Consignment by
The Ministry of the Environment of Japan

JCM Project Development Study for Realization of Carbon Neutral in Ubon Rachatani Province, Thailand

Final Report

March 8, 2024

EX Research Institute Limited

Index

List of Abbreviations

Abbreviations	Description
CN	Carbon Neutral
C2P2	Clean City Partnership Program
GAP	Good Agricultural Practices
GHG	Greenhouse Gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
IPCC	Intergovernmental Panel for Climate Change
IPPU	Industrial Processes & Products Use
KITA	Public Organization Kitakyushu International Techno-Cooperative Association
LULUCF	Land Use, Land Use Change & Forest
MOAC	Ministry of Agriculture & Cooperative
MOE	Ministry of Energy
NESDC	National Economy and Social Development Committee
NSDB	Office of the National Economic and Social Development Council
ONEP	Office of Natural Resources and Environmental Policy and Planning
POE	Provincial Office of Energy
PONRE	Provincial Office of Natural Resources & Environment
RFO	Royal Forest Department.
TGO	Thai Greenhouse Gas Management Organization
UNFCCC	United Nation Framework Convention for Climate Change
WG	Working Group

1. Objective

According to the Report of the Working Group 3 of the 6th Assessment Report (hereinafter referred to as "**AR6**") of the Intergovernmental Panel on Climate Change (hereinafter referred to as "**IPCC**"), Seventy percent of Greenhouse gases in total are emitted from the city and therefore the cities are requested to accelerate mitigation actions. In Japan, Japanese central government, in cooperation with cities, promote "Zero Carbon City" by development of more than 100 of "the Advanced Area for Decarbonization" under the Road Map for Area Decarbonization in June 2021.

To realize Decarbonization in the world, It is important to accelerate Decarbonization in Asia, where economy is rapidly growing up, thus International society push decarbonization in the cities, where socio-economic activities are taken.

The Ministry of the Environment of Japan, for example, established Green City Partnership Program (hereinafter referred as "the Program") with Japan International Cooperation Agency (JICA) in February 2023 with purpose of coping with various problems which the cities face. The Project aim to provide integrated and synergistic support to the partner cities, in the field of Climate Change, Pollution, Circular Economy and Environmental Restoration (Nature Positive) by connecting Local Administrative Organizations, Private Sector & Financial Sector in Japan. Furthermore, Japan will promote cooperation with partner countries such as members in Group of 7 (G7) and international financial organizations.

The Ministry of the Environment of Japan will conduct "JCM Project Development Study for Realization of Carbon Neutral in Ubon Rachatani Province, Thailand" (hereinafter referred to as "**the Study**") with purposes of supporting activities to be taken by the partner cities as well as introduction of technologies contribute for Decarbonization, together with Japanese Local Authorities with experience & knowledge, in cooperation with Institutes, Private Sector and academic sector.

2. Activities in the Study

In this study, the Party entrusted by the Ministry of the Environment of Japan (hereinafter referred to as "**the Contractor**") conducted activities for GHG emission reduction in the field of waste management, energy saving & renewable energy contribute including study the possibility of JCM project development as follows:

2.1. To support drafting Road Map for Carbon Neutral for Ubon Ratchathani by 2050

The Contractor conducted activities to support Ubon Ratchatani province (hereinafter referred as "**the Province**") in drafting Road Map for Decarbonization with which the province would achieve Carbon Neutral by 2050 (as one of output in multi-year from the study))

(1) To review GHG emission inventory in the Province.

1) To study GHG emission inventory in the Province

The Ministry of Natural Resources and Environment (hereinafter referred to as "**MONRE**") , as the competent government agency responsible for Climate Change, is implementing "the project to develop a guideline for GHG emission reduction in province level" and many provinces participate in the project. As for the Province, the governor of the Province issued an order to establishment of a working group for "the Project on Development of a Guideline for GHG emission reduction for Ubon Ratchathani province" as of January 18, 2023, chaired by the governor and started working on and after March 1, 2023. The working group, with cooperation from various department in the provincial office, could collect relevant data & information and drafted initial report by August 2023, together with forecast for that by 2030. In this Study, the Contractor review the Inventory, including methodologies for quantification and estimation of GHG emission and make in order as a part of preparation for Road Map development.

