# SECOND BIENNIAL UPDATE REPORT OF THAILAND

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# THE KINGDOM OF THAILAND

MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT - *POLICY FORMULATION AND NATIONAL FOCAL POINT*
OFFICE OF NATURAL RESOURCES AND ENVIRONMENTAL POLICY AND PLANNING
CLIMATE CHANGE MANAGEMENT AND COORDINATION DIVISION

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# FOREWORD

Climate change is a global environmental problem that endangers sustainable development. The international community has taken a significant collective step toward addressing the global challenge of climate change. The Paris Agreement was adopted 12 December 2015 at the 21st session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC). Thailand is one of the Parties that ratified the Paris Agreement on 21 September 2016 and put forward its best efforts through the Nationally Determined Contribution (NDC).

As a responsible member of the international community, the Kingdom of Thailand is committed to sustainable development and as such is working to achieve low carbon emission and a climate-resilient society consistent with the strategies of the 12th National Economic and Social Development Plan (NESDP) 2017-2021. In addition, Thailand's Climate Change Master Plan 2015–2050 corresponds with these national strategies and policies. In alignment with its greenhouse gas (GHG) emission reduction policy, Thailand has employed a global approach by submitting Nationally Appropriate Mitigation Actions (NAMAs) to lower greenhouse gas emissions below business as usual (BAU) levels by 2020. Moreover, as stated in NDC, Thailand will work to reduce emissions a further 20–25 % in 2030 compared to the BAU level. With this aim, Thailand has been engaging national and subnational networks to explore a comprehensive range of mitigation measures to achieve the defined emissions targets. These measures include further developing and improving institutional and technical capacity for effective cooperation and management.

The development of this report represents an essential contribution of the Kingdom of Thailand to addressing climate change both nationally and globally.

**Dr. Raweewan Bhuridej**

Secretary - General

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# LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

| | |
|---|---|
| AADMER | ASEAN Agreement on Disaster Management and Emergency Response |
| AD | Activity Data |
| ADB | Asian Development Bank |
| AEDP | Alternative Energy Development Plan |
| ARW | Advance Research WRF |
| AUD | Australian Dollar |
| BUR | Biennial Update Report |
| BMA | Bangkok Metropolitan Administration |
| BMUB | Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety |
| EEP | Energy Efficiency Plan |
| EF | Emission Factor |
| ETS | Emission Trading Scheme |
| EUR | Euro Rate |
| CAAS | Chinese Academy of Agricultural Sciences |
| CAAT | The Civil Aviation Authority of Thailand |
| CFC | Chlorofluorocarbon |
| $CH_4$ | Methane |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| $CO_2eq$ | Carbon Dioxide Equivalent |
| COP | Conference of The Parties |
| CS | Country Specific |
| CTCN | Climate Technology Centre and Network |
| DAE | Department of Agricultural Extension |
| DEB | Department of Energy Business |
| DEDE | Department of Alternative Energy Development and Efficiency |
| DEQP | Department of Environmental Quality Promotion |
| DIW | Department of Industrial Works |
| DLA | Department of Local Administration |
| DLD | Department of Livestock Development |
| DMCR | Department of Marine and Coastal Resources |
| DMF | Department of Mineral Fuels |
| DNP | Department of National Parks, Wildlife and Plant Conservation |
| DOA | Department of Agriculture |
| DOC | Department of Customs |
| DOH | Department of Health |
| DPIM | Department of Primary Industries and Mines |
| EE | Estimated Elsewhere |
| EF | Emission Factor |
| EEP | Energy Efficiency Plan |
| EGAT | Electricity Generating Authority of Thailand |
| EPPO | Energy Policy and Planning Office |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facilities |
| Gg | Giga Gram |
| GHG | Greenhouse Gases |
| GISTDA | Geo-Informatics and Space Technology Development Agency (Public Organization) |

# LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

| | |
|---|---|
| GWP | Global Warming Potential |
| HAII | Hydro and Agro Informatics and Institute |
| HFC | Hydrofluorocarbons |
| IAED | Chinese Institute of Agricultural Economics and Development |
| IEAT | Industrial Estate Authority of Thailand |
| IIEC | International Institute for Energy Conservation |
| IKI | International Climate Initiative |
| INDC | Intended Nationally Determined Contribution |
| IPCC | Intergovernmental Panel on Climate Change |
| IPPU | Industrial Processes and Product Use |
| ISIT | Iron and Steel Institute of Thailand |
| JCM | The Joint Crediting Mechanism |
| JFPR | Japan Fund for Poverty Reduction |
| JICA | Japan International Cooperation Agency |
| KCA | Key Source Category Analysis |
| KTOE | Kilo Ton Oil Equivalent |
| LDD | Land Development Department |
| LECB | Low Emission Capacity Building |
| LOD | Land Development Department |
| LULUCF | Land Use, Land-Use Change and Forestry |
| MAS | Marker Assisted Selection |
| MD | Marine Department |
| MEA | Metropolitan Electricity Authority |
| MoNRE | Ministry of Natural Resources and Environment |
| MOPH | Ministry of Public Health |
| MRV | Measurement, Reporting and Verification System |
| MSW | Municipal Solid Waste |
| Mt | Million Ton |
| $N_2O$ | Nitrous Oxide |
| NA | Not Applicable |
| NAMA | Nationally Appropriate Mitigation Actions |
| NC | National Communication |
| NCCC | National Committee on Climate Change Policy |
| NCV | Net Calorific Value |
| NDC | Nationally Determined Contribution |
| NDE | National Designated Entity |
| NE | Not Estimated |
| NEDO | New Energy and Industrial Technology Development Organization |
| NESDP | National Economic and Social Development Plan |
| NMVOC | Non-Methane Volatile Organic Compounds |
| NO | Not Occurring |
| $NO_x$ | Nitrogen Oxides |
| $O_3$ | Ozone |
| OAE | Office of Agricultural Economics |
| OECD | The Organization for Economic Co-operation and Development |
| OIE | Office of Industrial Economics |

# LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

| | |
|---|---|
| ONEP | Office of Natural Resources and Environmental Policy and Planning |
| OPS | Office of the Permanent Secretary |
| OTP | Office of Transport and Traffic Policy and Planning |
| PAT | Port Authority of Thailand |
| PCD | Pollution Control Department |
| PDP | Power Development Plan |
| PEA | Provincial Electricity Authority |
| PFC | Perfluorocarbon |
| PM | Particulate Matter |
| PMR | Partnership for Market Readiness |
| PMM | Parts Per Million |
| PTIT | Petroleum Institute of Thailand |
| QA | Quality Assurance |
| QC | Quality Control |
| RAOT | Rubber Authority of Thailand |
| RD | Rice Department |
| RFD | Royal Forest Department |
| RID | Royal Irrigation Department |
| SCWRM | Strategic Committee for Water Resources Management |
| SEC | Specific Energy Consumption |
| $SF_6$ | Sulphur Hexafluoride |
| SIDA | Swedish International Development Cooperation Agency |
| SIS | Safeguards Information System |
| $SO_2$ | Sulphur Dioxide |
| SRT | State Railway Authority of Thailand |
| STI | National Science Technology and Innovation Policy Office |
| TAI | Thailand Automotive Institute |
| TERI | The Energy and Resources Institute |
| TGEIS | Thailand Greenhouse Gas Emissions Inventory System |
| TGO | Thailand Greenhouse Gas Management Organization (Public Organization) |
| THB | Thai Baht |
| TWD | Thai Meteorological Department |
| UNDP | United Nations Development Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| USAID | United States Agency for International Development |
| USD | United States Dollar |
| VKT | Vehicle Kilometer Travelled |
| VOC | Volatile Organic Compound |
| WGIA | Workshop on Greenhouse Gas Inventories in Asia |
| WHO | World Health Organization |
| WRF | Weather Research and Forecasting |

# EXECUTIVE SUMMARY

The COP16 held in Cancun December 2010 resulted in adoption of the Cancun Agreements, which encourages non-Annex I parties to submit to UNFCCC Secretariat National Communications (NCs) every four years and Biennial Update Reports (BURs) every two years. Thailand, as a non-Annex I country, submitted its first BUR to the UNFCCC on 29 December 2015. According to its greenhouse gas emission reduction policies, Thailand has been contributing to a global approach by informing the COP of its intention to implement NAMAs and by communicating its INDC to the UNFCCC. Thus, Thailand has been reporting its progress on implementation under these policies since the first BUR.

## 1. NATIONAL CIRCUMSTANCES

### 1.1 PHYSICAL CONTEXT

Geographical location: Thailand is located in Southeast Asia and covers an area of 513,115 $km^2$. The country is bordered on the north by Myanmar and Laos; on the east by Laos, Cambodia, and the Gulf of Thailand; on the south by Malaysia; and on the west by Myanmar and the Andaman Sea. The topographic relief of Thailand includes hills in the north and flatland areas in the central part of the country. The southern part of Thailand features a long peninsula between the western Andaman Sea and the eastern South China Sea. Thailand is divided into 5 parts: Northern, Northeastern, Central, Eastern, and Southern region. The topography of each part is quite different.

Politics and Government: After the country went through a peaceful transformation in 1932, sovereign power passed to the Thai people. Now, the King is the Head of State, is above partisan politics, and discharges his role in accordance with the national constitution. The administration of the country is carried out by the prime minister and the cabinet formed by the Prime Minister. Thailand's public administration is divided into 3 tiers: central, provincial, and local administrations. The Ministry of the Interior appoints governors for all provinces, of which Thailand has 77. Bangkok, the capital city, is governed by a Metropolitan Administration, for which a governor is elected.

Climate: From the meteorological point of view, the climate of Thailand may be divided into 3 seasons. The rainy or southwest monsoon season runs from mid-May to mid-October. In this season, the southwest monsoon provides abundant rainfall to the country. The wettest period of the year is August to September. One exception is found on the south-east coast of Thailand where abundant rain continues until the end of the year. The winter or northeast monsoon season starts around mid-October and continues to mid-February.

Precipitation: According to Thailand's general annual rainfall pattern, the average annual rainfall falls in the range 1,300–2,000 mm per year.

Population: The total population of Thailand was 65,981,659 people, as measured in the 2010 Thailand Census. In 2015, it was estimated to be 65,729,098 people according to registration records. Thailand's population has generally increased over the past decades, despite the decline in the annual population growth rate since 1960 (from 2.70% per decade to only 0.80% in 2010).

## 1.2 ENERGY

Energy consumption: In 2015, the majority of energy consumption was attributed to commercial use, with the amount totaling 63,844 ktoe (81.98%) of all energy consumed. Of this, petroleum-product consumption made up the largest proportion (48.77%), followed by electricity (19.84%), natural gas (7.71%), and coal and coal products (5.65%).

Energy production: Total energy production in 2015 was 75,838 ktoe. Commercial energy contributed the most at 49,866 ktoe (65.75% of the total); renewable energy 10,879 ktoe (14.35%), traditional renewable energy 12,917 ktoe (17.03%), biofuel 1,941 ktoe (2.56%), and other energy sources contributed 235 ktoe (0.31%).

Alternative energy: Thailand has made reduction of carbon intensity of the power sector a key goal of its 2015 Power Development Plan (PDP). Recently, Thailand's final alternative energy consumption has increased continuously. In 2015, 10,077 ktoe of alternative energy was consumed, an increase of 11.70% from the previous year. The steady rise in alternative energy consumption could help to lower $CO_2$ emissions, thus reducing climate change-related impacts from $CO_2$ emissions.

## 1.3 NATURAL RESOURCES

Land resources and forestry: Thailand has a total land area of approximately 51.3 million hectares. As of 2015, 47% of the nation's total land area (or 24 million hectares) was categorized as agricultural land. Non-agricultural land and forested land accounted for 21 and 32%, respectively. About half of agricultural land use is for paddy use, which is equal to 11 million hectares or 22% of Thailand's total land area.

Water resource: Thailand contains 25 river basins, with the Chao Phraya River as the main river basin running through the center of the country. The average annual rainfall is approximately 1,455 mm, which results in average annual runoff of 33,123 million $m^3$. In the northern part of the basin, the estimated total storage capacity is 25,773 million $m^3$, but in the central area only 2,124 million $m^3$ can be stored.

Biodiversity: Thailand is located in the biogeographic region of the Oriental, or Indo Malayan, Region. This region ranked second of the 3 regions in terms of biodiversity. Its diverse ecosystems comprise many habitats supporting bountiful flora and fauna. The illegal harvest of wild flora and the hunting of wildlife remain causes of continuous decline in Thailand's biodiversity.

## 1.4 CURRENT STATE OF THE NATIONAL ECONOMY

National economy or economic profile: Thailand has experienced low single-digit GDP growth in the past decade, with the industrial and service sectors as the main drivers of recent growth. The economy is heavily export-dependent, with exports accounting for more than one-third of GDP. Both exports and imports have recently faced negative growth over the past few years. In recent years, Thailand's balance of payments has averaged approximately 5 billion USD, with total debt outstanding between 130 and 140 billion USD. Thailand has one of the world's lowest unemployment rates, at about 1%. This is because a large proportion of the population works in subsistence agriculture or in other vulnerable employment.

Agriculture sector: While 47% of Thailand's land is used for agriculture, in 2015 agriculture accounted for only 12.7% of Thailand's GDP while utilizing about one-third of the nation's labor force. The sector's GDP contribution has been decreasing slowly over the last decade. While Thailand's total GDP expanded 3.2% between 2010 and 2015, GDP from the agricultural sector only grew by 0.8%, in contrast with the 3.4% growth achieved by the non-agriculture sector. At the same time, agriculture's contribution to employment decreased from 38.20% of total employment in 2010 to 32.30% in 2015.

Tourism industry: The tourism industry is making a major economic contribution to Thailand's GDP. In 2015, tourism receipts amounted to 2,237 billion THB or 18% of total GDP. The international tourism industry in Thailand has established an impressive record of growth over the last decade (average of 20% per year), while the domestic tourism has been evaluated as growing moderately.

Poverty and Inequality: Thailand's poverty line increased from 2000–2014, until its decline in 2015 (2,644 THB per person per month) resulting in a slight decrease from the previous year. The poverty rate has declined continuously over time. In 2011, the share of the population under the poverty line was 13.22%, which declined to 7.21% in 2015. This translates to a reduction, by nearly half, of those below the poverty line from 8.80 to 4.80 million within a 5-year period. Regarding inequality between urban and rural areas, poverty is more concentrated in rural areas. The poverty rate gap between urban and rural areas has declined and tapered since 2011. In 2015, 8.91% of the population lived in poverty in rural areas, compared to 5.49% in urban areas.

## 1.5 STATE OF THE ENVIRONMENT

Air quality: The 5 major air pollutants are sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), carbon monoxide (CO), ozone ($O_3$) and particulate matter (PM) < 10 microns: PM10, and < 2.5 microns: PM2.5. The annual national average of PM10 was 42 µg/$m^3$, 2% decrease from the level detected in 2014. For PM2.5, the annual national average was 28 µg/$m^3$, 2 %decrease. For ozone, the maximum one-hour average was 125 parts per billion (ppb), which was 4% decrease compared to 2014. The national annual average of $SO_2$ and $NO_2$ was at 2 ppb and 14 ppb, respectively unchanged from the previous year. The maximum one-hour average of CO detected by all stations ranged from 1.6–9.2 parts per million (ppm). The level of 1,3-butadiene, 1,2-dichloroethane, and chloroform exceeded the standard in Rayong Province, where an industrial park is located.

Water quality: The overall water quality in Thailand was fair in 2015. For surface water, 41 % was fair, 34% was good, and 25% was water of deteriorated quality. In terms of a 10-year trend (2006–2015), water quality remained relatively stable. For coastal water quality, most of the monitoring data show that almost 72% of the water quality was fair, 16% was good, 9% was deteriorated, and 3% was water of severely deteriorated quality.

Waste: In 2015, the total amount of municipal solid waste (MSW) generated nationwide was 26.85 Mt, or 73,560 t per day. Of this waste, 16% was generated in Bangkok. Only 8.34 Mt of waste, or 31%, is appropriately disposed. About 4.94 Mt MSW was reused through waste recycling (76%), utilization of organic waste (21%), and electricity generation (3%).

## 1.6 INSTITUTIONAL ARRANGEMENTS

National committee on climate change policy (NCCC): The Government has established the National Committee on Climate Change Policy (NCCC), chaired by the Prime Minister. The NCCC is responsible for (i) national climate change policy and strategy; (ii) determination of national positions the international negotiations under UNFCCC and any relevant international agreements; and (iii) monitoring and evaluating implementation results of government agencies as stated in national policy and strategy.

Institutional arrangements for greenhouse-gas inventory preparation: The ONEP has had an established GHG inventory system for preparing BUR since 2015. The process of preparing the GHG inventory consists of compiling activity data from related agencies and data verification before submitting them to ONEP. The results of estimation of GHG emissions as part of BUR will be submitted to five working groups for approval. Then ONEP will hold a public hearing on BUR as part of the public inquiry process. After this, the BUR will be submitted to the Climate Change Knowledge and Database Sub-Committee for verification. Finally, ONEP as a secretariat of NCCC will submit BUR to NCCC for approval before its submission to UNFCCC.

# 2. NATIONAL GREENHOUSE GAS INVENTORY

Thailand's GHG inventory was compiled and submitted in line with Article 4.1(a) of the Convention, in accordance with Article 12: national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. This inventory report was prepared to the extent of the country's capabilities by using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997) which was agreed to by the Conference of the Parties (COP). The emissions are presented in the form of direct and indirect GHGs and sulphur dioxide ($SO_2$). Direct GHGs consist of carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$); indirect GHGs consist of nitrogen oxides ($NO_x$), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs). From 2000 to 2013, Thailand remained a net GHG emission source, because source emissions exceeded removal. Total emissions, excluding those from LULUCF, increased from 226,086 $GgCO_2eq$ in 2000 to 318,662 $GgCO_2eq$ in 2013 with an annual increase of 2.68%. The net removal of $CO_2$ increased from 11,995 $GgCO_2eq$ in 2000 to 86,102 $GgCO_2eq$ in 2013. Therefore, the net GHG emission is positive, increasing from 214,091

$GgCO_2eq$ in 2000 to 232,560 $GgCO_2eq$ in 2013: an annual increase of 0.64%. With both the total national GHG source emissions and removals increased, net GHG emissions in 2013 increased by 8.63% over the 2000 net GHG emission level. The increase of net GHG emissions is attributed to increased emissions in the energy, industrial processes, agricultural and waste sectors, with the exception the LULUCF sector. The major source of GHG emissions was the energy sector, which increased from 161,005 $GgCO_2eq$ in 2000 to 236,936 $GgCO_2eq$ in 2013. GHG emissions in the industrial processes sector increased slightly from 14,086 $GgCO_2eq$ in 2000 to 18,977 $GgCO_2eq$ in 2013. Emissions in the agriculture sector also slightly increased from 41,906 $GgCO_2eq$ in 2000 to 50,919 $GgCO_2eq$ in 2013. Emissions in the waste sector moderately increased from 9,089 $GgCO_2eq$ in 2000 to 11,830 $GgCO_2eq$ in 2013, Conversely, the LULUCF sector was found to be the major source of emission removal, increasing from 11,995 $GgCO_2eq$ in 2000 to 86,102 $GgCO_2eq$ in 2013.

Energy sector: The total emissions in the energy sector were generated by fuel combustion, consistingmostly of use for public electricity and heat production about 98,537.77 $GgCO_2eq$ or 41.59%. GHG emission from manufacturing-construction and transport were 46,537.39 $GgCO_2eq$ or 19.64% and 61,175.42 $GgCO_2eq$ or 25.82%, respectively. Fugitive emission from fuels was only 10,124 $GgCO_2eq$ or a little over 4% of total GHG emissions from the energy sector.

Industrial processes sector: Total direct GHG emissions from the Industrial Processes Sector in 2013 were estimated at 18,976.79 $GgCO_2eq$. Emissions from Mineral Product, Chemical Industry,and Metal Production were estimated to be (18,591.18, 367.72, and 17.89) $GgCO_2eq$, or (97.97,1.94, and 0.09) %, respectively.

Agriculture sector: In 2013, total GHG emissions from the agriculture sector contributed 50,919.34 $GgCO_2eq$. Enteric fermentation and manure management contributed 6,004.73 and 3,538.60 $GgCO_2eq$: 11.79 and 6.95 %, respectively. Meanwhile, rice cultivation and agricultural soils contributed 27,862.90 and 11,687.34 $GgCO_2eq$: 54.72 and 22.95 %, respectively. Field burning of crop residues accounted for the lowest GHG emissions, amounting to 1,825.76 $GgCO_2eq$ (3.59%).

Land use, land-use change, and forestry sector: The LULUCF sector in Thailand showed a trend of increased net removal, as the total removals exceeded total emissions. Since 2000, LULUCF activities have contributed to net removal from the atmosphere, and in 2005, when rubber plantations were included in the calculation, a tremendous increase of $CO_2$ removal resulted. In 2013, the LULUCF sector contributed to net removal of 86,101.84 $GgCO_2eq$, a six-fold increase compared with that in 2000.

Waste sector: Almost of the total GHG emissions in the waste sector was contributed from wastewater treatment, which accounted for 6,375.94 $GgCO_2eq$ or 53.90%, and solid waste disposal on land, which contributed 5,346.02 $GgCO_2eq$ or 45.19%. Waste incineration contributed 107.61 $GgCO_2eq$ (the smallest proportion) and accounted for 0.91% of total GHG emissions in this sector.

Constraints, gaps, and needs in national inventory: Thailand has several limitations, barriers, and constraints that affect the quality of the GHG inventory estimation and compilation. Improvement in national statistics and reporting of activity data by relevant agencies can improve the inventory quality. The country aims to improve inventory quality in terms of transparency, accuracy, completeness, consistency, and comparability. Thus, preparation of future GHG inventories needs a series of well-planned improvements, as well as support from developed countries and international funding.

## 3. INFORMATION ON MITIGATION ACTIONS

Thailand has made significant efforts as a signatory party to implement the UNFCCC according to its capabilities. Through domestic support for the development of GHG mitigation actions during 2010 to 2013, Thailand pledged its first Nationally Appropriate Mitigation Actions (NAMAs) to the UNFCCC in 2014. Thailand's NAMAs represent an opportunity for sustainable development as well as mitigation. Since the submission of its first BUR and ratification of the Paris Agreement in 2015, several climate change mitigation policies and measures have been put in place at the national level to fulfill Thailand's drive toward a low carbon, resilient society, as stated in the 12$^{th}$ NESDP. The 12$^{th}$ NESDP supports Thailand's NAMAs and strives toward the reduction of GHGs by 7 to 20 % in 2020. The target of 7% in 2020 will be intentionally achieved using domestic resources. However, the level of 20% GHG mitigation in 2020 is subject to sufficient international support under UNFCCC.

GHG emission mitigation measures: Thailand achieved early its short-term target of the National Climate Change Master Plan: a 7% reduction in GHG emissions from the BAU level by 2020. As such, the domestic Measurement Reporting and Verification (MRV) for the NAMA tracking process has been completed, by which the amount of national GHG reduction in terms of $MtCO_2eq$ was measured, reported, and verified. This achievement has shown that Thailand has put considerable effort, along with the international support given, to reduce GHG emissions. With sufficient support internationally, Thailand aims to lower its carbon trajectory to 20% below the BAU level by 2020. The key mitigation actions committed and implemented according to the NAMAs Roadmap for Thailand include: (i) Development of renewable and alternative energy sources, (ii) Improvement of energy efficiency in power generation, industries, buildings, and transportation, (iii) Substitution of bio-fuels for fossil fuels in the transport sector; and (iv) Advancement of the transport infrastructure development plan for Thailand.

