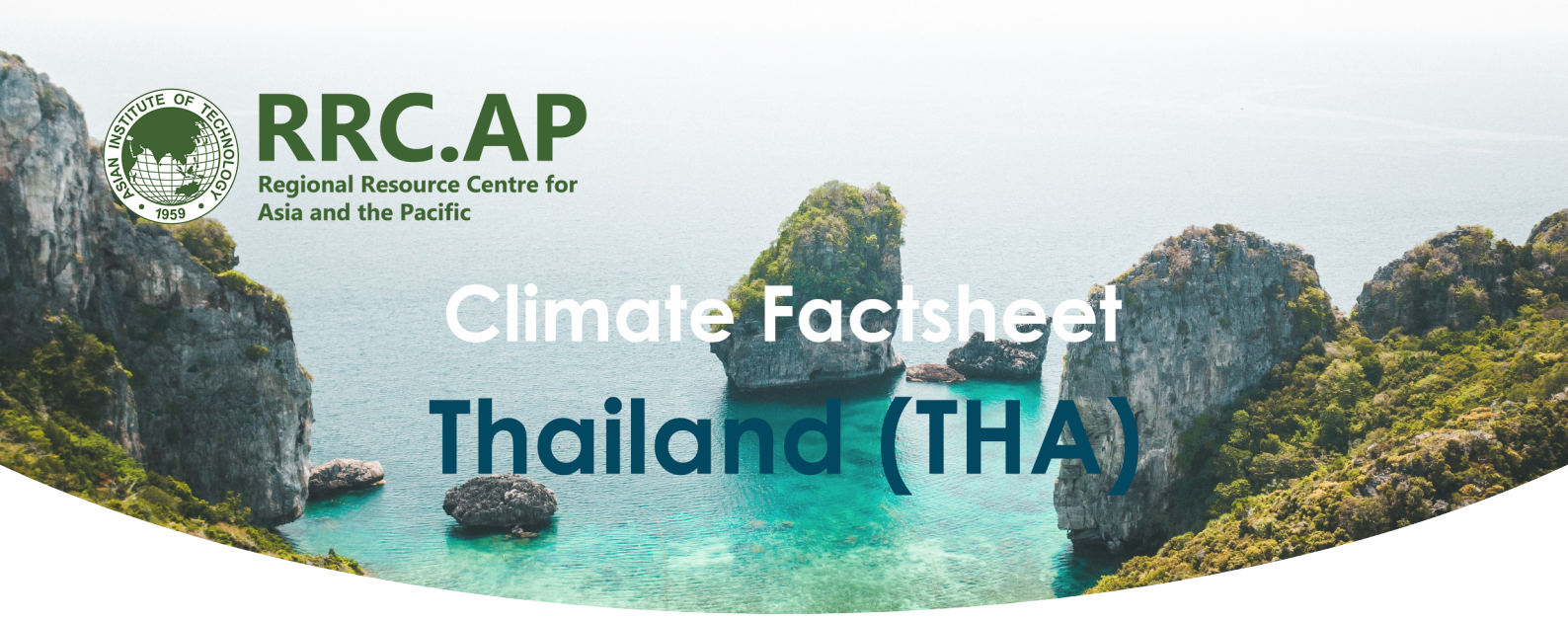

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Climate Factsheet
Thailand (THA)

Geography and People

» The Kingdom of Thailand, is situated in southeast Asia between latitudes 5° 37' N and 20° 27' N and longitudes 97° 22' E and 105° 37' E.[8]

» Thailand covers an area of 513,115 km^2 with total coastline of about 2,815 km.[8]

» 47% of the land is categorized for agricultural use. From the land dedicated for agricultural use, 21.43% of the land is dedicated for paddy fields.[9]

31.96% of Thailand's total land is categorized for forestry land use[9]

» Forest area has seen a historical decline since 1973, where total forest coverage was 43.2%. However, many legislative and institutional measures have been implemented and forest area in Thailand has stabilized since 2014.[8]

» The remaining 21.50% of Thailand's total land reserve has been categorized for non-agricultural land use.[9]

» Thailand shares its border with Myanmar and Laos to the north, and to the east with Laos and Cambodia. Malaysia and the Gulf of Thailand lies to the south while Myanmar and the Andaman sea are situated to the west.[8]

» Littoral area dominates much of Thailand's topography with coastal zones found along the Gulf of Thailand and the Andaman sea coast.[9]

» The country is comprised of high northern mountains, central plains, the northeastern plateau and the southern coastal plain.[9]

» Thailand has 25 major river basins and 254-sub basins.[9]

» Under the flora project of Thailand, the country was found to the home to 11,000 plant species, equating to approximately 3% of global plant species. 4,731 species of vertebrates were also recorded in 2016.[9]

Thailand's biodiversity is supported by seven ecosystems:[9]

Forests
Mountains
Agricultural
Marine and coastal area
Dry and semi humid areas
Inland water and
Islands

Total population of Thailand as of 2018 was 66,413,979

making it the 20th most populated country in the world.[10]

» Average annual population growth over the past decade is estimated to be around 0.4%. Population is projected to increase till around 2030, at which point decline will occur.[8]

» By 2025, Thailand will shift to an "Aged Society", bringing about several social and economic implications.[9]

» Thailand is transforming into a predominantly urban society. The urban population in 2010 was 43.3% and in 2020 it grew to 57.2%.3 Projections further indicate that by 2040, the country's urban population will be approximately 74.3%.[9]

