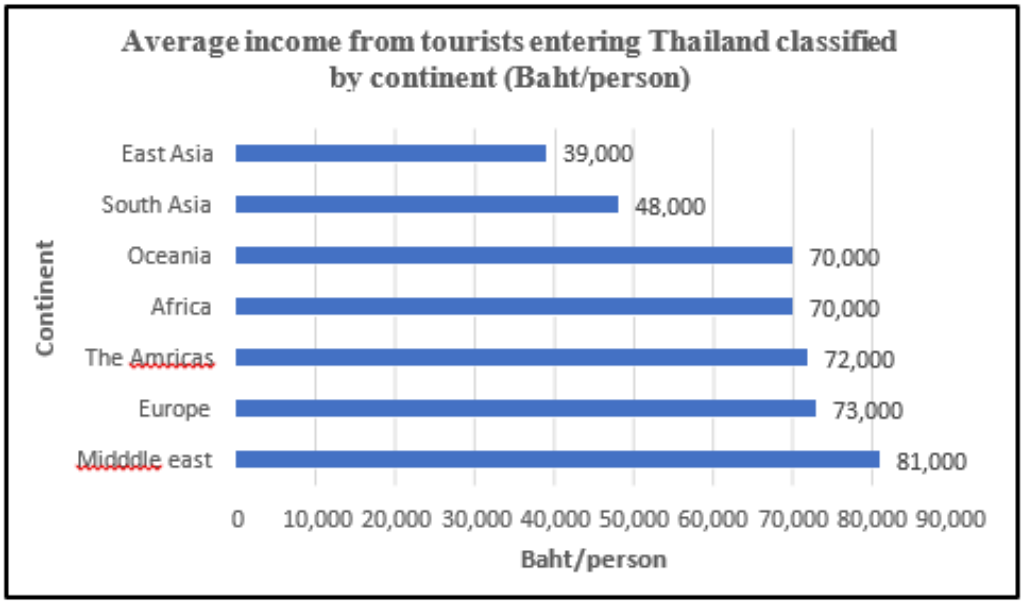
Graph 1: Proportion of GDP in tourism to gross GDP during 2017-2020[22]



1 AUD=23 Baht

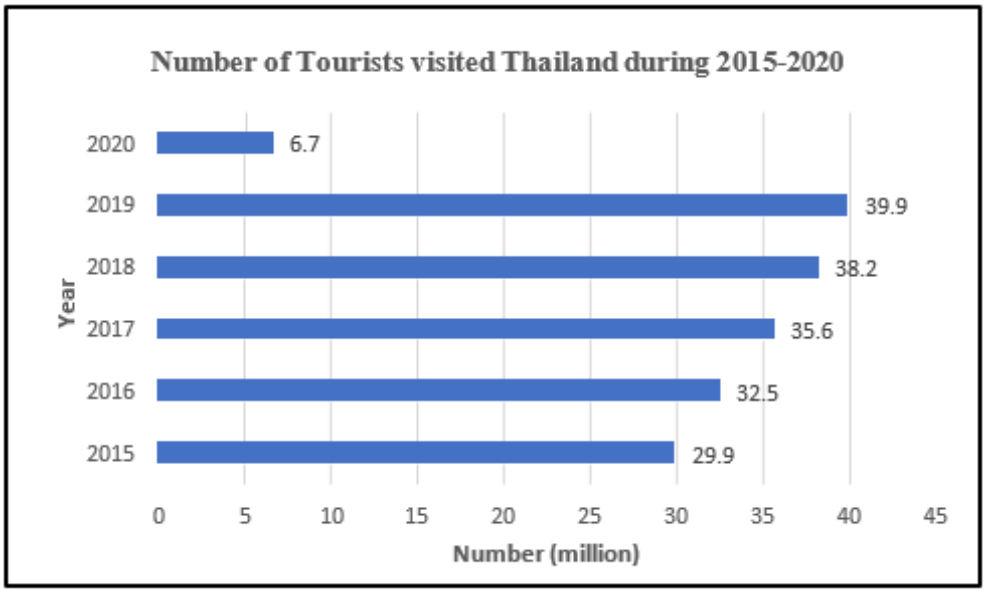
Graph 2: Main income of Thailand 2017[3]

Average income from tourists entering Thailand classified by continent (Baht/person), seen in Graph 3.[12]



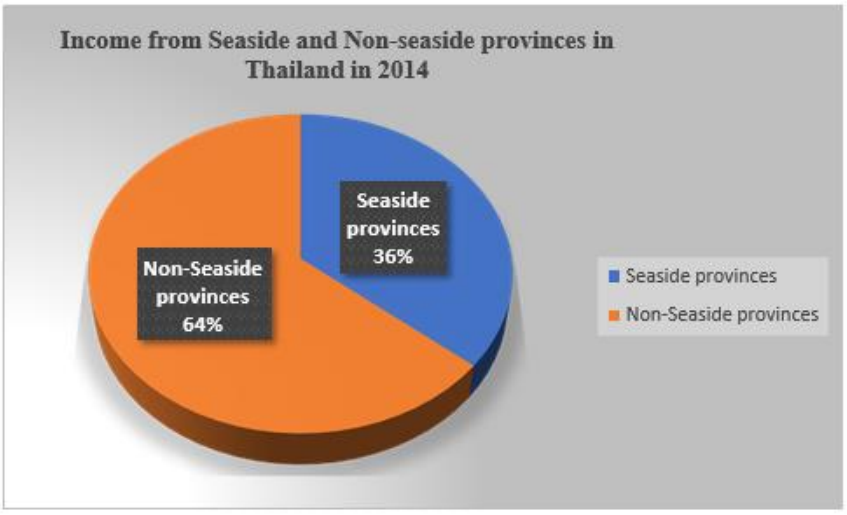
Graph 3: Average income from tourists entering Thailand classified by continent (Baht/person)[12]

The number of tourists that visited Thailand during 2015-2020 can be seen in Graph 4. The reason for the significant drop in tourist arrivals in 2022 was the Covid-19 pandemic. [12]



Graph 4: Number of tourists visited Thailand during 2015-2020.[12]

The proportion of tourism is divided into seaside provinces and non-seaside provinces in 2014 can be seen in Graph 5.[8]

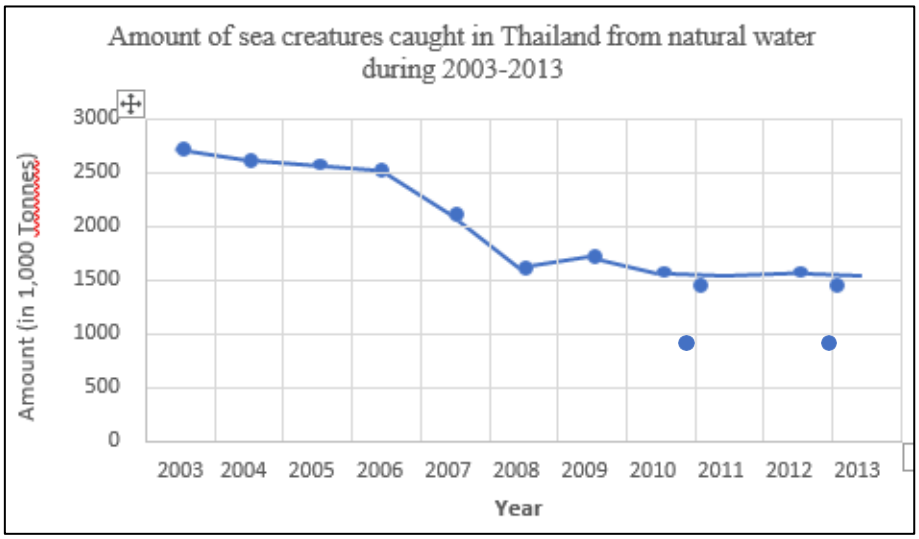


Graph 5: The proportion of tourism divided into seaside provinces and non-seaside provinces in 2014.[8]

Thailand's economy is a Bio-economic Circular and Green (BCG) economy which is important to its ability to create a sustainable tourism sector. The BCG economy is an economic model for sustainable development. It is the concept of bringing science and technology to bear to enhance sustainable competitiveness in four targeted industries (S-curves): agriculture and food, energy and materials, health and medicine, and *tourism and services*. BCG is also a development approach that aligns with the United Nations Sustainable Development Goals (SDGs), i.e. addressing climate change.

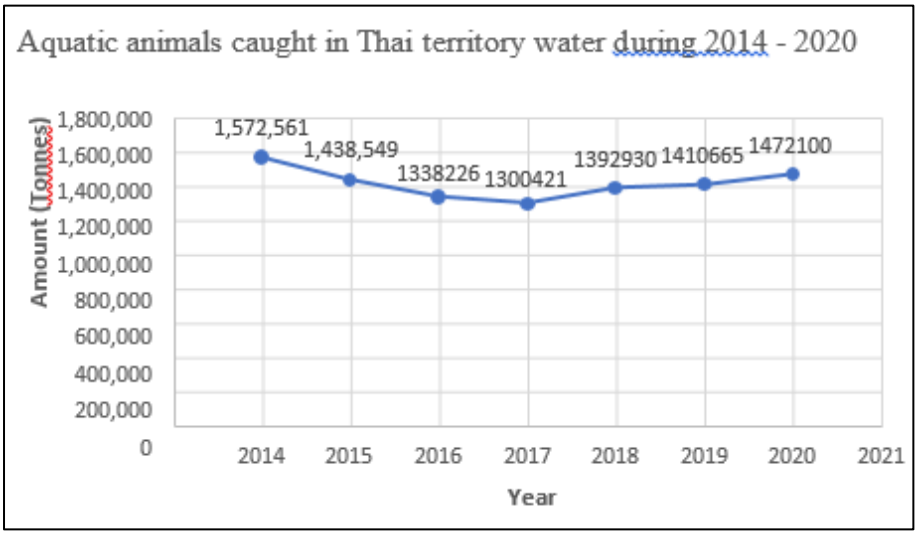
Fisheries

In 2013, Thailand produced about 1 million tons of fishery products per year, and the export value of fishery products reaches 100 billion baht. Amount of Sea creatures caughtin Thailand from natural water resources during 2003 – 2013 can be seen in Graph 6.[8]



Graph 6: Amount of Sea creatures caught in Thailand from natural water resources during 2003 – 2013[8]

Statistics of aquatic animals caught in Thai territorial waters during 2014-2020 can be seen in Graph 7.



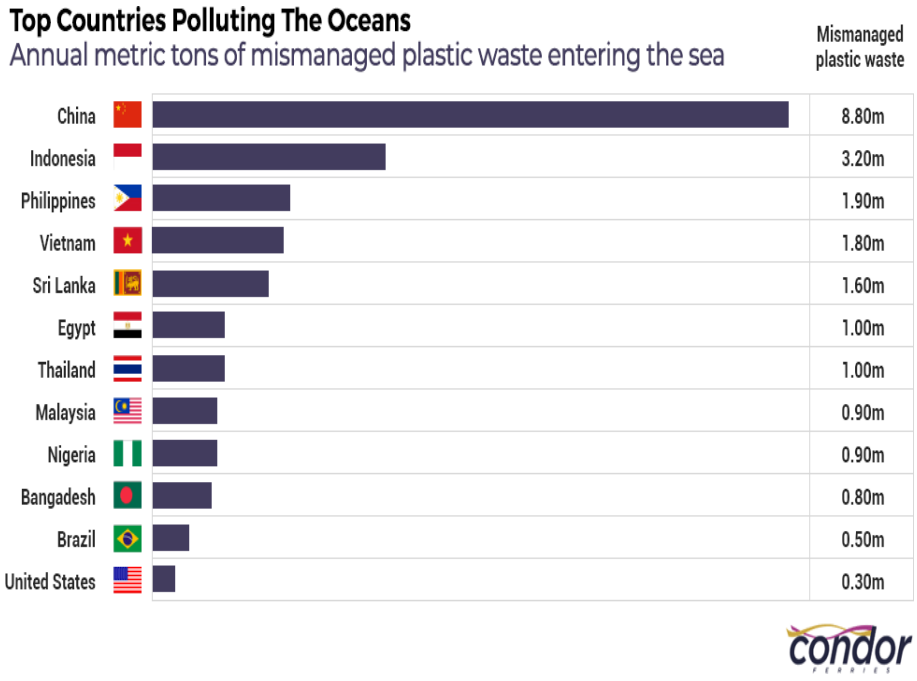
Graph 7: Statistics of aquatic animals caught in Thai territorial waters during 2014-2020[2]

Marine waste/pollution management

Five types of marine pollution are ocean acidification, plastic debris, eutrophication, noise, and toxins. The ocean is one of the most unexplored parts of our planet, with a

magnitude of undiscovered species and mysteries. It turns out from the studies conducted over the last few decades, this magnificent environment is under serious threat from human intervention such as: plastics set to outnumber fish by 2050 , around 100 million marine animal's lives get lost every year, over 500 marine locations recorded as dead zones where marine life cannot exist, between 1.15 million to 2.41 million tons of plastic are entering the ocean each year, and the largest trash site on earth is Great Pacific Garbage Patch, 1.6 million square kilometers, twice the area of Texas or three times the size of France with a nine feet deep, seen in Figure 1[57]. The top twelve countries in the world were serious polluters of the oceans in 2010. This can be seen in Graph 8.[15]