Information on domestic MRV: To monitor the implementation progress of the NAMA Roadmap, Thailand has developed a domestic MRV system for the sectors and included this in the NAMA Roadmap, as mentioned in the first BUR. The domestic MRV system for the other sectors has also been improved.

# 4. CONSTRAINTS, GAP, NEED AND SUPPORT RECEIVED

To focus effort on mitigating greenhouse gases by improving technology, as well as relevant research and databases; Thailand has several limitations, barriers, and constraints. These impacts the implementing of adaptation and mitigation measures, as well as inclusion of GHG inventory estimation and compilation. The improvement in national statistics and reporting of activity data by the relevant agencies can improve the inventory quality. The country aims to improve inventory quality in terms of transparency, accuracy, completeness, consistency, and comparability of data among the relevant agencies. For the past ten years, Thailand has received and expected to receive financial support, capacity building support, and technical assistance from a number of international governments and organizations.

CHAPTER 1:

# National Circumstances

# CHAPTER 1

# NATIONAL CIRCUMSTANCES

## 1.1 PHYSICAL CONTEXT

### 1.1.1 Geographical Location

Thailand is located in a tropical area (5° 37′ to 20° 27′ N and 97° 22′ to 105° 37′ E). Its total area is 513,115 km$^2$. Thailand's boundaries with adjacent areas include Myanmar and Laos to the north; Laos, Cambodia, and the Gulf of Thailand to the east; Malaysia to the south; and Myanmar and the Andaman Sea to the west (Figure 1-1). Thailand has coastal areas in 23 provinces. 17 of these are in the Gulf of Thailand, with a coastline of approximately 2,700 km, and 6 provinces border the Andaman Sea, with 865 km of coastline. Prachuap Khiri Khan Province has the longest coastline (251 km) and Bangkok (Bang Khun Thian District) has the shortest (5.5 km). Thailand may be divided into 5 parts, each with its own topography. The north is characterized as hilly and mountainous, the northeastern region is a naturally high plain, and the central region is a large, low altitude plain. In the east, most areas are plains and valleys with some small hills. The south is a peninsula with the Andaman Sea on its west side and the South China Sea on its east side.


Source: Department of Field Support Cartographic Section UNITED NATION

Figure 1-1: Map of the Kingdom of Thailand

## 1.1.2 Politics and Government

After the country went through a peaceful transformation in 1932, sovereign power passed to the Thai people. The King is now a Head of State who is above partisan politics and discharges his role in accordance with the national constitution. The administration of the country is carried out by the Prime Minister and the cabinet formed by the Prime Minister. Thailand's public administration is divided into 3 tiers of central, provincial, and local administrations. Local authorities consist of provincial administrative organizations, district organizations, sub-district organizations, and Tambon Administrative Organizations (TAOs). The Ministry of the Interior appoints governors for all provinces, of which Thailand has 77. Bangkok, the capital city, is governed by a Metropolitan Administration for which a governor is elected. The TAO Act of 1994 and the 1998 Decentralization Act clearly state the mandate and duty of TAOs in the protection and maintenance of natural resources and the environment within their jurisdiction.

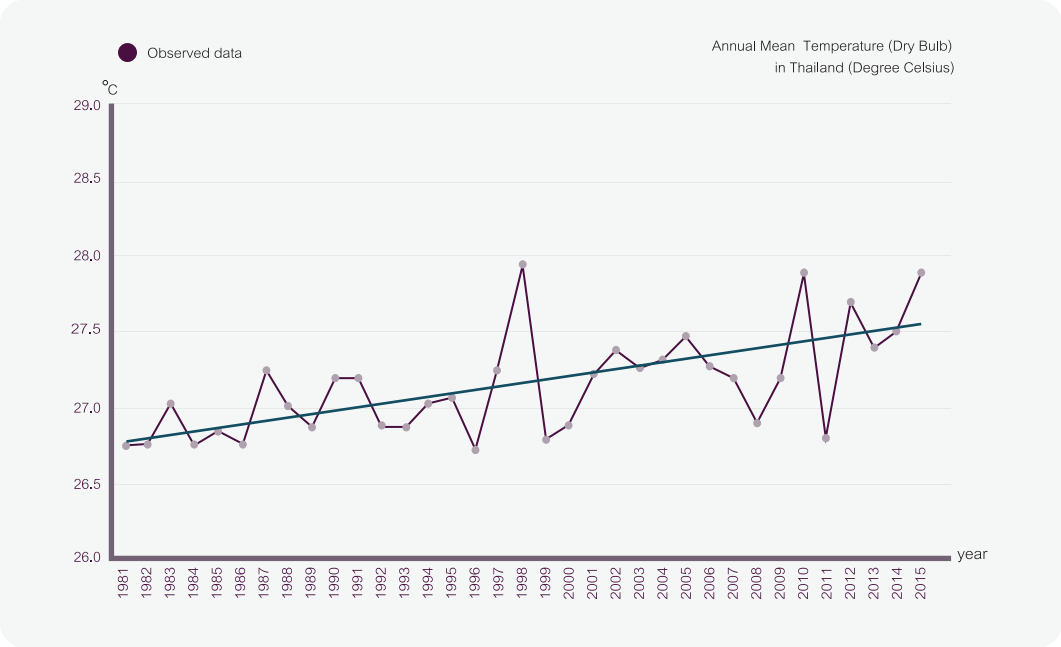
## 1.1.3 Climate

### 1.1.3.1 Season and Temperature

From the meteorological point of view, the climate of Thailand may be divided into 3 'seasons' as follows. The rainy or southwest monsoon season provides abundant rainfall throughout the country from mid-May to mid-October. The wettest period of the year is August to September. The exception is found on the east coast of Southern Thailand where abundant rain continues until the end of the year. The winter or northeast monsoon season occurs from mid-October to mid-February. This is a mild period of the year, but becomes quite cold in December and January in upper (non-peninsular) Thailand. There is a great amount of rainfall on the east coast of Southern Thailand, especially during October to November. The summer, or pre-monsoon season, occurs from mid-February to mid-May, and is the transitional period from the northeast to southwest monsoons. The weather becomes warmer, especially in upper Thailand. April is the hottest month. Figure 1-2 and 1-3 show the annual maximum and minimum mean temperatures in Thailand from 1951 to 2015. Over these 6 decades, all temperature measures have shown an upward trend. The rate of change has been more volatile since 1997, as can be observed by the wider deviation from year to year. The highest temperature ever recorded in Thailand is 44.6 °C, recorded in Mae Hong Son Province. The lowest temperature ever recorded was -1.4 °C, which was observed in Sakon Nakhon Province on 2 January 1974.


Source: Thai Meteorological Department

Figure 1-2: Trends of annual maximum and minimum mean air temperature in degree Celsius: 1951 - 2015

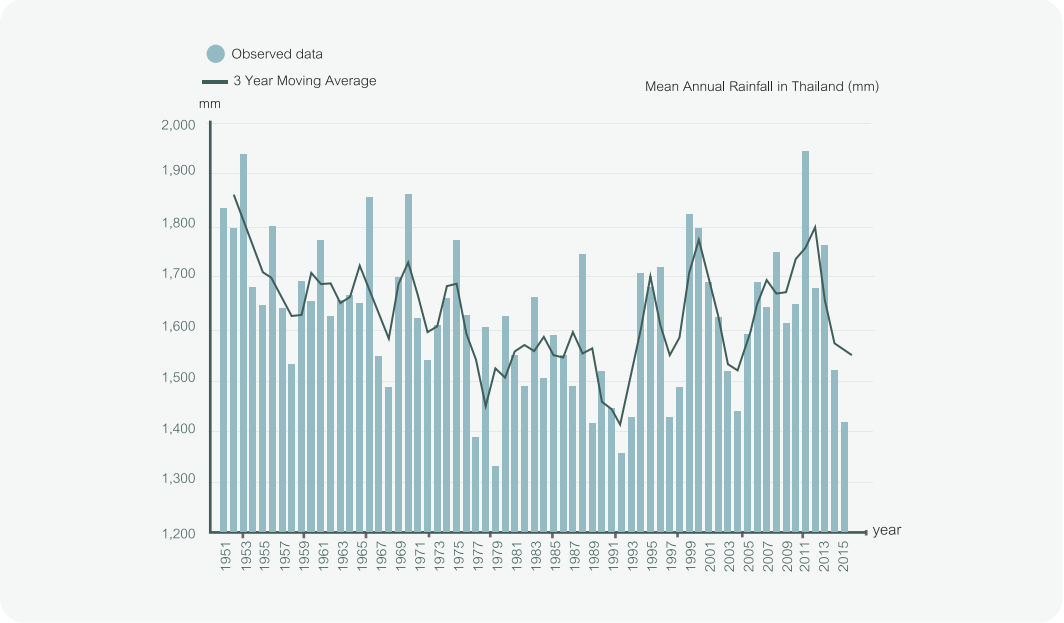



Source: Thai Meteorological Department

Figure 1-3: Trends of annual air temperature in degree Celsius: 1981 - 2015

### 1.1.3.2 Precipitation

According to Thailand's general annual rainfall pattern, the average range of annual rainfall is 1,300–2,000 mm per year (Figure 1-4). In the winter, northern Thailand usually experiences dry weather as a result of the northeast monsoons. In summer, thunderstorms and increased rainfall often occurs. From May to October, rainfall with thunderstorms increases because of the southwest monsoons. Peak rainfall occurs in August or September and often causes flooding in some areas. There is a difference in rainfall between the Southern (peninsular) and the Northern (non-peninsular) parts of Thailand. During the southwest monsoon, the west coast of Southern Thailand gets peak rainfall in September. The peak on the East Coast is in November, but significant rainfall continues until January of the following year, at the beginning northeast monsoons.

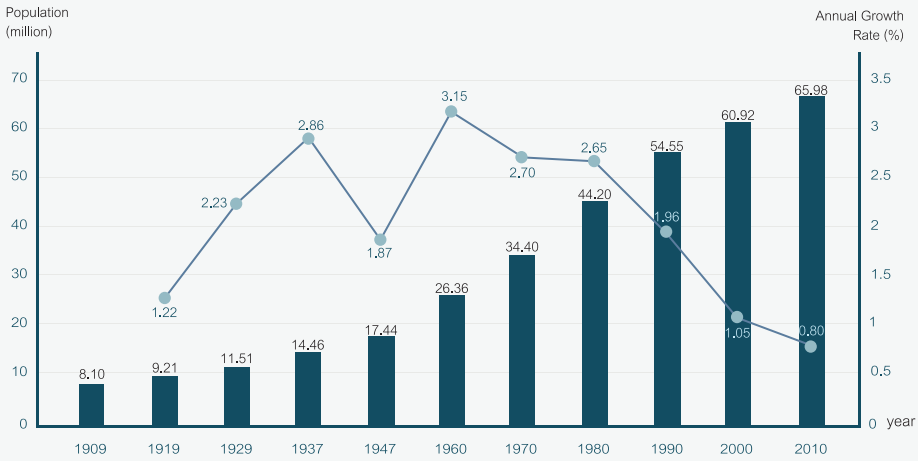



Source: Thai Meteorological Department

Figure 1-4: Trends of mean annual rainfall in Thailand (mm): 1951-2015

## 1.1.4 Population

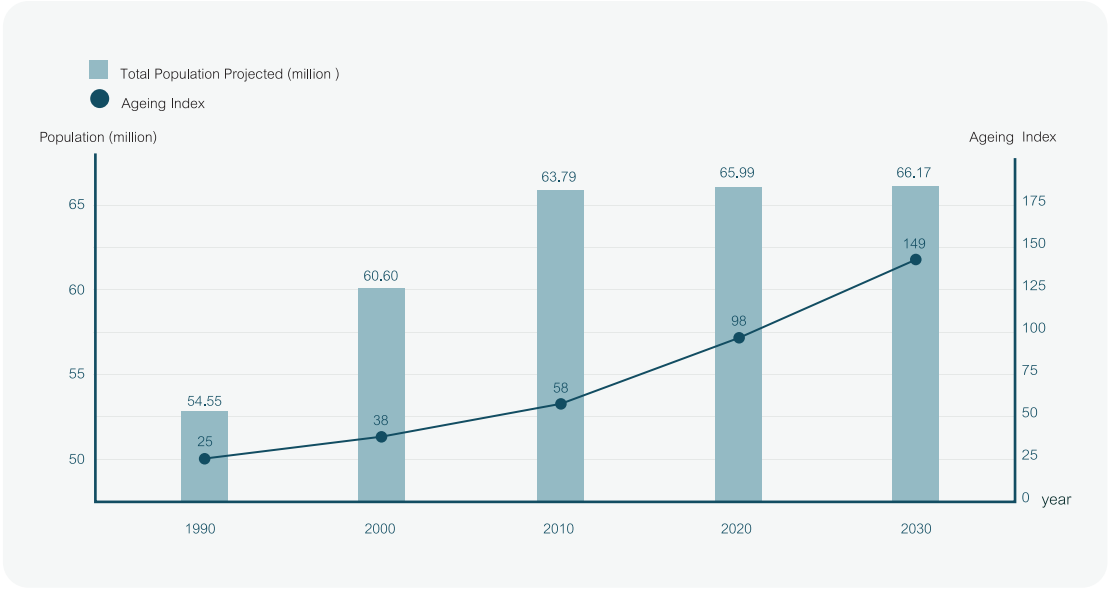
The total population of Thailand was 65,981,659 people as measured by the 2010 Thailand Census. In 2015, the estimate was 65,729,098 people according to registration records. Thailand's population has generally increased over the past decades despite the decline in the annual population growth rate since 1960 (from 2.70% per decade to only 0.80% in 2010; Figure 1-5). According to population projections, Thailand's population will continue to increase at this slower rate and will reach 66,174,658 people in 2030 (Figure 1-6).




Source: National Statistical office

Figure 1-5: Population and growth the rate: 2010 Census data

A decline in the birth rate with a concurrent increase in life expectancy has shaped Thailand's population structure into an aging society. Figure 1-6 shows that the projected ageing index will continue to rise at an increased rate. In 2020, the number of people aged 60 and over will catch up with the youthful population (i.e., ageing index of 98%). By 2030, the aging population will be one and a half times larger than the youthful population. This demographic transition translates into challenges in the care and support of aging members of society. Pension spending, health care, and long-term care systems for the elderly will pose large financial burdens. The anticipated shrinking labor force could also potentially harm Thailand's economy; thus, enhancing labor productivity is required.



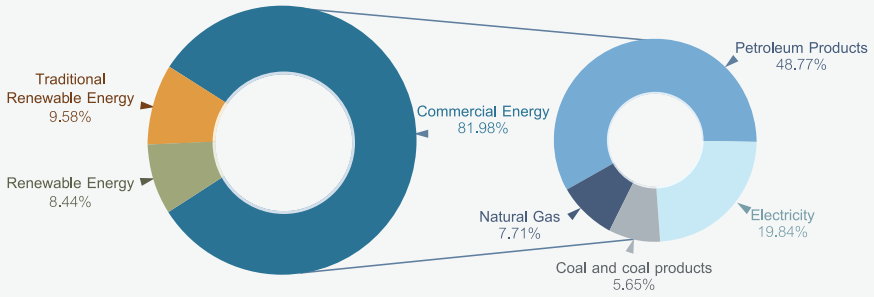

Source: Office of the National Economic and Social Department Board

Figure 1-6: Ageing Index, total population (1990-2030) and total projected population (2020-2030)

# 1.2 ENERGY

## 1.2.1 Energy Consumption

In 2015, the majority of energy consumption was for commercial use, which amounted to 63,844 ktoe (81.98% of total). Among the energy sources, petroleum product consumption had the largest proportion (48.77%), followed by electricity (19.84%), natural gas (7.71%), and coal and coal products (5.65%), (Figure 1-7).




Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy

Figure 1-7: Final energy consumption by fuel type: 2015

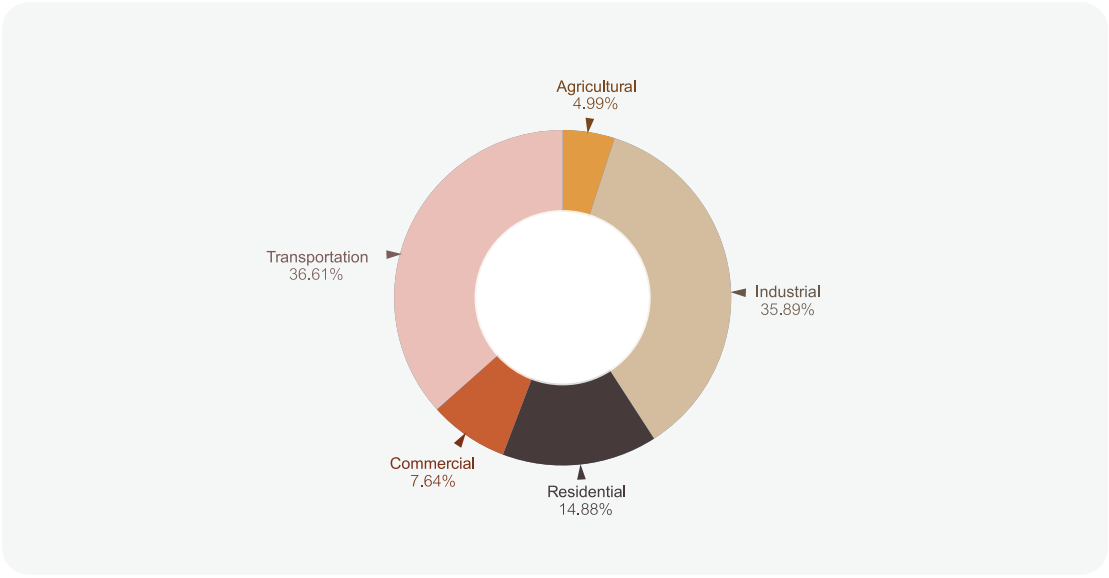
Table 1-1 shows Thailand's final energy consumption trend by fuel type. In 2015, the total amount of Thailand's final energy consumption was at 77,881 ktoe (a 2.74% increase from 2014). While commercial and renewable energy consumption (solar, fuel wood, paddy husk, bagasse, agricultural waste, MSW, and biogas) increased in 2015, traditional renewable energy consumption energy (fuel wood, charcoal, paddy husk, and agricultural waste) dropped by 10.31%. The consumption of coal and coal products decreased significantly (22.16 and 4.88 % in 2014 and 2015, respectively).

**Table 1-1** Final energy consumption by fuel type: 2013-2015

| Final Energy Consumption by Fuel Type | Quantity (ktoe) | | | Growth (%) | |
|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2014 | 2015 |
| Commercial Energy | 61,236 | 61,075 | 63,844 | -0.26 | 4.53 |
| • Petroleum Products | 35,948 | 36,570 | 37,981 | 1.73 | 3.86 |
| • Electricity | 14,002 | 14,371 | 15,455 | 2.64 | 7.54 |
| • Coal and Coal Products | 5,947 | 4,629 | 4,403 | -22.16 | -4.88 |
| • Natural Gas | 5,339 | 5,505 | 6,005 | 3.11 | 9.08 |
| Renewable Energy | 5,902 | 6,408 | 6,574 | 8.57 | 2.59 |
| Traditional Renewable Energy | 8,076 | 8,321 | 7,463 | 3.03 | -10.31 |
| Final Energy Consumption | 75,214 | 75,804 | 77,881 | 0.78 | 2.74 |

Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy

In 2015, the transportation sector consumed the largest share of energy (36.61%), followed by the industrial sector (35.89%), residential sector (14.88%), commercial sector (7.64%), and agricultural sector (4.99%), (Figure 1-8).




Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy

Figure 1-8: Share of final energy consumption by economic sectors 2015

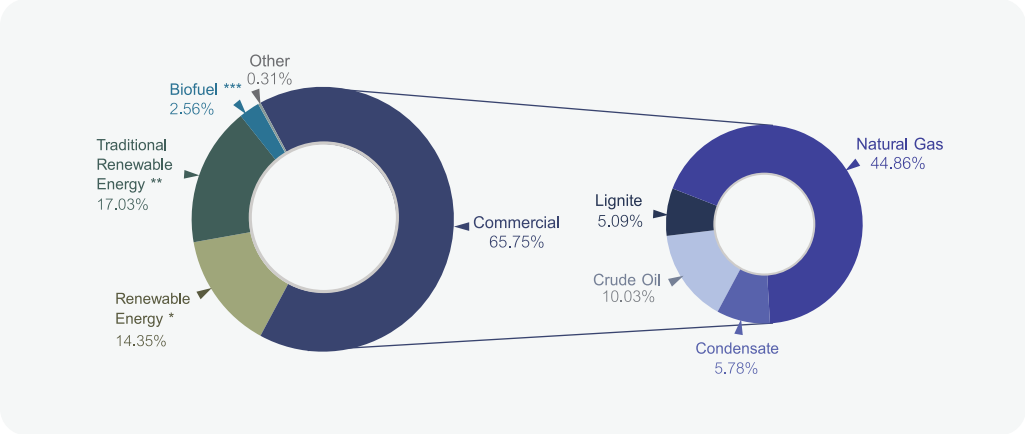
## 1.2.2 Energy Production

Total energy production was 75,838 ktoe in 2015 (Table 1-2). Commercial energy constituted the largest source of energy production 49,866 ktoe (65.75% of the total), renewable energy 10,879 ktoe (14.35%), traditional renewable energy 12,917 ktoe (17.03%), biofuel 1,941 ktoe (2.56%), and all other energy sources 235 ktoe (0.31%) (Figure 1-9). While the production of crude oil and biofuel increased over 2014 levels, Thailand's total energy production decreased by 4.37% as a result of reduced lignite, natural gas, and traditional renewable energy production. In 2015, total energy exports amounted to 11,971 ktoe; almost entirely of petroleum products (96.88%) and electricity (1.61%) (Figure 1-10). Energy imports totaled 74,928 ktoe, which included crude oil (58.31%), coal (18.48%), and natural gas (17.42%),

**Table 1-2** Energy production by fuel type: 2013-2015

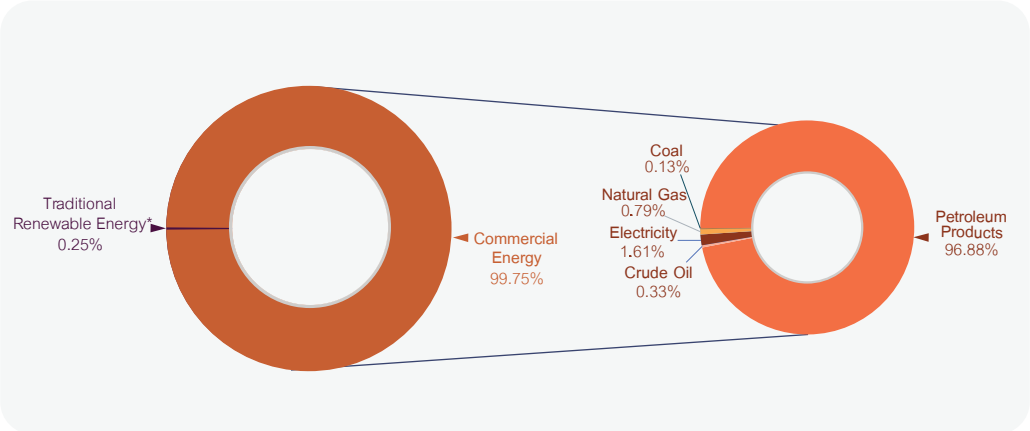
| Final Energy Production by Fuel Type | Quantity (ktoe) | | | Growth (%) | |
|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2014 | 2015 |
| Total Energy Production | 78,074 | 79,303 | 75,838 | 1.57 | -4.37 |
| Commercial Production | 52,736 | 52,888 | 49,866 | 0.29 | -5.71 |
| • Crude Oil | 7,363 | 6,906 | 7,604 | -6.21 | 10.11 |
| • Lignite | 4,459 | 4,622 | 3,858 | 3.66 | -16.53 |
| • Natural Gas | 36,405 | 37,035 | 34,020 | 1.73 | -8.14 |
| • Condensate | 4,509 | 4,325 | 4,384 | -4.08 | 1.36 |
| Renewable Energy* | 9,706 | 10,608 | 10,879 | 9.29 | 2.55 |
| Traditional Renewable Energy** | 13,739 | 13,740 | 12,917 | 0.01 | -5.99 |
| Biofuel*** | 1,609 | 1,799 | 1,941 | 11.81 | 7.89 |
| Other | 284 | 268 | 235 | -5.63 | -12.31 |