» Rapid urbanization has resulted in an exponential increase in energy consumption.[11]

» The country is geographically divided into six regions. These regions include north, west, east, northeast, south and central regions. Administratively, Thailand is divided into 76 provinces not including Bangkok.[8]

» The country is guided by the sufficiency economy philosophy and the "Thailand 4.0" policy, directed at achieving the objectives of "security, prosperity and sustainability".[10]

» "Sufficiency" means moderation, reasonableness, and the need of self-immunity for sufficient protection from impact arising from internal and external changes.[10]

» Thailand 4.0 policy aims to transform the country from a heavy manufacturing into a knowledge-based economy based on creativity, innovation, science, and technology. Transformation of the Thai society under this guiding philosophy aims to improve the quality of life with an emphasis placed on green growth.[11]

» Thailand is the second largest economy in south Asia, but fourth in Gross Domestic Product (GDP) per capita.[9]

» GDP/Capita of Thailand between 2017 to 2018 grew from $6,592.92 to $7,295.48.[8]

Thailand currently is regarded as a mix-typed economy, based on

Agriculture
Industry and manufacturing
Tourism
Service

Thai economy has expanded from 4.0% from 2017 to 4.1% in 2018; the highest expansion rate in the past 6 years.[9]

» In 2018, agriculture contributed 8% of the GDP but accounted to over 30% of total employment. Tourism contributed to 15% of the GDP and provided 10.9% of total employment.[9]

» The unemployment rate in Thailand is exceptionally low as less than 1% of the population for both sexes aged 15 and above are unemployed.[9]

The number of **poor people in 2018 has increased by 2.1% or 1.5 million of the total population** compared to 2017. Poverty is concentrated in rural areas as opposed to urban.[9]

» Strides have been made however to reduce the income inequality as the proportion of people living below 50% of median income has decreased from 15% in 2006 to 11% in 2016.[9]

Climate

» Climate and climate patterns in Thailand are influenced by two main monsoon winds.[2]

› The southwest monsoon, beginning in May and bringing warm moist air from the Indian Ocean causing abundant rain over the country.[8]

› The northeastern monsoon begins in October and brings cold, dry air from the Chinese mainland over the north and north-eastern regions of Thailand.[8]

» Climate of Thailand is divided into three seasons. The southwest monsoon from mid-May till mid-October, the northeast monsoon from mid-October to mid-February. And the pre-monsoon from mid-February to mid-May.[1]

» Data of surface and atmospheric temperatures recorded by weather stations throughout the country revealed that temperatures had increased significantly from 1955 to 2009.[8]

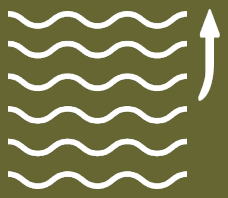
» Between 1981-1990, temperatures increased by 0.33°C. Between 1991-2000, recorded temperatures increased by 0.16°C per decade. 2001-2010, it increased by 0.145 per decade.[9]

Average temperature in Thailand from 2011-2019 has increased by an average of 0.09°C per year, making it the hottest period on record.

Temperatures throughout the country in the future, will most likely rise.[8]

» Thailand recorded its highest temperature in April 2016 since 1951 of 44°C in Mae Hong Son province.[1]

» Surface temperatures of the Gulf of Thailand and the Andaman sea has risen by 0.1°C per decade from 1967-2006.[1]



According to data collected from four sea level stations in the Gulf of Thailand, **sea levels tended to rise at a rate of 3.0-5.0 mm per year from between 1895-2004.**[1]

» Variations in rainfall and the number of rainy days has oscillated as per findings from the Thai meteorological department.[1]

» Between 2015-2019, rainfall variation has been the highest. Average annual rainfall in 2015 was recorded to be 2000mm whereas in 2019, average annual rainfall of Thailand was the lowest since 1979, at 1343 mm.[9]

» In 2018, Thailand recorded its highest annual average rainfall of 2017 mm since rainfall data was recorded in 1951.1 Variations in Thailand's precipitation regime have been attributed to the El Niño and La Niña oscillations.[9]

Between 1955 to 2014, **the number of rain days in Thailand has significantly decreased by 0.99 days per decade.**[8]

» National projections indicate heavier rainfalls are expected in areas with already high precipitation level, such as the southern peninsula. Areas such as inland northeastern region, however, are expected to see a reduction in rainfall.[1]

» In 2012, Green House Gas (GHG) emissions per capita was 5.63 tCO_2eq. In the same year, emissions per GDP (US$ million) was 409.54 tCO_2eq, lower than world average.[2]

» Total water resources available in Thailand amount to 1,130 billion m^3 of water, but only 45 billion m^3 has the potential to be extracted for utilization.[8]

» Total water demand in 2015 was 147 billion m^3, but the accessible amount was only 102 billion m^3, shortage of roughly 45 billion m^3 of water.[8]

» Water quality assessments carried out in 64 provinces during 2018 showed that 27 provinces had good water quality, 29 had fair and 8 provinces with poor quality.[9]

» Assessment on 27 groundwater basins in Thailand were carried out, to test the quality of water across 1,587 sites. The assessment concluded that ground water was acceptable for consumption.[9]

The five major air pollutants in Thailand are[1]

Sulphur dioxide
Nitrogen dioxide
Carbon monoxide
Particulate matters (PM10 and PM25)