2) Knowledge Sharing (Introduction of activities contribute for decarbonization in Japan)

The Contractor organized a workshop to share knowledge, experience, and technology might be applicable for the Province in line with current situation and need of the Province.

3) Discussion on development of the Road Map (version 1) for the Province

The Contractor exchanged ideas as for the possibility of GHG emission reduction in

the Province based on the review stated 2.1 (1) above and workshop organized under the Study and make it in order.

(2) To study the possibility of GHG emission reduction in Warin Chamrap Town Municipality in the Province

Warin Chamrap Town Municipality (hereinafter referred to as "**Warin TM**") is one of the five town municipalities in the Province, as well as one of host for wide area for Municipal Solid Waste (hereinafter referred as "**MSW**") processing & disposal. Since large amount of MSW is transported and landfilled at landfill owned by Warin TM, together with the point of view of JCM project development, It is desirable to develop a Road Map for decarbonization for the Municipality.

1) To study GHG emission inventory in the Province

The Contractor held meetings with Warin TM and checked its status regarding to Climate Change including GHG Inventory and mitigation actions under planning or consideration by the Warin TM.

2) Knowledge Sharing (Introduction of activities contribute for decarbonization in Japan)

The Contractor organized a workshop to share knowledge, experience and technology considerable to be introduced to the Municipality based on the Inventory as well as situation of the Municipality.

3) Discussion on development of the Road Map (version 1) for the Municipality

The Contractor exchanged ideas as for the possibility of GHG emission reduction in the Municipality based on the review stated 2.2 (1) above and workshop organized under the Study and make it in order.

2.2. Possibility on development of MSW based biogas power plant at the Municipality

(1) Legal framework with procedure for development of the biogas project

The Contractor reviewed legal framework and procedures to develop the biogas project in the Municipality and made it in order.

(2) Biogas Business in Thailand

In this activity, the Contractor tried to find potential Thai business partner(s) for the target project, i.e. MSW based Biogas Power Plant in Warin Chamrap city for the Japanese parties who have interest in participating in the Project

(3) Data collection for the target Project (Project Site & Waste (Quantity & Quality))

In this activity, the Contractor collected Data & information as well as conducted analysis for MSW which collected and transported to landfill, owned and operated by Warin Chamrap town municipality.

(4) Potential Technology to be employed for the target project

In this activity, the Contractor introduced Technologies can be applicable for the target project belong to KOBELCO Environment Solution Co., Ltd., who is co-proposer of "the JCM Project Development Study for Realization of Carbon Neutral in Ubon Rachatani Province, Thailand (hereinafter referred as "the Study")".

2.3. Other potential projects contribute for decarbonization in the Province

(1) To study the possibility of MSW management projects development

There are 4 Clusters, i.e., belong to Phibun Mangsahan Town Municipality, Ubon Ratchathani City Municipality, Trakhan Phut Phon Subdistrict Municipality & Ded Udom Town Municipality other than that belong to Warin Chamrap Town Municipality. In this activity, the Contractor collected basic data & information related to the project under development by those clusters, from the point of view of Japanese participation in the projects.

(2) Wastewater treatment facilities in the Province

There are 2 wastewater treatment facilities in the Province. One is operated by Warin Chamrap Town Municipality, while the other by Ubon Ratchathani City Municipality (hereinafter referred as "**Ubon CM"**), As the City Municipality might suspend their operation

of existing wastewater treatment facility, together with wastewater generating in other areas, such as liquor manufacturer in the Province, The Province concerns water quality as well as much more GHG emission form the Wastewater subsector to be generated in future. In this activity, the Contractor conducted initial survey to collect relevant data & information for the possibility of GHG emission reduction.

2.4. Horizontal Expansion of the Study

(1) Workshop for the Study

The Contractor organized the Workshop for the Study, with purposes horizontal expansion of activities under the Study, by sharing knowledge and experience might be useful for decarbonization for the `Province, Warin Chamrap Town Municipality and other Local Administrative Organizations (hereinafter referred as "**LAOs**") in the Province.