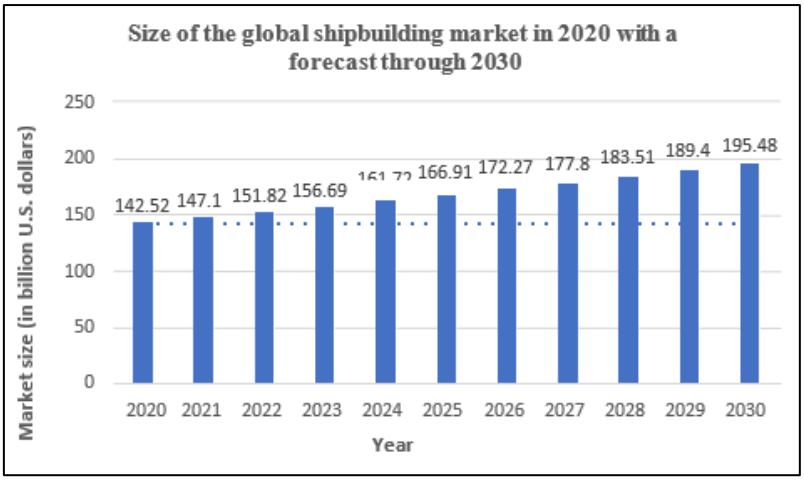
Figure 1: Great Pacific Garbage Patch, situated in the Pacific Ocean, between Hawaii and California[57]



Graph 8: Top twelve countries pollute the oceans by throwing plastic waste into the sea[15]

Shipyard (Ship building and Ship repairing)

Shipbuilding is the upstream of this industry. If the upstream industry is not developed, the commercial marine industry will not grow, as it should. We may have freight boats, excursion boats or other types of boats floating in the sea or in the river but there is no system to ensure their continued use. The shipbuilding industry is an industry that createsa huge related industry thus supporting shipbuilding products sold worldwide such as thesteel industry, not to mention machinery equipment, communications devices, pumps, generators, wires, electronic systems and so on. Employees, when employed, have to pay tax-generating money in circulation in the country. Size of the global shipbuilding marketin 2020, with a forecast through 2030, in billion U.S. dollars, seen in Graph 9.



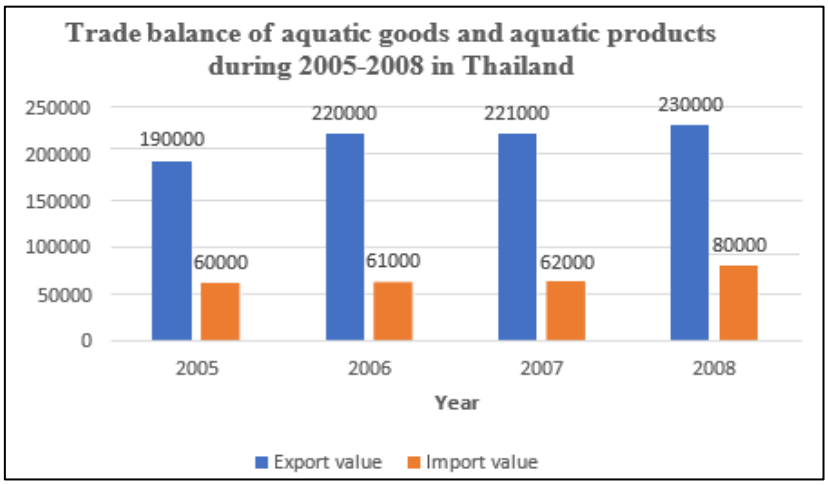
Graph 9: Size of the global shipbuilding market in 2020 with a forecast through 2030[11]

In 2006, there were 306 shipyard operators in Thailand, spread along important rivers, namely: Chao Phraya River, Tha Chin River, Mae Klong River, along the Gulf of Thailand and Andaman coast and the Malacca Strait. The ship building capabilities of Thai shipyards can be divided into 3 groups: small shipyards, medium shipyard and a large shipyard.

Aquaculture near the sea (coastal farming)

Coastal farming refers to the introduction of aquatic animals to be cultivated in coastal areas. Aquatic animals such as shrimp, sea prawns, sea milkfish, white shrimp, red tilapia, sea bass, abalone, mackerel, golden pomfret, sea grapes, etc. Natural marine life in Thai waters is greatly reduced. To make matters worse, Thai fishing fleets expend large amount of fuel getting to fishing fields beyond those depleted by overfishing. Aquaculture has been

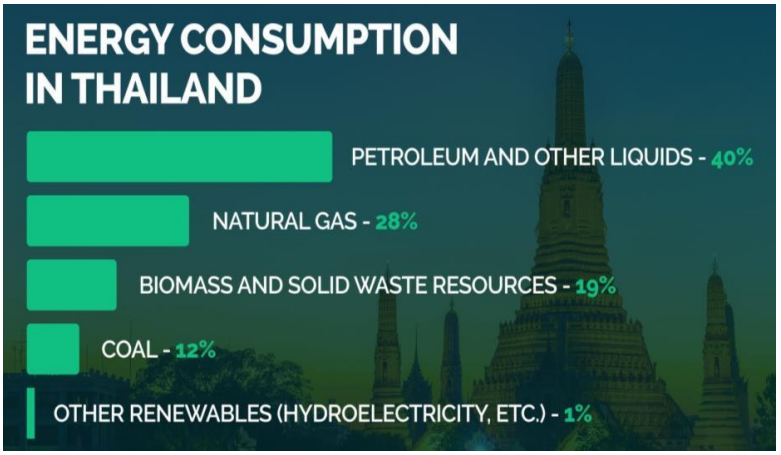
introduced to offset this challenge. Trade balance of aquatic goods and aquatic products in 2005-2008 in Thailand, seen in Graph 10[58]. In 2004, Thailand's aquaculture production was ranked fourth in the world with a total aquaculture production of 1,172 thousand tons, valued at 78,393.48 million baht, more than half of the aquatic animal production comes from coastal aquaculture, amounting to 736.3 thousand tons, valued at 49,250.1 million baht.



Graph 10: Trade balance of aquatic goods and aquatic products in 2005-2008 in Thailand[58]

Energy

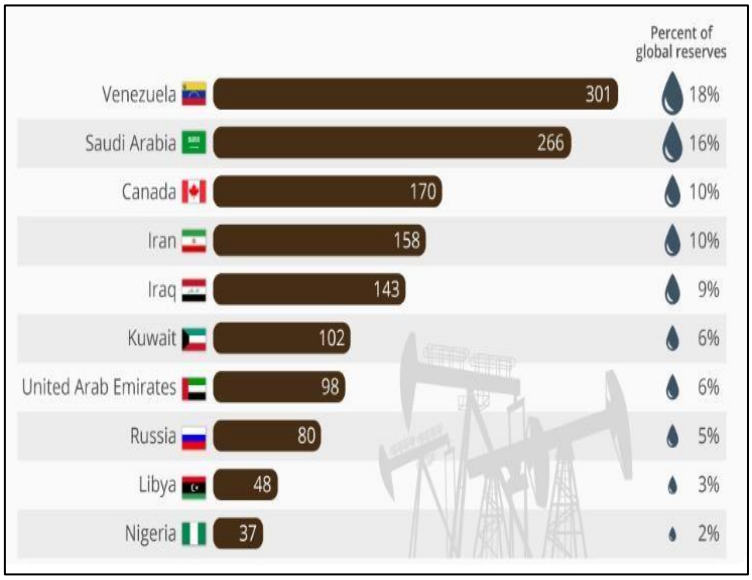
Energy can change from one form to another, such as electrical energy to mechanical energy, etc. The energy source used by humans is wide and varied: electric energy, oil energy, water energy, mechanical energy, coal energy and gas energy to name a few. Thailand's energy usage in 2014 can be seen in Graph 11.[30] The energy source favored by Thais was "petroleum, and other liquids" at 40%, whereas the least was "other renewables (hydroelectricity)" coming in at 1%. The second and third were "natural gas" and "biomass and solid waste resources" at 28%, 19% respectively.



Graph 11: Thailand energy usage in 2014[30]

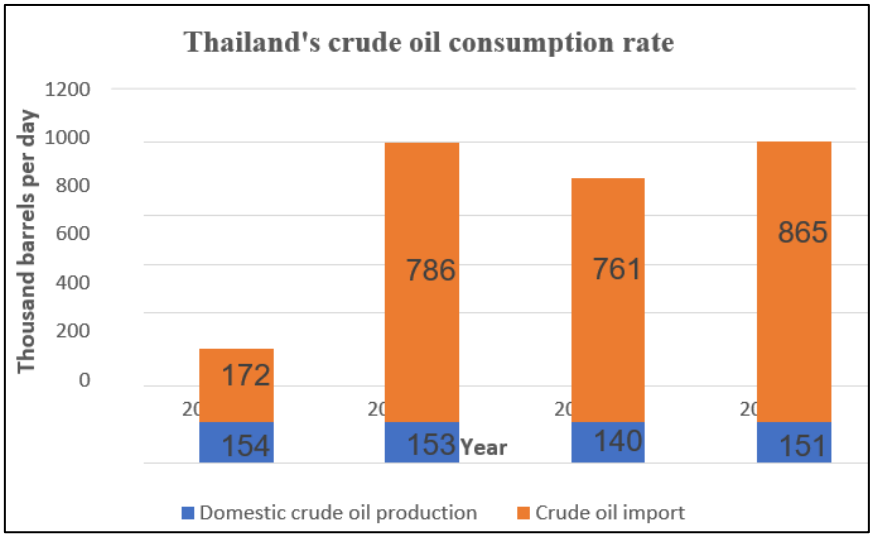
Oil

Top ten countries housing world's largest oil reserves in 2019 are as follow, Graph 12.[16]



Graph 12: Top ten countries housing world's largest oil reserves[16]

Thailand's crude oil reserves are approximately 4 hundred million barrels. This accounted for less than 0.02% of global reserves, which is 1.65 trillion barrels. Thailand's crude oil consumption rate from 2009-2012 was shown in Graph 13.[59]



Graph 13: Thailand's crude oil consumption rate from 2009-2012[59]

Natural gas

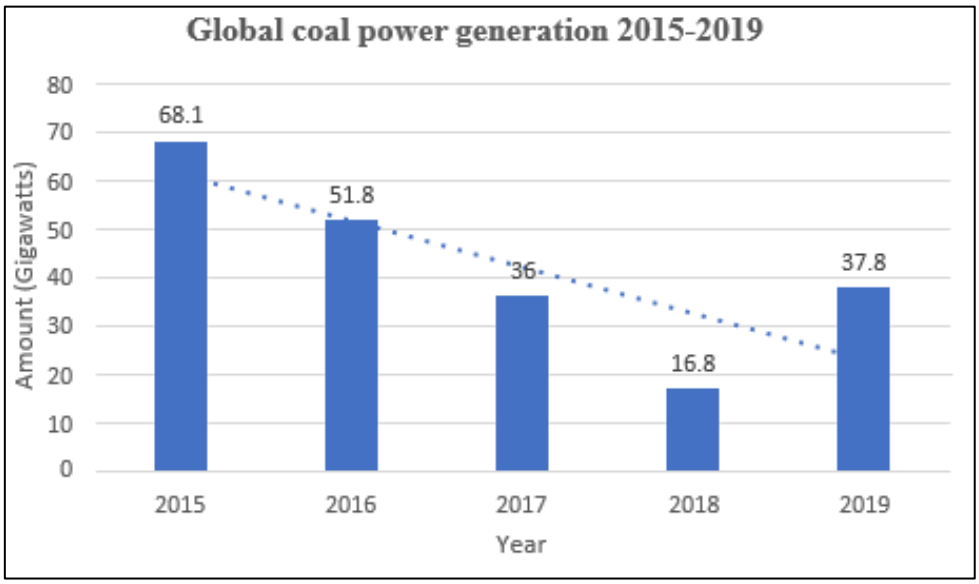
In 2012, the ten countries with the largest proven natural gas reserves in the world are in Table 3.[60] In 2012, the total amount of natural gas consumed per day around the world was 311,800 million cubic feet. If reserves did not increase and natural gas had continued to be consumed at these levels, the world will have nature remains for the next 64 years. Thailand has approximately 10.1 trillion cubic feet of proven reserves of natural gas or 0.1% of global reserves, which is 7,361 trillion cubic feet. Production rates from the concession area in Thailand are 2,794 million cubic feet per day. If the production rate is stable at this level, Thailand will have gas surplus for the next 10 years.