» In 2018, air quality was relatively stable except for levels of PM10, PM25 and ozone that exceeded standard levels.[9]

» PM10 values have greatly exceeded maximum guidelines particularly in Saraburi province, a major area for cement production. Ozone values have remained stable but in excess since 2018.[9]

» In the rural areas in northern Thailand, there is a recurring issue of atmospheric hazing due to open crop burning and forest fires. Hazing has been attributed to a combination of the dry season leading to air stagnation and point source pollution. These sources are areas with heavy traffic, open burning from agriculture and industry and construction.[9]

Regional Climate Change

» As per the Intergovernmental Panel on Climate Change's (IPCC) 2014 report on Impacts, Adaptation and Vulnerability, it is likely that number of cold days and nights in Asia will likely decrease in the future.[5]

» Conversely, the report also stated that the number of warm days and nights and heat wave frequency across Asia since the 1950's has also increased.[5]

Across southeast Asia, warming has occurred at a rate of **0.14°C to 0.20°C** per decade since the 1960's.[5]

» It is likely that under the RCP8.5 (high emissions scenario as per IPCC's fifth assessment report) scenario, temperature throughout southeast Asia will be greater than 6°C in the late 21st century, compared to the pre-industrial temperature of the late 20th century.[5]

» In south Asia, seasonal average rainfall shows a declining trend with inter-decadal variability compared to pre-industrial levels. Rainfall in this region is influenced mainly by the monsoon and the geographical characteristics of the various countries.[12]

» The frequency of heavy rainfall and extreme rainfall events in south Asia is increasing, while light rainfall events are decreasing compared to pre-industrial levels.[12]

» Based on projections by Nakaegawa et al., in 2013, there is a high confidence that water demand in most Asian countries will increase because of increasing population, irrigated agriculture and industry.[5]

» Mismanagement of water sources, rainfall variability and changes to glacial regimes occurring since the late 20th century, will further increase the tension of water scarcity in more arid regions of Asia.[5]

» Increasing frequencies of droughts since the late 20th century, can disrupt further exacerbate issues of food security and malnutrition.[5]

» Changes to species distributions are consistent with the warming that has gradually occurred since the late 20th century.[5]

» Recent climate change has extended the growing season and led to earlier spring greening. This, coupled with the increasing frequency of droughts, has led to changes in the growing cycle of lowland rainforests in southeast Asia.[13]

» By 2100, large area of tropical and subtropical lowland Asia is projected to experience temperatures and rainfall outside of current range. The impact of these novel conditions is largely unknown.[5]

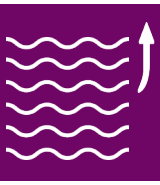
» In southeast Asia, under A2 ("the Full World" scenario as per IPCC's fourth assessment report) and B1 ("the Vegetarian World" scenario as per IPCC's fourth assessment report) climate scenarios, widespread decline of bats species richness is to be expected. Large species reductions and northward range shifts for many species are also to be expected.[5]

The tropical and subtropical coasts in **Asia support 45% of the world's Mangrove forests.**

Additionally, **Asia supports approximately 40% of the world's coral reef area,** located mostly in southeast Asia.[5]

» Climate change will negatively impact marine productivity, especially in the tropics, mainly due to the vulnerability of coral reefs to ocean warming and acidification.[6]

Coastal ecosystems of Asia are under threat from both climate change and human impacts. Large deltas in Asia are sinking much faster than the global sea level is rising.



Ocean acidification and increasing sea surface temperatures will result in large-scale decline of coral reefs by the mid-21st century.[6]

» The Indian Ocean is one of the most rapidly warming ocean basins. From 1951 to 2015, sea surface temperatures have risen by 1.0°C on average. Climate modelling simulations show that over 90% of the warming that has occurred in the Indian Ocean, was very likely a result of increasing anthropogenic emissions.[15]

» Upper ocean heat content in the Indian Ocean has also increased between 1950 to 2015, at a rate of 1.0 x 1022 Joules per decade.[15]

» Patterns of sea level rise in the Indian Ocean are not fully understood due to a lack of in-situ data. The current understanding is that sea level rise in the Indian Ocean is spatially varied as sea level has decreased substantially in the south tropical Indian Ocean, whereas it has increased elsewhere. Along the coasts of the north Indian Ocean, data from tide gauges show a rise of 12.9 cm in sea level per century.[14]

» Since the late 20th century, surface ocean pH over the Indian Ocean has declined by 0.1 unit.[15]

» First incident of coral bleaching occurred in July 1998, where sea temperatures of the Indian ocean rose to 31°C. 90% of massive corals and 75% of branching corals across India were bleached.[6]

» Future trends of sea level rise are expected to exceed those of recent decade, increasing coastal flooding, erosion, and saltwater intrusion in countries such as Bangladesh, Thailand, and Malaysia.[5]

› 7% of Vietnam's agricultural land may be submerged due to a 1-meter rise in sea level.[5]

Asia is responsible for 90% or more of the world's total rice production. **Climate change is projected to significantly decrease rice yield over a large portion of the continent.[5]**

» Heat stress induced by recent warming will negatively impact yields of rice in many southeast Asian countries such as Myanmar, Vietnam, Laos, and Cambodia.[5]

» Increasing frequency of extreme weather, temperature and rainfall events can also negatively affect crop yields in many southeast Asian countries. Rice growing areas are expected to shift with climate change throughout Asia.[5]