3. Implementation of the Study (Organization & Duration)

3.1. Organizational Structure

The Study was implemented by EX Research Institute Limited (hereinafter referred to as "**EXRI**"), as main implementation party, together with City of Kitakyushu and KOBELCO ECO-SOLUTION Co., Ltd. (hereinafter referred to as "**KOBELCO**") as co-implementation parties under the City-City Cooperation among City of Kitakyushu, Ubon Ratchathani province and Warin Chamrap Town Municipality. Kitakyushu International Techno Cooperative Association (hereinafter referred as "**KITA**") supported implementation of the Study, by dispatch expert in the field of waste & wastewater management, REZIL INC. (hereinafter referred to as "**REZIL**") and Shabondama Soap Co., Ltd. (hereinafter referred to as "**Shabondama**") shared their knowledge & experience with parties from the Province through their presentations at the Workshop.

Provincial Office of Natural Resources & Environment, Ubon Ratchathani (hereinafter referred as "**PONRE**") and Warin TM as counterparts, Rajabhat University as collaborating organization and other LAOs as interesting parties, participated in the Study from Thai side. PONRE also worked as focal point for the Study, while Warin TM offered venue for the meetings as well as the Workshop. **Figure 3-1** shows Organizational Structure for implementation of the Study.

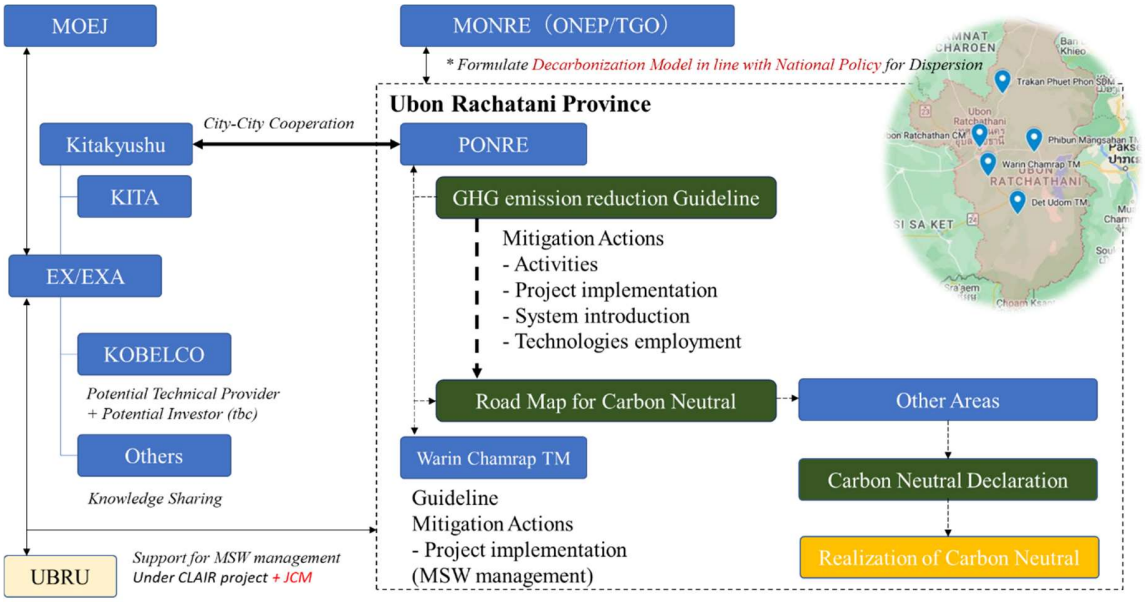


Figure 3-1. Organizational Structure for implementation of the Study

3.2. Duration

The Contractor implemented the Study during November 2, 2023 to March 8, 2024.

4. Findings from the Study

4.1. Road Map for Decarbonization for Ubon Ratchathani Province

4.1.1. Climate Change in Thailand and the Province

(1) Climate Change in Thailand

Thai Government set "20 years National Strategy (2018-2037)" as the highest National Policy in Thailand followed by 4 main plans as 2nd level, then others for each sector and/or issue as 3rd level. For Climate Change, as the same as other issues, Thai Government formulated "the Master Plan for Climate Change (2015-2050)" in accordance with upper-level National Plans mentioned above. All activities in the field of Climate Change are conducted in line with "the Master Plan for Climate Change". **Figure 4-1** shows correlation among National Strategy, 4 main Plans and others.