* Includes solar (heat), solar (electricity), wind, hydro, geothermal, fuel wood, paddy husk, bagasse, agricultural waste, MSW and biogas
** Includes fuel wood, paddy husk and agricultural waste
*** Includes ethanol and biodiesel
Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy



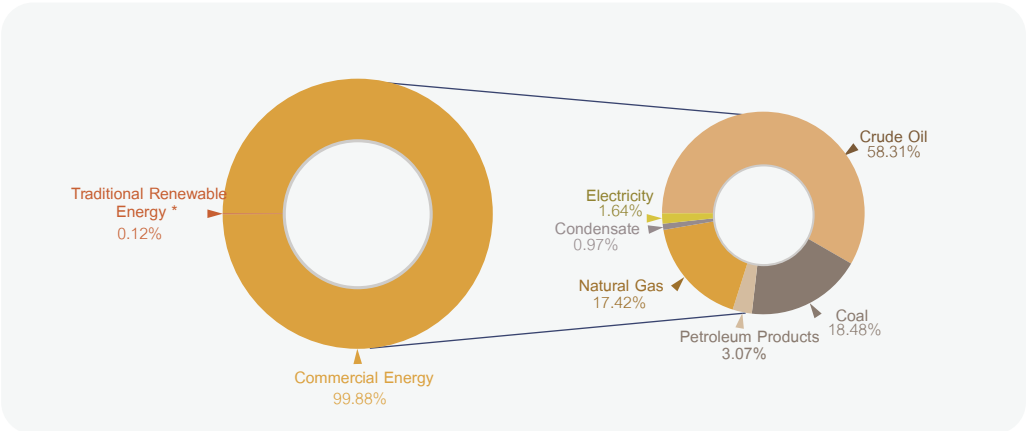

* Includes solar (heat), solar (electricity), wind, hydro, geothermal, fuel wood, paddy husk, bagasse, agricultural waste, MSW and biogas
** Includes fuel wood, paddy husk and agricultural waste
*** Includes ethanol and biodiesel
Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy

Figure 1-9: Share of final energy production by fuel type: 2015




* Includes solar (heat), solar (electricity), wind, hydro, geothermal, fuel wood, paddy husk, bagasse, agricultural waste, MSW and biogas
Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy

Figure 1-10: Share of exported energy: 2015




* Includes solar (heat), solar (electricity), wind, hydro, geothermal, fuel wood, paddy husk, bagasse, agricultural waste, MSW and biogas
Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy

Figure 1-11: Share of imported energy: 2015

## 1.2.3 Alternative Energy

Thailand's alternative energy consumption has increased continuously. In 2015, total alternative energy usage increased by 11.70% from the previous year. Biodiesel and renewable heat consumption (solar, biomass, MSW and biogas) increased by 16.90% and 13.90% respectively while renewable electricity consumption (solar, wind, hydro, biomass, MSW and biogas) increased by 6.10% (Table 1-3). Thailand has formulated the Alternative Energy Development Plan (AEDP) 2015 aiming to promote alternative energy and reduce dependency on energy import such as oil and natural gas. The overall goal is to increase the share of renewable energy consumption to 30% by 2036.

**Table 1-3** Alternative energy consumption: 2013-2015

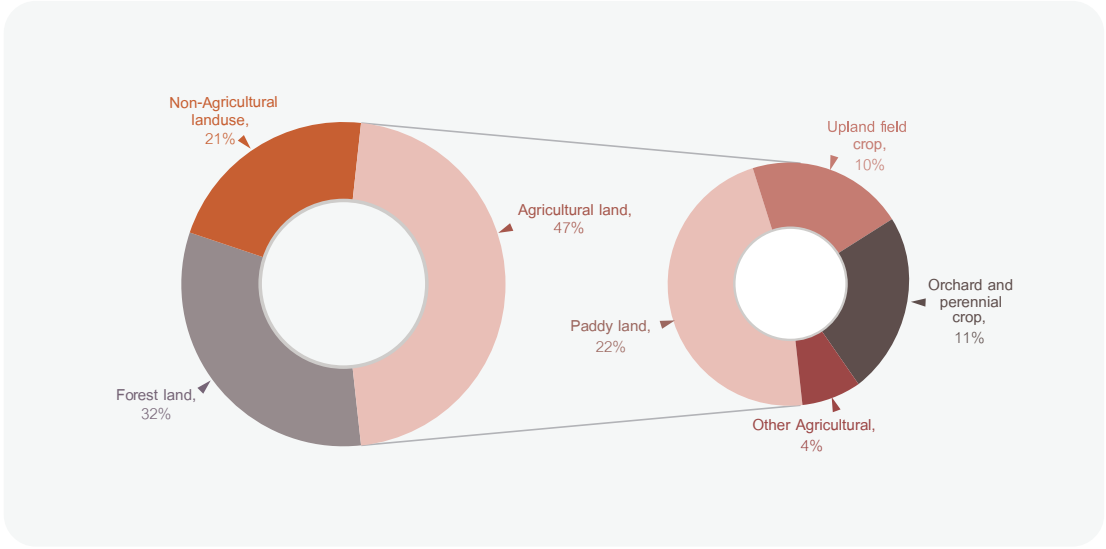
| Alternative Energy Consumption | Quantity (ktoe) | | | Growth (%) |
|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2015 |
| 1. Electricity (solar, wind, hydro, biomass, MSW and biogas) | 1,341 | 1,467 | 1,556 | 6.10 |
| 2. Heat (solar, biomass, MSW and biogas) | 5,279 | 5,775 | 6,579 | 13.90 |
| 3. Biofuel | | | | |
| • Ethanol | 707 | 847 | 879 | 0.60 |
| • Biodiesel | 905 | 909 | 1,063 | 16.90 |
| Total | 8,232 | 9,025 | 10,077 | 11.70 |

Source: Energy Balance of Thailand 2015, Department of Alternative Energy Development and Efficiency: Ministry of Energy

# 1.3 NATURAL RESOURCES

## 1.3.1 Land resources and Forestry

Thailand has a total land area of approximately 51.3 million hectares. As of 2015, 47% of the nation's total land area (or 24 million hectares) was categorized as agricultural land (Figure 1-12). Non-agricultural land use and forested land accounted for 21 and 32 %, respectively. About half of agricultural land use is attributed to paddy use, equal to 11 million hectares or 22% of Thailand's total land area.



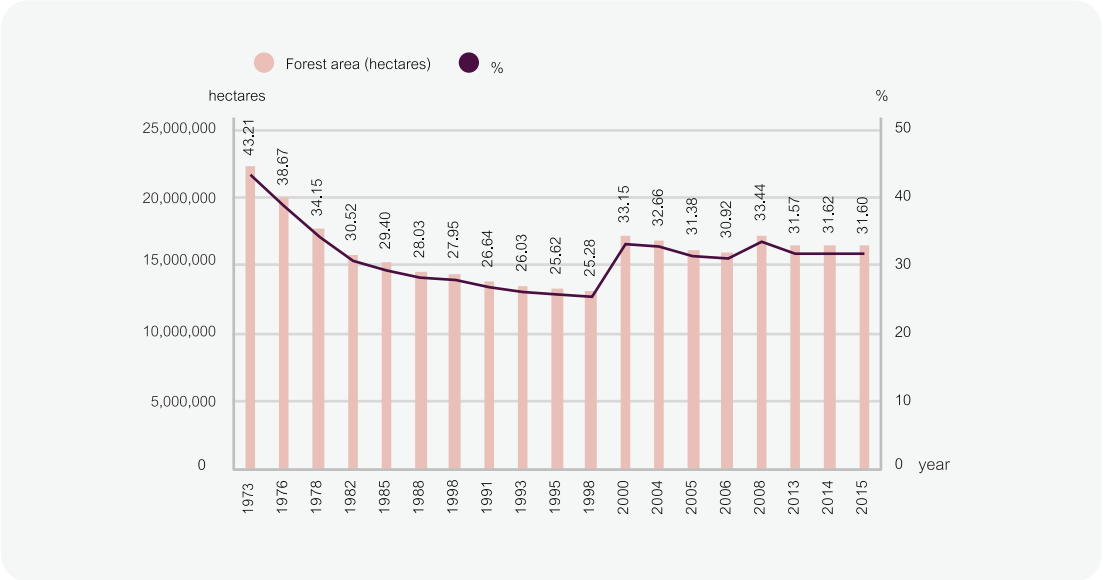

Source: Agricultural Statistics of Thailand 2015, Office of Agricultural Economics

Figure 1-12: Share of land use in Thailand in 2015

Forested areas are being encroached upon for the purpose of slash-and-burn farming, shifting cultivation, land resettlement, and dam and road construction. The Thai government imposed a nationwide logging ban by emergency decree in January 1989. In 1973, the total forest area of Thailand covered over 43% of the country but the portion of forested area had declined to 25.28% in 1998 (Figure 1-13). Forested area increased in 2000 as a result in changes in the scale and method of calculation, establishing a new benchmark for this land use. One of the threats facing Thailand's forests is illegal logging, which is degrading Thailand's remaining forests. To reduce deforestation, several actions have been taken such as improving forest law enforcement, declaring national conserved forests, rehabilitating degraded forests, and promoting community forest management. These implementations have reduced the deforestation rate, and the current (2015) estimate of forested area is 16,358,557 hectares.

In 2016, Thailand received a grant for 3.6 million USD from the Forest Carbon Partnership Facility (FCPF) to carry out activities for the REDD+ Readiness Phase during 2016–2019. The implementation of this project officially started on 17 June 2016 and the Implementing Agency for the FCPF REDD+ Readiness Preparation project is the Department of National Parks, Wildlife, and Plant Conservation (DNP), in the Ministry of Natural Resources and Environment.

The objective of the grant is to support development of the Readiness Preparation Activities. This will be achieved by supporting preparation of the REDD+ strategy for Thailand, the technical and accounting methods of Measurable, Reporting and Verification System (MRV), the Forest Reference Emission level/Forest Reference level (FREL/FRL), the Safeguards Information System (SIS), the strategic Environmental and Social Assessment and Environmental and Social Management Framework, and readiness organization and consultation. It is expected that in 2019, Thailand will submit the FREL/FRL to the UNFCCC, and that the National REDD+ Strategic will be completed in 2020.




Source: Royal Forest Department

Figure 1-13: Thailand's Forest area: 1973-2015

## 1.3.2 Water Resource

Based on geographical characteristics, Thailand can be divided into 25 river basins, with the Chao Phraya River as the main river basin running through the center of the country. Thailand's average annual rainfall is approximately 1,455 mm, while the average annual runoff is 33,123 million $m^3$. In the northern part of the basin, the total storage capacity is estimated at 25,773 million $m^3$, while the central area can store only 2,124 million $m^3$. Due to the lack of fully developed water infrastructure, deforestation, and climate change during the last decade, Thailand is particularly vulnerable to drought and flood. This has resulted in several extreme climatic events recently. In 2011, Thailand faced major flooding that impacted over 13 million people and cost more than 1.44 trillion THB in economic losses (estimated by the World Bank).

In 2015, Thailand also experienced one of the worst droughts in decades, leading to critically low levels of water in reservoirs countrywide. Rapid economic growth has also caused water demand to grow in the main economic sectors such as agriculture, industry, and tourism. However, the construction of dams and reservoirs is often delayed due to concerns over adverse environmental impacts. In response to the threat of flood, drought, and increasing water demand, the government has set up the Strategic Committee for Water Resource Management (SCWRM) to formulate a Master Plan on Sustainable Water Resource Management. The plan addresses both urgent and long-term issues to ensure continuity of development even under the threats of future drought and flooding.

### 1.3.3 Biodiversity

According to Thailand's Fifth National Report on the Implementation of the Convention on Biological Diversity, Thailand is located in the Oriental biogeographic region, also called the Indo Malayan Region. This region ranked second of the three regions in terms of biodiversity, and its diverse ecosystems comprise many habitats supporting abundant flora and fauna. Despite several policy actions taken, Thailand is facing the loss of its natural habitats including forests, wetlands, and natural reservoirs due to agricultural and urban expansion resulting from population and economic growth.

## 1.4 CURRENT STATE OF THE NATIONAL ECONOMY

### 1.4.1 National Economy or Economic Profile

Thailand has experienced low single-digit GDP growth in the past decade, with the industrial and service sectors as the main drivers of recent growth. Thailand is the second-largest economy in Southeast Asia, but ranks fourth behind Singapore, Brunei, and Malaysia in GDP per capita. The economy is heavily export-dependent, with exports accounting for more than one-third of GDP. Both exports and imports have recently faced negative growth over the past few years. In recent years, Thailand's balance of payments has averaged approximately 5 billion USD, with total debt outstanding being 130–140 billion USD. Thailand has one of the world's lowest unemployment rates (about 1%). This is because a large proportion of the population works in subsistence agriculture or in other vulnerable employment (own-account work and unpaid family work).

Thailand is entering its fourth industrial revolution, known as "Thailand 4.0." Thailand 4.0 policy will promote 5 new industries (called the "New S-Curve") in which Thailand has the potential to succeed. The New S-Curve industries include robotics, aviation and logistics, biofuels and biochemical, the digital industry, and the medical hub. Currently, Thailand is implementing the 12$^{th}$ National Economic and Social Development Plan that will continue until 2021. The 12$^{th}$ NESDP will run in tandem with the 20-year National Strategy, a larger framework for Thailand's development.

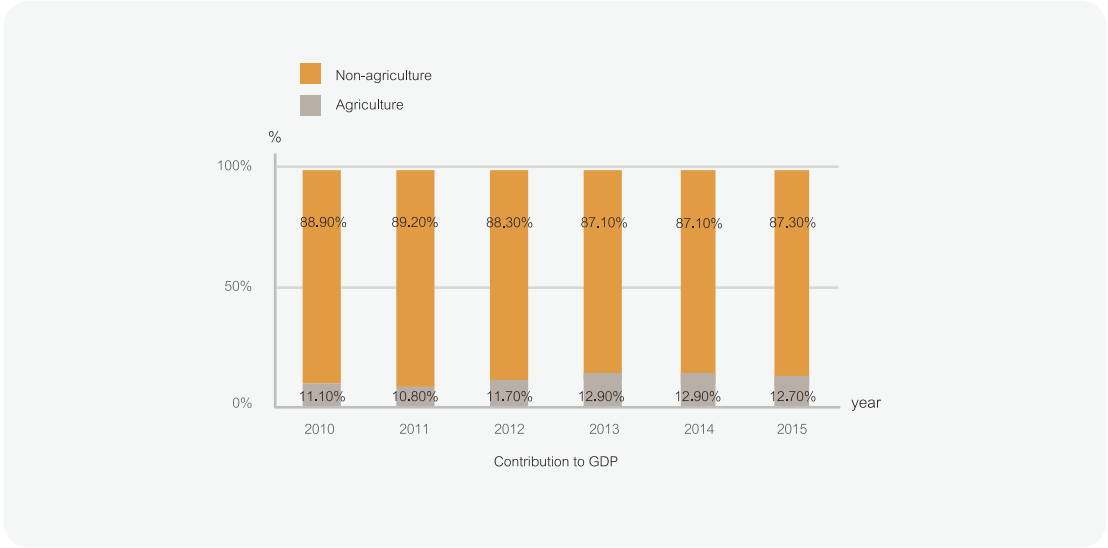
**Table 1-4** Thailand's Economic indicators: 2012-2015

| Economic indicators | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|
| GDP growth (%) | 7.20 | 2.70 | 0.80 | 2.90 |
| GDP per capita (THB) | 138,114 | 147,735 | 141,735 | 143,958 |
| GDP per capita (USD) (@33THB:USD) | 4,185 | 4,477 | 4,295 | 4,362 |
| GDP growth- Agriculture (%) | 2.70 | 0.80 | 0.70 | - 5.70 |
| GDP growth - Non-Agriculture (%) | 7.80 | 2.90 | 0.80 | 3.90 |
| Export growth (%) | 3.00 | -0.10 | -0.30 | -5.60 |
| Import growth (%) | 8.40 | -0.10 | -7.90 | -10.60 |
| Current accounts as % of GDP (%) | -0.40 | -1.20 | 3.70 | -8.10 |
| Net capital movements (billion USD) | 12.80 | -2.50 | -16.20 | -17.10 |
| Balance of payments (billion USD) | 5.30 | -5.00 | -1.20 | 5.90 |
| Total debt outstanding (billion USD) | 130.70 | 141.90 | 141.70 | 131.40 |
| Labor force (million people) | 38.32 | 38.23 | 38.08 | 38.02 |
| Employment rate (%) | 0.71 | 0.70 | 0.69 | 0.69 |

Source: Office of the National Economic and Social Development Board, National Statistical Office

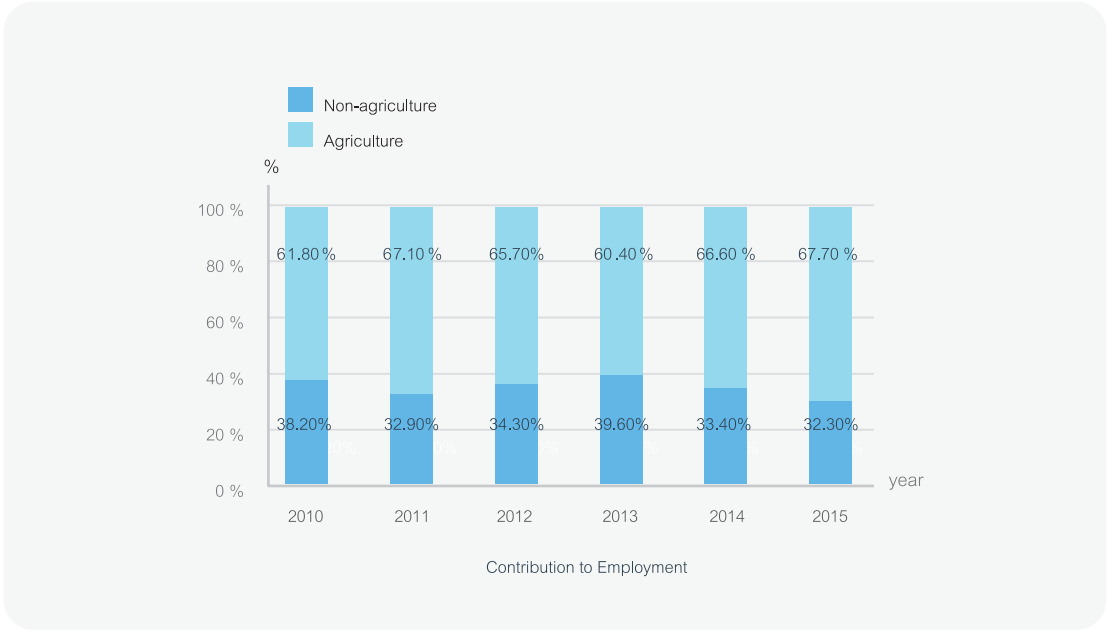
### 1.4.2 Agriculture Sector

As noted in Section 1.3.1, 47% of the land in Thailand is used for agriculture. However, in 2015 agriculture accounted for 12.7% of Thailand's GDP (Figure 1-14) while utilizing about one-third of the nation's labor force (Figure 1-15). The sector's GDP contribution has been slowly decreasing over the last decade. While Thailand's total GDP expanded 3.2% between 2010 and 2015, GDP from the agricultural sector only grew by 0.8%. This is contrasted with the 3.4% growth achieved by the non-agriculture sector. At the same time, agriculture's contribution to employment decreased from 38.20% of total employment in 2010 to 32.30% in 2015.




Source: Office of the National Economic and Social Development Board

Figure 1-14: Agriculture and Non-Agriculture contribution to GDP in THB billion

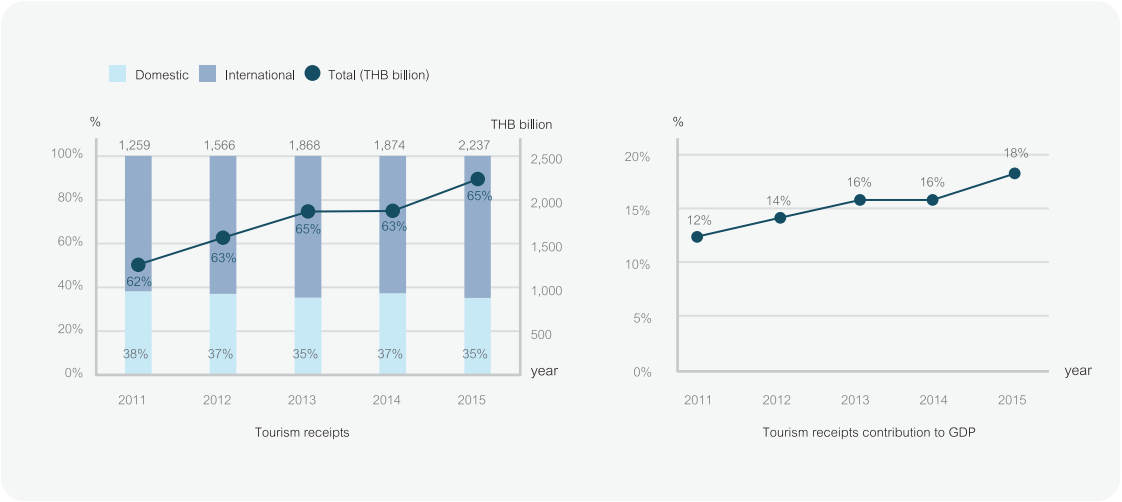



Source: National Statistical Office

Figure 1-15: Agriculture and Non-Agriculture contribution to employment in THB billion

## 1.4.3 Tourism Industry

The tourism industry is making a major contribution to Thailand's GDP. In 2015, tourism receipts amounted to 2,237 billion THB, or 18% of the total GDP (Figure 1-16). Thailand's tourism industry has been growing at a double-digit rate, except in 2014. The industry recovered in 2015. Average receipts from international tourists have grown at 20% per year, while domestic tourism has been evaluated as growing moderately.