» Such impacts of climate change led to food insecurity and loss of livelihood for many in southeast Asia.[13]

Asia has experienced the highest number of weather and climate related disasters in the world between 2000-2008, accounting to **27.5% of global economic losses.**

» Two-thirds of Asia's cities with 1 million or more inhabitants are exposed to one or multiple hazards such as flooding or cyclones.[5]

› Large parts of southeast Asia are exposed to high degree of cumulative climate-related risk.[5]

› By 2070, top Asian cities in terms of population exposure to coastal flooding are Kolkata, Mumbai, Dhaka, Guangzhou, Ho Chi Minh City, Shanghai, Bangkok, Rangoon, and Hai Phong.[5]

» Studies carried out in south and east Asia have shown an association between increased incidence of diarrhoea and dengue outbreaks with higher temperature and rainfalls.[5]

» Warming and increased heatwaves have also been associated with higher mortality amongst elderly populations in India and Thailand.[5]

Future Climate Projections

» Projections of Thailand's future climate till 2100 show increase in temperature, but with varied growth rates depending on patterns of GHG emissions.[1]

By the end of the 21st century, **temperature in Thailand is expected to increase from a range of 0.56°C to 4.0°C** from the previous century.[1]

» The number of days with temperatures higher than 33°C are expected to increase by 2-3 weeks per year compared to the previous century.[11]

» Number of days with temperatures less than 15°C will likely decrease by 2-3 weeks per year.[8]

» Summers are expected to be prolonged by 2-3 months in throughout the country by the end of the century.[8]

» Precipitation in Thailand showed an undefined pattern of change across the simulations from climate modelling studies.[9]

» Modelling results show that average annual rainfall levels are likely to increase in every region of Thailand, indicating that rainfall can become heavier than it was in the past.[1]

» The number of days with rainfall greater than 3mm are expected to remain like historical patterns, suggesting that future rainy seasons might not deviate to current patterns.[1]

» Future projections by the IPCC suggest a decrease of river runoff in Chao Phraya River basin, exacerbating issues of water scarcity.[5]

» The annual climatic effect of monsoon seasons that affect Thailand and south east Asia are projected to increase in duration, resulting in increased and more variable precipitation patterns.[1]

» Within the next 100 years, the upper regions of the country further away from sea are expected to undergo only small changes in wind patterns.[9]

» Changes in windspeed and direction are expected to be evident more in the coastal areas of Thailand, namely the lower central region, the southern regions peninsula, and the eastern region.[9]

» Sea level rise will severely impact the Gulf of Thailand and Andaman sea with the enhanced melting of glaciers and thermal expansion of water.[9]

» Mean sea level in Krabi is estimated to increase by 11 cm by 2020 and 21 cm by 2050.

» Projected increases in sea level will also impact water availability. Salt intrusion of seawater will be more severe with changes to climate.[1]

» In terms of biodiversity, it is estimated that the species richness of butterflies in Thailand will decline by 30% by 2070-2099.[5]

Impacts of Climate Change

» Thailand is a developing country that is highly vulnerable to the impacts of climate change. The country as per the Global Climate Risk Index (CRI), is the 8th most affected countries in the period 1999-2018.[8]

» Thailand is also considered as one of the sixteen countries in the "extreme risk" category that are most vulnerable to the future climate change impacts over the next thirty years.[8]

Coastal Areas

» Thailand's coastal zone is one of the most vulnerable areas and it is at greater risk of intensive flooding resulting from sea-level rising and coastal erosion in several provinces, including the capital.[9]

» Around 155 coastal locations accounting for 23% of Thailand’s total coastline has undergone erosion crisis, leading to a total economic damage of 6,000 million Baht.

» 23 provinces with a total population of approximately 12 million people were situated in these areas, coastal erosion in these areas not only impacted people’s source of income, but also damaged coastal fishery communities.[9]

» Bangkok and its surrounding provinces have been ranked as one of the top cities in the world that is at risk of intensive flooding from changes to precipitation, sea-level rise, and coastal erosion under climate change.[1]

Water Crisis

» Deforestation, underdeveloped water infrastructure and climate change has made Thailand particularly vulnerable to flooding and droughts.[11]

» During the monsoon season in 2011, Thailand experienced major flooding. More than 1.44 trillion THB of damage was done to the economy and over 13 million people were impacted.[8]

» Severe flooding in a similar magnitude to the 2011 flood in Thailand could cost as much as US$40 billion to the economy.[9]

» The most severe droughts in recent history occurred in 1979,1994 and 1999.[10]

» The economic loss due to the recent drought can be estimated as equivalent to 0.52% of the country's GDP in 2015, with disproportionate impacts to the agricultural sector.[9]

» Thailand has experienced several water shortages issues which have been further compounded with the increasing frequency of droughts over the last 10 years. Water shortages affected a total area of 42,280 km^2 and has significantly impacted the incomes of farmers and the total economic output of the country.[9]

» 75,000 villages experienced water shortages in 2017 due to lack of centrally controlled plumbing system.[9]

» Paradoxically to all the issues with water shortages, over the past 30 years almost all provinces additionally were affected by flooding, causing damage to life, property, and economy.[9]

» Expansion of cities, deforestation, and changing land-use into agricultural areas have affected natural resources and water reservoirs.[8]

» Expansion of palm oil plantations and tourist activities increases the pressure for water.[9]

» Use of water for human activity such as agriculture could lead to the contamination of freshwater sources on the surface.[1]