Country	Proven natural gas reserves (Trillion cubic feet)
1. Russian	1574.98
2. Iran	1168.56
3. Qatar	884.53
4. Turkmenistan	858.80
5. USA	299.82
6. Saudi Arabia	287.82
7. United Arab Emirates	215.06
8. Venezuela	195.18
9. Nigeria	180.46
10. Algeria	159.06

Table 3: The top ten countries with the largest proven natural gas reserves in the world, in 2012. [60]

Coal

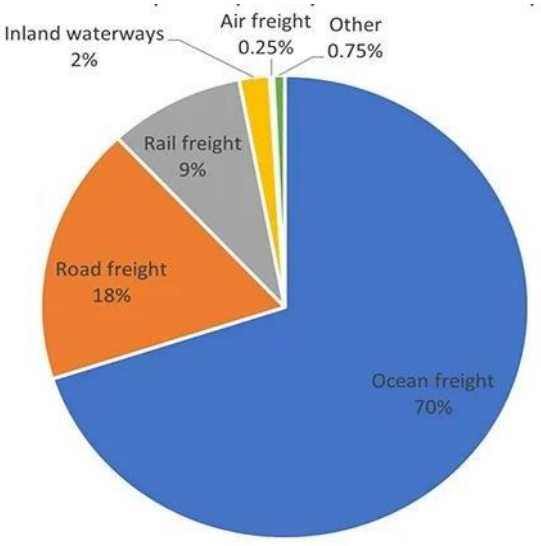
Global coal power generation between 2015-2019 was seen in Graph 14.[23]



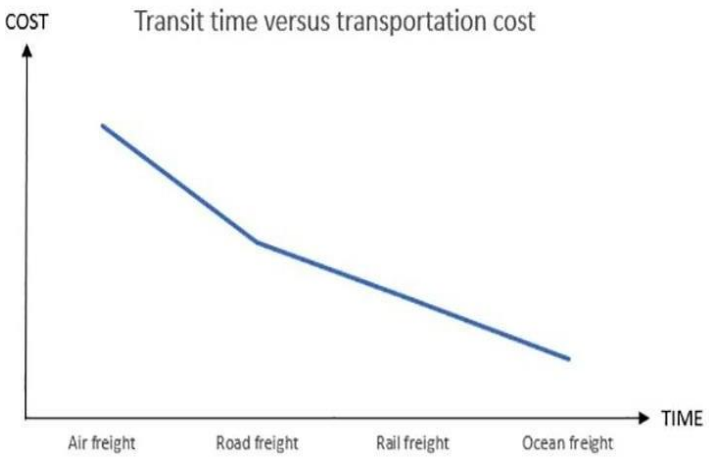
Graph 14: Global coal power generation between 2015-2019.[23]

Logistics

Global transport split by mode of transport in 2022 can be seen in Graph 15.[10] Transit time versus transportation cost can be seen in Graph 16.[10] Ninety percent of trade between Thailand and trading partners relies mainly on ship deliveries because it can carry large quantities of goods and the cost of transportation is cheaper than other transportation.



Graph 15: Global transport split by mode of transport in 2022[10]



Graph 16: Transit time versus transportation cost[10]

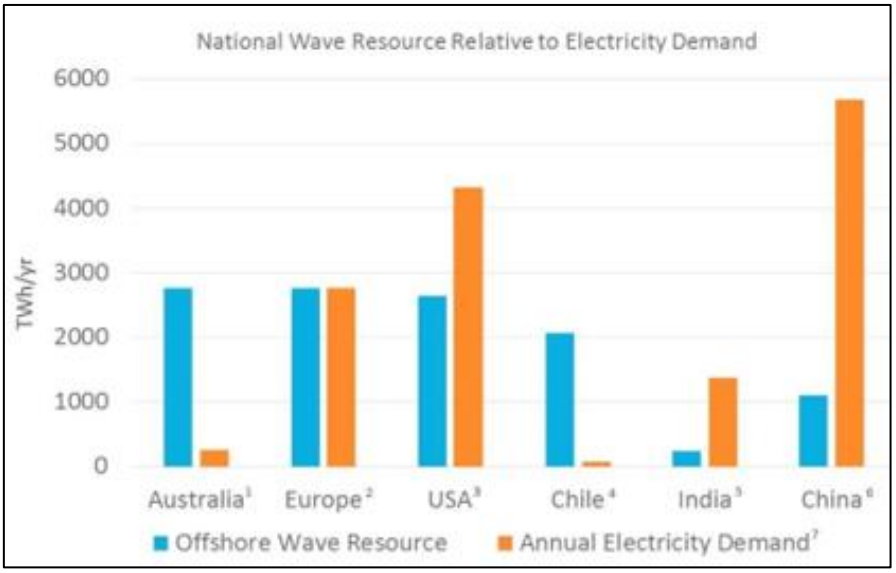
Renewable energy from the ocean

The oceans represent almost 70% of the surface of our planet. There are almost 200 countries in the world, and over 150 countries have access to the sea. It can be used in huge amounts, as energy never runs out. It is clean and environmentally friendly.

Ocean wave energy

Wave energy is a form of renewable energy that can be harnessed/captured from the motion of the waves which is generated by wind passing over the sea' surface. As long as the waves propagate slower than the wind speed just above, energy is transferred from the wind to the waves. In theory, wave energy globally could meet the world's annual electricity needs, if it was fully harnessed, scientists have estimated. Waves have the highest energy density of renewable energy sources, compared to others like wind, solar, biomass and geothermal. The challenge is that wave energy is far behind in its development compared to other renewable energies.

Waves around the United States coasts could provide 66% of the country's electricity, according to the US Energy Information Administration. In Australia, the government approved a national offshore electricity infrastructure bill in 2021. This provides a policy framework for building and operating offshore electricity projects. National wave resource relative to electricity demand can be seen in Graph 17.[14]



Graph 17: National wave resource relative to electricity demand[14]

Ocean tidal energy

Tidal energy is a form of power produced by the natural rise and fall of ocean tides caused by the gravitational interaction between the sun, and the moon. The technology can take up 10 years to construct an operational tidal power plant. The futuristic sketch of the plant can be seen in Figure 2.[61]

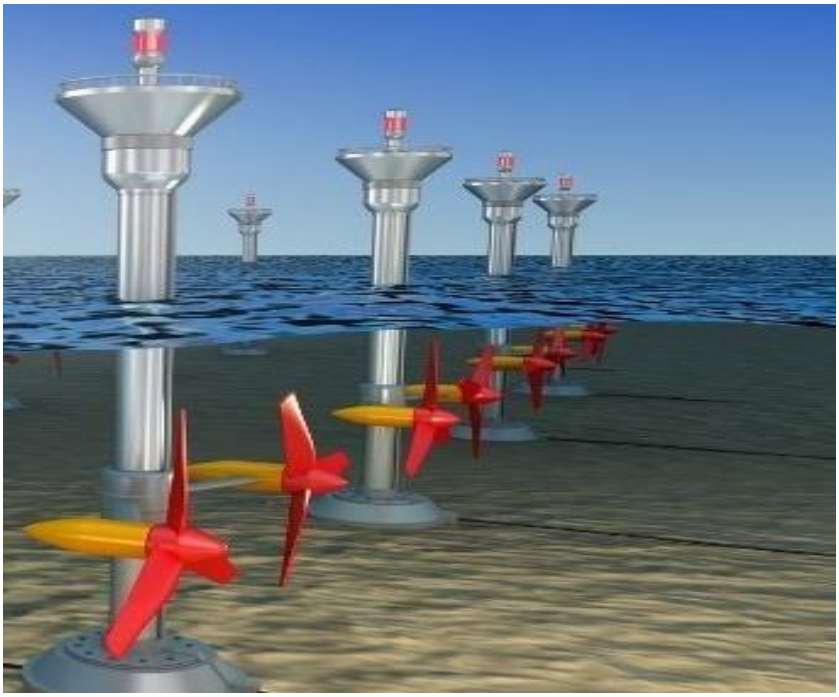


Figure 2: The futuristic sketch of the tidal power plant[61]

Ocean thermal energy

Ocean thermal energy produces by harnessing the temperature differences in ocean waters between ocean surface waters and deep ocean waters.

Ocean current energy

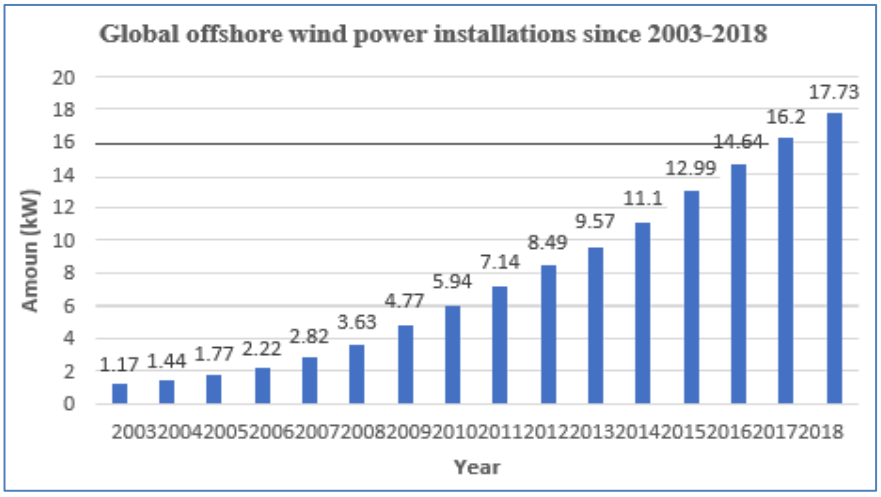
Ocean currents are generated from a steady flowing ocean current.

Ocean salinity energy

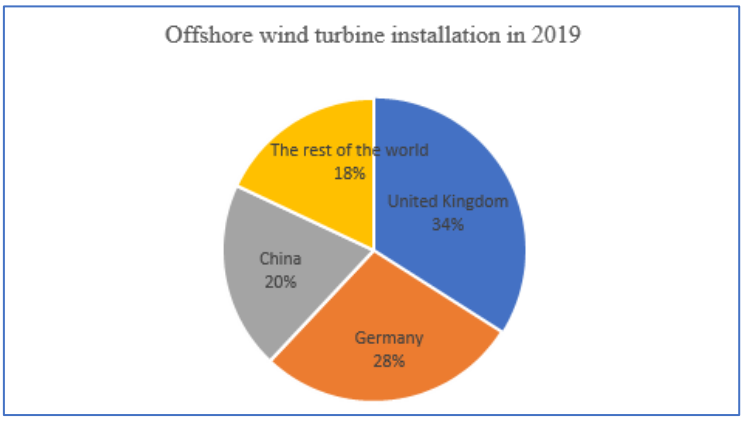
Salinity energy is the energy created from the difference in salt concentration between two fluids such as fresh water and seawater.

Ocean wind energy

This energy type is electricity generated by harnessing the wind that spins an electric generator attached to a wind turbine. Below is a graph displaying global offshore wind power installations since 2003-2018, seen in Graph 18.[13] Offshore wind turbine installations in 2019 can be found in Graph 19.[13] In 2022, China was ranked the world's most offshore wind power generation by producing around 16.9 million kilowatts.



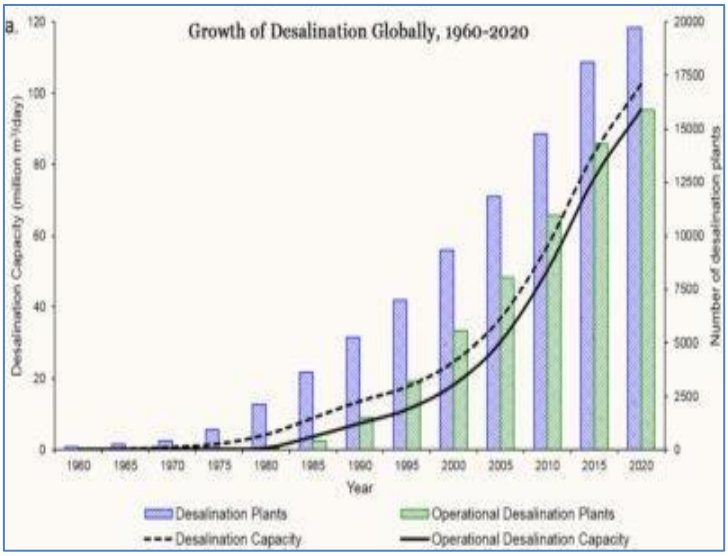
Graph 18: Global offshore wind power installations since 2003-2018[13]



Graph 19: Offshore wind turbine installation in 2019 according to three most countries of the production and the rest of the world.[13]

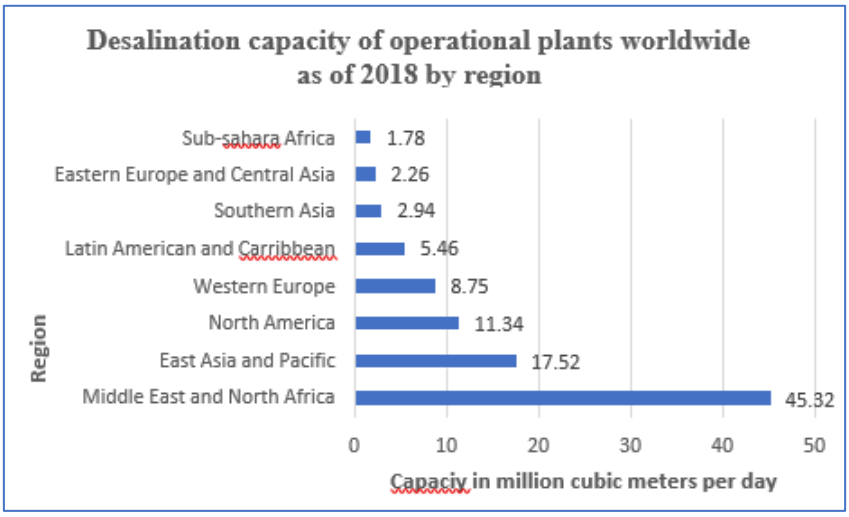
Desalination

About 71 percent of the Earth's surface is covered by ocean, and the oceans hold about 96.5 percent of all Earth's water, making saline water a viable option when looking for fresh water supplies for human life.[28] Desalination is a process of bringing sea water into the production to be able to get fresh water. The advantage of desalination is the development of alternative water sources that do not need to rely on rainwater conditions. This will also reduce the burden of using water from the reservoir. After decades of slow progress, desalination is increasingly being used to provide drinking water around the globe. Costs for processing salt water for drinking water have dropped, but it remains an expensive option. Around 1% of the world's population now depends on desalinated water in order to be sufficient to meet daily needs. From 1960-2020, growth of desalination globally can be seen in Graph 20.[27]



Graph 20: Growth of desalination globally in 1960-2022[27]

United Nations estimates that 14% of the world's population will face water scarcity by 2025. Desalination capacity of operational plants worldwide as of 2018 by region, seen in Graph 21.[17]



Graph 21: Desalination capacity of operational plants worldwide as of 2018 by region[17]

In Thailand, desalination is used to solve the problem of water shortage in the Eastern Special Development Zone (EEC). The situation of water demand in 2027 will require the development of a desalination system in the Map Ta Phut area, EEC zone, no less than 100,000 cubic meters/day, which must be produced continuously including the need to develop an additional backup system in the year when the amount of water is less, about 100,000 cubic meters/day.