Source: Thailand's Department of Tourism

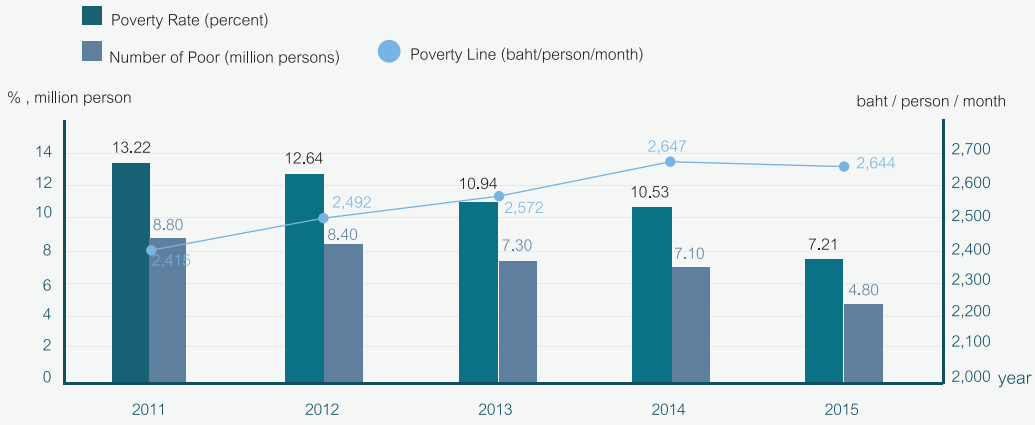
Figure 1-16: Tourist Receipts: 2011-2015

Thailand's natural resources are a large draw for tourists, with the country's beach destinations being ranked globally for their appeal. These resources, however, face serious environmental concerns that must be addressed immediately to maintain their status and value. Global warming has begun to have obvious adverse impacts on the country's tourism. Thailand's best-known island, Koh Tachai, has been closed indefinitely due to degradation of natural resources and the environment. This includes coral bleaching connected to climate change, as well as to damage from tourism. Coral bleaching has accentuated the impacts of tourism on Thailand's coral reefs. Thailand likely will continue to be disproportionately affected by the consequences of climate change, and with the southern part of Thailand, where most of the famous islands and beaches are located, being the most vulnerable area.

## 1.4.4 Poverty and Inequality

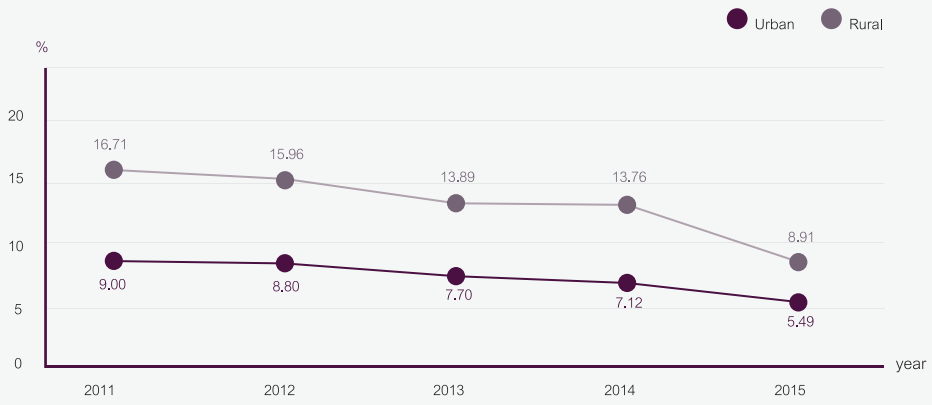
Thailand's poverty line increased from 2000–2014, until its decline in 2015 (2,644 THB per person per month) resulting in a slight decrease from the previous year. The poverty rate has declined continuously over time. In 2011, the share of the population under the poverty line was 13.22%, which declined to 7.21% in 2015. This translates to a reduction, by nearly half, of those below the poverty line (from 8.80 to 4.80 million) within a 5 year period (Figure 1-17).

Regarding inequality between urban and rural areas, poverty is more concentrated in rural areas. Figure 1-18 shows that the poverty rate gap between urban and rural areas has declined and tapered since 2011. In 2015, 8.91% of the population lived in poverty in rural areas, compared to 5.49% in urban areas.



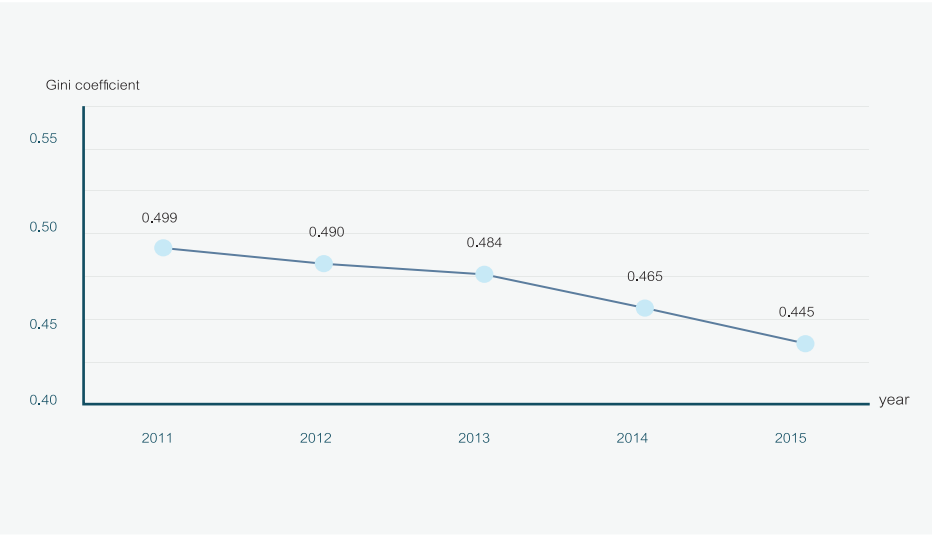

Source: Office of the National Economic and Social Department Board

Figure 1-17: Poverty line, poverty rate and number of the poor: 2011-2015




Source: Office of the National Economic and Social Department Board

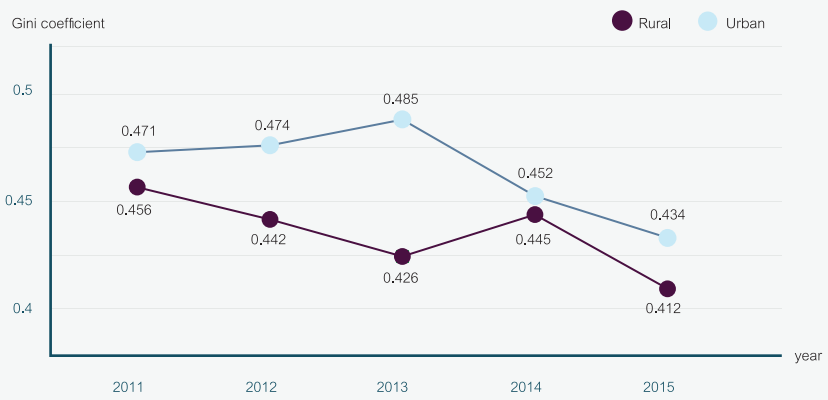
Figure 1-18: Poverty rate in Urban and Rural areas: 2011-2015




Source: Office of the National Economic and Social Department Board

Figure 1-19: Gini coefficient for all of Thailand: 2011-2015

In Thailand, income inequality is considered to be moderate and improving, and the Gini coefficient has fallen since 2007, from 0.499 to 0.445 in 2015 (Figure 1-19). Inequality in urban areas is higher than in rural areas. In 2015, the Gini coefficient was 0.434 in urban areas and 0.412 in rural areas (Figure 1-20).




Source: Office of the National Economic and Social Department Board

Figure 1-20: Gini coefficient in Urban and Rural areas: 2011-2015

## 1.5 STATE OF THE ENVIRONMENT

### 1.5.1 Air quality

The overall air quality in Thailand improved in 2015. The 5 major air pollutants are sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), carbon monoxide (CO), ozone ($O_3$), and particulate matter (PM: <10 microns: PM10) and < 2.5 microns: PM2.5). The annual national average of PM10 was 42 µg/$m^3$ (2% decrease from the level in 2014). For PM2.5, the annual national average was 28 µg/$m^3$, which was 3% decrease. For ozone, the maximum one-hour average was 125 parts per billion (ppb), which was 4% decrease compared to 2014. The national annual average of $SO_2$ and $NO_2$ was 2 and 14 ppb, respectively: unchanged from the previous year. The maximum one-hour average of CO detected at all stations was in the range1.6 –9.2 parts per million (ppm). The level of 1,3-butadiene, 1,2-dichloroethane, and chloroform exceeded the standard in Rayong Province where an industrial park is located.

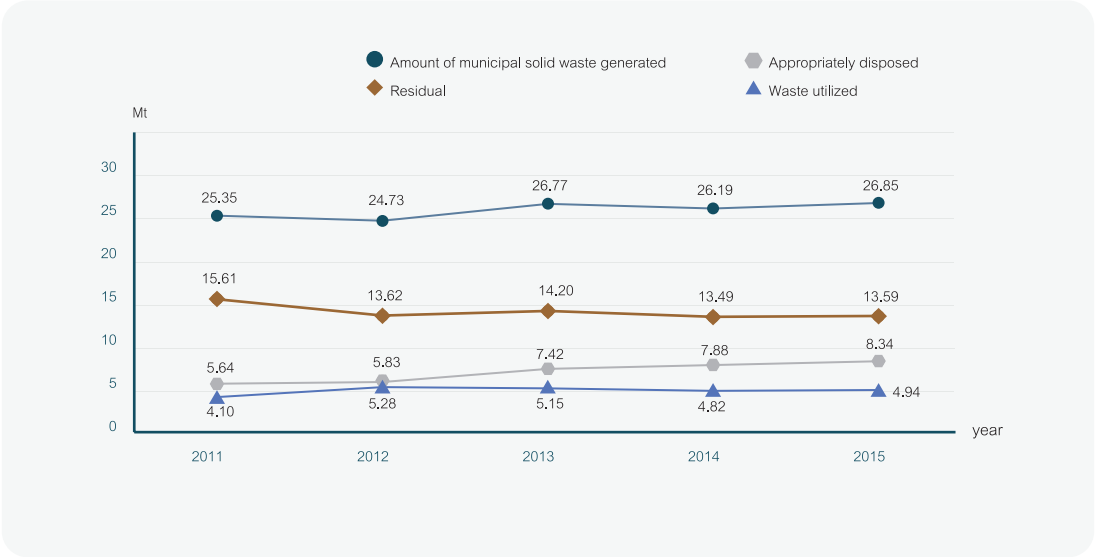
Sources of pollution differed from area to area. In general, the main sources of air pollutants were activities that required energy consumption. In Bangkok, the main sources were motor vehicles and dust from construction. On the eastern seaboard, the main sources of volatile organic compounds (VOCs) were petrochemical industries. In Thailand's northern and southern regions, haze results from open-burning agricultural practices. Thailand is also adversely affected by transboundary haze pollution resulting from wildfire and agricultural burning in neighboring countries. This has become a crucial problem that requires cooperation among members under the ASEAN Agreement on Transboundary Haze Pollution.

## 1.5.2 Water Quality

The overall water quality in Thailand was fair in 2015. For surface water, 41% was of fair quality, 34% was good, and 25% was water of deteriorated quality. In terms of a 10-year trend (2006–2015), water quality remained relatively stable. For coastal water quality, most of the monitoring data show that 72% of the water quality was fair, 16% was good, 9% was deteriorated, and 3% was water of severely deteriorated quality. As for the 10-year trend (2006–2015) for coastal water, most was of fair quality, but the quality did deteriorate as predicted. The main water quality problems involve contamination from communities, wastewater effluent from industrial factories, and agricultural activities such as leachate release from paddy fields and livestock farms. Overall, the quality of coastal water was fair. For the inner Gulf of Thailand, however, the water quality was much lower (deteriorated to very deteriorated) because of bacteria and chemical contaminants. The aforementioned contaminants are one of the causes of the red tide phenomena, which often occur in the Gulf of Thailand.

## 1.5.3 Waste

In 2015, the total amount of municipal solid waste (MSW) generated nationwide was 26.85 Mt, or 73,560 t/d. Of this waste, 16% was generated in Bangkok. Only 8.34 Mt of waste (31%), was appropriately disposed. About 4.94 Mt MSW was reused through waste recycling (76%), utilization of organic waste (21%), and electricity generation (3%) (see Figure 1-21).




Source: Thailand State of Pollution Report 2015

Figure 1-21: Amount of waste generated, utilized, and correctly disposed (million tons): 2011-2015

Hazardous waste refers to hazardous waste generate by communities, industrial activities, and infectious waste. In 2015, it was estimated that 3.445 Mt of hazardous waste was generated nationwide, an increase of 0.752 Mt (28%) from the amount in 2014. From that amount, 81% (or 2.8 Mt) was industrial hazardous waste, approximately 17% (0.591 Mt) was household hazardous waste (including electrical and electronic equipment waste), while 2% (0.054 Mt) was infectious waste. The recorded amount of hazardous and non-hazardous industrial waste sent for disposal outside of factories showed that 0.97 Mt of hazardous waste (34.6%) was managed. Most infectious waste was disposed of using waste incinerators, but the waste from small-scale hospitals might have been inappropriately treated as MSW.

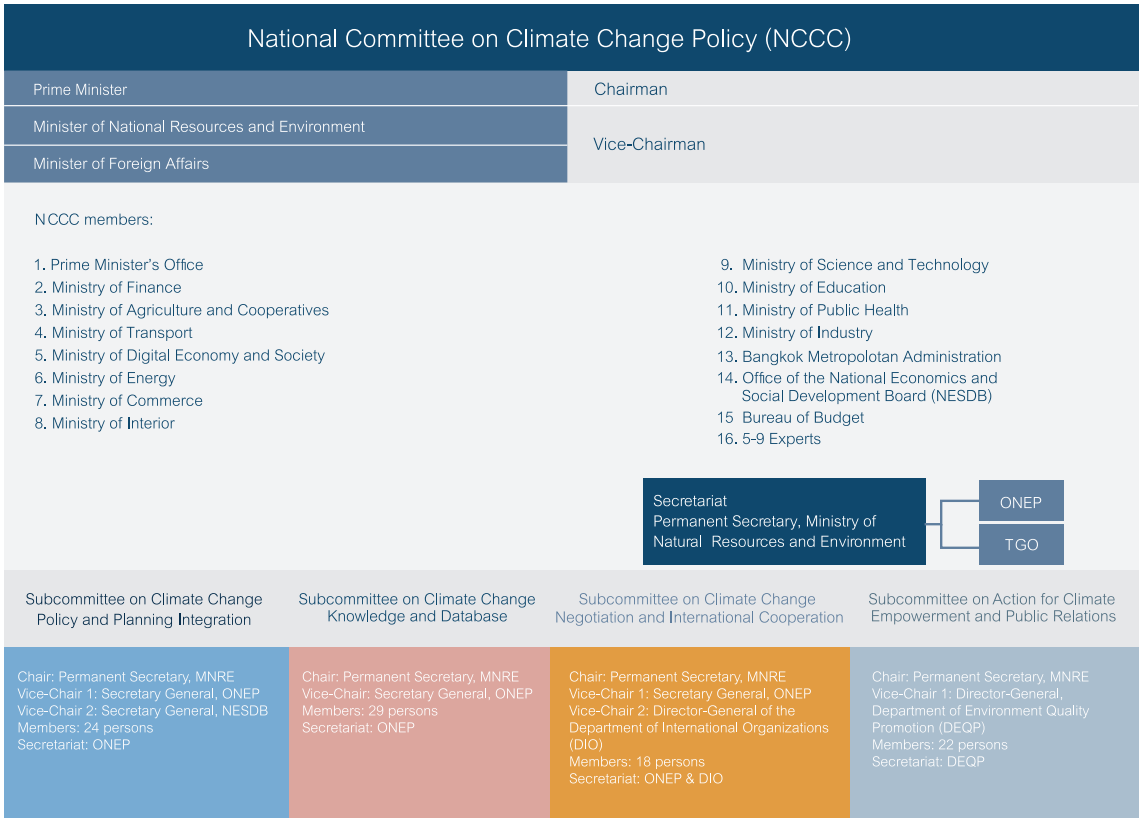
## 1.6 INSTITUTIONAL ARRANGEMENTS

### 1.6.1 National Committee on Climate Change (NCCC)

The Government has established the National Committee on Climate Change Policy (NCCC), chaired by the Prime Minister. The NCCC is responsible for (i) national climate change policy and strategy; (ii) determination of national positions in international negotiations under the UNFCCC and any relevant international agreements; and (iii) monitoring and evaluating implementation results of government agencies, as stated in the national policy and strategy. There are four sub-committees under the NCCC (Figure 1-22), namely, the Sub-Committee on Climate Change Policy and Planning Integration, the Sub-Committee on Climate Change Knowledge and Database, the Sub-Committee on Climate Change Negotiation and International Cooperation, and the Sub-Committee on Action for Climate Empowerment and Public Relations. The latter has been revised from its previous structure. Under the Climate Change Knowledge and Database Sub-Committee, 5 sectoral working groups were set up to review the GHG inventory and provide recommendations on which Measurement, Reporting, and Verification (MRV) systems are suitable for the country.

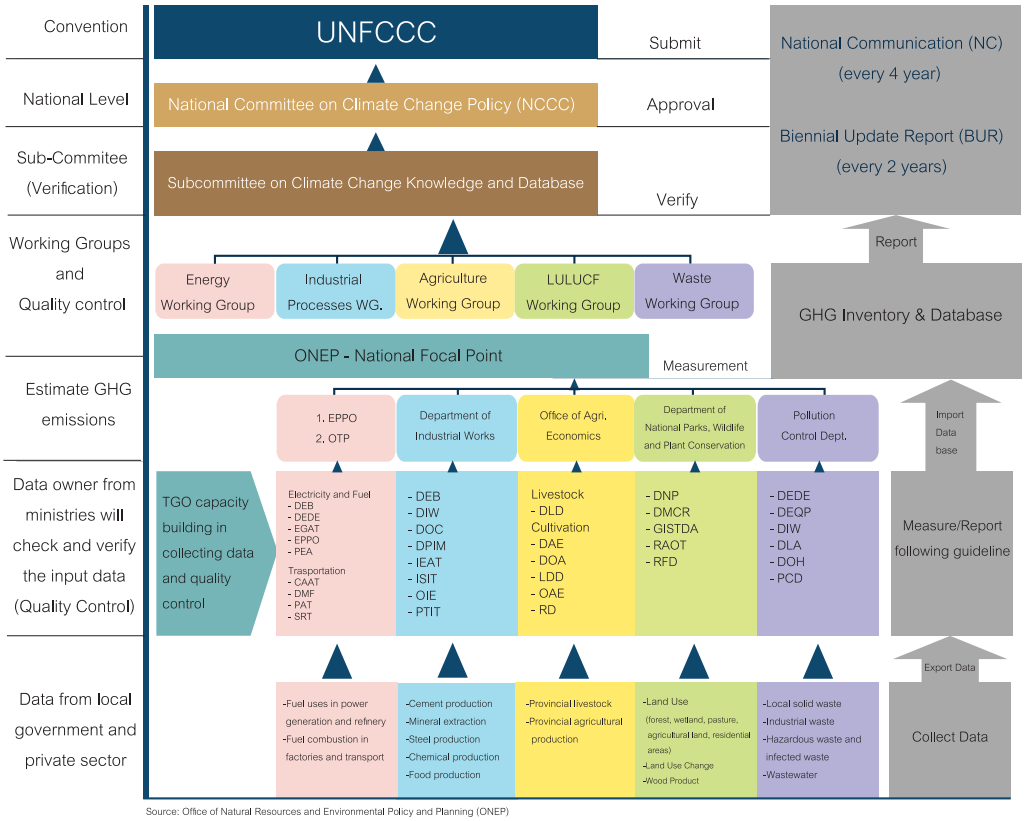
### 1.6.2 Institutional Arrangements for Greenhouse gas inventory preparation

The ONEP established a GHG inventory system to prepare BURs in 2015. The process of preparing the GHG inventory consists of five steps. First, the lead agencies of five economic sectors (namely energy, industrial processes, agriculture, LULUCF, and waste) compiled activity data from related agencies (e.g., agencies under their supervisors, local government, and the private sector). Second, lead agencies check and verify the data (QA) before submitting them to ONEP. Third, ONEP and expert teams estimate GHG emissions for all sectors based on the data provided by the lead agencies. Fourth, the results of this GHG emission estimation are submitted to five working groups: the appointed representatives of the five sectors. Each working group of related agencies reviews the methodology of the GHG emission estimation as part of quality control to ensure that the GHG emission estimates of their sectors are valid, accurate, and complete. After the GHG emissions have been approved by the five working groups, GHG inventories of the 5 sectors are submitted as part of the BUR to the Climate Change Knowledge and Database Sub-Committee for verification. Then, in the final step, as secretariat of the NCCC, ONEP will submit the BUR to the NCCC for approval before submitting it to the UNFCCC.




Sourec: Office of Natural Resources and Environmental Policy and Planning (ONEP)

Figure 1-22: Structure of the National Committee on Climate Change Policy




Source: Office of Natural Resources and Environmental Policy and Planning (ONEP)

| | | | |
|---|---|---|---|
| CAAT | = The Civil Aviation Authority of Thailand | IEAT | = Industrial Estate Authority of Thailand |
| DAE | = Department of Agricultural Extension | ISIT | = Iron and Steel Institute of Thailand |
| DEB | = Department of Energy Business | LDD | = Land Development Department |
| DEDE | = Department of Alternative Energy Development and Efficiency | OAE | = Office of Agricultural Economics |
| DEQP | = Department of Environmental Quality Promotion | OIE | = Office of Industrial Economics |
| DIW | = Department of Industrial Works | ONEP | = Office of Natural Resources and Environmental Policy and Planning |
| DLA | = Department of Local Administration | OTP | = Office of Transport and Traffic Policy and Planning |
| DLD | = Department of Livestock Development | PAT | = Port Authority of Thailand |
| DMCR | = Department of Marine and Coastal Resources | PCD | = Pollution Control Department |
| DMF | = Department of Mineral Fuels | PEA | = Provincial Electricity Authority |
| DNP | = Department of National Parks, Wildlife and Plant Conservation | PTIT | = Petroleum Institute of Thailand |
| DOA | = Department of Agriculture | RAOT | = Rubber Authority of Thailand |
| DOC | = Department of Customs | RD | = Rice Department |
| DOH | = Department of Health | RFD | = Royal Forest Department |
| DPIM | = Department of Primary Industries and Mines | RID | = Royal Irrigation Department |
| EGAT | = Electricity Generating Authority of Thailand | SRT | = State Railway Authority of Thailand |
| EPPO | = Energy Policy and Planning Office | | |
| GISTDA | = Geo-Informatics and Space Technology Development Agency (Public Organization) | | |

Figure 1-23: Preparation Structure National Communication and Biennial Update Report

CHAPTER 2:

# National Greenhouse Gas Inventory

# CHAPTER 2

# NATIONAL GREENHOUSE GAS INVENTORY

## 2.1 INVENTORY PROCESS IN THAILAND

Thailand's GHG inventory was compiled and submitted in line with Article 4.1(a) of the Convention in accord with Article 12: national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol. This inventory report was prepared to the extent of the country's capabilities using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), agreed by the Conference of the Parties (COP). This inventory report presents Thailand's national GHG emissions by sources, and removals by sinks, of all GHG emissions from 2000 to 2013. The GHG emissions estimated in this report include direct emission ($CO_2$, $CH_4$, and $N_2O$) and indirect emission ($NO_X$, CO, NMVOCs, and $SO_2$).

### 2.1.1 Methodology of Calculation of GHG Emission and Removals

All the methodologies and tools used for GHG inventory reporting followed the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997) Good Practice Guidance, and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The methodology used were from Tier 1 to Tier 2, wherever activity data and country-specific emission factors were available. In this inventory report, Tier 1 was adopted for all activity data in the energy and industrial processes sectors; however, Tier 2 was adopted for the agriculture, LULUCF, and waste sectors. GHG emissions from the energy and industrial processes sectors were calculated using default emission factors provided in the IPCC Guidelines. Country specific emission factors were used for some sub-sectors of waste, LULUCF, and agriculture sectors, as available. Table 2-1 is a summary table of the methods and emission factors used in this inventory report.