» Extension of dry season in some regions of Thailand due to changes in monsoon seasons will further compound the pressures of water demand and supply.[1]

» Extended summers and rising temperatures will affect water evaporation. Studies carried out on the Chao Phraya River determined that the maximum and minimum temperatures within that region during this century will rise. Relative humidity levels will also fall, increasing the evapotranspiration rate by 2.67%.[1]

Agriculture

» Thailand's agricultural sector is a vital part of the national economy that has been battered by unpredictability and extreme variations in weather conditions because of climate change.[10]

» Increasing GHG emissions are predicted to slightly impact the yield of production of certain crops. In a 1998 study by Hoogenboom et al., rice production is projected to increase between 1.48-15.29% in Thailand and between 10-15% in certain areas.[1]

» In a 2005 study conducted by Buddhaboon et al., in Khon Kaen province showed that climate change increased the increased the yield of corn and sugar cane while reducing that of cassava.[1]

» Rise of GHG levels has shortened the growth stage of sugar cane.[1]

» In climate scenarios with rising GHG emissions but low rainfall, yield of cassava would decrease. In scenarios with large amounts of rainfall and GHG concentrations of 540 and 730 ppm, cassava yield increased significantly.[8]

» Although fluctuations to climate can positively impact the yield of certain crops, areas that are already vulnerable to climate hazards will be put at further risk; significantly affecting future agricultural output. [9]

» Areas in the northern region that are used for growing rice, corn and sugarcane will be especially impacted by shortages in water and changes to the seasons.[9]

Biodiversity

» Thailand is facing rapid loss of its natural habitats due agricultural and urban expansion resulting from population and economic growth.[2]

» Changes to climate in the latter half of the century are expected to alter the distribution of plant species, particularly evergreen plants.[9]

» HadCM3 global circulation model studies on biodiversity found that 11 plants native to Thailand would lose ideal conditions for growth, while another 12 would gain better conditions.[1]

» Deciduous plants are predicted to expand their distribution range in the northern region of Thailand.[1]

» Sensitive ecosystem located on the mountainous regions will especially be affected by the projected increases in temperature.[1]

» Rising temperatures will also impact the Mangrove forests. Mangroves are an invaluable asset to Thailand as it protects coastal areas from storm surges, are spawning grounds for marine animals and are sources of food and firewood for local communities.[5]

» Areas such as Krabi are expected to see a retreat of 18 meters of Mangrove forests over the next 25 years.[1]

Wellbeing

» Changing climate has also resulted in changing patterns of disease spread and re-emergence of infectious diseases, impacting the well-being of the Thai people.[10]

» Rising temperatures and rainfall in many areas will lead to increased cases of vector-borne and water-borne illnesses.[10]

» By 2050's temperatures are expected to rise by 1.16°C from the baseline period of 1931-1980, resulting in higher likelihoods of dengue outbreaks.[5]

» Tendency for outbreaks to occur peaks from April-May, but July and August will see the largest number of reported patients.[9]

» Changes in temperature will increase the power demand during Summer in a hot and tropical region such as Thailand.[9]

» Usage of air conditioning is highest in the Summer, corresponding to the nation's peak electricity demand.

Mitigation and Adaptation to Climate Change

Current Situation of Climate Change

» Thailand's National Greenhouse Gas (GHG) emissions represent only 0.64% of global emissions in 2015. Country's share of cumulative emissions from 1990-2012 is 0.75% of global emissions.[11]

» As per the National Greenhouse Gas Inventory in 2016, Thailand's total direct emissions was 353,357.61 $GgCO_2eq$. Thailand's net removal was 91,134.15 $GgCO_2eq$. Net emissions of Thailand during 2016 therefore were 263,223.45 $GgCO_2eq$.[9]

A sector-wise breakdown of the direct emissions of 353,357.61 $GgCO_2eq$ in 2016	
Energy sector	Energy sector had the highest share of direct emissions at 67.20%, corresponding to 165,144.91 $GgCO_2eq$.[9]
Agriculture sector	Agriculture then followed, responsible for 48,976.87 $GgCO_2eq$ or 19.93% of direct emissions.[9]
Industrial sector	Industrial processes and product use constituted 8.61% of total direct emissions, equivalent to 21,169.49 $GgCO_2eq$.[9]
Waste sector	The waste sector had the lowest share, at 4.26% or 10,466.94 $GgCO_2eq$ of direct emissions.[9]

» Total GHG emissions in Thailand (excluding those from Land-Use, Land-Use Change and Forestry) have increased from 245,757.14 $GgCO_2eq$ in 2000 to 354,357.61 $GgCO_2eq$ in 2016, an average annual increase of 2.31%.[9]

» Accordingly, total net removals of CO2 have increased from 61,960.76 $GgCO_2eq$ to 91,134 $GgCO_2eq$ during the same time.[9]

» Net GHG emissions therefore has increased from 183,796.37 $GgCO_2eq$ in 2000 to 263,223.46 $GgCO_2eq$ (2016), an average annual increase of 2.27%.[9]

» Indirect GHG emissions of nitrogen oxides, carbon monoxide, non-methane volatile organic compounds and sulfur dioxides have also increased from 2000 to 2016. The increases in indirect emissions are as follows:[9]

- Nitrogen oxides from 928Gg in 2000 to 1,382.31 Gg in 2016.[9]
- Carbon monoxides from 5,104.72 Gg to 7,144.59 Gg.[9]
- Non-methane volatile organic compounds from 731.44 Gg to 971.01 Gg.[9]
- Sulphur dioxide from 594.94 to 452.09 Gg.[9]