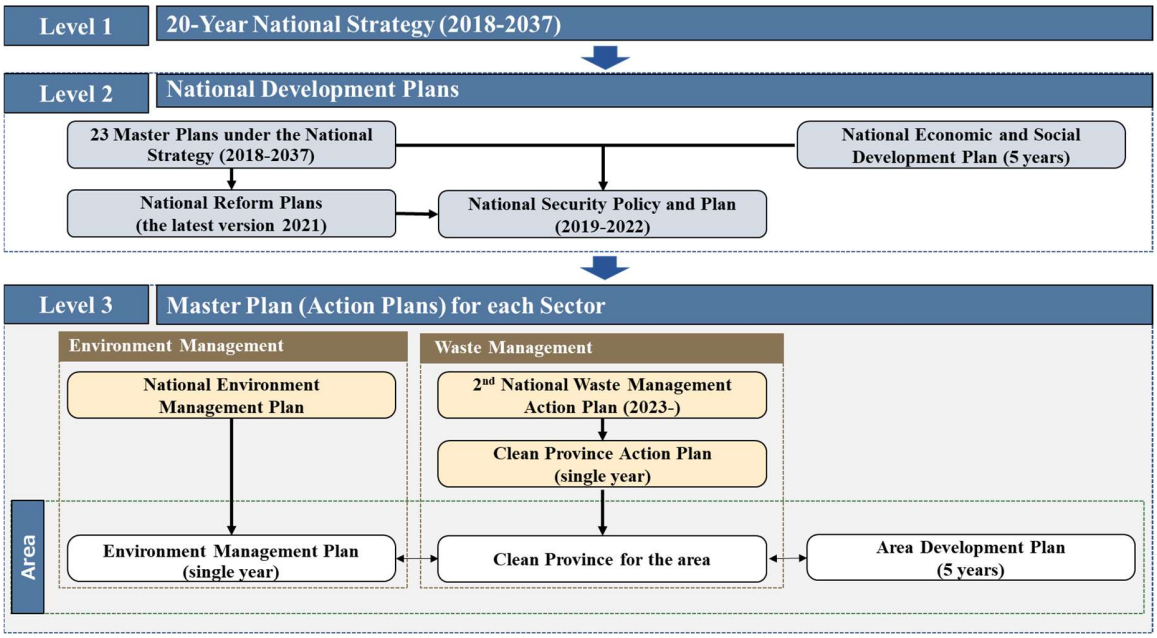


Figure 4-1. Correlation among National Strategy, National Policy & Master Plans

Climate Change related strategies and policies stated in "the 20 years National Strategy (2018-2037)", "23 Master Plans under the 20 years National Strategy(2018-2037)" and "13th National Economic & Social Development Plan (2023-2027)" are as described below.

1) the 20 years National Strategy (2018-2037)

The 20 years National Strategy (2018-2037), the highest National Policy, consists of 6 chapters as follows:

1.	Green Development & Sustainable Development
2.	Economic Growth with sustainable marine management
3.	Social Development responding to Climate Change
4.	Sustainable Development of Urban area, Rural area, agricultural field, industrial area
5.	Eco-friendly water& energy generation and Agricultural Safety
6.	Uplifting standard in National Policy making

The Contractor found that Climate Change related description in the "Item 3. Social Development responding to Climate Change" above, Those are (1) Mitigation (GHG emission reduction, (2) Adaptation (disaster prevention caused by Climate Change & damage

mitigation), (3) Public & Private Investment in low carbon infrastructure and (4) System Development for infectious disease caused by Climate Change, of which structure is as per shown in **Figure 4-2** below.