**Table 2-1** Summary of methods and emission factors.

| Greenhouse gas source and sink categories | $CO_2$ | | $CH_4$ | | $N_2O$ | | $NO_x$ | | CO | | NMVOCs | | $SO_2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor | Method applied | Emission factor |
| 1. Energy | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| A Fuel Combustion Activities | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| 1 Energy Industries | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| 2. Manufacturing Industries and Construction | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| 3. Transport | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| 4. Other Sectors | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| B. Fugitive Emissions from Fuels | | | T1 | D | | | | | | | | | | |
| 1. Solid Fuels | | | T1 | D | | | | | | | | | | |
| 2. Oil and Natural Gas | | | T1 | D | | | | | | | | | | |
| 2. Industrial Processes | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| A. Mineral Products | T1 | D | | | | | | | | | T1 | D | T1 | D |
| B. Chemical Industry | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| C. Metal Production | T1 | D | | | | | T1 | D | T1 | D | T1 | D | T1 | D |
| D. Others Production | T1 | D | | | T1 | D | T1 | D | T1 | D | T1 | D | T1 | D |
| E. Production of Halocarbons and Sulphur Hexafluoride | | | | | | | | | | | | | | |
| F. Consumption of Halocarbons and Sulphur Hexafluoride | | | | | | | | | | | | | | |
| 3. Agriculture | | | T1, T2 | CS, D | T1, T2 | D | T1, T2 | D | T1, T2 | D | | | | |
| A. Enteric Fermentation | | | T1, T2 | CS, D | | | | | | | | | | |
| B. Manure Management | | | T1, T2 | CS, D | T2 | D | | | | | | | | |
| C. Rice Cultivation | | | T2 | CS | | | | | | | | | | |
| D. Agricultural Soils | | | | | T1 | D | | | | | | | | |
| E. Prescribed Burning of Savannas | | | | | | | | | | | | | | |
| F. Field Burning of Corp Residues | | | T1, T2 | D | T1, T2 | D | T1, T2 | D | T1, T2 | D | | | | |
| 4. Land Use, Land-Use Change & Forestry (LULUCF) | T1, T2 | CS, D | T1, T2 | D | T1, T2 | D | T1, T2 | D | T1, T2 | D | | | | |
| A. Change in Forest and Other Woody Biomass Stocks | T2 | CS | | | | | | | | | | | | |
| B. Forest and Grassland Conversion | T1, T2 | CS, D | T1, T2 | D | T1, T2 | D | T1, T2 | D | T1, T2 | D | | | | |
| C. Abandonment of Management Land | T1, T2 | CS, D | | | | | | | | | | | | |
| D. $C_2O$ Emission and Removal Soils | | | | | | | | | | | | | | |
| 5. Waste | T1, T2 | CS, D | T1, T2 | CS, D | T1, T2 | CS, D | | | | | | | | |
| A. Solid Waste Disposal on Land | | | T2 | CS, D | | | | | | | | | | |
| B. Wastewater Handling | | | T1 | D | T1 | CS, D | | | | | | | | |
| C. Waste Incineration | T1, T2 | CS, D | | | T1, T2 | CS, D | | | | | | | | |

Note: T1 = Tier 1
T2 = Tier 2
T3 = Tier 3
CS = Country specific
D = IPCC default

According to Decision 17/CP.8, for aggregated GHG emissions and removal, expressed in $CO_2$ equivalents, Global Warming Potential (GWP) was recommended and the use of GWP was provided by the IPCC in its Second Assessment Report (1995 IPCC GWP Values) based on the effects of GHGs over a 100-year time horizon.

## 2.1.2 Uncertainty Analysis

An uncertainty analysis aims to provide information on where inventory resources should be allocated in order to improve inventory quality. Inventories prepared in accord with Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), will typically contain a wide range of emission calculations. In this report, Tier 1 uncertainty analysis of the aggregated figures was used following the IPCC Good Practice Guidance. The uncertainties in total emissions, based on IPCC guidance for both excluding and including emissions and removals from the LULUCF sector, are presented in Table 2-2. The overall uncertainty when excluding the LULUCF sector ranged from 5.04 to 5.63 %.

**Table 2-2** Overall uncertainty of excluding and including the LULUCF

Unit: Percentage

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Excl. LULUCF | 5.34 | 5.16 | 5.16 | 5.37 | 5.16 | 5.04 | 5.15 | 5.43 | 5.39 | 5.63 | 5.50 | 5.51 | 5.45 | 5.54 |
| Incl. LULUCF | 11.05 | 11.21 | 10.47 | 11.09 | 12.10 | 20.30 | 20.76 | 21.35 | 22.93 | 23.54 | 23.66 | 24.43 | 28.06 | 29.29 |

## 2.1.3 Key Category Analysis

A key category analysis (KCA) presents the importance of emission sources and sinks. The key categories are the emission sources and sinks that contribute 95% of the total annual emissions when ranked from greatest to least. A key source has a significant influence on the national inventory of direct GHG emissions in terms of the absolute level. The KCA reported in this inventory follows the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), and is estimated for both level and trend assessment. The results for the level assessment in 2013 are presented in Table 2-3, and trend assessment in Table 2-4. There are 15 key categories in the level assessment, among which public electricity and heat production led the KCA, followed by changes in forest and other woody biomass stocks, road transportation, manufacturing industries and construction, and rice cultivation. Results of the KCA changed slightly under trend assessment, where the public electricity and heat production still dominated, but were followed by road transportation, manufacturing industries and construction, rice cultivation, and abandonment of managed lands.

**Table 2-3** Key category analysis for the year 2013: Approach 1 – Level assessment

| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| IPCC category code | IPCC category | GHG | 2013 Ex,t (Gg $CO_2$eq) | 2013 \|Ex,t\| (Gg $CO_2$eq) | Lx,t | Cumulative Total of Column F |
| *1A1a* | Public Electricity and Heat Production | $CO_2$ | 88,089.54 | 88,089.54 | 20.38 | 20.38 |
| 5A | Changes in Forest and Other Woody Biomass Stocks | $CO_2$ | -83,385.22 | 83,385.22 | 19.29 | 39.67 |
| *1A3b* | Road Transportation | $CO_2$ | 58,646.11 | 58,646.11 | 13.57 | 53.24 |
| *1A2* | Manufacturing Industries and Construction | $CO_2$ | 45,690.41 | 45,690.41 | 10.57 | 63.81 |
| 4C | Rice Cultivation | $CH_4$ | 27,862.90 | 27,862.90 | 6.45 | 70.26 |
| 2A | Mineral Products | $CO_2$ | 18,591.18 | 18,591.18 | 4.30 | 74.56 |
| 5C | Abandonment of Managed Lands | $CO_2$ | -16,451.66 | 16,451.66 | 3.81 | 78.36 |
| 5B | Forest and Grassland Conversion | $CO_2$ | 13,330.14 | 13,330.14 | 3.08 | 81.45 |
| 4D | Agricultural Soils | $N_2O$ | 11,687.34 | 11,687.34 | 2.70 | 84.15 |
| 1A4c | Agriculture/Forestry/Fishing | $CO_2$ | 11,398.75 | 11,398.75 | 2.64 | 86.79 |
| 1A1b | Petroleum Refining | $CO_2$ | 9,954.94 | 9,954.94 | 2.30 | 89.09 |
| 1B2b | Natural Gas | $CH_4$ | 9,397.52 | 9,397.52 | 2.17 | 91.27 |
| 4A | Enteric Fermentation | $CH_4$ | 6,004.73 | 6,004.73 | 1.39 | 92.66 |
| 6B | Wastewater Handling | $CH_4$ | 5,347.83 | 5,347.83 | 1.24 | 93.89 |
| 6A | Solid Waste Disposal on Land | $CH_4$ | 5,346.02 | 5,346.02 | 1.24 | 95.13 |

**Table 2-4** Key category analysis for the year 2013: Approach 2 – Trend assessment

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| IPCC category code | IPCC category | GHG | 2000 Ex,0 (Gg $CO_2$eq) | 2013 Ex,t (Gg $CO_2$eq) | Tx,t | % Contribution to Trend | Cumulative Total of Column G |
| *1A1a* | Public Electricity and Heat Production | $CO_2$ | 57,873.29 | 88,089.54 | 7.13 | 21.05 | 21.05 |
| *1A3b* | Road Transport | $CO_2$ | 45,452.68 | 58,646.11 | 5.64 | 16.65 | 37.69 |
| 1A2 | Manufacturing Industries and Construction | $CO_2$ | 30,733.62 | 45,690.41 | 3.79 | 11.19 | 48.88 |
| 4C | Rice Cultivation | $CH_4$ | 22,304.74 | 27,862.90 | 2.77 | 8.18 | 57.06 |
| 5C | Abandonment of Managed Lands | $CO_2$ | - 20,832.02 | -16,451.66 | 2.59 | 7.65 | 64.71 |
| 5B | Forest and Grassland Conversion | $CO_2$ | 15,962.62 | 13,330.14 | 2.01 | 5.93 | 70.64 |
| 2A | Mineral Products | $CO_2$ | 13,765.49 | 18,591.18 | 1.70 | 5.03 | 75.67 |
| 5A | Changes in Biomass Stocks | $CO_2$ | -7,618.66 | -83,385.22 | 1.23 | 3.64 | 79.31 |
| 4D | Agricultural Soils | $N_2O$ | 8,421.93 | 11,687.34 | 1.04 | 3.08 | 82.38 |
| 4A | Enteric Fermentation | $CH_4$ | 7,164.27 | 6,004.73 | 0.90 | 2.66 | 85.04 |
| *1A1b* | Petroleum Refining | $CO_2$ | 6,900.49 | 9,954.94 | 0.85 | 2.52 | 87.56 |
| *1A4c* | Agriculture/Forestry/Fishing | $CO_2$ | 6,708.60 | 11,398.75 | 0.82 | 2.43 | 89.98 |
| 6B | Wastewater Handling | $CH_4$ | 5,310.61 | 5,347.83 | 0.66 | 1.96 | 91.95 |
| *1B2b* | Natural Gas | $CH_4$ | 4,523.00 | 9,397.52 | 0.57 | 1.67 | 93.62 |
| *1A4b* | Residential | $CO_2$ | 4,330.83 | 5,069.95 | 0.54 | 1.59 | 95.21 |

### 2.1.4 Time Series Consistency

Under this inventory, the activity data for each source category were drawn from the same sources as the national statistics for all years (2000–2013), and the same emission factors were used, following the Revised 1996 IPCC Guidelines. Thus, the inventory allows a consistent time series to be built with good confidence in the emission trends..

### 2.1.5 Quality Assurance and Quality Control

As defined in the IPCC Guidelines, quality control (QC) and quality assurance (QA) procedures were implemented during the preparation of this inventory. In addition, under Thailand's Institutional Arrangements and Inventory Preparation, Thailand utilized its own national system for quality control (QC) of data collection among the ministerial agencies (Figure 1-23). All data were controlled, at each stage of the data collection process, by the respective institute until the final quality assurance process by the lead agency of each sector.

### 2.1.6 Completeness Assessment

The assessment of completeness of the inventory was conducted, following the IPCC guidelines, within each source category. Results of the assessment for the Energy and Industrial Processes sectors are presented in Table 2-5. The following notation keys are used in the assessment.

- NA Not Applicable
- NO Not Occurring
- NE Not Estimated
- EE Estimated Elsewhere

**Table 2-5** National greenhouse gas inventory of Thailand, 2013

Unit: Gg

| Greenhouse gas source and sink categories | $CO_2$ emissions | $CO_2$ removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOCs | $SO_2$ |
|---|---|---|---|---|---|---|---|---|
| Total national emissions and removals | 286,170 | -130,654 | 2,852 | 55 | 1,351 | 7,037 | 828 | 573 |
| 1. Energy | 223,309 | NO | 586 | 4 | 1,289 | 5,531 | 583 | 553 |
| A. Fuel Combustion Activities | 223,309 | | 104 | 4 | 1,289 | 5,531 | 583 | 553 |
| 1. Energy Industries | 98,044 | | 6 | 1 | 289 | 164 | 14 | 57 |
| 2. Manufacturing Industries and Construction | 45,690 | | 13 | 2 | 167 | 1,318 | 23 | 433 |
| 3. Transport | 60,684 | | 17 | 0 | 611 | 2,305 | 424 | 7 |
| 4. Other Sectors | 18,890 | | 68 | 1 | 223 | 1,745 | 122 | 56 |
| B. Fugitive Emissions from Fuels | NO | | 482 | | NO | NO | NO | NO |
| 1. Solid Fuels | | | 32 | | NO | NO | NO | NO |
| 2. Oil and Natural Gas | | | 450 | | NO | NO | NO | NO |
| 2. Industrial Processes | 18,609 | NO | 10 | 1 | 1 | 7 | 244 | 20 |
| A. Mineral Products | 18,591 | | | | 0 | NA | 8 | 14 |
| B. Chemical Industry | | | 10 | 1 | 0 | 3 | 79 | 1 |
| C. Metal Production | 18 | | NA | NA | 0 | 0 | 0 | 0 |
| D. Others Production | NA | | | | 1 | 4 | 157 | 5 |
| E. Production of Halocarbons and Sulphu Hexafluoride | | | | | | | | |
| F. Consumption of Halocarbons and Sulphur Hexafluoride | | | | | | | | |
| 3. Solvent and other product use | NA | | | NA | | | NA | |
| 4. Agriculture | | | 1,730 | 47 | 56 | 1,345 | NA | NA |
| A. Enteric Fermentation | | | 286 | | | | | |
| B. Manure Management | | | 53 | 8 | | | NA | |
| C. Rice Cultivation | | | 1,327 | | | | NA | |
| D. Agricultural Soils | | | NA | 38 | | | NA | |
| E. Prescribed Burning of Savannas | | | NO | NO | NO | NO | NA | |
| F. Field Burning of Corp Residues | | | 64 | 2 | 56 | 1,345 | NA | |
| 5. Land Use, Land - Use Change and Forestry (LULUCF) | 44,147 | -130,654 | 18 | 1 | 4 | 153 | | |
| A. Change in Forest and Other Woody Biomass Stocks | 30,817 | -114,202 | | | | | | |
| B. Forest and Grassland Conversion | 13,330 | | 18 | 0.12 | 4 | 153 | | |
| C. Abandonment of Managed Lands | | -16,452 | | | | | | |
| D. $CO_2$ Emission and Removal Soils | NE | NE | | | | | | |
| 6. Waste | 104 | | 509 | 3 | NO/NA | NO/NA | NA | NA |
| A. Solid Waste Disposal on Land | | | 255 | | | | NA | |
| B. Wastewater Handling | | | 255 | 3 | NO | NO | NA | |
| C. Waste Incineration | 104 | | NA | 0 | NA | NA | NA | NA |
| 7. Other (please specify) | NA | NA | NA | NA | NA | NA | NA | NA |
| Memo Items | | | | | | | | |
| International Bunkers | NA | | NA | NA | NA | NA | NA | NA |
| International Aviation | NA | | NA | NA | NA | NA | NA | NA |
| International Water-Borne Navigation | NA | | NA | NA | NA | NA | NA | NA |
| $CO_2$ emission from biomass | NA | | | | | | | |

## 2.2 KEY FINDINGS FROM THE NATIONAL GHG INVENTORY

In this report, covering the trends of Thailand's GHG emissions for the period 2000 to 2013, all emission sources and removals followed the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997). Emissions were estimated for the energy, industrial processes, agriculture, LULUCF, and waste sectors. Emissions in the solvent and other product use sector were not estimated due to insufficient activity data. The emissions are presented in the form of direct and indirect GHGs and sulphur dioxide ($SO_2$). Direct GHGs consist of carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$); whereas indirect GHGs consist of nitrogen oxides ($NO_x$), carbon monoxide (CO), and non-methane volatile organic compounds (NMVOCs).

### 2.2.1 Trend of Thailand's GHG emissions from 2000 to 2013

During 2000–2013, total emissions (excluding those from the LULUCF sector) increased from 226,086 $GgCO_2eq$ in 2000 to 318,662 $GgCO_2eq$ in 2013. The net removal of $CO_2$ increased from 11,995 $GgCO_2eq$ in 2000 to 86,102 $GgCO_2eq$ in 2013. Therefore, the net GHG emission increased from 214,091 $GgCO_2eq$ in 2000 to 232,560 $GgCO_2eq$ in 2013, with annual increase of 0.64%. With the inclusion of the LULUCF sector, the net emission in 2013 increased by 8.63% when compared with the net emission in 2000 (Table 2-6 and Figure 2-1). The major source of GHG emissions was the energy sector, which increased from 161,005 $GgCO_2eq$ in 2000 to 236,936 $GgCO_2eq$ in 2013, an increase of 47.16%.

**Table 2-6** National GHG emissions/removals by sector: 2000–2013

Unit: Gg $CO_2eq$

| Year | Source category | | | | | Net emissions |
|---|---|---|---|---|---|---|
| | Energy | Industrial processes | Agriculture | LULUCF | Waste | |
| 2000 | 161,005 | 14,086 | 41,906 | -11,995 | 9,089 | 214,091 |
| 2001 | 168,939 | 16,389 | 43,208 | -7,718 | 9,767 | 230,585 |
| 2002 | 178,226 | 18,661 | 41,845 | -20,183 | 11,066 | 229,615 |
| 2003 | 188,039 | 16,215 | 45,350 | -20,987 | 12,282 | 240,899 |
| 2004 | 204,007 | 17,423 | 44,931 | -17,254 | 12,772 | 261,879 |
| 2005 | 209,214 | 19,235 | 46,294 | -51,551 | 12,985 | 236,177 |
| 2006 | 210,752 | 20,085 | 46,398 | -53,467 | 13,749 | 237,517 |
| 2007 | 215,955 | 20,008 | 50,979 | -60,521 | 14,113 | 240,535 |
| 2008 | 218,180 | 18,800 | 50,997 | -65,341 | 15,050 | 237,686 |
| 2009 | 218,646 | 18,650 | 52,238 | -66,690 | 14,925 | 237,769 |
| 2010 | 230,364 | 18,698 | 52,316 | -65,262 | 13,542 | 249,658 |
| 2011 | 229,886 | 18,690 | 52,927 | -70,938 | 12,769 | 243,334 |
| 2012 | 240,001 | 19,039 | 55,682 | -84,839 | 10,058 | 239,941 |
| 2013 | 236,936 | 18,977 | 50,919 | -86,102 | 11,830 | 232,560 |

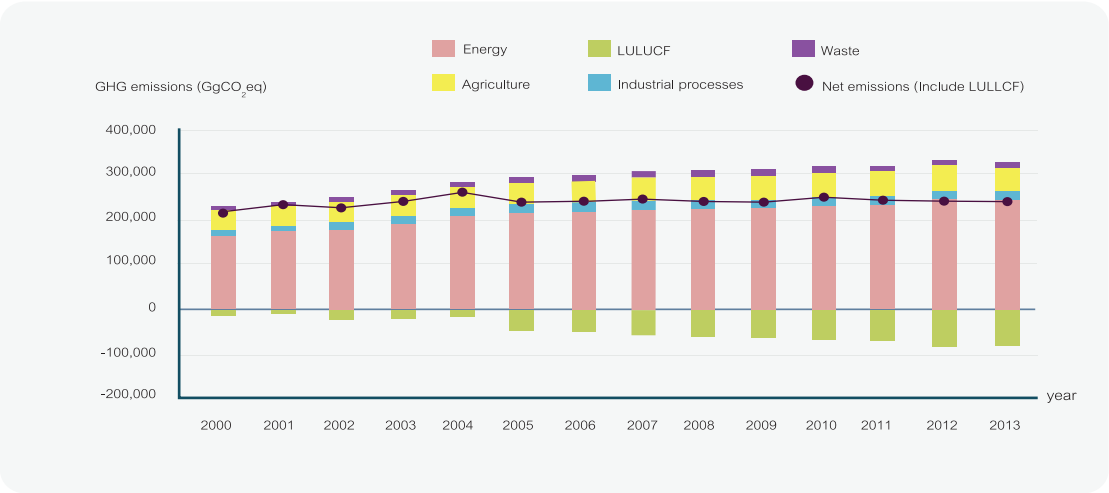



Figure 2-1: Trends of GHG emissions/removals: 2000–2013

The proportion of GHG emissions in the energy sector accounted for 71.21% of the national net emissions in 2000, and increased by 74.35% in 2013. On the other hand, and in the same period, emissions in the agriculture sector decreased from 18.54% in 2000 to 15.98% in 2013, Emissions in the industrial processes sector remained constant (Figure 2-2).

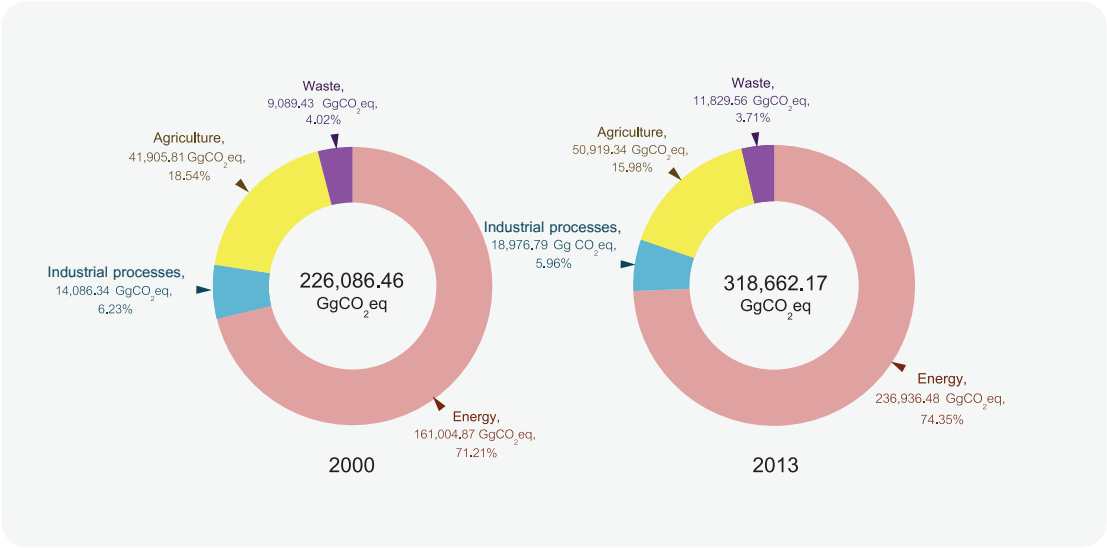



Figure 2-2: Total GHG emissions by sector: 2000–2013

## 2.2.2 Trend of indirect GHG emissions

This section concludes the trends of indirect GHG emissions and $SO_2$. The indirect GHG emissions were $NO_x$, CO, and NMVOCs. These 4 gases were included and reported here, but they were not included in the national inventory. Emissions of these gases for the period 2000 to 2013 are given in Table 2-7. Emissions of CO increased from 5,180 Gg in 2000 to 7,037 Gg in 2013. Thus, CO accounted for an increase of 1,857 Gg in that period, followed by $NO_x$ (increase of 413 Gg), and NMVOCs (increase of 251 Gg).