Interventions Implemented

» To prepare for adverse changes in climate and climate related disasters, the country has begun implementation of policies and rolled out capacity building measures to improve resilience to a new future under climate change.[2]

» Climate change is addressed at the highest policy levels in Thailand. Climate change is seen as an issue of upmost importance, and parts of its dimensions are addressed in every major policy or plan.[2]

» *National Strategy 2018-2037* ensures long-term continuity of climate change alongside in the country's development trajectory. Some key measures outlined in the National Strategy regarding climate action are:[10]

- Placing emphasis on preserving the stability of marine and terrestrial natural resources and environment, to sustainably reap the benefits of natural ecosystems.[10]
- Ensuring a balance between economic growth and the country's natural resources and environment.[10]
- Carrying out smart farming and protecting the nation's food supply from the adverse impacts of climate change.[10]

» Thailand submitted its *Nationally Appropriate Mitigation Actions (NAMA)* in 2014, with the aim of 7-20% reduction in GHG emissions from Business-as-usual levels by 2020.[9]

» GHG reduction efforts are primarily focused on energy and transport sectors, as these sectors are the largest contributors of GHG emissions in Thailand.[9]

The main strategies outlined in the *NAMA* are:[9]
Development of renewable energy and alternative energy sources.[9]
Carry out energy efficiency improvements in power generation, industries, buildings, and transportation.[9]
Substitute biofuels for fossil fuels within the transportation sector.[9]
Establish Thailand's Transport Infrastructure Development Plan.[9]

» In 2018, Thailand reduced 57.84MtCO_2eq of GHG emissions from the transport and energy sectors, approximately around 15.76% lower than BAU level. Largest share of reductions was from heat generation from bio-renewable energy sources.[9]

» Thailand submitted its Nationally Determined Contribution (NDC) in 2015, building on and enhancing the reduction efforts pledged in the NAMA to 2030.[11]

» Reduction could further increase from 20% as initially pledged in the NAMA to 25%, if the nation receives adequate and enhanced access to technology development and transfer, financial resources, and capacity building measures.[11]

Mitigation measures that are planned under Thailand's *NDC action plan* include:
Focusing on renewable energy generation and improving energy efficiency.[11]
Improving energy efficiency across all modes of transport and initiating a change in the patterns of transport.[11]
Implementation of more eco-friendly industrial practices and improving industrial waste management.[11]
Developing an integrated waste management programs to decrease the amount of waste generated and to increase the productions of biogas.[11]

» As of 2015, Thailand has achieved 4% of the reduction that was pledged in both the NAMA and the NDC.[11]

» The *Climate Change Master Plan (CCMP) of Thailand 2015-2050* aims to provide a long-term national framework for climate change adaptation and low-carbon growth promotion, according to sustainable development principle. The CCMP of Thailand has three main strategies.[1]

	Climate change adaptation.[1]
1	**Water resources, flood, and drought management** – Development of integrated and effective water resource management to provide equal access to water supply and being resilient to water related hazards.[1]
2	**Agriculture and food security** – Improving adaptive capacity of agricultural sector to withstand the changing climate.[1]
3	**Tourism** – Focus on sustainable and eco-tourism models to conserve natural resources and the cultural value of Thailand.[1]
4	**Public health** – Ensuring equal access to health care and planning measures to surveil, prevent and control epidemics.[1]
5	**Natural resources management** – Restoration and conservation of natural resources and ecosystems and developing a framework for sustainable use of natural resources.[1]

6	**Human settlement and security** – Reduction of risks and damages and improving adaptive capacity of the population with increased frequency of climate related hazards.[1]

Mitigation and low carbon development.[1]	
1	**Power generation and energy supply** – Decreasing dependency on fossil fuels and developing infrastructure that enables for a low carbon society.[1]
2	**Transport** – Increasing the efficiency of the various modes of transport and applying sustainable principles to manage transport demand.[1]
3	**Energy consumption in buildings** – Reducing the emissions produced from buildings by improving energy conservation and efficiency.[1]
4	**Industry** – Improving machine performance, reducing energy efficiency and waste produced by industrial processes. Encouraging the use of low-carbon and environmentally technologies for industrial processes.[1]
5	**Waste management** – Improving waste management efficiency and focus on waste-at-source reduction in accordance with the waste hierarchy.[1]
6	**Agriculture** – Focus on low emission agricultural practices with environmental and financial co-benefits.[1]
7	**Forestry** – Enhancing the capacity of the country's carbon sinks through forest conservation, restoration, reforestation, and afforestation
8	**Urban management** – Increasing urban greenspace and transforming cities in Thailand into low-carbon and sustainable cities.[1]

Enabling environment on climate change management.[1]	
1	**Data, research, and technology development** – Making improvements on the quality of data, information, and research.[1]
2	**Development support mechanisms for climate change adaptation and mitigation** – Developing mechanisms to support GHG emissions reductions, low - carbon development incentives and adaptation measures.[1]
3	**Raising climate change awareness and mobilizing developmental partners** – Raising awareness and under standing of climate change amongst target groups and the public.[1]
4	**International climate change cooperation** – facilitating international dialogues to harmonize policies and produce win-win outcomes via trade.[1]

» The long-term Low Greenhouse Gas Emissions Development Strategy is currently under development, aiming to guide Thailand towards a climate-resilient and low greenhouse gas emission development.[8]