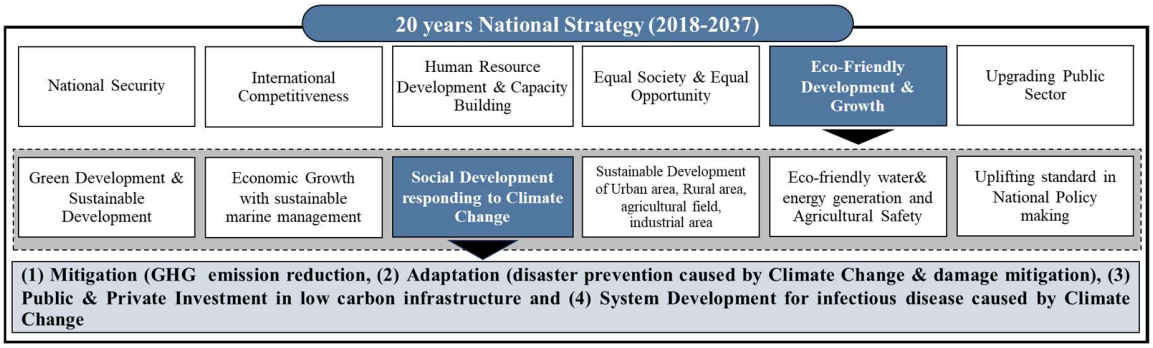


Figure 4-2. Climate Change related strategy in 20 years National Strategy

Source: by the Contractor based on information published by Thai Government

2） National Plan

As shown in **Figure 4-1**, There are 4 National Plans regard as 2nd level National Plans. Description as for Climate Change in 23 Master Plans under the 20 years National Strategy (2018-2037)" and "13th National Economic & Social Development Plan (2023-2027)" among those are as follows:

23 Master Plans under the 20 years National Strategy (2018-2037)

"23 Master Plans under the 20 years National Strategy (2018-2037)" is in the middle of "20years National Strategy" and other National Plans, formulated by Office of the National Economic and Social Development Council (hereinafter referred as "**NESD**"). The 23 Master Plan covers 23 issues, including National Security, International Relation and etc. Climate Change is under "No. 18. Sustainable Growth" of which details are as per shown below.

Article 18　Sustainable Growth (Goal) To improve environment in Thailand by sustainable way and upgrade environmental quality. To upgrade quality of life by environmental conservation and promote development contribute for restoration of natural resources in both land & sea from 5 aspects stated below.

- Economic Growth based on Sustainable Green
- Economic Growth based on Sustainable Ocean
- Development of sustainable low carbon society
- Pollution and Chemical Control in Agricultural Sector
- Strengthen Paradigm in Natural Resources & Environment Management

（Target set up in Climate Change ）

Field	Description	2023-2027	2028-2032	2033-2037
Climate Change	GHG emission reduction[1]	>20%	>0%	>40%
	Vulnerability Ranking	<40	<50	<60

13th National Economic & Social Development Plan (2023-2027)

"The National Economic & Social Development Plan" is a 5 year National Plan formulated by NESD. 13th edition covers 2013-2027 is the latest, in which Thai Government states, "Sufficient Economy", "BCG Economy", "Sustainable Development" and "Resilient Nation" as basic policy in national development, set up 5 Goals in 4 different sectors and 13 KPI for assessment.

(Goals)

① Restructuring of manufacturing & service by innovation
② High Human Development Index（over 8.2）
③ Equitable society with opportunities
④ Sustainable production & consumption
⑤ Strengthen responding capability to changes in the world & risk management

(Fields & Activities)

Field		KPI
1. Manufacturing & Service Sector	:	① Value added agri-agro products ② Sustainable Tourism ③ Manufacturing hub for EV in the world ④ Hub for Advanced medical & social welfare ⑤ Hub for Investment, Trading & Transportation in the region ⑥ Manufacturing Hub for Electro & Electric products in ASEAN
2. Equal Opportunity	:	⑦ SME with high potentiality & Competitiveness Power ⑧ Energic and Safe Smart City with Sustainable Growth ⑨ Less gap between rich & poor among generations with adequate social security system

[1] In comparison with BAU (2005)

3. Sustainable Natural Resources & Environment	:	⑩ Circular& low carbon society ⑪ Resilience against Climate Change
4. Restructuring of Nation	:	⑫ Lifelong Learning and high-quality labor force for future development ⑬ Modern, Effective & transparent pubic service

（Climate Change）

Climate Change might have something to do with many activities, while ⑩ and ⑪ in "the field 3. Sustainable Natural Resources & Environment" correspond to mitigation and adaptation in Climate Change. **Table 4-1** shows targets set up in the field.