Pharmaceutical industry

There are many chemicals and drugs that we use today which we may not even know that it is derived from the sea, such as:

- Ambergris, seen in Figure 3, is obtained from whale regurgitation and used as an ingredient in the production of perfumes and in cosmetics.[62]

Figure 3: Ambergris, obtained from whale regurgitation[62]

- Sea Moss, seen in Figure 4,[65] is commonly found along the North Atlantic coast, British Isles Coast, Ireland, North America and Europe. The benefits of sea moss are as follows: support thyroid health, support gut health, support immunity, improve blood sugar control, and support heart health. It can also be made into an energy drink named "Irish Moss Drink" (Irish Moss Drink), seen in Figure 5, and it is popular in Ireland and the Caribbean.[64]

Figure 4: Sea Moss[65]

Figure 5: Energy drink called “Irish Moss” [64]

- Cod liver oil, comes from cod, which can be seen in Figure 6, high in vitamin A and vitamin D. The important role of vitamin A is to help in seeing in the dark or dim light. Vitamin D is important for normal bone formation.[66]

Figure 6: Cod[66]

- Red algae, seen in Figure 7, has pigments which possess antioxidant properties that is suitable to be used as an ingredient in food and cosmetics to help slow down aging by free radicals.[63]

Figure 7: Red algae[63]

- Sea Weed, seen in Figure 8, helps in the functioning of the thyroid gland because the thyroid can function requiring iodine which is abundant in seaweed.[67]

Figure 8: Sea Weed[67]

- Spermaceti, is the term given to the liquid waxes present in the head of the sperm whale, seen in Figure 9. It creates sea amber that used for making perfume heads.[68]

Figure 9: Sperm whale[68]

Minerals under the sea

The exploitation of mineral resources such as gravel, tellurium, sand, manganese, zinc, gold, silver, phosphorus, cobalt, nickel and copper from the sea will become more and more necessary because resources from land are becoming increasingly scarce. Demand for minerals will increase six-fold by 2050 as electric cars and renewable energy technologies all require minerals found in these seas. Deep-sea mining is focusing on finding mineral deposits at a depth of 200 meters or more, as seen in Figure 10.[69] There is currently no full-scale undersea mining. It is still in the process that experts are collecting data on ocean bottom life and ecosystems due to little or almost zero understanding. This makes it difficult to predict the impact of deep-sea mining. The disadvantages of deep-sea mining that might occur are the opening of the subsurface for deep sea mining at sea, causing organisms clinging to these mineral deposits to be destroyed. There is also the risk of creating a light that could harm deep-sea ecosystems and cause sediment to drift and affect the lives of marine life over kilometers wide. Scientists at the University of Bergen in Norway drove a robot underwater to a depth of 2,500 meters in the waters between Norway and Greenland, where they found rich minerals such as zinc, gold and copper that can be used in the production of smartphone screens, battery for car, magnets, camera lenses and X-ray machines.

Figure 10: Futuristic deep-sea mining[69]

Ports

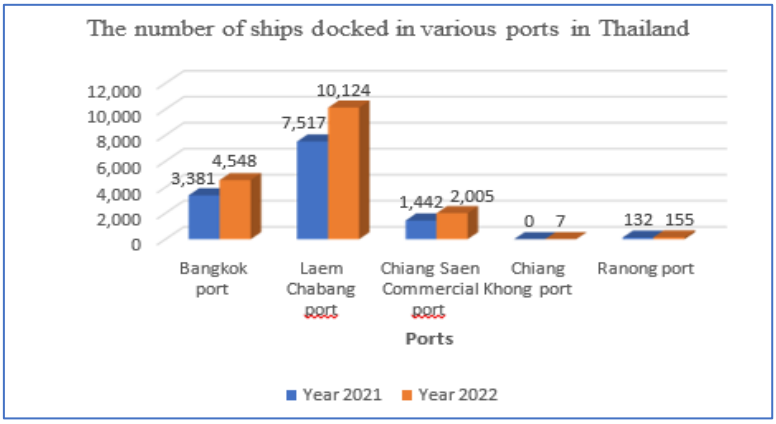
Top 20 global port utilization ranking in 2019 can be seen in Table 4.[31] The Port Authority of Thailand shows the 2022 financial statement with a net profit of 11,004 million baht (478 million AUD). The number of ships docked in five ports in Thailand, shown in Graph 22.[7]

Port	Cargo Container (TEU*)
1. Shanghai	43,303,000
2. Singapore	37,195,636
3. Ningbo-Zhoushan	27,530,000
4. Shenzhen	25,770,000
5. Guangzhou	23,236,200
6. Busan	21,992,001
7. Qingdao	21,010,000
8. Hong Kong	18,361,000
9. Tianjin	17,264,000
10. Rotterdam	14,810,804
11. Dubai	14,111,000
12. Klang	13,580,717
13. Antwerp	11,860,204
14. Xiamen	11,122,200
15. Kaohsiung	10,428,634
16. Los Angeles	9,337,632
17. Hamburg	9,274,215
18. Tanjung Pelepas	9,100,000
19. Dalian	8,760,000
20. Leam Chabang (Thailand)	8,106,928

*TEU=Twenty foot Equivalent Unit

Table 4: Top 20 Global port utilization ranking in 2019[31]

B. CHALLENGES



Graph 22: The number of ships docked in five ports in Thailand[70]

The challenges to the blue economy comprises nine factors: effort to reduce the degradation of marine resources, increase the recruitment in the marine sector, effort to reduce climate change, thorough stewardship of marine resources, increase human rights, reduce fossil energy use, efficient waste disposal, green port and appreciation of the sea. It can be explained in the following topic.

Effort to reduce the degradation of marine resources Ways to reduce the degradation of marine resources are as follows:

Increase artificial coral

Artificial coral, seen in Figure 11, aims to revitalize aquatic animal resources along the sea coast to become more tangible, as a result, they are in abundant making the fishermen have more income from catching aquatic animals and some earn from tourism.[71]

Figure 11: Artificial coral[71]

Stop illegal, Unreported, and Unregulated (IUU) fishing

Illegal fishing refers to fishing activities in contravention of applicable laws and regulations. Unreported fishing refers to fishing activities that are not reported or are misreported to relevant authorities. Unregulated fishing is done by vessels without nationality or that are not regulated by their flag state, the country in which a vessel is registered. For example, if the European Union (EU) finds that, a country does not have a good or inadequate control over fishing; it will issue a yellow card. It warns that the country is at risk of becoming uncooperative in the fight against IUU fishing, and getting a yellow card. The EU will provide assistance and advice so that the country improves the fisheries control system to meet standards. If it ignores and does not perform any updates, it will announce a red card resulting in the EU suspending imports of fisheries caught by that

country's vessels. In April 2015, the EU gave Thailand a yellow card and removed it in 2019. The reason Thailand got the yellow card revoked because the government put a lot of effort in trying to solve the problem by approval of the establishment of the Command Center for Combating Illegal Fishing (CCCIF) on May 6, 2015 to combat the issue.

According to the Global Initiative Against Transnational Organized Crime's IUU Fishing Index, which benchmarks countries' vulnerability to, prevalence of, and response to IUU fishing, four of the top five worst-scoring countries are in Southeast Asia. China tops the list, and Russia is the sole non–Southeast Asian country, at number four, shown in Figure 12.[34]

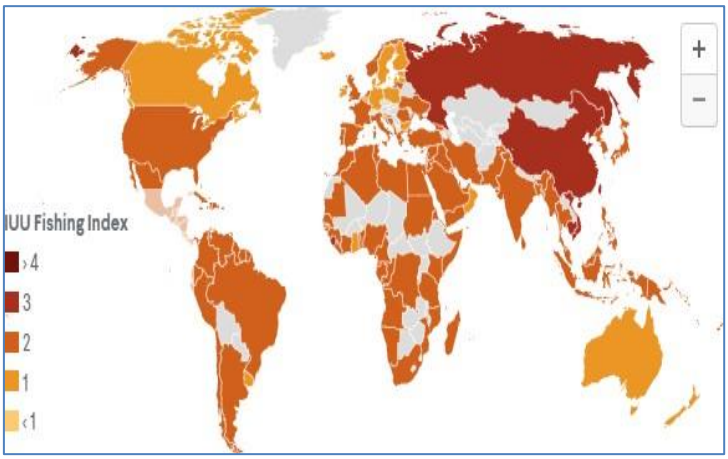


Figure 12: IUU fishing Index[34]

Do not collect corals or marine life as souvenirs

Coral reefs, shells are considered protected species under the Wildlife Preservation and Protection Act, 1992, which cannot: hunt, harm, possess, trade or breed without permission, who violate it will be punishable by imprisonment for a term not exceeding four years or a fine not exceeding 40,000 baht or both so it cannot take it back to their home countries from the tourists. Coral was confiscated from tourists at Chiang Mai airport, Thailand, in 2018, seen in Figure 13.[72]

Figure 13: Coral confiscated from tourists in 2018 at Chiang Mai airport.[72]

Do not eat rare marine animals such as Sharks, Stingrays, and Parrotfish, as seen in Figure 14.[73]

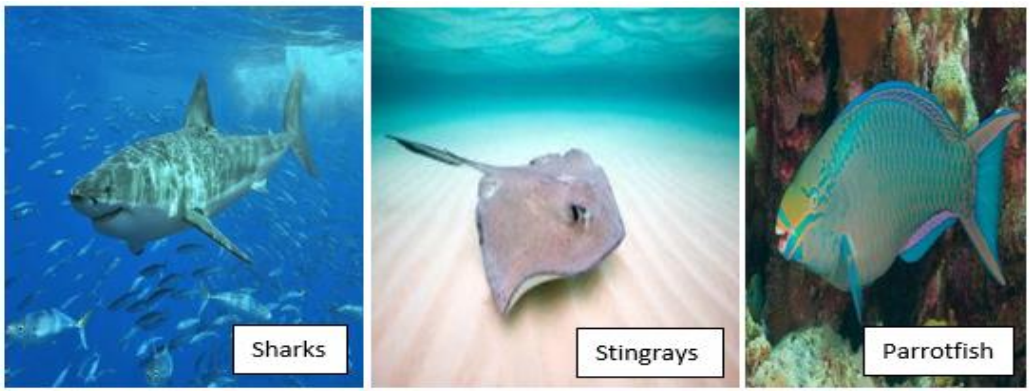


Figure 14: Sharks, Stingrays, Parrotfish[73]

Prohibit fishing in the off-season

Actions that are taken by Thailand are: the department of fisheries announced the closure of the Gulf of the Andaman Sea from April 1 to June 30, 2022, to control fisheries in the spawning season in areas of following provinces: Phuket, Phang Nga, Krabi, Trang, to restore aquatic animals to be sustainable.[39]

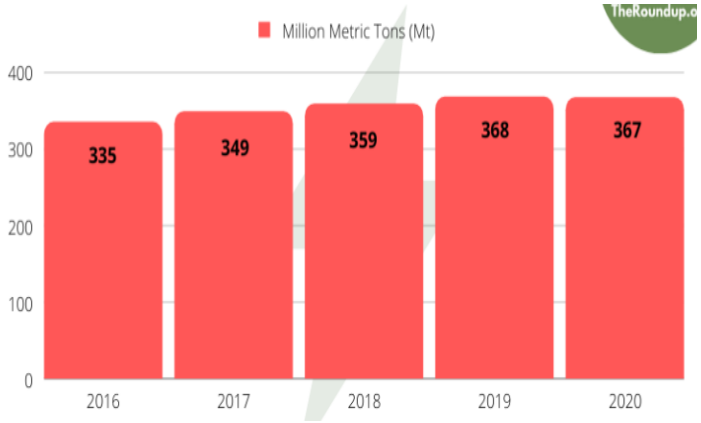
Integration cooperation between agencies to oversee and safeguard maritime and coastal resources

Things to be considered in order for the integration to be successful are: implementation of a long-term solution not a short & specific one, do a systematic data collection, have a maritime national policy.