» The Ministry of Energy has additionally devised the *20-year Energy Efficiency Development Plan (EEDP)*, which will be in effect from 2011-2030.[7]

» In 2018, Thailand's final energy consumption was 83,952 ktoe; a 4% increase from 2017. 84.36% of the final energy consumed was from commercial energy source such as petroleum products and electricity.[7]

» The largest growth in energy consumption between 2017-2018, was from coal and coal products. From 5,327 ktoe to 6,865 ktoe.[7]

The aim of this plan is to reduce Thailand's total energy intensity by 25% percent in 2030 from 2005 levels and to reduce final energy consumption by 20% or 30,000 ktoe in the same target year.[7]

» By 2030, conservation target for transportation is 13,400 and 11,300 ktoe for the industrial sector. With the successful implementation of the EEDP, by 2030, the aim is to: [7]

- Save a total 289,000 ktoe of energy, 14,500 ktoe annually.[7]
- Avoid 976 million tons of CO2 emissions, annual average of 49 million tons.[7]
- Cumulative savings in energy expenditure will be approximately 5.4 million baht, or 272 million baht annually.[7]

» The strategic approaches outlined in the *EEDP* to achieve conservation targets are:[7]

- Establish mandatory conservation requirements via rules, regulations, and standards.[7]
- Promote and support of energy conservation measures.[7]
- Encourage a behavioral shift and creating public awareness regarding energy conservation.[7]
- Encourage technological development, innovations and, research and development into energy conservation.[7]
- Develop human resources and institutional capacity for energy conservation.

» Thailand has formulated the *Alternative Energy Development Plan in 2015 (AEDP)*. This plan promotes energy generation from alternative sources and to reduce the country's dependency on energy imports such as oil and natural gas.[3]

» The target of the plan is to increase the share of renewable energy to 30%, equivalent to 131,000 ktoe in the final energy consumption by 2036. Many sub-targets for renewable energy have also been set in AEDP 2015:[3]

- 19,684 MW of electricity to be generated from renewable energy.[3]
- 25,088 ktoe of heat to be generated from renewable energy.[3]
- 8,712.43 ktoe of biofuels to be generated from renewable energy.[3]

Strategies that are outlined to promote the development of renewable and alternative energy are:[3]
Developments made to infrastructure and investments into raw materials and renewable technology.[3]
Increasing the capacity for renewable energy production, utilization, and market potential.[3]
Creating awareness and improving access to knowledge and facts of renewable energy.[3]

» Share of energy consumed from renewables between 2017 to 2018 has increased by 8.15%. Furthermore, consumption of alternative energy from 2016-2018 increased by 10.78%.[3]

» The *Power Development Plan 2010-2030* was prepared in 2012 by the Ministry of Energy and the Electricity Generating Authority of Thailand (PDP). This plan aims to stabilize the country's energy.[4]

» Total energy produced was 72,609 ktoe in 2018, with commercial energy producing the largest share of energy at 63.12%. This was followed by renewable energy with a share of 23.63% and traditional energy, producing the lowest share at 9.66%.[4]

» The aims of the *PDP 2015* are to:[4]

- Ensure power system reliability throughout the country in-terms of power generation, transmission, and distribution.[4]
- Focus on fuel diversification to lessen the dependance on a particular type of fuel, mainly fossil fuels. Emphasis is placed on generating power from renewable and nuclear while reducing dependency of natural gas.[4]
- Maintaining the level of reserve margin, not less than 15% of peak power demand.[4]

Fuel requirement targets as per the *PDP 2015* have been outlined below:[4]
Increasing the use of imported hydro power from 7% in 2014 to 15-20% in 2036.[4]
Increasing the dependency on clean coal and lignite from 8% in 2014 to 15-20% in 2036.[4]
Introduce nuclear energy to satisfy the country's energy demands.[4]
Decreasing the dependency of natural gas from 64% in 2014 to 30-40% in 2036.[4]
Gradually phasing out diesel to generate power from 2014 onwards.[4]

» In December 2018, the Thai Government created the *20-Year Master Plan on the Prevention and Management of Pollution* caused by Solid and Hazardous Waste (2018-2037). The plan places emphasis on waste management frameworks such as the '3R's' and the circular economy to carry out the sustainable management of waste.[1]

- 27.93 million tons of municipal solid waste was generated in 2018; a 2% increase from 2017. This increase because of increasing urbanization, increasing population, increasing tourism activities and higher consumption.[9]
- Although municipal solid waste generated in 2018 increased from 2017, the management of solid waste had improved. More than 9.76 million tons of waste was separated at source and re-utilized; a 15% increase from 2017.[9]
- The amount of industrial waste managed by an appropriated treatment was 22.02 million tons, a 33% decrease from 2017. Highest treatment and disposal capacity are in the east, followed by the central region, west, northeast, south and north.[9]

» The *National Water Resources Management Strategies (2015-2026)* and the *20-Year Master Plan on Water Resources Management (2018-2037)* have been put into place in-order to secure Thailand's natural water supply, but to also carry out efficient and equitable supply of water.[9]

» In 2018, implementation of disaster management strategies has effectively managed to reduce the number of deaths and missing persons attributed to disasters from 0.19 per 100,000 population in 2015 to 0.13 per 100,000 population in 2019.[9]