**Table 2-7** Indirect GHG emissions by gas and $SO_2$: 2000 – 2013

Unit: Gg

| Year | Indirect Gases | | | |
|---|---|---|---|---|
| | $NO_x$ | CO | NMVOCs | $SO_2$ |
| 2000 | 938 | 5,180 | 577 | 601 |
| 2001 | 987 | 5,312 | 597 | 650 |
| 2002 | 1,037 | 5,453 | 638 | 698 |
| 2003 | 1,108 | 5,811 | 811 | 627 |
| 2004 | 1,199 | 6,100 | 1,525 | 730 |
| 2005 | 1,204 | 5,752 | 1,938 | 783 |
| 2006 | 1,198 | 5,984 | 2,447 | 721 |
| 2007 | 1,230 | 6,174 | 848 | 649 |
| 2008 | 1,223 | 6,287 | 745 | 658 |
| 2009 | 1,247 | 6,402 | 771 | 627 |
| 2010 | 1,290 | 6,671 | 781 | 655 |
| 2011 | 1,318 | 6,761 | 821 | 661 |
| 2012 | 1,364 | 6,792 | 821 | 549 |
| 2013 | 1,351 | 7,037 | 828 | 573 |
| % Change 2000-2013 | 44.03% | 35.85% | 43.50% | -4.67% |

## 2.2.3 Recalculations

The previous inventories submitted in the SNC were recalculated to provide a consistent series. Recalculations were performed for past inventories (2000–2004) to establish consistency for the years 2005 and 2013. The emissions for the period 2000–2004 were recalculated with updated activity data and revised emission factors. The results of these recalculations of national GHG emissions for the years 2000 to 2004 are presented in Figure 2-3.

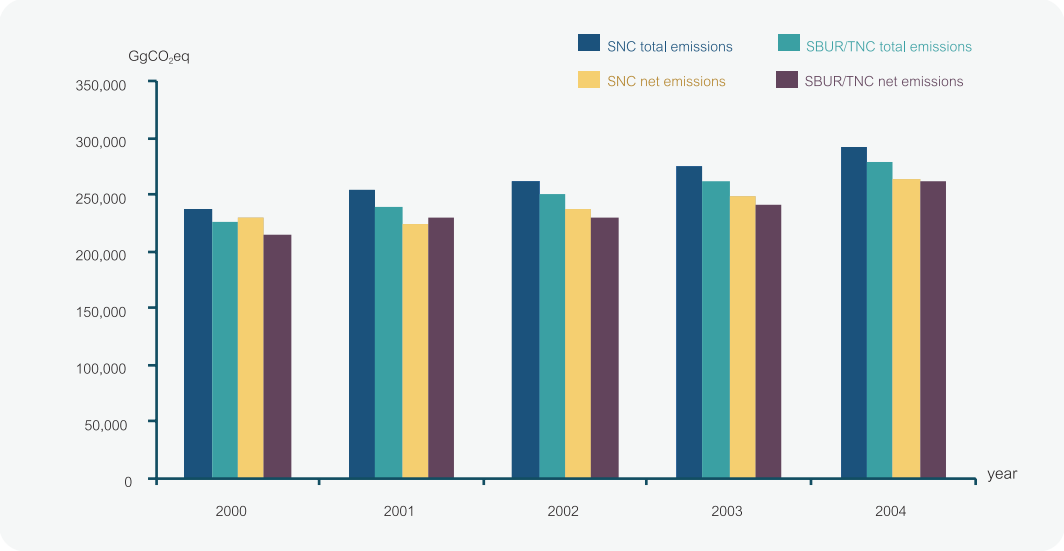



Figure 2-3: Comparison of Thailand's GHG emissions between SNC and present inventories

## 2.3 GREENHOUSE GAS EMISSIONS BY SECTOR

### 2.3.1 Energy Sector

The majority of GHG emissions in the energy sector arose from fuel combustion, mostly for production of public electricity and heat, and accounted for about 98,537.77 $GgCO_2eq$ (41.59%). GHG emission from transportation, and manufacturing and construction, were 61,175.42 $GgCO_2eq$ (25.82%) and 46,537.39 $GgCO_2eq$ (19.64%), respectively. Fugitive Emission from fuels only emitted 10,123.99 $GgCO_2eq$, a little over 4% of total GHG emissions from the energy sector. Details of GHG emissions from the energy sector by gas type and source in 2013 are presented in Table 2-8 and Figure 2-4.

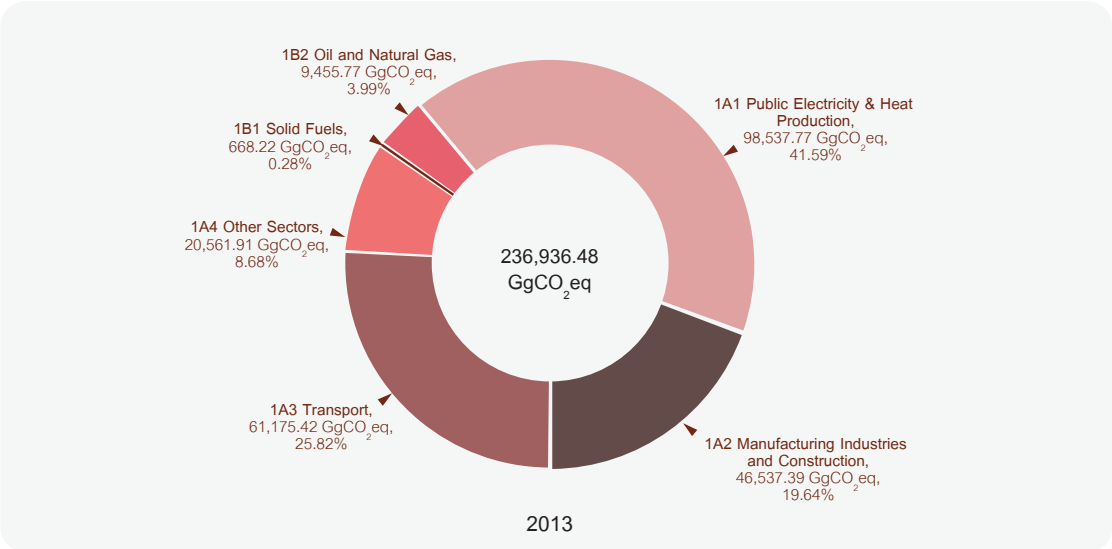



Figure 2-4: GHG emissions in the energy sector: 2013

**Table 2-8** GHG emissions from various sources relative to total GHG emissions in the energy sector: 2013

| Greenhouse gas source and sink categories | $CO_2$ emissions | $CO_2$ removals | $CH_4$ | | $N_2O$ | | $NO_x$ | CO | NMVOCs | $SO_2$ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | $GgCO_2eq$ | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | Gg | Gg | Gg | $GgCO_2eq$ |
| 1. Energy | 223,309.28 | NO | 585.73 | 12,300.43 | 4.28 | 1,326.77 | 1,289.47 | 5,531.48 | 583.44 | 553.24 | 236,936.48 |
| 1A Fuel Combustion | 223,309.28 | NO | 103.64 | 2,176.44 | 4.28 | 1,326.77 | 1,289.47 | 5,531.48 | 583.44 | 553.24 | 226,812.49 |
| 1A1 Public Electricity & Heat Production | 98,044.48 | NO | 5.83 | 122.43 | 1.20 | 370.86 | 288.55 | 164.16 | 14.05 | 56.94 | 98,537.77 |
| 1A2 Manufacturing Industries and Construction | 45,690.41 | NO | 13.48 | 283.05 | 1.82 | 563.92 | 167.06 | 1,317.57 | 23.28 | 433.41 | 46,537.39 |
| 1A3 Transport | 60,684.23 | NO | 16.74 | 351.50 | 0.45 | 139.69 | 611.01 | 2,304.76 | 423.98 | 6.81 | 61,175.42 |
| 1A4 Other Sectors | 18,890.15 | NO | 67.59 | 1,419.46 | 0.81 | 252.29 | 222.85 | 1,744.99 | 122.14 | 56.08 | 20,561.91 |
| 1B Fugitive Emissions from Fuels | NO | NO | 482.09 | 10,123.99 | NO | NO | NO | NO | NO | NO | 10,123.99 |
| 1B1 Solid Fuels | NO | NO | 31.82 | 668.22 | NO | NO | NO | NO | NO | NO | 668.22 |
| 1B2 Oil and Natural Gas | NO | NO | 450.27 | 9,455.77 | NO | NO | NO | NO | NO | NO | 9,455.77 |

Note: NO = Not Occurring

## 2.3.2 Industrial Processes Sector

Total direct GHG emissions from the industrial processes sector in 2013 were estimated to be 18,976.79 $GgCO_2eq$. The majority of GHG emissions in this sector is Mineral product accounted for about 18,591.18 $GgCO_2eq$ (97.97%). GHG emission from chemical industry and metal production were estimated to 367.72 $GgCO_2eq$ (1.94%) and 17.89 $GgCO_2eq$ (0.09) %, respectively. Details of direct and indirect GHG emissions in the industrial processes sector by gas type and source in 2013 are presented in Table 2-9 and Figure 2-5.

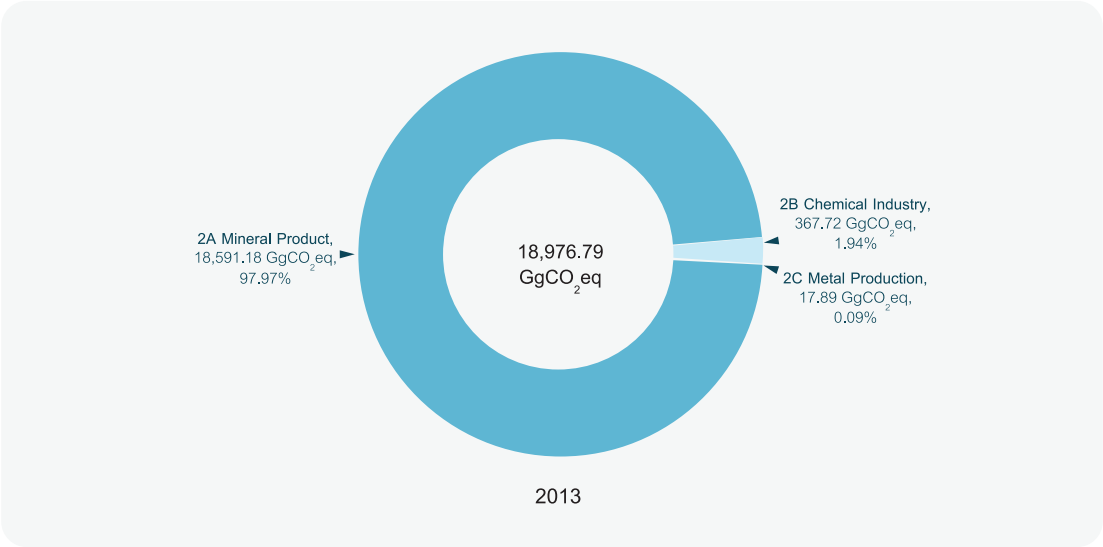



Figure 2-5: GHG emissions in the industrial processes sector: 2013

**Table 2-9** GHG emissions from the various sources relative to total GHG emissions in the industrial processes sector: 2013

| Greenhouse gas source and sink categories | $CO_2$ emissions | $CO_2$ removals | $CH_4$ | | $N_2O$ | | $NO_x$ | CO | NMVOCs | $SO_2$ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | $GgCO_2eq$ | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | Gg | Gg | Gg | $GgCO_2eq$ |
| 2. Industrial Processes | 18,609.07 | NO | 9.68 | 203.28 | 0.53 | 164.44 | 1.39 | 7.25 | 244.24 | 19.79 | 18,976.79 |
| 2A Mineral Product | 18,591.18 | | | | | | 0.18 | NA | 8.05 | 13.64 | 18,591.18 |
| 2A1 Cement Production | 18,377.68 | | | | | | 0.18 | | | 13.64 | 18,377.68 |
| 2A4 Soda Ash Production and Use | 213.50 | | | | | | | | 0.03 | | |
| 2A7 Glass Production | | | | | | | | | 8.02 | | |
| 2B Chemical Industry | | | 9.68 | 203.28 | 0.53 | 164.44 | | 3.26 | 79.47 | 1.01 | 367.72 |
| 2B2 Nitric Acid Production | | | | | 0.53 | 164.44 | | | | | |
| 2B5 Other Chemicals | | | 9.68 | 203.28 | | | | 3.26 | 79.47 | 1.01 | |
| 2C Metal Production | 17.89 | | NA | NA | | | 0.14 | 0.00 | 0.11 | 0.16 | 17.89 |
| 2C1 Iron and Steel | 17.89 | | | | | | 0.14 | 0.00 | 0.11 | 0.16 | |
| 2D Other Production | NA | | | | | | 1.07 | 3.99 | 156.62 | 4.98 | |
| 2D1 Pulp and Paper | | | | | | | 1.07 | 3.99 | 2.63 | 4.98 | |
| 2D2 Food and Drink | | | | | | | | | 153.99 | | |

Note: NA = Not Applicable , NO = Not occuring

### 2.3.3 Agriculture Sector

Total GHG emissions from the agriculture sector in 2013 were 50,919.34 $GgCO_2eq$. Enteric fermentation and manure management were estimated to have emitted 6,004.73 $GgCO_2eq$ (11.79%) and 3,538.60 $GgCO_2eq$ (6.95 %), respectively. Meanwhile, rice cultivation and agricultural soils were estimated to have emitted 27,862.90 $GgCO_2eq$ (54.72%) and 11,687.34 $GgCO_2eq$ (22.95 %), respectively. Field burning of crop residues contributed the least GHG emissions: 1,825.76 $GgCO_2eq$ (3.59%). Details of GHG emissions in the agriculture sector by gas type and source in 2013 are presented in Table 2-10 and Figure 2-6.

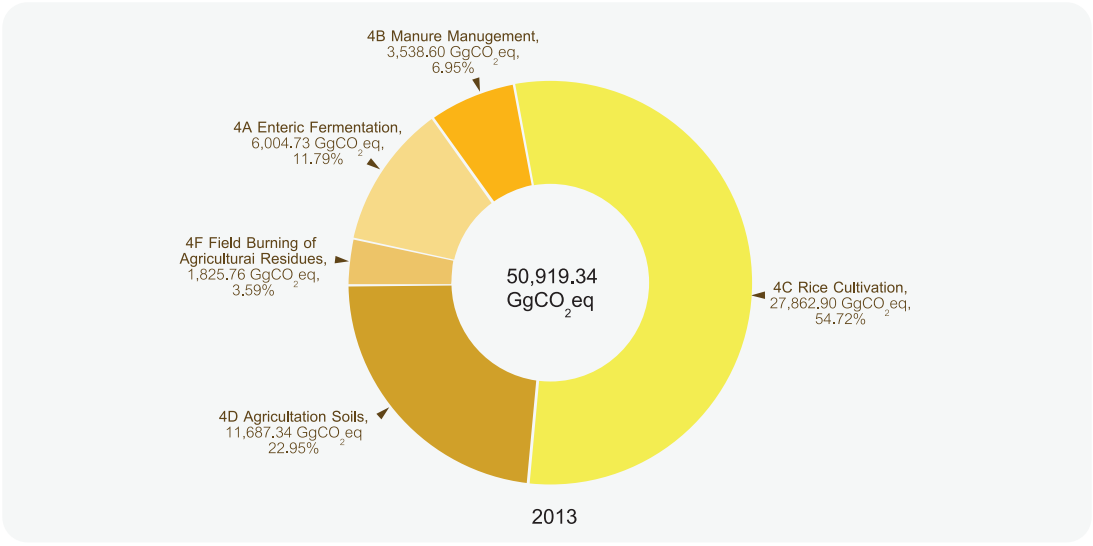



Figure 2-6: GHG emissions in the agriculture sector: 2013

**Table 2-10** GHG emissions from various sources relative to total GHG emissions in the agriculture sector: 2013

| Greenhouse gas source and sink categories | $CO_2$ emissions | $CH_4$ | | $N_2O$ | | $NO_x$ | CO | NMVOCs | $SO_2$ | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Unit | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | Gg | Gg | Gg | $GgCO_2eq$ |
| **4. Agriculture** | | **1,729.66** | **36,322.78** | **47.09** | **14,596.55** | **56.04** | **1,345.08** | **NA** | | **50,919.34** |
| 4A Enteric Fermentation | | 285.94 | 6,004.73 | | | | | | | 6,004.73 |
| 4B Manure Management | | 52.86 | 1,110.07 | 7.83 | 2,428.53 | | | NA | | 3,538.60 |
| 4C Rice Cultivation | | 1,326.80 | 27,862.90 | | | | | NA | | 27,862.90 |
| 4D Agricultural Soils | | NA | NA | 37.70 | 11,687.34 | | | NA | | 11,687.34 |
| 4E Prescribed Burning of Savannas | | NO | NO | NO | NO | NO | NO | NA | | |
| 4F Field Burning of Agricultural Residues | | 64.05 | 1,345.08 | 1.55 | 480.68 | 56.04 | 1,345.08 | NA | | 1,825.76 |

Note: NA = Not Applicable , NO = Not Occurring

## 2.3.4 Land Use, Land-Use Change, and Forestry

The LULUCF sector in Thailand showed a trend of increased net removal, because the total removals exceeded the total emissions. Since 2000, LULUCF activities contributed to net removal from the atmosphere, and in 2005, when rubber plantations were included in the calculation, a tremendous increase of $CO_2$ removal resulted. In 2013, the LULUCF sector contributed to net removal of 86,101.84 $GgCO_2eq$ (a six-fold increase compared with 2000). Details of GHG emissions in the LULUCF sector by gas type and source in 2013 are presented in Table 2-11 and Figure 2-7.

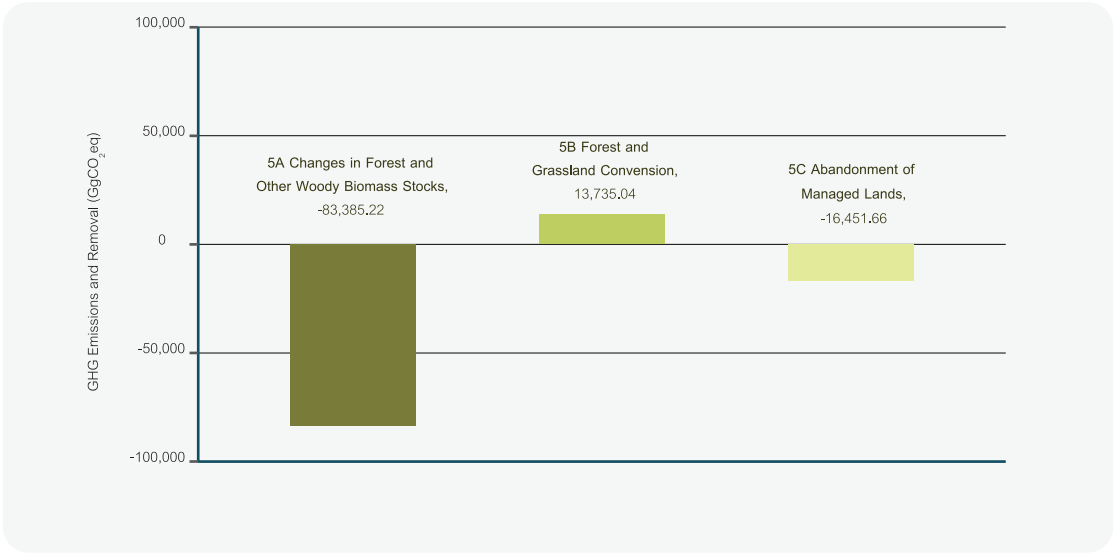



Figure 2-7: GHG emissions relative to the land use, land-use change, and forestry sector: 2013

**Table 2-11** GHG emissions from various sources relative to total GHG emissions in the land use, land-use change and forestry sector: 2013

| Greenhouse gas source and sink categories | $CO_2$ emissions | $CO_2$ removals | Net | $CH_4$ | | $N_2O$ | | $NO_x$ | CO | NMVOCs | $SO_2$ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | $GgCO_2eq$ | $GgCO_2eq$ | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | Gg | Gg | Gg | $GgCO_2eq$ |
| 5. Land Use, Land-Use Change and Forestry | 44,147.17 | -130,653.91 | -86,506.74 | 17.51 | 367.61 | 0.12 | 37.29 | 4.35 | 153.17 | NO | NO | -86,101.84 |
| 5A Changes in Forest and Other Woody Biomass Stocks | 30,817.03 | -114,202.25 | -83,385.22 | NO | NO | NO | NO | NO | NO | NO | NO | -83,385.22 |
| 5B Forest and Grassland Convention | 13,330.14 | | 13,330.14 | 17.51 | 367.61 | 0.12 | 37.29 | 4.35 | 153.17 | NO | NO | 13,735.04 |
| 5C Abandonment of Managed Lands | NO | -16,451.66 | -16,451.66 | NO | NO | NO | NO | NO | NO | NO | NO | -16,451.66 |
| 5D Change in Soil Carbon | NE | NE | NE | NO | NO | NO | NO | NO | NO | NO | NO | NE |

Notes: NE = Not Estimated , NO = Not Occurring

## 2.3.5 Waste

Almost all of the total GHG emissions in the waste sector was contributed by wastewater treatment estimated at 6,375.94 $GgCO_2eq$ (53.90%) and solid waste disposal on land estimated to be 5,346.02 $GgCO_2eq$ (45.19%). Waste incineration was estimated to contribute 107.61 $GgCO_2eq$ (0.91%) which was the smallest proportion of total GHG emissions in this sector. Details of GHG emissions in the waste sector by gas type and source in 2013, are given in Table 2-12 and Figure 2-8.