Plastic reduction usage

Plastic takes 450-1,000 years, depending on the type, to degrade and fully break down and disappear from the earth while the average time that a plastic bag is used is just 12 minutes. The world produces around 400 million metric tons of plastic waste every year, seen in Graph 23. Every one second, more than 160,000 plastic bags will be discarded around the world. Ten million tons of plastic per year-end up in the ocean.[37] Toxins contained in plastic bags can spread into: the air, water, soil and food sources, causing many effects on humans and other creatures including being a major cause of global warming. Thais use 45 billion plastic bags per year or an average of 8 per person per day. Some 750 million plastic items ended up in the seas in 23 coastal provinces in 2018. The

ways to reduce the usage of plastic are: buy less and do not use plastic bags, use a cloth bag, use a water bottle instead of a plastic water bottle.[38]



Graph 23: Total annual global plastic production between 2016-2020[38]

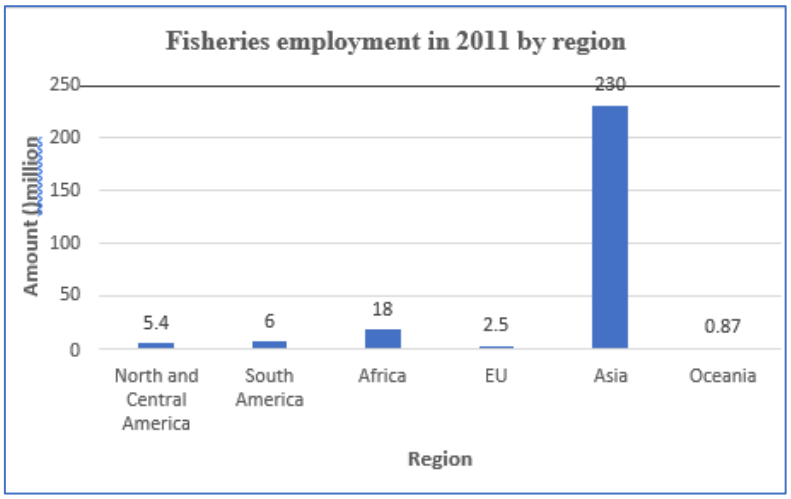
Do not anchor on the coral reefs

This can be seen in Figure15. The way to avoid it is by installing a mooring buoy.[74]

Figure 15: Anchoring at coral reefs[74]

Increase the recruitment in the marine sectors

There are approximately 260 million marine fisheries jobs worldwide, according to new research.[41] A survey from mandaq.com shows that workforce shortages are the single most important challenge shipping companies face today. The sector continues to face a talent crisis. To increase the recruitment in the marine sectors, it can be done such as: develop home-grow for internal talent pool for the future, retain/keep skilled seafarers by paying more than shore job, promote a comfortable workplace environment, recruit online because it helps companies discover seafarers in many countries faster and more conveniently. Fisheries employment in 2011 by region can be seen in Graph 24.[41]



Graph 24 Fisheries employment in 2011 by region[41]

Effort to reduce climate change

Climate change is a change in temperature, humidity and precipitation in any areas or regions. Greenhouse gases trap heat above the Earth's surface and prevent it from being released into the atmosphere. Therefore, if there is a large enough amount, it is sure enough to cause global warming. After the Industrial Revolution, the world's climate has changed. The major activities that affect climate change are activities that increase the amount of greenhouse gases in the atmosphere: from the use of fossil fuels, deforestation, and industrial livestock production, as a result, the temperature of the Earth's surface rises, known as global warming.[43] Ways to reduce climate change are as follows*:* reduce greenhouse gas emissions. Fossil fuel burning is a major contributor to greenhouse gas concentrations, which in turn lead to greenhouse effect or global warming. The way to eradicate the greenhouse gas emissions is to use clean energy such as solar energy or wind energy, reduce marine air pollution, plant a tree such as the mangrove area, choose a fuel-efficient or non-gasoline vehicle.

At the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP) 21 Conference, the world set a common long-term goal of keeping global warming below 2°C and trying to limit it to 1.5°C compared with pre-industrial levels.[45] Electric vehicles will likely become increasingly important. Given the rate at which technology is improving, it is possible the battery capacity of electric vehicles could increase by three times in just five years resulting in the cost of battery prices tend to decrease. In

2022, 48% more Thais ought electric cars after supportive measures and high oil prices. Conversely, passenger cars using fossil fuels shrunk from 2021 to 8.8%.[48] Thailand, in 2020, was able to reduce greenhouse gas emissions in total by 14.34 million tons of carbon dioxide equivalent (MtCO2e), or 3.91% from the following 5 measures, Table 5, and tries to reduce greenhouse gases to 20-25% in 2030, achieve carbon neutrality in 2050, and achieve zero greenhouse gas emissions by 2065.[44] Climate protection index in 2020 can be seen in Figure 16 in which Thailand scored "Low".[75]

Measures to reduce greenhouse gas emissions in the energy sector	The amount of greenhouse gases that can be reduced (million MtCO2e)
1. Produce electricity from natural renewable energy	0.98
2. Measures to produce electricity from renewable energy in the category of bio-Energy	8.04
3. Biodiesel production measures for use in the transport sector	2.83
4. Ethanol production measures for use in the transportation sector	2.07
5. Measures to increase the efficiency of Electricity Generating Authority of Thailand (EGAT)	0.42
Total	14.34

Table 5: Thailand's reduction of greenhouse gas emission in 2020[44]

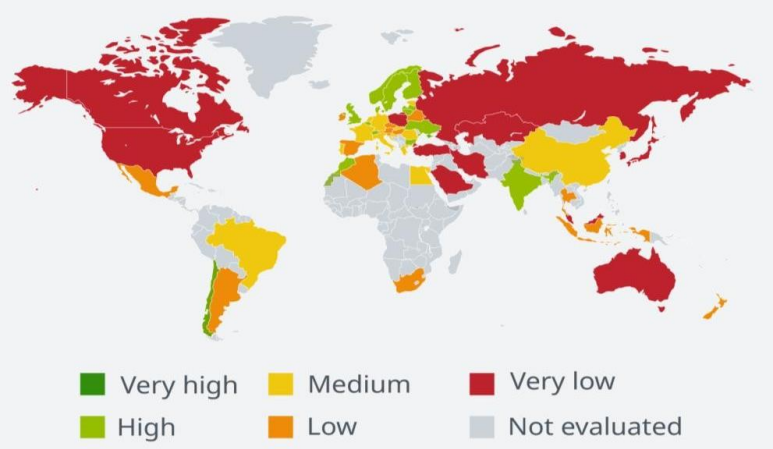


Figure 16: Climate protection index in 2020[75]

Though the country relies on coastal and ocean resources for its economic growth, the blue economy is one of the concerns that Thai government has used BCG to boost the sustainable development of energy sector. This is in line with UN's Seventh SDG, seen in Figure 17, and put the emphasis on, by aiming to achieve carbon neutrality by 2050 and zero greenhouse gas emissions by 2065.[52]

Figure 17: Sustainable Development Goal[52]

Thorough stewardship of marine resources

It is evident that the number of tourists and tourism activities have a direct impact on the health of coastal seas, marine wildlife and other natural resources. The massive influx of tourists far exceeds the country's carrying capacity, which has dealt a heavy toll on the natural environment.

The ways to look after marine resources are:

1. *Ecotourism.* These are organized holidays that are designed in a way that minimizes the damage tourists do to the environment. If tourism activities were regulated to be within the carrying capacity of nature, the country's natural resources would be able to regenerate more effectively, meaning a more sustainable sector for the economy. Managing the carrying capacity of the tourist sites is, therefore, key to reviving deteriorated ecosystems and to maintaining their health as the country's sustainable source of tourism income. The

measures for ecotourism are: the number of hotels and other accommodations must be limited under the carrying capacity, the annual closing of national marine parks is also necessary to allow nature to recover, setting fees for entering tourist attractions – for both Thai and foreigners - so that economic activities can generate income while creating sustainability for marine and coastal resource.

2. *Enforce the existing law vigorously.* For example, Marine and Coastal Resources Management Promotion Act, 2015.

3. *Establishment of marine and coastal protected areas*. It aims to limit the impact of human activities. For example, on Losin Island, Pattani, there are at least 11 species of animals that have never been reported before in Thailand; there are 116 types of fish alone. See Figure 18.[49]

4. *Clearly define the zoning of activities,* such as coastal farming areas, business area (restaurant) and residential area.

Figure 18: Losin Island, Thailand, marine and coastal protected areas[49]

Increasing human rights

Human right violations at sea are human trafficking, transnational crime, physical harm, sexual harassment and over-work. Workers are forced to work long hours of difficult and hazardous work for extremely low wages on projects that involve dismantling ships bare- handed in harsh and toxic conditions in developing countries, for instance: Bangladesh, India and Pakistan. Ways to increase human rights are strengthening the

capacity for flag states to ensure compliance with international and national laws on ships flying their flag to prevent forced labor. Build a more knowledgeable consumer base of forced labor in the fisheries sector and help the "Rohingya" come by boat in the sea of Satun, Thailand, that seek asylum from Myanmar, seen in Figure 19. As of 2023, there are approximately 96,000 refugees in Thailand, fleeing conflict within Myanmar. Most of them are ethnic Karen and Red Karen (Kayah) minorities. The TIP Report (Trafficking In Persons Report) 2022 elevated Thailand from "Tier 2 Watch List" (Tier 2 Watch List) to Tier 2.55 Thailand got 1% in 2019 for population in modern slavery (global slavery index), as seen in Figure 20.

Figure 19: Asylum seeker, Rohingya, from Myanmar[50]

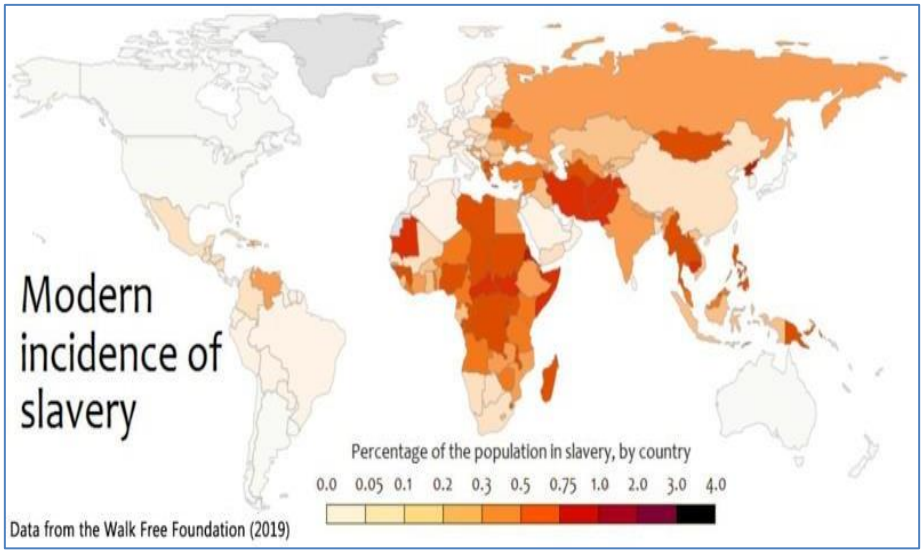


Figure 20: Modern incidence of slavery in 2019[56]

Reduce fossil energy usage

Fossil fuels are formed from the decomposition of buried carbon-based organisms. They create carbon-rich deposits that are extracted and burned for energy. They are non-renewable and currently supply around 80% of the world's energy. They are also used to make plastic, steel and a huge range of products. There are three types of fossil fuel: coal, oil and gas. When fossil fuels are burned, they release large amounts of carbon dioxide, a greenhouse gas, into the air. Greenhouse gases trap heat in our atmosphere, causing global warming. Already the average global temperature has increased by 1C. Warming above 1.5°C risks further sea level rise, extreme weather, biodiversity loss and species extinction, as well as food scarcity, worsening health and poverty for millions of people worldwide.

Fossil fuel energy is used up day by day. The statistics are as follows: crude oil currently has 1,048 billion barrels in reserves worldwide and can be used in another 20 years, world's coal reserves are 984 billion tons and can be used for another 70 years, there are 5,502 trillion cubic feet of natural gas reserves worldwide, which can be used for another 30 years. Thailand implements intensive energy saving measures by setting a goal for government agencies to reduce electricity and oil consumption by 20% in September 2022. Some examples include adjusting the temperature of air conditioners to 25-26 degrees Celsius and scheduling to turn off air conditioners during lunch and at least 30-60 minutes before finishing work, close some elevators during low usage periods and campaign to go up and down one floor without using the elevator. Other include encouraging employees to wear breathable clothing and refrain from wearing suits, encourage online meetings to reduce travel and fuel consumption, invite Thai people to reduce energy use through the air conditioner cleaning project to help the nation. This has resulted in the cleaning of more than 15,000 air conditioners, saving up to 2.26 million units of electricity, or 17.93 million baht reduction in electricity costs and reducing emissions more than 1,000 tonnes of CO2 equivalent. In 2022, 48% more Thais bought electric cars after supportive measures and high oil prices contrary to internal combustion engines cars usage that use gasoline as fuel shrunk from 2021 to 8.8%.[53]

Efficient waste disposal

The problem of marine litter, especially plastic waste, is threatening the world's marine ecosystems. Every year, 12 million tons of plastic waste end up in the seas and oceans,

and only five percent of it is found floating in the sea. The rest is either submerged or swept away by currents to the bottom of the ocean. Marine debris has a clear impact on the environment, such as sea turtles and other aquatic animals being entangled in netting, as seen in Figure 21.[76] One of the problems of waste disposal is that famous beaches in Bali, Indonesia, such as Kuta, Legian, Seminyak, are now facing the problem of garbage being blown from the sea onto the coast which is an event that occurs every year during the monsoon due to inefficient waste management system, seen in Figure 22.[77]

Figure 21: Sea turtles entangled in the net[76]

Figure 22: Garbage being blown into coast of Bali, Indonesia[77]

In 2019, Thailand found 10 kilometers of plastic waste in the sea off the coast of Chumphon Province. The death of a pilot whale found to have up to 85 plastic bags in its stomach led to believe that the country still lacked in behind in waste disposal management into the sea. In addition, Jambeck's research published in the journal *Science* in 2015 ranked Thailand as the sixth country with the amount of plastic waste lacking correct management.