» The Thai Government has implemented the *20-Year Master Plan on Air Quality Management (2018-2037)* to establish standards for atmospheric air quality and emissions from and a national air quality reporting system.[1]

» The *4th Master Plan for Integrated Biodiversity Management (2015-2021)* aims to conserve and restore Thailand's rich biodiversity. The values and objectives of this policy are very much in line with SDG 15: *Life on Land*.[1]

- The proportion of territorial key biodiversity areas covered by protected areas in Thailand has increased from 67% in 2000's to 70.7% in 2019.[9]

» Forest areas that are controlled independently from verified forest management certification schemes has also expanded from 76,400 km^2 in 2010 to 757,800 km^2 in 2019. [9]

» Many legislative and institutional measures have been put into place to protect the forested areas, such as:[9]

- The 20-Year Forestry Strategy (2017-2036).[9]
- The Forest Act of 1941.[9]
- National Reserved Forest Act of 1964.[8]
- Commercial Forest Plantation Act of 1992.[8]
- Community Forest Act of 2019.[8]

Support Needed for Climate Action

» To further aid the climate action currently carried out by Thailand, support is needed in many key areas:[1]

- **Technological development and transfer** to realize and carry out innovative and practical solutions to climate change.[1]
  - Adaptation technologies include measures such as forecasting and early warning systems, climate modelling technology and precision farming.[1]
  - Mitigation technologies include measures such as smart grids, improvement of fuel combustion efficiency technology and carbon capture and sequestration technology.[1]
- **Technical support** in the form of knowledge sharing and consultancy services to support development and implementation of policy and climate mechanisms.[1]
- **Capacity building** is needed to strengthen the ability, skills and human resources of organizations and other relevant stakeholders in Thailand for climate change action.[1]
- **Financial support** from external parties is needed to cover the incremental cost or risk premium, required to make investments into climate change action.[1]

» Additionally, there were many constraints and gaps during the GHG inventory for the Third Biennial Update report, that must be addressed.[9]

- Country-specific emission factors for main fuels used in Thailand needs to be developed, to improve the accuracy of inventory methodology.[9]
- Data collection approaches need to be across all emission categories to improve inventory quality and transparency in mitigation. Approaches include but are not limited to:[9]
  1. Gathering data on fuel economy and vehicle mileage in transport sector.[9]
  2. Inclusion of Fluoride gases in GHG emission inventory within the Industrial processes and product use sector.[9]
  3. Estimation of burnt crop area or determining the fertilizer usage in the agricultural sector.[9]
- Professional capacity of national experts that are involved in the inventory processes need to be enhanced.[9]

References

[1]Climate Change Mangement and Coordination Division. (2017). Thailand Country Programme on Climate Change. Bangkok : Climate Change Mangement and Coordination Division.

[2]Office of Natural Resources and Environmental Policy and Planning. (2015). Climate Change Master Plan 2015-2020. Bangkok : Office of Natural Resources and Environmental Policy and Planning.

[3]Department of Renewable Energy Development and Energy Efficiency. (2015). Alternative Energy Development Plan 2015-2035. Bangkok : Department of Renewable Energy Development and Energy Efficiency.

[4]Energy Policy and Planning Office. (2015). Thailand Power Development Plan . Bangkok : Energy Policy and Planning Office.

[5]National Strategy Secretariat Office. (2018). National Strategy 2018-2037. Bangkok : National Strategy Secretariat Office.

[6]Ministry of Natural Resources and Management. (2018). Thailand Third Biennial Update Report. Bangkok : Ministry of Natural Resources and Management.

[7]Office of Natural Resources and Environmental Policy and Planning. (2015). Thailand's Intended Nationally Determined Contribution. Bangkok : Office of Natural Resources and Environmental Policy and Planning.

[8]Ministry of Natural Resources and Environment. (2018). Thailand's Third National Communication. Bangkok : Ministry of Natural Resources and Environment.

[9]Ministry of Energy. (2011). Thailand 20-Year Energy Efficiency Development Plan. Bangkok : Ministry of Energy.

[10]Belinda, Y., & Leon.K. Climate Change and Urban Planning in Southeast Asia. (2009). 3, s.l. : S.A.P.I.E.N.S, Vol. 2. 1993-3819.

[11]Xu, Y., Zhou, B.T., Wu, J., Zhang, Y.X., & Wu, J. (2017). Asian climate change under 1.5-4°C warming targets. Beijing : Ke Ai, 2017, Vol. 8.

[12]Kandhari, R. (2015). Corals turn white and die off in the Andamans . [News article] Delhi : India Climate Dialogue.

[13]IPCC. (2014). AR5 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Cambridge.

[14]Han, W., Meehl, G.A., Rajagopalan, B., Fasullo, J.T., Hu, A., Lin, J., Large, W.G., Wang, J.W., Quan, X.W., Trenary, L.L., Wallcraft, A., Shinoda, T., & Yeager, S. (2010). Patterns of Indian Ocean sea-level change in a warming climate.Nature Geoscience.

[15]Roxy, M.K., Gnanaseelan, C., Parekh, A., Chowdary, J.S., Singh, S., Modi, A., Kakatkar, R., Mahopatra, S., &Dhara, C. (2020). Indian Ocean Warming. In R. Krishnan., J. Sanjay., C. Gnanaseelan., M. Mujumdar., A. Kulkarni., & S. Chakraborty (Eds). Assessment of Climate Change over the Indian Region. Pune : Springer Open, 2020, pp. 192-205.

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