Table 4-1. Target set up in Sustainable Natural Resource & Environment

	Description	KIP	Target by 2027
1	Circular Economy & Added value creation by effective use of raw material	1-1. Increase GDP by circular economy	Not less than 1%
		1-2. Domestic Utilization of Natural Resources	Decrease not less than 25%
		1-3. Recycling rate of target waste, such as plastic, construction material, agricultural & food waste	Increase not less than 10%
2	Conservation, Restoration & Sustainable usage of Natural Resources	2-1. Environmental Ranking Index	Score will be not less than 55 and not lower than 3rd ranking in Southeast Asia
		2-2. Forest Area	Increase not less than 33%
3	Development of Low Carbon Society	3-1 . Utilization of Renewable Energy in Energy consumption	Increase not less than 24%
		3-2. Waste Recycle	Increase not less than 40%
		3-3 . Decrease amount of waste generation per capita (in comparison with that in 2017)	Decrease not less than 10%

Climate Change Master Plan (2015-2020)

Climate Change Master Plan was developed by Office of Natural Resources and

Environmental Policy and Planning (hereinafter referred as "ONEP"), Ministry of Natural Resources & Environment (hereinafter referred as "MONRE") in 2015, of which outline is as below:

Goal	:	Realization of vulnerable low carbon society through sustainable development
Target	:	① Adaptation（vulnerability mitigation） ② Mitigation（GHG emission reduction & realization of low carbon society） ③ Strengthen management capability
② Goal in Mitigation :		
Short Term (-2016)		1) Development of middle-Long term Goal & development of road map in cooperation with mass GHG emitters 2) Establishment of integrated system consisting legal framework & economy to promote low carbon society
Middle Term (-2020)		1) Reduction of GHG emission in energy & transportation sectors by 7-20 percent 2021 2) Increase utilization ratio of energy generated by Renewable Energy up to 25 percent by 2021 3) Increase no. of LAOs with 10m2 of Green Area per person
Long Term (2021-)		1) Energy intensity will be decrease by 25 percent in comparison with BAU by 2030 2) Utilization of Public Transportation will be increased 3) GHG emission from Transportation Sector will be reduced 4) Investment in low carbon and eco-friendly industry will be increased 5) No. of Open Dump will be decreased 6) Organic farming & No, of GAP[2] certificated farmers are increased 7) Field burning in agricultural sector will be decreased 8) GHG emission per capita will be decreased

3）Commitment by Thai Government

Thailand's GHG mitigation goal committed to UNFCCC can be divided into 2 phases: Pre-2020 and Post-2020. Thai Government submitted "Nationally Appropriate Mitigation Action (NAMA)" in 2014 for the Pre-2020, and National Determined Contribution (NDC) for the Post-2020.

[2] Stands for "Good Agriculture Practices"

1) Nationally Appropriate Mitigation Action (NAMA)

Thai Government submitted "Nationally Appropriate Mitigation Action (NAMA)" to the United Nation Framework Convention for Climate Change (hereinafter referred as "**UNFCCC")** in 2015 in accordance with International Agreement in 2014 and pledged in a range of 7-20 percent of GHG emission reduction in Energy & Transportation sector in comparison with BAU GHG emission in 2020. Thai Government announced that the Thailand could achieve 17% of GHG emission reduction in 2019.

2) National Determined Contribution

Gen. Prayuth Chan-o-cha, Thai Prime Minister (at the time) stated "Carbon Neutral by 2050" and "Net Zero Emission by 2065" as Thai's goals in mitigation, and in order to achieve the goals, Thai would upwards its contribution in mitigation from 20-25% to 40% of GHG emission reduction with supports to be provided by international society at the 26rh Conference of the Parties (COP) as per stated in the revised National Determined Contribution (NDC) submitted in 2020. Based on the Prime Minister's statement above, Thai Government accelerate its movement forward achievement of its goal. Contents of the 2nd NDC in comparison with that in 2022 is as per shown in below.