Green ports

Port areas have many activities that contribute to the creation of greenhouse gases and may be noisy including many transport ships that come to port also contributed to the formation of oil slicks in the sea. Ports generate significant environmental impacts because energy is used to transport goods and services causing pollution in both water and land. To make a green port, we can do as follows: ports switch to LED bulbs usage and save up to 65 percent in annual costs. A crane with a rubber-wheeled can be used, which not only saves more than 50 percent in fuel consumption, but also reduces carbon dioxide emissions and noise pollution. No cargo ships will be permitted at the berth to drop sewage, paint or detergent; garbage is sorted regularly at the port. In 2022, The Port Authority of Thailand (PAT) purchased and installed a power generation system with solar cells to reduce environmental impacts and develop operations to be a green port in order to enhance the quality of life of employees, service users and surrounding communities creating a sustainable coexistence. The ultimate goal is to reduce carbon dioxide (CO2) emissions by 10 percent by 2023.

Appreciation of the sea

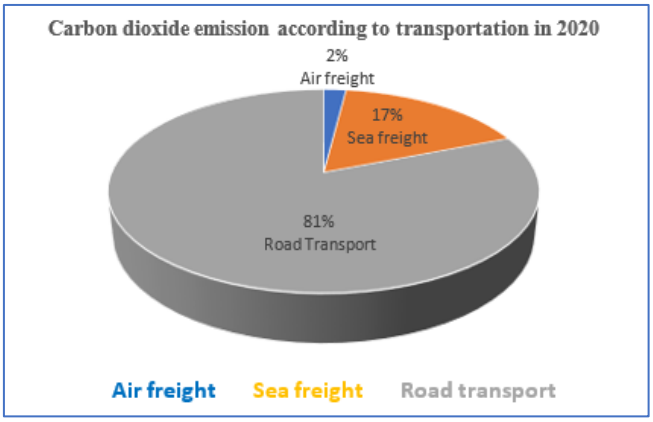
The Thai Maritime Enforcement Command Center (MECC), established in 2019, has duties and powers and is responsible for the preservation of national interests at sea. The duty of MECC are: to disseminate information to raise public awareness of the importance of maritime national interests and sovereign rights. Further rights include protecting Thailand's maritime jurisdiction, the right to exploit resources in the maritime zone/areas, encouraging people to take part in preventing and solving various problems that affect national interests at sea and teaching at all levels about preserving and cherishing marine natural resources. The problem that Thailand is faced with is a lack of support for coastal communities to participate in the management of marine and coastal resources. Among others are is lack of knowledge that the sea is different from the land in the following aspects. The international maritime law can complicate matters. The marine environment is more difficult to manage and regulate than the land environment. In addition to this, sea currents circulate pollution across the seas, complicating any response. For example, as current age and shrink, they change in direction. This causes pollution problems to return or flow to unplanned areas.[78]

C. NON-TRADITIONAL THREATS

Non-traditional threats are threats that are not viewed from the perspective of the state. Non-traditional threats can be divided into eighteen categories: climate change, transnational terrorism, transnational crime, shortage of energy resources, destruction of natural resources. Others include goods which evade tax, money laundering, the division of thought among people in the society, distrust of political institutions, pandemics, security in the three most southern provinces, poverty, rotten water, piracy, smuggling at sea, illegal fishing, natural disaster at sea and territorial dispute.

Climate change

Climate change means changes in climate because of human activities that directly or indirectly change the composition of the global atmosphere and in addition to natural climate variability observed during the same time, e.g. temperature, humidity, seasonal precipitation. One of the human activities, which have such an impact, is the burning fossil fuels. Signs of a worsening climate are heavy rainfall such as the deadly floods in Western Europe like Germany and Belgium on July 12, 2021 due to heavy rains. At least 220 people died, and this was the heaviest rain in 400 years. Over the past 100 years, the world's average sea level has risen by 17 centimeters due to rising water surface temperatures causing the sea surface to expand plus the melting of the polar ice. Since 1978, the ocean has warmed by 0.17 degrees Celsius because the ocean absorbs more heat. Since 2002, the polar ice sheets in Greenland and the Antarctic has decreased by less than 150 cubic km per year. The melting of glaciers around the world, include the Alps, the Himalayas, the Andes, and Alaska. Since the industrial revolution era, ocean acidification has increased by 30 percent due to more carbon dioxide emissions into the atmosphere and the ocean absorbs an additional 2 billion tons of this gas per year. The amount of snow covered in the Arctic has decreased over the past 50 years. Increasing temperatures causing more water from water sources, land and oceans to evaporate into the atmosphere. As such, coastlines are increasingly eroded because of rising sea levels.[46] The Intergovernmental Panel on Climate Change (IPCC) has assessed that since the 19th century, the average global temperature has increased by 0.6 °C, and by 2100, the average global temperature will increase by another 1.4 to 5.8 °C. Carbon dioxide emissions by shipping in 2015 were approximately 800 million tons, or 2.2% of global carbon dioxide emissions and 17% in 2020, seen in Graph 25, and is expected to increase to 50-250% by 2050.[9]



Graph 25: Carbon dioxide emission according to transportation in 2020[9]

Thailand is the ninth most vulnerable country from climate change. In addition, Thailand's ability to deal with disasters is relatively low (ranked 39 out of 48 countries). Over the past nearly 50 years (1970 to 2017), the average temperature in Thailand has warmed by 1.3°C, with another 2-4°C warming expected by 2100. Research by Pipitpukdee and Attavanich (2021) found that climate change in Thailand will result in a decline in the production of rice, sugar cane, cassava and rubber. The production of rice will decrease by about 10 percent, while other production such as sugar cane will decrease by about 25 percent.21

Transnational terrorism

The nature of terrorism has changed over the last twenty years. Often perpetrators are not members of terrorist organizations. They are otherwise known as “lone wolves” and have grown out of ideological influences spread via social media. A good example is the attack at Brussels Airport in Belgium, on 22 March 2016, which caused 31 deaths and over 300 injuries, seen in Figure 23.78 It was a new type of terrorism in which only a handful of the perpetrators operated together. Another incident, 7 July 2005 four explosions in a row in London, three subway trains were bombed within half an hour. Half an hour later, another double-decker bus exploded. At least 56 people were confirmed dead and more than 700 injured.

Thailand is not a direct target of international terrorism. There had been four incidents of international terrorism that have occurred in Thailand in 1972, 1976, 1981, and 1982.

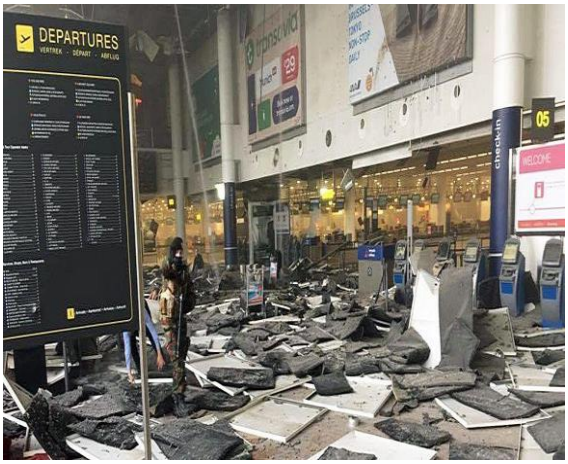


Figure 23: Terrorists attacked at Brussel airport, 22 March 2016[78]

Transnational crime

Transnational crime refers to a continuing offence from one country to another or having an impact on two or more countries. Transnational crime has continued to grow and expand across the world. The business value of transnational crime grew from $0.8 trillion in 2001 to 1.2 and 1.7 trillions of dollars in 2003 and 2006, respectively. Thailand's transnational crime happens because of: able to travel in and out of Thailand easily, the cost of living is not very high, one can buy weapons for use in criminal activities easily causing transnational criminals to want to live in the country.

Shortage of energy reserves (resource scarcity)

Today's energy shortages are fueled by severe weather conditions, which increases energy consumption in heating and warming. China has insufficient crude oil resources to meet demand causing the need to import more crude oil and becoming the world's largest importer of crude oil. In 2019, China imported crude oil worth 240,000 US dollars. The price of oil and natural gas around the world has increased many times and tends to move up again due to inability to increase production capacity. The price of natural gas in Europe increased by more than 130%. Therefore, higher energy prices will cause inflation problems, expensive products, and slow down spending. To deal with energy shortage, the German government has restricted public buildings other than hospitals to have a temperature limit of 19 degrees. The Japanese government plans to restart nuclear reactors that have been shut down for more than ten years to produce more nuclear power to ease the energy price crisis.

Destruction of natural resources

Natural resources refer to sources such as water, air, light, soil, plants, animals, minerals, forests, coal, gas and oil, for example. Threats to these natural resources are overfishing, over-use of fossil fuels, eating rare marine animals in the off-season, damage caused by tourists, and the destruction of mangroves used for shrimp farming, as seen in Figure 24,[79] and deforestation, in which every year, the entire world is losing forest areas the size of England.

Figure 24: Mangrove encroachment for shrimp farming in Thailand[79]

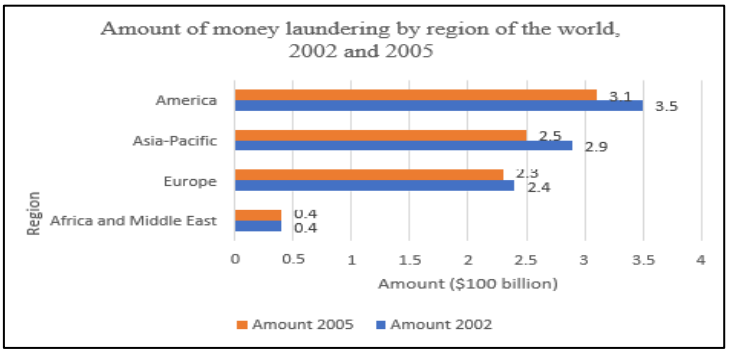
Tax-evaded goods by sea

Tax-evaded goods by sea in Thailand, are: cigarettes, electronic cigarette, smuggled oil, foreign liquor brands, seen in Figure 25.[80] Measures to counter smuggling of tax-evaded goods are: if a crew member is found guilty of smuggling, he or she would be subjected to vigorously legal charges, any involved officers will be severely punished.

Figure 25: Tax-evaded goods by sea[80]

Money Laundering

Money laundering is any actions to cover up or disguise acquisition of money so that ill- gotten money or dirty money appear to be clean money. Money laundering methods can be done, for example: to buy things, give it to other people to deposit to the bank on their behalf or open the company. Money from money laundering may be used in cases of: drug trafficking, terrorism, arms trafficking. Amount of money laundering by region of the world, 2000 and 2005 ($100 billion), can be seen in Graph 26.[81]



Graph 26: Amount of money laundering by region of the world, 2000 and 2005 ($100 billion)[81]

Polarized society

This is a result of the different views between opposite groups of beliefs on issues such as politics, the environment, and human rights. In addition, the generation gap tends to become a more problematic problem in Thai society from having differences in ideas, beliefs, habits and ways of working. This facilitates misunderstandings and conflicts between them, and is a sensitive issue that may escalate into another social problem.

Distrust of political institutions

Democratic politics is expected by the people to be a regime that can improve quality of life, respond to needs, and reduce conflicts within society, which consists of various groups. Thailand is a country with a democratic system of government with the king as head of state making the parliament an important political institution as a place for representatives to make laws on behalf of the people and have to check and balance the work of the management. Problems that making people in doubt of political institutions especially politicians are: lack of trust in politicians and political parties to be able to run the country without corruption. The way to rectify this is by choosing a politician who does not cheat into the government, install tools to monitor the use of power by politicians and governments, civil society drives democracy along with anti-corruption.

Public health

The public health of Thailand is crucial for national wellbeing and economic sustainability. One major concern of public health is pandemics. It is the nature of a disease outbreak that has spread around the world and often affects a large number of people such as the influenza outbreak that dates back to 1918 (Spanish flu), a new strain of influenza in 2009 and the latest COVID-19 pandemic. Two key factors contributing to its widespread spread are: the ability to communicate from one patient to another and travel of people especially the plane that can carry infectious diseases to new areas of the world within hours. Over the past two years, 2020-2022, there had been 6,691,532 deaths worldwide. The top five countries with the highest death rates are the US, Brazil, India, France, Germany, with the number of deaths: 1,117,194, 693,604, 530,696, 161,715, and 161,133 respectively.18 Measures to prepare "COVID-19" to enter the endemic disease are: more than 60% of booster vaccination, especially in high-risk groups, the elderly and people with underlying diseases, and the mortality rate is not more than 0.1%.