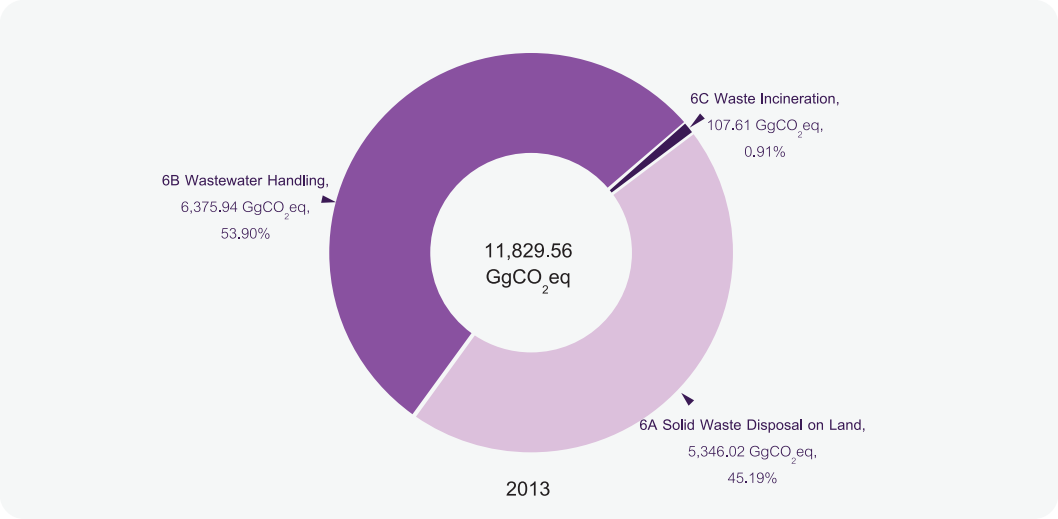



Figure 2-8: GHG emissions in the waste sector: 2013

**Table 2-12** GHG emissions from various sources relative to total GHG emissions in the waste sector: 2013

| Greenhouse gas source and sink categories | $CO_2$ emissions | $CH_4$ | | $N_2O$ | | $NO_x$ | CO | NMVOCs | $SO_2$ | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Unit | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | $GgCO_2eq$ | Gg | Gg | Gg | Gg | $GgCO2_eq$ |
| 6. Waste | 104.27 | 509.23 | 10,693.85 | 3.33 | 1,031.44 | NO/NA | NO/NA | NA | NA | 11,829.56 |
| 6A Solid Waste Disposal on Land | | 254.57 | 5,346.02 | | | | NA | NA | | 5,346.02 |
| 6A1 Landfill Site | | 206.26 | 4,331.52 | | | | NA | NA | | |
| 6A2 Open Dump | | 48.31 | 1,014.50 | | | | NA | NA | | |
| 6B Wastewater Handling | | 254.66 | 5,347.83 | 3.32 | 1,028.10 | NO | NO | NA | | 6,375.94 |
| 6B1 Industrial Wastewater | | 142.48 | 2,992.04 | | | NO | NO | NA | | |
| 6B2 Domestic Wastewater | | 112.18 | 2,355.79 | 3.32 | 1,028.10 | NO | NO | NA | | |
| 6C Waste Incineration | 104.27 | NA | NA | 0.01 | 3.34 | NA | NA | NA | NA | 107.61 |

Note: NA = Not Applicable , NO = Not Occurring

## 2.4 CONSTRAINTS, GAPS, AND NEEDS IN THE NATIONAL INVENTORY

As a developing country, Thailand has limitations, barriers, and constraints that affect the quality of its GHG inventory estimation and compilation. Improvement in the national statistics and reporting of activity data by the relevant agencies could improve the inventory quality. The country aims to improve inventory quality in terms of transparency, accuracy, completeness, consistency, and comparability. However, Thailand should, in particular, improve its inventory quality regarding two issues, namely activity data and emission factors. For example:

- Data collection on fuels used by end-users and technologies in the energy industries category should be improved to estimate emissions using Tier 2 or Tier 3 levels.
- Activity data on bio-fuel consumption should be improved and collected accurately by the relevant agencies.
- Country specific emission factors should be developed and introduced for the main fuels used in the country, including bio-fuels.
- Approaches need to be developed to collect activity data up to Tier 3 for manufacturing industries and the construction category for the benefit of both inventory quality and transparency in mitigation.

Thus, preparation of future GHG inventories calls for a series of improvements, some support from developed countries, and international funding. The process of estimating GHG emission and removal could be enhanced by international support in the forms of the following institutional and procedural improvements:

- Gradual transition to the 2006 IPCCC Guidelines for National Greenhouse Gas Inventories in all sectors and enhancing the professional capacities of national experts involved in the inventory process. Also needed is a transition from default EFs and Tier 1 methodologies to country-specific emission factors and Tier 2 and 3 methodologies, with particular focus on key categories.

So far, the national inventory in the energy sector has been relatively improved due to support from both bilateral and international organizations, including such as:

- In terms of GHG inventory improvement, the Department of the Environment and Energy Australia has supported the development of Thailand greenhouse gas emission inventory system (TGEIS), which will improve the management of Thailand's GHG inventory system in the near future;
- In the transport category, the Ministry of Transport via the Department of Land Transport Thailand is developing an approach to collect data on vehicle characteristics such as mileage, vehicle kilometer travelled (VKT), and fuel economy; and
- In the transport category, the Ministry of Transport via the Civil Aviation Authority of Thailand (CAAT) is developing an approach to collect data on fuel consumption for international aviation.

Regarding improvement in the industrial processes sector:

- An advanced technique to obtain activity and emission data is required to fill an information gap. A methodology is needed to obtain both activity and emission data in a higher tier by means of measurement or modeling. GHG estimation could improve to the IPCC2006 version, if this need were fulfilled.
- For the calculation of uncertainty, the default values for each subcategory were adopted. If a system for collection of activity data were developed, the uncertainty data calculation might be made more appropriate.
- Promoting understanding among industrial owners and other stakeholders about the significance of GHG estimation is the highest priority for supporting a new data collection,

Regarding improvement in the agriculture sector:

- For being routinely and more accurate GHG estimations and aiming to adopt the higher IPCC methodologies in the agriculture sector, needs are required for (i) improving systematic data collection, (ii) better understanding in the IPCC Guidelines for relevant government agencies, (iii) developing country-specific emission factors in some sub-sectors and (iv) improving the QA/QC procedure and uncertainty analysis. Hence, more research investigations and capacity buildings in these topics are of importance for the relevant agencies, e.g., technical trainings of systematic data collection and IPCC methodology for GHG estimation, together with techniques for data gap filling.

In the land use, land-use change, and forestry (LULUCF) sector:

- Steps are needed regarding activity data related to areas in the LULUCF sector involving multiple departments (i.e., Royal Forest Department and Forest Industry Organization) that report activity data in different formats that are not comparable.
- There is also a gap between public and private data, for instance, activity data on area planted and wood harvested by the private sector are not reported elsewhere. Thus, an approach must be developed for the private sector to report essential activity data.
- To provide more accurate GHG estimation, a change is needed in how forest area is classified into forest types.
- Due to limitation of information, some emission factors are adopted from IPCC defaults (i.e., biomass after land conversion, trace gases emission ratio, and uncertainty estimation), thus it is suggested that a new process for development of country-specific values should be established for the LULUCF sector.
- Development of an MRV system for the LULUCF sector is needed.

Regarding improvement in the waste sector:

- Technical issues need to be addressed, for example, (i) development of MRV systems for solid waste disposal on land, waste composition, wastewater handling (including domestic and industrial wastewater), estimation of carbon fraction and fossil fraction in incinerated waste; and (ii) development of country specific emission factors in the waste sector.
- Some cross cutting issues need to be addressed, for instance, (i) archiving procedures and plans; (ii) procedures for documentation of inventory data at the national level; (iii) development and implementation of a QA/QC system; and (iv) a process for assessing uncertainty.

CHAPTER 3:

# Information on Mitigation Actions

# CHAPTER 3

# INFORMATION ON MITIGATION ACTIONS

Thailand has made significant efforts as a signatory Party to implement the UNFCCC according to its capabilities. Through domestic support for the development of GHG mitigation actions during 2010 to 2013, Thailand has submitted its Nationally Appropriate Mitigation Actions (NAMAs). Since the submission of its NAMAs, several climate-change mitigation policies and measures have been put in place at the national level to fulfill Thailand's drive toward a resilient, low-carbon society, as stated in the 12th National Economic and Social Development Plan (NESDP), 2017-2021. The 12th NESDP supports Thailand's NAMAs and sustains efforts towards reduction of GHGs by 7–20 % in 2020.

## 3.1 GHG EMISSION MITIGATION MEASURES

In 2016, Thailand achieved its NAMA target of 7% reduction in GHG emissions over the BAU level by 2020. As such, the domestic MRV for the NAMAs tracking process has been put in place to confirm the amount of national GHG reduction.

Thailand also communicated its INDC to the UNFCCC in October 2015, with the intention to reduce its greenhouse gas emissions by 20% from the projected business-as-usual (BAU) level by 2030. The level of contribution could increase up to 25%, subject to adequate and enhanced access to technology development and transfer, financial resources, and capacity building support through a balanced and ambitious global agreement under the UNFCCC. Moreover, the Cabinet approved Thailand's Nationally Contribution Roadmap on Mitigation 2021-2030 in May 2017. The roadmap is based on relevant national plans already approved, or in the pipeline for approval, by the Cabinet. The primary mitigation measures are in the energy, industrial processes, and waste sectors (Table 3-1).

**Table 3-1** Summary information on Thailand's NDC mitigation measures

| Sector | Measure | Description |
|---|---|---|
| Energy and transport | | Thailand's NDC Roadmap on Mitigation 2021-2030 was formulated based on the following plans already approved or in the pipeline for approval by the Cabinet.<br>The example are as follows:<br>• National Economic and Social Development Plans<br>• Climate Change Marter Plan B.E.2558-2593 (2015-2050)<br>• Power Development Plan B.E.2558-2579 (2015-2036)<br>• Thailand Smart Grid Development Master Plan B.E. 2558-2579 (2015-2036)<br>• Energy Efficiency Plan B.E.2558-2579 (2015-2036)<br>• Alternative Energy Development Plan B.E.2558-2579 (2015-2036)<br>• Master Plan for Sustainable Transport System and Mitigation of Climate Change Impacts<br>• National Industrial Development Master Plan B.E.2555-2574 (2012-2031)<br>• National Waste Management Master Plan B.E. 2559-2564 (2016-2021)<br>• Thailand Transport System Development Strategy 20 years B.E 2560-2579 (2017-2036)<br>• Environmental Quality Management Plan B.E. 2560-2564 (2017-2021) |
| • Power generation | • Energy efficiency improvement<br>• Substitution of RE | |
| • Manufacturing industry | • Energy efficiency improvement<br>• Substitution of RE | |
| • Transportation | • Energy efficiency improvement<br>• Substitution of RE | |
| • Buildings | • Energy efficiency improvement | |
| • Residential | • Energy efficiency improvement<br>• Substitution of RE | |
| IPPU | | |
| • Cement industry | • Substitution of clinker substance | |
| • Consumption of Halocarbons and Sulphur Hexafluoride | • Substitution of refrigerant substance | |
| Waste | | |
| • Waste | • Waste management | |
| • Wastewater | • Methane recovery from industrial wastewater<br>• Clean technology<br>• Municipal wastewater management | |

Source: Thailand's Nationally Determined Contribution Roadmap on Mitigation 2021-2030, 2017

In addition to supporting the mitigation plan, the NCCC has established a subcommittee on climate change policy and planning integration, which is tasked with preparing and proposing mitigation mechanisms and measures that encompass the relevant legal, economic, fiscal, and social instruments.

## 3.2 PROGRESS TOWARD THE ROADMAP OF THAILAND'S NAMAs

Details of the NAMA Roadmap and current achievements for the energy and transport sectors are presented in Table 3-2.

**Table 3-2** Description of NAMA roadmap and achievement: 2013 – 2015

| Mitigation Measures | GHGs | Target | Indicator | Methodology of GHG reduction calculation | Mitigation policy | Achieved outcome by 2015 | GHG Reduction ($MtCO_2eq$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2013 | 2014 | 2015 |
| Electricity generation from Natural Renewable Energy (RE) | $CO_2$ | Increase the ratio of electricity generation from RE to 20 percent of total electricity generation by year 2036 | GWh of electricity was generated by renewable energy | Calculated from GWh of electricity was generated by renewable energy multiplied with $CO_2$ emission factor of electricity system for renewable energy power plant (supply side) | • Promote renewable energy to generated electricity under the Alternative Energy Development Plan (AEDP)<br>• Subsidy through "Feed-in Tariff" | 6,585.88 GWh of electricity was generated by renewable energy as wind power, hydropower and solar power | 0.98 | 4.04 | 3.60 |
| Electricity generation from Bio-renewable Energy (biomass and biogas) | | | | | | 14,562.20 GWh of electricity was generated by renewable energy as biomass, biogas and waste | 8.04 | 8.65 | 7.96 |
| Heat generation from Natural Renewable Energy (RE) (solar) | $CO_2$ | Increase the ratio of heat production from RE to 30 to 35 percent of heat demand by 2036 | ktoe of heat was generated by renewable energy | Calculated from ktoe of heat was generated by renewable energy multiplied with $CO_2$ emission factor of heat generation system in manufacture industry sector | • Promote renewable energy to generated heat under the Alternative Energy Development Plan (AEDP) | 5.70 ktoe of heat was generated by renewable energy as solar power | (n/a) | 0.01 | 0.01 |
| Heat generation from Bio-renewable Energy (biomass and biogas) | | | | | | 6,573.00 ktoe of heat was generated by renewable energy as biomass, biogas and waste | (n/a) | 19.10 | 21.35 |

**Table 3-2** Description of NAMA roadmap and achievement: 2013 – 2015 (continued)

| Mitigation Measures | GHGs | Target | Indicator | Methodology of GHG reduction calculation | Mitigation policy | Achieved outcome by 2015 | GHG Reduction ($MtCO_2eq$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2013 | 2014 | 2015 |
| Biodiesel consumption for transportation | $CO_2$ | Biodiesel consumption to 14.0 million liters per day by 2036 | Million liters of Biodiesel was consumed by transportation | Calculated from million liters of Biodisel consumed for transport multiplied with net calorific value (NCV) and $CO_2$ emission factor of diesel | • Promote consumption in diesal vehicles by blending with (as B5) under the Alternative Energy Development Plan (AEDP) | 1,238 million liters of Biodiesel was consumed by transportation | 2.83 | 2.84 | 3.34 |
| Ethanol consumption for transportation | $CO_2$ | Ethanol consumption to 11.3 million liters per day by 2036 | Million liters of Ethanol was consumed by transportation | Calculated from million liters of Ethanol consumed for transport multiplied with net calorific value (NCV) and $CO_2$ emission factor of gasoline | • Promote ethanol consumption in gasoline vehicles by blending with gasoline (as E10, E20, E85) under the Alternative Energy Development Plan (AEDP) | 1,1738 million liters of Ethanol was consumed by transportation | 2.07 | 2.55 | 2.55 |
| Energy Efficiency improvement by Thermal Power Plants | $CO_2$ | Retrofit and improve efficiency of thermal power plants was in accordance with schedule of the Power Development Plan (PDP) | TJ of fossil fuel, which is converted from SEC, was reduced by thermal power plant<br>SEC: Specific Energy Consumption | Calculated from TJ of lignite was reduced by thermal power plant multiplied with net calorific value (NCV) and $CO_2$ emission factor of lignite | • Improve the heat rate of the thermal power plants under the Power Development Plan (PDP) | 1,510.25 TJ of lignite was reduced by thermal power plant | 0.42 | 0.28 | 0.15 |

Table 3-2

| Mitigation Measures | GHGs | Target | Indicator | Methodology of GHG reduction calculation | Mitigation policy | Achieved outcome by 2015 | GHG Reduction ($MtCO_2eq$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2013 | 2014 | 2015 |
| Energy Efficiency improvement by clean technology power plant | $CO_2$ | Improve efficiency of the clean technology power plants was in accordance with schedule of the Power Development Plan (PDP) | TJ of fossil fuel, which is converted from SEC was reduced by clean technology power<br><br>SEC: Specific Energy Consumption | Calculated from TJ of natural gas was reduced by clean technology power plant multiplied with net calorific value (NCV) and $CO_2$ emission factor of natural gas | • Improve the heat rate of the clean technology plants under the Power Development Plan (PDP) | 13,372.30 TJ of natural gas was reduced by clean technology power plant | (n/a) | (n/t) | 0.75 |
| Energy Efficiency Standard and Labeling for the electric equipments | $CO_2$ | 4,149 ktoe of electricity was saved by the high efficiency electric equipment that were approved by energy efficiency standard or energy efficiency labeling by year 2036 | GWh of electricity was saved by high efficiency electric equipment | Calculated from GWh of electricity was saved by high efficiency electric equipment multiplied with $CO_2$ emission factor of electricity system for energy efficiency (demand side) | • Promote energy efficiency standard for the electric equipment under the Energy Efficiency Plan (EEP) | 828.72 GWh of electricity was saved by the high efficiency electric equipment | (n/a) | (n/t) | 0.43 |
| | | | | | | | 14.34 | 37.47 | 40.14 |

Note : (n/a) is not available methodology
(n/t) is not available tracking process

## 3.3 INFORMATION ON DOMESTIC MRV

To monitor the implementation progress of the NAMA Roadmap, Thailand has developed a domestic MRV system for the sectors and included it in the NAMA Roadmap as mentioned in the first BUR. Currently Thailand has improved the domestic MRV system (the revised structure in Figure 3-1).

- Measurement is carried out according to specific GHG emission reduction measures by responsible installations (e.g., power plants and liquid fuel production plants);
- Reporting is carried out by responsible installations to corresponding authority (e.g., Energy Regulatory Commission, Department of Energy Business, and EGAT); and
- Verification is undertaken by authorized agencies such as the Department of Alternative Energy Development and Efficiency.

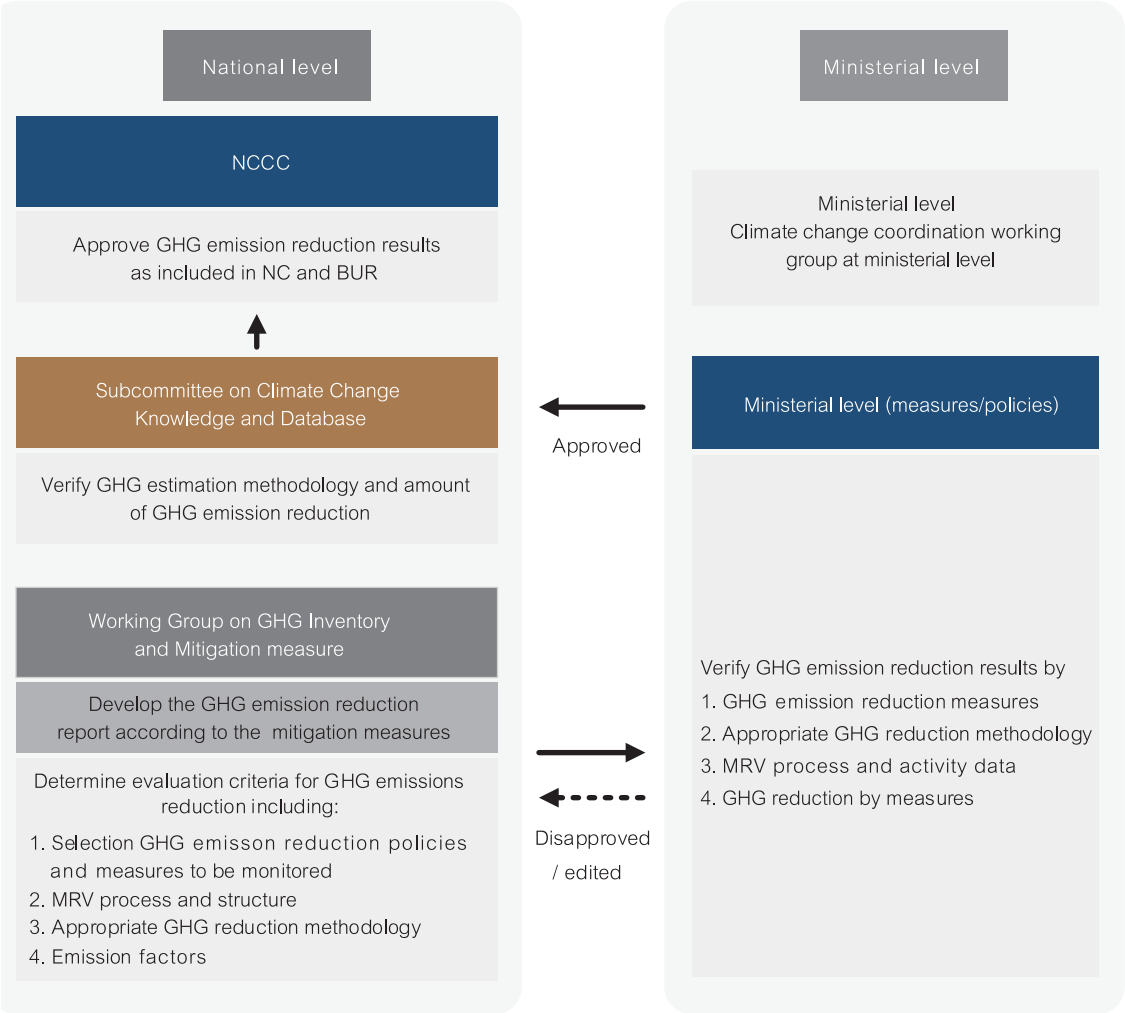



Figure 3-1: The revised structure of domestic MRV system

CHAPTER 4:

# Constraints, Gap, Needs and Support Received

# CHAPTER 4

# CONSTRAINTS, GAP, NEEDS AND SUPPORT RECEIVED

After best efforts to mitigate greenhouse gases, including improving technology as well as research and creation of databases, Thailand still has several limitations, barriers, and constraints. These impact the implementation of both adaptation and mitigation, including GHG inventory estimation and compilation. The improvement in national statistics and reporting of activity data by the relevant agencies can improve the inventory quality. The country aims to improve inventory quality by taking steps to improve transparency, accuracy, completeness, consistency, and data comparability in relevant agencies.

## 4.1 CLIMATE CHANGE MITIGATION AND ADAPTATION CONSTRAINTS AND NEEDS

According to Decision2/cp.17, Non-Annex I Parties should provide updated information on constraints and gaps, and related financial, technical, and capacity-building needs. They should also report support received from various sources: of funding available under the convention and that received from other developed-country parties. Information on constraints, gaps, and support needs for implementation of climate change actions in Thailand are shown in the Table 4-1. However, the information on gaps, constraints, and support-needs that deal with development of the national GHG inventory, were identified in Chapter 2.