Table 4-2. National Determined Contribution

	2nd NDC (2022)	NDC (2020)
GHG emission reduction by 2030 （in comparison with BAU）	30% and 40% with appropriate support to be provided by International Society.	20% and 25% with appropriate support to be provided by International Society.
GHG emission reduction by sector	(Energy & Transportation)[2] 113.0 million tCO2 (Waste Sector) 2.0 million tCO2 (Industry Sector) 0.1 million tCO2	Achieved 17% of GHG emission reduction in 2017, in comparison with BAU emission in 2020 based on commitment in NAMA, which Thai committed 7-20% of GHG emission reduction
GHG emission reduction methodology	• Improve efficiency in Power Generation • HEMS • BEMS • Improve efficiency in Transportation sector • Improve efficiency in Industry sector • Renewable Energy based power generation	Introduction of supporting measures for promotion of renewable energy • Feed in Tariff（FIT） • Tax Incentive • Financial Support（access to Financial Sources）

	• Renewable Energy utilization in domestic • Renewable Energy utilization in industry • Biofuel utilization in Transportation • Methane recovery from wastewater • Domestic Wastewater management • Industrial wastewater management • Substitution of refringent • Substitution of clinker	

Source: by the Contractor based on data & information published by Thai Government

(3) Activities in Climate Change

1) Climate Change Master Plan

In line with the policy & direction set up by Thai Government, Greenhouse Gas Management Organization (hereinafter referred as "**TGO**") formulated "Climate Change Master Plan" and published long term plan for realization of "Carbon Neutral by 2050" and "Net Zero Emission by 2065" as per shown in **Figure 4-3** below.

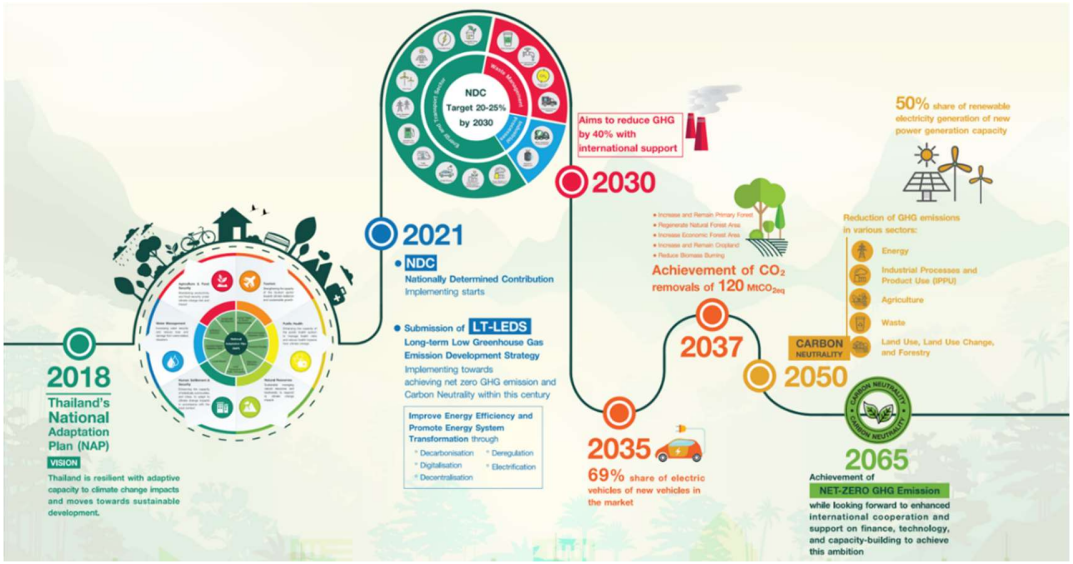


Figure 4-3. Long term plan under Climate Change Master Plan

Source: TGO

2) The Project on development of Guideline for GHG emission reduction at province level

Thai Government, with purpose of achieve its goal in Climate Change, instructed to take various actions, and at the province level, TGO kicked off "the Project on Development of GHG Reduction Guideline at Provincial Level" (hereinafter referred to as "**the Guideline development Project**") and under preparation of Guidelines for 76 provinces in Thailand, thorough which Thai Government expect to understand GHG emission reduction and mitigation & adaptation plan in the province by ① to collect GHG emission related data & information, ② to study GHG emission reduction measures and ③ to prepare mitigation action plan. The Guideline development project was started in Bangkok Metropolitan and Phuket province in 2016, then expanded to other areas. In 2023, 48 provinces including Ubon Ratchathani province as last group, started The Guideline development project, of which details are as per shown in Table **4-3** in below.