Insurgency in the three southernmost provinces and four cities in Songkhla provinces

In the opinion of local residents, the likely causes of unrest in the three southern border provinces are: distrust of government officials, unfair treatment, people were oppressed, officers arrest innocent people, religious challenges and frictions, dissatisfaction with state policy, separatist groups. Whatever the causes that might trigger the unhappiness of locals, the fight with the government has been going on since 2004.

Poverty

In 2021, Thailand has 4,404,616 million poor people, accounting for 6.32% of the country's population, the total population is 69,693,291. For the criteria to determine whether a person is poor or not poor, in 2021, the National Statistical Office set the base of thinking from monthly income that must be less than 2,802 baht per person per month or 33,624 baht per person per year.

Rotten water

Rotten water arises from human activities such as discharge of wastewater from industrial factories, communities, livestock farms, agriculture, mining or oil stains from long-tailed boats in the river. For example, in 2011 a huge amount of rotten water representing a

volume of up to 138 million cubic meters flew into the sea from 14 provinces across Thailand affecting the marine ecosystem, coastal farming and tourism. In 2018, the polluted water that flowed into the sea at Bang Saray Beach, Chonburi province was caused by the rotten sediments of communities and establishments near the seashore causing the sea water along the beach to turn black spreading about 100 meters wide, emitting a putrid smell and there are still many dead sea creatures.

Piracy

The South China Sea is a particularly vulnerable area to piracy that has increased significantly since the Asian financial crisis in 1997. There have been reports of piracy and armed robbery in 2012 more than 90 times, making the South China Sea the second most pirated sea space in the world. The Malacca strait, which stretches over 800 kilometers, has an area of a quarter of the world's shipping maritime routes, and half of the world's oil tankers have traveled on it since the 1970s. To counter the problem of piracy, in 2004 Singapore, Malaysia and Indonesia initiated an air reconnaissance program in the Strait of Malacca called “Eyes in the Sky”. The Philippines joined with the United States in organizing an anti-piracy seaman workshop in 2013. The most concrete form of cooperation among the ten ASEAN nations was their significant contribution to the establishment of the Regional Cooperation Agreement on Combating Piracy and Armed Robbery against ships in Asia - ReCAAP, which came into force in September 2006, though Malaysia and Indonesia did not sign and ratify the agreement.

The piracy problem will never be solved if countries are not continuing to revise lax maritime laws. In addition, the issue of coordination between countries that are not very serious in anti-piracy since many countries often have disputes over their maritime sovereignty causing each country to fear that signing of any international maritime agreement could become an unintended recognition of other nations' maritime territorial rights.

Smuggling at sea

Thailand has a maritime border of about 3,100 kilometers with 21 coastal provinces. Economic prospects in Thailand attract huge numbers of people from neighboring countries, such as the 2.14 million to come to work in Thailand both legally and illegally. The cause of this smuggling at sea are corruption of border officials, labor shortages in

Thailand and higher labor wages than neighboring countries. The problem that arises when we are taking illegal workers are perpetrators cannot be traced when those people fled to their own country illegally after they commit the offense, and human rights violations against illegal migrant workers.

Illegal fishing (IUU fishing)

IUU fishing is Illegal, Unreported, and Unregulated fishing, a definition given by the Food and Agriculture Organization (FAO) of the United Nations. The key player in the control of fishing vessels is the owner state of the flag of that fishing vessel (Flag State), which is responsible for registering the fishing vessel, issuing a fishing license and control the behavior of fishing vessels hoisting their flag. To alleviate the problem of IUU fishing, EU issued the IUU Regulation or EU Regulation No. 1005/2008, which has been effective from January 2010. If the EU finds any country that does not have a fisheries control system or inadequate controls, it will hand out the yellow card as a warning that the country is at risk of becoming countries that do not cooperate in the fight against IUU fishing. While getting a yellow card, the EU will provide assistance and advice so that the country improves the fisheries control system to meet standards if ignored and do not perform any updates then EU will announce a red card and suspends imports of fisheries caught by that country's vessels.

The negative impact of IUU fishing are global losses from IUU fishing are estimated to be around 10-23.5 billion Euros per year, between 13%-31% fisheries products come from global IUU catches. In Thailand, the problem still exist despite lifting of the yellow card due to inefficient application of the Fisheries Law, such as: labor abuse and debt bondage in the industry, poor working conditions, and 40% of fishers had been trafficked into the industry.

Natural disasters at sea

There are many types of natural disaster at sea such as:

1. Underwater volcano. The total number of underwater volcanoes is estimated to be more than 1 million craters, of which about 75,000 rise more than 1km above the seafloor. It can create air bubbles underwater, which will reduce the density of the water to the point of making ships sunk. For example, on 15th January 2022, underwater volcano erupted and disrupted Tonga with a force to 500 Hiroshima nuclear bombs resulting of three deaths and repercussions are being felt by the entire world.

2. Tsunami. This is a wave caused mainly by a large earthquake beneath the seafloor causing water to flow in the rift gap creating a huge wave that moves out towards the shore. In December 26, 2004, an earthquake centered on the island of Sumatra. that occurred under the water caused large water waves called a tsunami and destroyed the coast of Thailand on the Andaman side causing about 5,400 deaths and more than 8,000 injuries.

3. Accident at sea. The statistics for accidents at sea are as follows: in 2017, there were five boat collisions at sea. Most of the incidents were caused by negligence. Apart from boat collision, boat capsizes and boat sinking happened also. The precaution that authorities have done to alleviate the problem are not allow to load the passengers more than the limit of the boat, ask tourists to wear life jackets and strictly check the helmsman's license and boat staff for the safety of operations.

4. Oil spill. The causes of it are the equipment used in the containment or pumping damaged, during oil transfer at sea from large ships to small ships or between the ship and the jetty, illegal throw away, shipwreck due to collision, hit the reef or catch fire, leak from a petroleum rig at sea, oil pipeline accident in the middle of the sea by ships crashing into it. The incidents that have happened in Thailand are in 1997, 160,000 liters of oil spilled into the sea while transferring oil from ships to Star Petroleum Refining Company's crude oil terminal, Thailand. PTT Global Chemical Co., Ltd.'s oil pipeline leaked into the sea, causing crude oil to spread into the sea.

5. Overflowing seawater. More than 70% of the world's coastal areas are experiencing sea level rises of approximately 20% above global mean sea level. During the year 2008-2011, the sea level on both sides of Thailand, both the Gulf of Thailand and the Andaman Sea saw an increase of about 0.55-0.65m. One direct effect of rising sea levels is that coastal areas are slowly being absorbed. As the sea level rises, more and more coastal areas will be lost, especially in coastal areas with low slopes will disappear more than the coastline with higher slopes.

Territorial/border dispute at sea

Thailand has maritime borders with six neighboring countries, namely: Cambodia, Vietnam, Malaysia, Indonesia, India and Myanmar. Some have territorial disputes with Thailand due to declaration of the maritime zone of each contiguous country, which we often call “Maritime Overlapping Claims Areas”. At present, there are areas that have been negotiated and settled while others still cannot be settled. Thailand and Cambodia have

overlapping claims of approximately 26,400 square kilometers with negotiations at a standstill. Thailand and Vietnam have an overlapping area of approximately 13,290 square kilometers. However, the two countries were able to reach an agreement on demarcation of the border in 1997. Thailand and Malaysia have overlapping areas of approximately 7,250 square kilometers. Both countries reached an agreement on mutual benefits, and designated as a joint development area (Joint Development Area: JDA), as seen in Figure 36 with a Memorandum Of Understanding in the year 1983. Thailand and Myanmar share claims in areas near the shore, starting from the north of Koh Surin to the Kra Buri River.

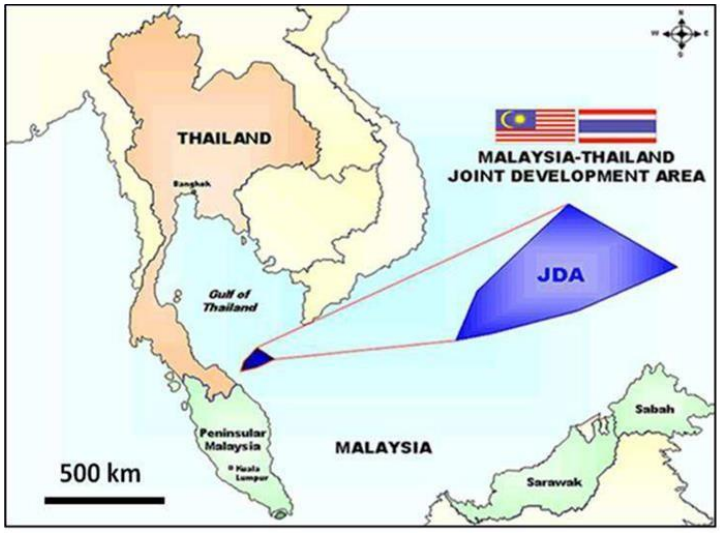


Figure 36: Joint development Area between Thailand and Malaysia

Bartlett's Model of Strategic Development

Henry C. Bartlett's model of strategic and force planning framework can be seen in Figure 37.

Figure 37: Bartlett's model of strategic development

OODA loop model

The OODA (Observe-Orient-Decide-Act) loop model was invented by Group Captain John Boyd, United Stated Air Force, as depicted in Figure 38 (can be adapted into our problem).

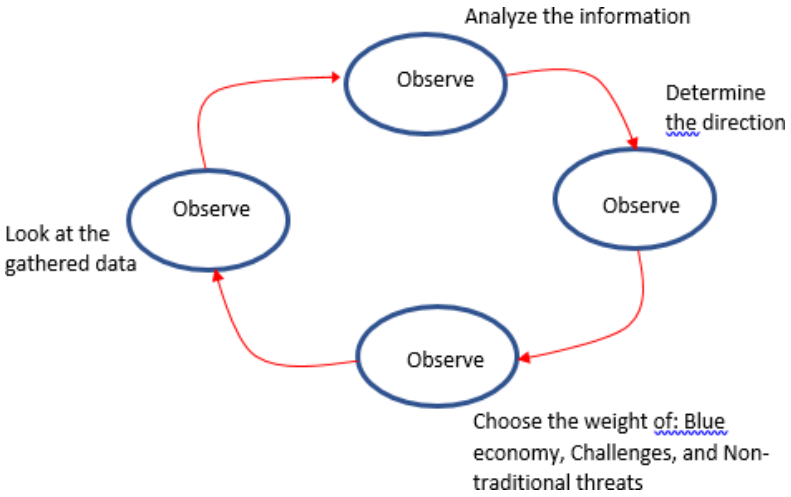


Figure 38: OODA loop

Maslow's hierarchy of needs – motivation theory

Maslow's hierarchy of needs or motivation theory can be seen in Figure 39.

Figure 39: Maslow's hierarchy of needs

Challenges (Non-traditional threats)

This paper proposes the use of the Bartlett Model to determine how Thailand should prioritise the non-traditional challenges that pose a challenge to its blue economy. This model uses a quantitative decision making method. The three criteria for testing are as follows: Suitability, Feasibility, and Acceptability.

Topics					Weight*								
				Challenges	4.2.1	4.2.2	4.2.3	4.2.4	4.2.5	4.2.6	4.2.7	4.2.8	4.2.9
					5	3	4	3	2	5	2	2	4
				Non-traditional threats	-2	-2	-1	-2	-1	-1	-1	-1	-2
				Challenges + Non-traditional threats	3	1	3	1	1	4	1	1	2
Weight*	Type of Blue economy	4.1.1	4	(Multiple Column and Row)	12	4	12	4	4		4	4	8
		4.1.2	3		9	3	9	3	3		3		6
		4.1.3	2		6			2		8	2	2	4
		4.1.4	3			3			3	12		3	
		4.1.5	3		9	3	9	3	3		3		6
		4.1.6	4			4				16			8
		4.1.7	5			5			5	20	5	5	
		4.1.8	2							8			
		4.1.9	2		6		6						
		4.1.10	2		6		6	2					
		4.1.11	1		3		3	1					
		4.1.12	3			3			3	12	3	3	6
				Total	**51**	**25**	**45**	**15**	**21**	**76**	**20**	**17**	**38**

Table 6: Superior solution

Weight*: The number is range from -5 to 5, when -5 is the least importance and 5 is the most important.

As Table 6 illustrates, the challenges arranged from the most important to least important are as follows:

1. Reduce fossil energy usage (4.2.6)
2. Effort to reduce the degradation of marine resources (4.2.1)
3. Effort to reduce climate change (4.2.3)
4. Appreciation of the sea (4.2.9)
5. Increase recruitment in the marine sector (4.2.2)
6. Improve human rights (4.2.5)
7. Efficient waste disposal (4.2.7)
8. Green port (4.2.8)
9. Thorough stewardship of marine resources (4.2.4)

Visualization of Findings

From Bartlett's model, we can adapt it into our research problem as seen below in Figure 40.

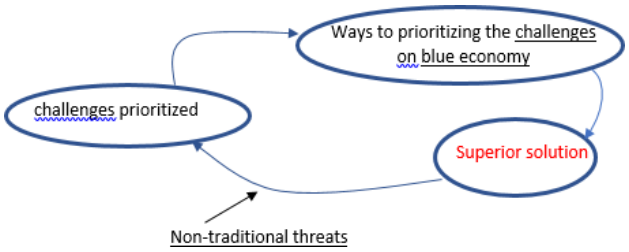


Figure 40: Solutions to our research using Bartlett's model

The simplified representation to the solution of the research can be seen in Figure 41.