Table 4-1 Information on the constraints, gaps, and support needs for implementation of climate change actions in Thailand

**Table 4-1** Information on the constraints, gaps, and support needs for implementation of climate change actions in Thailand

| Need Area | Gaps/ Barriers/ Constraints | Needs | Rationales |
|---|---|---|---|
| Technology Transfer | Priority should be put to maintain observation sites especially those in AERONET and FLUXNET which are not the responsibility of other operational agencies. These sites are maintained by research institutions and universities, thus are reliant on funding availability. Support can strategically be focused on those sites that already provide long, non-disrupted, high-quality records. In addition, support for development of an in situ ocean observation network, such as oceanographic buoys is urgently needed. | Development of in situ ocean observations such as oceanographic buoys. | To focus on sites that already provide long, non-disrupted, high-quality records. |
| Capacity Building | In capacity building issue, capacity building for personnel to operate and maintain the observation sites for meteorological atmospheric and oceanic variables should be continually supported. Moreover, capacity building is required on new issues emerging from the Paris Agreement, green growth education and business models for renewable energy. Research on adaptation to climate change in high-risk and vulnerable areas has shown that financial support is needed, especially in low-income communities. | Formulate long-term climate-economic models for use by policy-makers to forecast economic impacts from climate policies or measures. | To evaluate GHG emission mitigation capacity by sectoral approach and macro-economic approach |
| | | Training programs for staff (who work on research and systematic observations) to operate and maintain the sites to gather data on meteorological, atmospheric, and oceanic variables. | To set up continual data collection and coordination among related agencies. |
| | | Integrated training for staff (who work on research and systematic observations) to carry out specific jobs or holistic tasks and new emerging issues (in context of the Paris Agreement). | To strengthen the technical capacity of a broader range of staff. |
| | | Establishing some reporting and monitoring systems for ACE, in particular those in the nationally determined contributions. | To strengthen the technical capacity for a broader range of cooperation among related ministries and agencies. |

**Table 4-1** Information on the constraints, gaps, and support needs for implementation of climate change actions in Thailand (continued)

| Need Area | Gaps/ Barriers/ Constraints | Needs | Rationales |
|---|---|---|---|
| Mitigation | Very high investment and operation costs for technologies and infrastructures to implement measures according to NDC roadmap<br>Lack of methodologies and technologies for tracking the progress of NAMAs and NDCs | Financial support for investment and operation. Capacity building and technological support for tracking NAMAs and NDCs. | - |
| Adaptation | • Community and urban planning to avoid inundation and impact during high-tide in the mouth of the rivers or during flooding season, including investments in housing, walkways, and streets.<br>• Investment in hard structures to protect from sea-level rise along coastlines or shorelines.<br>• Expenses for promoting soft structures (e.g., regulations and public services) to protect vulnerable lands and coastal areas from immigrants or settlements, and to raise awareness as well as adaptive capacity for health problems relating to climate change. | Investment in hard structures to avoid sea level rise along coastlines or shorelines. | To avoid and prevent huge damage and irreversible losses. |
| | | Expenses relating to promoting soft structure (e.g. regulations and public services), and in raising awareness and adaptive capacity for health problems to climate change. | To protect vulnerable lands or coastal areas from immigrants or settlements. |
| Adaptation | The Technology Needs Assessments for Climate Change Adaptation in Thailand for climate change adaptation are categorized into three sectors:<br>• Agriculture,<br>• Water Resource Management, and<br>• Modelling. | Three groups of technology needs for adaptation in the agricultural sector are identified:<br>• forecasting and early warning systems,<br>• crop improvement for climate–resilient [Marker Assisted Selection (MAS) and genetic engineering],<br>• precision farming technologies. | • to reduce the risk of damage from extreme climate events and pest/ disease outbreaks as well as to increase the ability<br>• to select the right crops based on specific planting time and crop cycle,<br>• to reduce the risk of yield loss while increasing resource efficiency, and<br>• to enable farmers to make informed decisions concerning their farming operations as well as to reduce inputs while maintaining maximum productivity and minimizing the effects on the environment. |

**Table 4-1** Information on the constraints, gaps, and support needs for implementation of climate change actions in Thailand (continued)

| Need Area | Gaps/ Barriers/ Constraints | Needs | Rationales |
|---|---|---|---|
| Adaptation | | The high-impact technologies that have been prioritized as technology needs in water resource management include:<br>• networking (via pipes or canals) and management of infrastructures (including zoning),<br>• seasonal climate prediction as a part of weather and hydrological modeling, and sensor web using<br>• observation and/or modeling data as a part of an early warning. | • to increase the efficiency in water resources allocation among users - in both density and remote areas, and<br>• to reducing risk and poverty of the farmers who are main population in Thailand. |
| | | The expert groups and other stakeholder have identified the following technology as high priority for the modeling:<br>• the national data center, national data collection, transfer, and management process, and<br>• integrated modeling i.e., Weather Research and Forecasting (WRF) and Advanced Research WRF (ARW). | To empower both public and private sectors as well as civil society for adapting to climate change. |
| Adaptation | Climate change has severe impacts upon seasonal rain pattern, causing floods and droughts in The Great Chao Phraya Basin, which is the largest watershed in Thailand, causing loss and damage in vulnerable agricultural-livelihood dependent households. | Financial support for project implementation on "Enhancing climate resilience in Thailand through effective water management and sustainable agriculture" | • to improve climate and risk informed planning in the water and agricultural sectors,<br>• to strengthen and improve water infrastructure and management, using eco-based adaptation principles, for greater resilience to climate change impacts of flood and drought, and<br>• to develop climate smart agriculture to increase resilience of agricultural livelihoods in the watershed basin. |

**Table 4-1** Information on the constraints, gaps, and support needs for implementation of climate change actions in Thailand (continued)

| Need Area | Gaps/ Barriers/ Constraints | Needs | Rationales |
|---|---|---|---|
| Adaptation | Thailand is one among the top twelve countries that the coastal ecosystems and communities are most vulnerable to the impacts of climate change, and their potential to store carbon is being diminished by poor management and development choices. | Financial support for project implementation on "Building climate change resilient coastal communities and ecosystem in Asia" | • protection and management of coastal ecosystems,<br>• development of sustainable and alternative livelihoods for vulnerable communities, and<br>• embedding high-quality long-term decision-making principles within local and national governing entities. |

In addition, the National Science Technology and Innovation Policy Office (STI) in the Ministry of Science and Technology, was appointed as the National Designated Entity (NDE) of Thailand in a cabinet resolution in November 2014. So far, Thailand has already submitted 6 requests by STI, as shown in Table 4-2.

**Table 4-2** Summary of gaps, barriers, constraints and needs for mitigation and adaptation to the CTCN

| Gaps/ Barriers/ Constraints | Needs | Status |
|---|---|---|
| Thailand's agriculture production depends on the natural cycle. Therefore, climate change has some effects to agriculture in several ways.Existing applied technologies will not be good enough to accommodate the changes expected. | Increase the technical capacity on technology development for efficient use of resources in agriculture sector to Thai stakeholders in the knowledge and application of agricultural technologies that will help better manage the allocation of resources required for optimal resilience to climate change and associated impacts on productivity. | Implementation /Asian Institute of Technology (AIT) |
| Lack of adequate regional climate models, collection, and distribution of spatial and temporal meteorological and hydrological data. | Enhancing climate Information for adaptation decision making in Thailand with high resolution climate modeling. | Design |
| Lack of capacity in management of an urban environmental issues such as rising sea levels and an increased frequency of extreme weather events. | Strengthening Bangkok's early warning system to respond to climate induced flooding. | Implementation/ UNEP and Danish Hydraulic Institute (DHI) |
| Lack of knowledge and capacity on green building design, as well as evaluation, construction, technology implementation, retrofits, operation and maintenance. | Fostering green building in Thailand towards low carbon society. | Design |
| The iron and steel industry is the largest energy consuming industry, and one of the most greatest sources of GHGs emissions. Thailand would like to study the baseline of energy consumption and GHG emissions among other countries as a benchmark to support Thailand's NAMA implementation. | Benchmarking Energy Consumption and GHGs emission of Iron and steel industries of Thailand | Implementation/New Energy and Industrial Technology Development Organization (NEDO) |

Table 4-2 Summary of gaps, barriers, constraints and needs for mitigation and adaptation to the CTCN (continued)

| Gaps/ Barriers/ Constraints | Needs | Status (as of July 2017) |
|---|---|---|
| Implementation of energy efficient street lighting technologies has been very slow at the municipal level. The key barriers that contribute to the slow uptake are the lack of confidence when investing in these new technologies at a large scale, and limited access to investment finance. | Assessment of energy efficient street lighting technologies and financing models for Thai municipalities. | Implementation/ The Energy and Resources Institute (TERI)/ International Institute for Energy Conservation (IIEC) |

Source: National Science Technology and Innovation Policy Office (STI), Ministry of Science and Technology, Thailand

## 4.2 SUPPORT RECEIVED

Thailand has received, and expected to receive, financial support, capacity building support, and technical assistances from a number of international governments and organizations. GEF provided grant funding, through UNDP, to assist Thailand in the preparation of its NC and BUR. The 4-year project, entitled Thailand's Third National Communication and Biennial Update Report to the UNFCCC, was initiated in April 2014 and will be completed in April 2018. It was supported with GEF funding of USD 852,000 and in-kind support from the Thai Government of USD 700,000.

In February 2018, Thailand received an additional grant from GEF, through UNDP, for the preparation of its SBUR for submission to the UNFCCC. GEF allocated USD 352,000, with the Thai Government's in-kind support of USD 100,000. ONEP was the implementing agency, under the oversight of Thailand's Technical and GHG Database Sub-Committee of the National Committee on Climate Change Policy (NCCC).

Thailand's TNC will be finalized by May of 2018 for submission to the UNFCCC. The SBUR will build upon the progress made in the previous BUR. The main components of the SBUR include: (i) updated information on National Circumstances and Institutional Arrangements; (ii) updated national GHG inventories by sources and sinks; (iii) updated measures to mitigation climate change and its effects; (iv) updated information on constraints, gaps and related financial, technical/capacity needs, and supports needed and received; and (v) updated information on the domestic MRV. The project will be implemented over 16 months, from January 2017 until April 2018. ONEP under the Ministry of Natural Resources and Environment (MoNRE) will coordinate implementation of activities. The Australian Department of the Environment and Energy, has entered into a bilateral agreement with ONEP to support development of Thailand Greenhouse Gas Emissions Inventory System (TGEIS). The system is to support future development of Thailand's NC and BUR, inform policy formulation, and improve the decision-making process. Project completion is expected in June 2018.

The United States of America, through the USAID's regional programs, has provided training to Thai governmental officers and GHG compliers on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

The Greenhouse Gas Inventory Office of Japan has organized capacity building through a workshop series, Workshop on Greenhouse Gas Inventories in Asia (WGIA), to improve the accuracy of GHG inventories in Asia, including Thailand. The Global Green Growth Institute (GGGI) assisted the implementation of Thailand's Climate Change Master Plan by developing a clear roadmap for GHG reduction in three selected industrial sub-sectors of the Thai economy, namely palm oil production, frozen foods, and automotive parts. The project was financially supported by the German Government. GGGI contributed to the development of the NDC Action Plan for the Thai Industrial sector, focusing on GHG reduction from the energy sector, which offers high potential in terms of cost-effective GHG reduction measures and enhanced industrial competitiveness. Regarding capacity building in the area of climate finance, UNDP supported ONEP on Strengthening Thailand's Capacity to Link Climate Policy and Public Finance (2013–2017), with partial financial support by the Swedish International Development Agency (SIDA). Thailand's Domestic Preparation for Post-2020 Contributions (2014–2016) and achieving Low Carbon Growth in Cities through Sustainable Urban Systems Management in Thailand (LCC) were funded by GEF through UNDP. Another project, Low Emission Capacity Building (LECB), supported by the European Commission, the German Federal Ministry for the Environment, Nature, Conservation, and Nuclear Safety, and the Australian government, is currently being implemented in Thailand with UNDP support.

Table 4-3 summarizes the sources of funding from international organizations and agencies related to climate change activities in Thailand. These include technology transfer, capacity building, mitigation, and adaptation.

**Table 4-3** Sources of funding from international organizations for climate change activities regarding technology transfer, capacity building, mitigation, and adaptation

| Project Name | Project Period | Project Description | Donor Agency / Government |
|---|---|---|---|
| **Technology transfer** | | | |
| Project on Technical Collaboration for Preparing Bangkok Master Plan on Climate Change | Since 2012 | Scope includes environmentally friendly and sustainable transport system; energy efficiency and alternative sources of energy; efficiency in waste and wastewater management; green urban planning; and strategies for adaptation to climate change, especially flooding, coastal erosion, drought, and salt water intrusion, that each of these strategies raises relevant measures for relevant agencies to implement and MRV. | JICA |
| Strengthening Thailand's Capacity to link Climate Policy and Public Finance | 2013-2017 | The project is in cooperation with the Fiscal Policy Office, Bureau of Budget, National Economic and Social Development Board, and other related agencies. The main purpose is to strengthen Thailand's capacity to link climate policy and public finance, and to develop an efficient and effective monitoring and evaluation framework. | UNDP & SIDA (Swedish International Development Agency) |
| Flood & Drought Management Tools, which include a decision support system (DSS) | 2014-2018 | The project outcome will enable stakeholders to compile information, with models, indicators and existing planning methods to develop future planning scenarios that are robust and resilient. The developed methodologies will be applied both on the regional basin scale through IWRM, as well on a local scale for urban and industrial areas. Three pilot basins used in the developing and testing of the methodology are Chao Phraya Basin (HAII), Lake Victoria Basin (The Lake Victoria Basin Commission), and Volta Basin (The Volta Basin Authority). | GEF (source of fund) UNEP, IWA and DHI |
| Project TA-8359 REG – Regional Climate Projections Consortium Data Facility in Asia and the Pacific (RCCDF) | 2015-2017 | This was technical assistance (TA) initiated by Asian Development Bank (ADB) with grants to Australian CSIRO to operate the project. Objectives include building networks in Asia and Pacific countries, in accordance with climate change issues; enhancing access to climate data; and strengthening capacity building for regional adaptation to climate change impacts. | Japan Fund for Poverty Reduction (JFPR) and ADB |

**Table 4-3** Sources of funding from international organizations for climate change activities regarding technology transfer, capacity building, mitigation, and adaptation (continued)

| Project Name | Project Period | Project Description | Donor Agency / Government |
|---|---|---|---|
| **Capacity Building** | | | |
| 2050 Thailand - UK Pathways Calculator | 2013-2014 | The project is designed to calculate the energy balance and GHG emissions from the energy sector in Thailand, as well as to collaborate in technology and knowledge transfer. TGO is the national focal point for developing the model. The project was supported by the Department of Energy and Climate Change (DECC), the Foreign and Commonwealth Office, and the Department for International Development. | UK |
| Low Emission Capacity Building (LECB) Project in Thailand | 2013-2018 | The goal of this project is to build capacities for the development of Nationally Appropriate Mitigation Actions (NAMAs) in selected industrial sectors and to systematize the GHG inventory in the sectors of Transport and Waste, with four outcomes:<br>• Strengthened institutional & procedural system for National GHG Inventory system for the transport and waste sectors,<br>• Portfolio of NAMA proposals and their built-in MRV systems developed for selected industrial sector(s), Multiple-source Finance and Technology Transfer Framework formulated to support implementation of<br>• NAMAs and policies/programs in selected industrial sectors, and<br>• Knowledge Platform established to ensure the flow of expertise among key stakeholders of NAMAs in selected industrial sectors. | The European Commission, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, and the Australian government |
| Thailand's Domestic Preparation for Post-2020 Contributions | 2014-2016 | The objective of this project is to identify Thailand's contributions to the post-2020 global climate agreement (called 'Intended Nationally Determined Contributions' or 'INDC') and to strengthen Thailand's engagement in the UNFCCC negotiation process leading to the post-2020 agreement. The need to submit INDC follows from a recent decision adopted by UNFCCC COP 19 in November 2013. | GEF |
| Third National Communication and Biennial Update Report | 2014-2018 | The project aims to enable Thailand to prepare its Third National Communication (TNC) under decision 17/CP7 and the first Biennial Update Report (BUR) under decision 2/CP17 to the UNFCCC. ONEP is the host. | GEF<br>906,398 USD |
| Advancing and Measuring Sustainable Consumption and Production (SCP) for a Low-Carbon Economy in Middle-Income and Newly Industrialized Countries (Advance SCP) | 2015-2018 | This project is funded by Germany (Ministry of Environment) organized by GIZ and agencies in four ASEAN countries (Thailand, Indonesia, Malaysia, and the Philippines).The Pollution Control Department (PCD) is the supported agency. | Government of Germany<br>2,000,000 EUR |

**Table 4-3** Sources of funding from international organizations for climate change activities regarding technology transfer, capacity building, mitigation, and adaptation (continued)

| Project Name | Project Period | Project Description | Donor Agency / Government |
|---|---|---|---|
| Readiness Preparation Proposal (R-PP) on REDD+ | 2016 | This was a grant from the Forest Carbon Partnership (FCPF) under the MOU between The Public Debt Management Office, Ministry of Finance, and FEPF. The focal point of this project is the Department of National Parks and Wildlife (DNP). | FCPF<br>3,600,000 USD |
| Thailand's Second Biennial Update Report (SBUR) to the UNFCCC | 2017-2018 | Thailand's Second Biennial Update to the UNFCCC Project involves the preparation of the SBUR for submission to UNFCCC, in accordance with its commitment as a party to the Convention as per Decision 2/CP.17 taken at COP 17. | GEF<br>352,000 USD |
| Thailand Greenhouse Gas Emissions Inventory System :TGEIS) | 2017-2018 | ONEP and the Australian Department of the Environment and Energy have signed an MOU for Australia-Thailand Cooperation on National Greenhouse Gas Inventories (June 2016) to support the Greenhouse Emission Inventory in Thailand by applying the Australian Greenhouse Emissions Information System (AGEIS) and establishing the Thailand Greenhouse Gas Emissions Inventory System (TGEIS). The TGEIS will contribute to a more efficient inventory system to support the Thailand National Communication (NC) and Biennial Update Report (BUR). | Government of Australia<br>286,915 AUD |
| **Mitigation** | | | |
| Measurement and Performance Tracking (MAPT) of Climate Change Mitigation Activities | 2011-2016 | Global Support | BMUB/IKI |
| Partnershipship for market readiness | 2011-2021 | Global Support | BMUB/IKI |
| Capacity Development on Climate Change Mitigation/Adaptation in the Southeast Asia Region | 2013-2016 | The project consisted of four training programs:<br>• Greenhouse Gas Inventory<br>• Low Carbon and Resilience Society Development<br>• Mitigation Mechanism<br>• Climate Change Economics | JICA |
| NAMA-Programme for the construction sector in Asia | 2013-2017 | Regional Support | BMUB/IKI |
| WaCClim: Water and Wastewater Companies for Climate Mitigation | 2013-2019 | Global Support | BMUB/IKI |

**Table 4-3** Sources of funding from international organizations for climate change activities regarding technology transfer, capacity building, mitigation, and adaptation (continued)

| Project Name | Project Period | Project Description | Donor Agency / Government |
|---|---|---|---|
| Green Growth Project in Bangkok | Since 2013 | Promoting green growth in Bangkok, includes transport sector, infrastructure, adaptation to climate change, resource consumption, environmentally friendly production, and contribution of community or public participation. There are four areas of work shared with other agencies and neighboring provinces: land use and transport, waste and water resources management, greener energy and flood protection, and re-habitation. | OECD |
| Capacity Development on Renewable Energy and Grid Integration | 2014-2016 | Global Support | BMUB/IKI |
| Mitigation Momentum II | 2014-2017 | Global Support | BMUB/IKI |
| Strategic Environmental Dialogues | 2014-2019 | Global Support | BMUB/IKI |
| GHG Reduction and Carbon Credit Development Projects under Joint Credit Mechanism (JCM) | 2015-2016 | Japan government has given support in several activities:<br>• Financial support no more than 50% of the total investment of each GHG reduction project under JCM,<br>• Technical support in GHG reduction measurement,<br>• Subsidy of the expense of the Third Party Entity (TPE), and<br>• Funds for capacity building of such as project developers and monitors. | Government of Japan |
| Green Banking - Capacity Building on Green Energy and Climate Finance | 2015-2018 | Regional Support | BMUB/IKI |
| Partnership for Market Readiness (PMR) | 2016-2019 | PMR is the financial and technical support for capacity building in countries that aim to develop market mechanisms for reducing GHG emissions. There were three main elements:<br>• Preparation for increasing energy efficiency and GHG reduction in buildings and factories (Energy Performance Certificate scheme (EPC).<br>• Preparation for municipalities and communities toward Low Carbon Cities.<br>• Study and propose legal framework for an Emission Trading Scheme (ETS). | World Bank<br>3,000,000 USD |

**Table 4-3** Sources of funding from international organizations for climate change activities regarding technology transfer, capacity building, mitigation, and adaptation (continued)

| Project Name | Project Period | Project Description | Donor Agency / Government |
|---|---|---|---|
| Thailand Refrigeration and Air Conditioning NAMA (RAC NAMA) | 2016-2020 | Bilateral Support | NAMA Facility<br>14,700,000 EUR |
| Establish Low Carbon Consumption and Production in Indonesia, Thailand and the Philippines | 2017-2019 | Regional Support | BMUB/IKI |
| Achieving Low Carbon Growth in Cities through Sustainable Urban Systems Management | 2017-2021 | The project aims at promoting sustainable low carbon development in four pilot cities including Nakhon Ratchasima Municipality, Khonkaen Municipality, Koh Samui Municipality and Chiang Mai Municipality through capacity enhancement as well as integrated framework at the local level. | GEF |
| **Adaptation** | | | |
| Biodiversity Finance Initiative – BIOFIN | 2012-2016 | Global Support | BMUB/IKI |
| Ecosystems Protecting Infrastructure and Communities (EPIC) | 2012-2017 | Global Support | BMUB/IKI |
| 100 Resilience Cities (100RC) Bangkok | Since 2013 | This is the preparation project for coping to climate change. The objectives are (a) to reduce risk and increase capacity building in adapting to climate change; and (b) to drive the economy towards more and stronger competitiveness. There are 60 projects for Bangkok. In 2017, 10 projects were implemented. | Rockefeller Foundation |
| Community Water Management in Adaptation of Climate Change | 2014-2016 | This is sharing of information and research related to water management at the community level for coping with climate change using science and technology to utilize water resources efficiently and to raise living standards. Funding sources include the Chinese Institute of Agricultural Economics and Development (IAED), and the Chinese Academy of Agricultural Sciences (CAAS). | IAED/ CAAS |
| Supporting developing countries to integrate the agricultural sectors into National Adaptation Plans (NAPs) | 2014-2018 | Global Support | BMUB/IKI |

**Table 4-3** Sources of funding from international organizations for climate change activities regarding technology transfer, capacity building, mitigation, and adaptation (continued)

| Project Name | Project Period | Project Description | Donor Agency / Government |
|---|---|---|---|
| Strategic research on adaptive flood risk management and innovative tools for water management | 2014-2019 | Objectives of the project are to establish research collaboration focusing on developing flexible strategies for adaptive flood management, taking into account the effect of climate change; to enhance capacity building for the development of flood modeling and operational management systems; to develop and promote the use of innovative tools for flood and water management; and to initiate a joint project between Deltares and HAII to stimulate scientific exchange between specialists and researchers and to organize workshops and training | Deltares (The Netherlands) |
| Qualitative Assessment of Health Vulnerability and Adaptation to Climate Change Risks in Thailand | 2015 | To assess health vulnerability from climate change impacts. This support was provided to the Department of Health, Ministry of Public Health, by the World Health Organization (WHO). | WHO |
| Climate profile-Thailand 2015 | 2015 | To access climate information related to health. | WHO |
| Risk-based national adaptation plan (Risk NAP) | 2015-2019 | To integrate adaptation activities in the Project "master plan for climate change adaptation in risk management" There are four action plans:<br>• Climate change risk assessment and analysis<br>• National adaptation master plan<br>• Integrate climate change risk in making plan<br>• Financial incentive for climate change adaptation activities. | BMUB/IKI<br>3,750,000 EUR |
| Qualitative assessment of the risks of heat stress in Thailand | 2016 | To assess the risks of heat stress in Thailand | WHO |
| The Strengthening Institutional and Policy Framework on Disaster Risk Reduction and Climate Change Adaptation Integration | 2016-2017 | This project is funded by the Japan International Cooperation Agency (JICA) for the Department of Disaster Protection and Mitigation, Thailand under the ASEAN Agreement on Disaster Management and Emergency Response (AADMER) Work Programme. It is to analyze and propose an integrated policy framework in ASEAN to reduce disaster risk and adaptive capacity to climate change at community, country, and regional levels. | JICA<br>1,520,000 USD |

Table 4-3 Sources of funding from international organizations for climate change activities regarding technology transfer, capacity building, mitigation, and adaptation (continued)

| Project Name | Project Period | Project Description | Donor Agency / Government |
|---|---|---|---|
| Advancing Co-Design of Integrated Strategies with Adaptation to Climate Change in Thailand (ADAP-T) | 2016-2021 | To share knowledge on climate change issues and to take appropriate adaptation measures to protect from adverse impacts from climate change in a sustainable way. This support provided to Thai Meteorological Department (TWD). | JICA/JST |
| Project for Capacity Development to accelerate Low Carbon and Resilient Society realization in the Southeast Asia region | 2017-2020 | The Project consists of three elements:<br>• Developing training programs for specific target groups (i.e., Mitigation Mechanism/MRV training program and Climate Finance training program).<br>• Establishing a network of academic and technical experts at regional level with international organizations (e.g., ASEAN Secretariat, UNFCCC, and GCF).<br>• Enhancing knowledge related to climate change for stakeholders (government, private sector, education, public, and journalists) in Thailand and ASEAN members. | JICA |
| Production Driven Forest Landscape Restoration under REDD+ through Private Sector – Community Partnerships as Asian Regional Learning Exchange | 2017-2021 | Regional Support | BMUB/IKI |

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