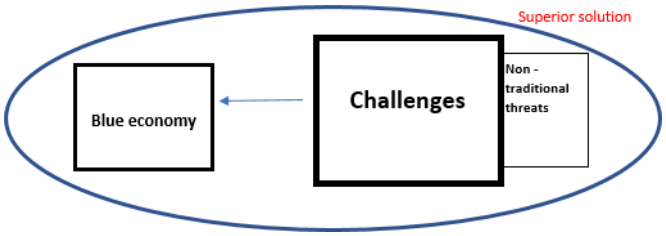


Figure 41: Simplified representation to the solution of the research

From the Table 6, the weight of blue economy are as follows in Table 7. By using OODA loop model for choosing the weight.

Blue economy	Weight	Remarks
1. Tourism	4	- In 2016 "Marine tourism" contributed the fifth highest amount to overall marine-based revenues. - In 2020, the second most important contributor to the economy and the country was "Tourism". - Thailand uses a BCG (Bio Circular Green) economic model to boost its sustainable development of tourism. - In 2017, tourism was the second highest income provider. - Between 2015 and 2019, the number of tourists constantly increased.
2. Fisheries	3	- In 2016 "Fisheries" contributed the ninth highest amount to overall marine-based revenues.
3. Marine pollution management	2	- This did not surpass the top thirteen contributors to marine revenue in 2016.

4. Shipyard	3	- In 2016 “Shipyard and ship repair industry income” contributed the twelth highest amount to overall marine-based revenues
5. Aquaculture near the sea	3	- In 2016 “coastal aquaculture industry” contributed the eleventh highest amount to overall marine-based revenues
6. Energy	4	- In 2016 “Industries related to petrochemicals - plastics” contributed the second highest amount to overall marine-based revenues - In 2016 “Import-export of crude oil, finished oil, gas, fuels” contributed the third highest amount to overall marine-based revenues Thailand uses a BCG economic model to boost the sustainable development of its energy sector in line with UN’s 7th SDG.
7. Logistics	5	- In 2016 “Import - export by sea” contributed the highest amount to overall marine-based revenues. - In 2020 The greatest benefit Thailand got from the sea was from “Logistics”. In 2016 “Maritime logistics services industry” contributed the fourth highest amount to overall marine-based revenues.
8. Renewable energy from the ocean	2	Though important to the Thai economy, it did not surpass the top thirteen contributors to marine revenue in 2016.
9. Desalination	2	Though important to the Thai economy, it did not surpass the top thirteen contributors to marine revenue in 2016.
10. Pharmaceutical industry	2	Though important to the Thai economy, it did not surpass the top thirteen contributors to marine revenue in 2016.
11. Minerals under the sea	1	Still in exploration phase.
12. Ports	3	In 2016 “Revenue from the Port Authority of Thailand” contributed the thirteenth highest amount to overall marine-based revenues.

Table 7: blue economy with a given weight and reasons/remarks

The weight of challenges and non-traditional threats and the sum of those two can be seen in Table 8, which used OODA loop model for choosing the weight and explaining the reason for various threats by Maslow's hierarchy of needs.

Challenges/Weight	Non-traditional threats/Weight	Remarks (Challenges + Non-traditional threats)/Weight
1. Effort to reduce the degradation of marine resources/5 - Thailand established the Command Center for Combating Illegal Fishing (CCCIF) in 2015 to combat IUU fishing issue. It succeeded due to the ability to remotely monitor fishing at sea and conduct robust inspections at port. (Thailand got a yellow card in 2015 from European Union and removed in 2019.)	- Climate change (Thailand got score "Low" in climate protection index 2020) (4.3.1) - Shortage of energy resources (The price of oil and natural gas has continued to move up because shortage of energy resources (Crude oil can only be expected to be useful for the next 20 years or until renewables provide a credible alternative. Global gas stocks will be reduced to zero in 30 *years*. Coal can be used for another 70 years from now.)) (4.3.4) - Destruction of natural resources (Thailand is the world's third largest seafood exporter. Thailand is the fifth largest plastic polluting country) (4.3.5) - Poverty (4.3.12) - Rotten water (For 45 years, from 1977- 2022, Thailand spilt oil into the ocean on roughly 235 occassions.) (4.3.13) - IUU fishing (4.3.16) - Natural disasters (4.3.17) - Territorial dispute (4.3.18) - 2	3

2. Increase the recruitment in the marine sectors/3 - Improve rates of pay for sea-based jobs relative to land-based jobs. - Recruit online for worldwide recruitment. - Promote a comfortable work-place environment.	- Transnational terrorism (4.3.2) - Transnational crime (4.3.3) - Shortage of energy resources (4.3.4) - Destruction of natural resources (Thailand, the seventh biggest polluter of the ocean) (4.3.5) - Poverty (4.3.12) - Piracy (4.3.14) - IUU fishing (Global losses from IUU fishing are estimated to be around 10-23.5 billion Euros per year. Between 13%-31% fisheries products come from global IUU catches) (4.3.16) - Natural disasters (4.3.18) - Territorial dispute (4.3.18) (-2)	1
3. Effort to reduce climate change/4 - In 2022, 48% more Thais bought electric cars after supportive measures and high oil prices contrary to internal combustion engines cars that use gasoline as fuel shrunk from 2021 to 8.8%. - Thailand used its BCG model to boost the sustainable development of blue economy which in line with 13th SDG, climate action. - Aim to achieve carbon neutrality by 2050 and zero greenhouse gas emissions by 1065. - Project of cleaning "15,000 air conditioner" reducing 1,000 tonnes of CO2 equivalent.	- Climate change (Thailand got score "Low" in climate protection index 2020) (4.3.1) - Destruction of natural resources (4.3.5) - Poverty (4.3.12) - Rotten water (4.3.13) - Natural disasters (4.3.17) (-1)	3

4. Thorough stewardship of marine resources/3 - Established marine and coastal protected areas such as one in Losin island, Pattani, Thailand. - Is pursuing eco-tourism measures	- Climate change (4.3.1) - Destruction of natural resources (4.3.5) - Tax-evaded goods (4.3.6) - Poverty (4.3.12) - Rotten water (4.3.13) - IUU fishing (4.3.16) - Natural disasters (4.3.17) - Territorial dispute (4.3.18) -2	1
5. Increasing human rights/2 - In 2023, Thailand accepted 96,000 Rohingya refugees from Myanmar.	- Poverty (4.3.12) - Smuggling at sea (Human trafficking) (4.3.15) - IUU fishing (4.3.16) -1	1
6. Reduce fossil energy usage/5 - In 2022, 48% more Thais bought electric cars after supportive measures and high oil prices contrary to internal combustion engines cars usage that use gasoline as fuel shrunk from 2021 to 8.8%. - Aim to achieve carbon neutrality by 2050 and zero greenhouse gas emissions by 2065. - Thailand implemented intensive energy saving measures by setting a goal for government agencies to reduce electricity and oil consumption by 20% in September 2022.	- Climate change (4.3.1) - Shortage of energy resources (4.3.4) - Destruction of natural resources (4.3.5) - Poverty (4.3.12) -1	

7. Efficient waste disposal/2 - In 2015, Thailand ranked as the sixth largest country to poorly mismanage its plastic waste.	- Poverty (4.3.12) - Territorial dispute (4.3.18) -1	1
8. Green port/2 - In 2022, Port Authority of Thailand used solar cells power generation system and has tried to reduce CO_2 emissions by 10% by 2023.	- Poverty (4.3.12) -1	1
9. Appreciation of the sea/Sea nation/4 - One of the roles of the Thai Maritime Enforcement Command Center (MECC), established in 2019, is to raise public awareness of the importance of the maritime domain to the nation. It has a duty to safeguard the interests of the maritime nation and take part in preventing and solving problems that affect national interests at sea.	- Shortage of energy resources (4.3.4) - Destruction of natural resources (4.3.5) - Tax-evaded goods (4.3.6) - Money laundering (4.3.7) - Discrepancy of thought among people (4.3.8) - Poverty (4.3.12) - Piracy (4.3.14) - Smuggling at sea (Human trafficking) (4.3.15) - IUU fishing (4.3.16) - 2	2

Table 8: Challenges and Non-traditional threats with a given weight

D. CONCLUSION

Each of the twelve elements of the blur economy do not have the same weight as each other. Each is scored from one to five according to the necessity to the economy. Each can be ranked as follows: tourism (4), fisheries (3), marine waste management (2), shipyard (3), aquaculture near the sea (3), energy (4), logistics (5), renewable energy from the sea (2), desalination (2), pharmaceutical industry (2), minerals under the sea (1), and ports (3). Nine challenges weigh differently, and are scored from one to five. This appears as such: Thailand's effort to reduce the degradation of marine resources (5), increase the recruitment in the marine sector (3), its effort to reduce climate change (4), its thorough stewardship of marine resources (3), an improvement of human rights (2), reduce fossil energy use (5), efficient waste disposal (2), green port (2), and appreciation of the sea (4).

Not all non-traditional threats are associated with every one of challenges, the detail can be seen in table 3. Challenges can be prioritized based on non-traditional threats by using the quantitative method derived from Bartlett's model and arranged from the most important to least important. This appears as follows: reduce fossil energy usage, effort to reduce the degradation of marine resources, effort to reduce climate change, appreciation of the sea, increase the recruitment in the marine sector, increasing human rights, efficient waste disposal, green port, and thorough stewardship of marine resources. What should be noted is that the data gathered to explain all the matters is based on available public source information, which by no mean the most up-to-date one.

E. RECOMMENDATIONS

1. Tactical level: ensure data on non-traditional threats can be exploited more readily to get an accurate result.

2. Tactical level: the Royal Thai Navy (RTN) should maintain the support to the government. In 2003, the RTN planted 5000 rai (2,000 acres) of mangrove forests. In 2003, RTN made an underwater park project. In the same year, the RTN undertook a sea turtle conservation project and project to conserve seashells. In 2020, the RTN organized the environmental conservation youth leadership project to preserve the national interests of the sea in 2020. In 2021, RTN organized activities to conserve coral reefs and marine life in Thailand according to His Majesty's initiatives. In 2021, the RTN jointly released 116 sea

turtles for conservation and restoration natural resources. In 2022, the RTN organized the project of conservation of coral reefs and marine life, it released sharks and aquatic animals and it organized diving activities to conserve coral reefs and marine life in Thailand in accordance with His Majesty's initiative. In 2023, RTN organized a mangrove planting activity to conserve and restore the marine and coastal environment. In 2023, RTN organized resources conservation and artificial reef planting project, Samae San island in honor of His Majesty the King.

3. Operational level: Australia should maintain the cooperation of training with Royal Thai Navy such as: exercise AUSTHA (as part of Indo-Pacific Endeavour). This occurred in 2019, 2021 and is upcoming in 2023. One of the training components is searching suspected ships carrying tax-evading goods, drug, or human trafficking.

4. Operational level: ASEAN should maintain the support of the blue economy by having the RTN host the 7th ASEAN Navy Young Officers Interaction Program 2018 (7th ANYOI 2018), during 19 - 22 June 2018, Thailand, with young naval officers from the ASEAN Navy. 19 officers participated in the activity (ten nations including the Royal Thai Navy) under the framework of "Protection and Conservation of the Marine Environment" to build relationships and cooperation at the level of new naval officers of the Navy in ASEAN countries in all dimensions. In 2017, The RTN hosted the 11th ASEAN Navy Chiefs' Meeting in Chonburi, Thailand. The commander-in-chief of the ASEAN navy agreed to set up a marine environmental interconnected warning system to solve the problem of theft at sea and help each other conserve and preserve the marine environment. ADMM – plus (ASEAN Defence Ministers' Meeting) where dialogue partners are Australia, New Zealand, China, India, Russia, United States, Japan and Republic of Korea. These countries maintain cooperation and dialogue with each other in all aspects of maritime security.

5. Strategic level: Thailand should try to increase in research and development of marine technology so it can be able to apply new knowledge from research to develop society to have the potential to compete with foreign countries. At the same time, it should also focus on research to be able to restore and conserve the environment to maintain the balance of the ecological system in the end.

6. Strategic level: Thailand should try to achieve the Sustainable Development Goal: SDG. The SDG are the blueprint to achieve a better and more sustainable future for all.

They address the global challenges we face, including those related to poverty, hunger, health, education, equality, clean water, clean energy, economic growth, climate action, life below water, life on land and peace. The seventeen goals are all interconnected, and in order to leave no one behind, it is important that we achieve them all by 2030, such as the seventh goal affordable and clean energy, the 13th goal climate action and the 14th goal life below water.

7. Strategic level: Australia should maintain the support to the Royal Thai Armed Force by continuing in providing Defence Cooperation Program (DCP) scholarships. A number of these are involved in work on the blue economy.

8. Strategic level: The Sea Power Centre Australia (SPC-A) and Sea power Centre Thailand should continue observing the current Memorandum Of Understanding (MOU) to ensure both centers can continue working together bilaterally on issues, like the blue economy, to do with maritime security.

9. Strategic level: The Royal Thai Navy should investigate how to best reduce the country's fossil fuel footprint. This is the number one challenge to future of Thailand's blue economy.

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