Table 4-3. Implementation Status of the Guideline development project

Year	No.	Province implement the Project
2016	2	Bangkok & Phuket
2017	2	Nonthaburi & Songkhla
2018	4	Nan, Saraburi, Smut Prakan & Udon Thani
2019	4	Chonburi, Sakaeo, Nong Khai & Sathon
2020	5	Chiang Mai, Nakhon Ratchasima, Supan buri, Uthai Thani & Karasin
2021	6	Surin, Rayong, Sukhothai Chachoengsao & Nakhon Phatom
2022	4	Plea, Kong Kaen, Kanchanaburi & Krabi
2023	48	**Others including Ubon Ratchathani**
Total	**76**	

Source: by the Contractor based on information disclosed by TGO

4.1.2. Climate Change in Ubon Ratchathani province

(1) Development Plan of Ubon Ratchathani Province (2023-2027)

Development Plan of Ubon Ratchathani Province (2023-2027) was formulated by Ubon Ratchathani Provincial Office in accordance with Determining Plan and Process of Decentralization to Local Government Organization Act, B.E. 2542 (1999). Development Plan covers 5 years and revised annually. Latest Version of the Development Plan of Ubon Ratchathani Province is that of 2023 – 2027 consists of 268 pages in 9 chapters, of which outline is as per described below.

Table 4-4. Content of the Development Plan of Ubon Ratchathani Province (2023-2027)

1) Vision & Target in Development

Vision

- To be a modern and active province
- To upgrade agriculture, bioeconomy, trade, investment, tourism & others to international level

Targets

1）To develop the province as modern & active province through achieve all the targets set up in “Smart City Concept 2027” based on Smart City Development Guideline

2）To increase GPP in Agricultural Sector by improvement of production efficiency, upgrading standard and added value creation in agri-agro products

3）To share knowledge as for bioeconomy and create bio economy in the province

4） To increase Investment & trading
5) To promote tourism and increase income from tourism

2) General Information

Geographic Information

Ubon Ratchathani Province is located in the southeastern tip of the northeastern region of Thailand. It lies between latitudes 14 degrees 12 minutes and 16 degrees 5 minutes and longitudes 104 degrees 23 minutes and 105 degrees 38 minutes east. According to the Department of Provincial Administration, the province has an area of 15,763.41 square kilometers. It is the fifth largest province in Thailand and the second largest in the northeast, after Nakhon Ratchasima Province. It is located approximately 575 kilometers from Bangkok.

The north adjacent to Amnat Charoen, Yasothon Province and Lao PDR, the south adjacent to Phra Wihan Province, Cambodia, the east adjacent to Champassak Province, Lao PDR, and the west adjacent to Si Saket and Yasothon Province.

Population

In 2019 66.12 percent of the land area is utilized for agriculture, 17.89 percent for forest, 6.68 percent for miscellaneous areas, 5.36 percent for communities and the remaining 3.95 percent for water.

Administrative Division

Administrative division in the Province is as per shown in the table below.

Administrative Division			Local Administrative Organization				
District	Sub District	Village	PAO	City Municipality	Town Municipality	Sub-District municipality	SAO
25	219	2,704	1	1	4	54	179

In Thailand. There are two types of organizations administrate the area, i.e., area administrative offices of central government, such as “Provincial Office”, “District Office” & “Village Office” and LAOs, such as Provincial Administrative Organization, Municipality & Sub District Organization. Municipality is divided into 3 classes, depending on population and socio-economic condition. Chiefs of area administrative offices, except for those for villages, are appointed by the central government, while chief of LAOs are selected by local resident in the area. There are local administrative body for LAOs to administrate the area.

Socio Economy

In 2021, Gross Provincial Product (GPP) of Ubon Ratchathani province is 135,617 million baht ranked in 3rd of northeastern part and 21st of Thailand. The service activity accounted for 63.49 percent (86,103 million baht) is the largest, the second is agricultural products accounted for 19.82 percent (26,885 million baht) and industrial sector accounted for 16.69 percent (22,630 million baht). GPP per capita is 78,275 baht/person/year. Ubon Ratchathani Province has trade borders with 2 neighboring countries i.e., Lao PDR and Cambodia.

There are 1,323 educational institutes in 2017 , 851 medical centers (2020) and 1,652 religious facilities, i.e., 1,583 temples, 68 churches, 1 mosques existing in the province, which has the following details:

3) Climate Change related Activities

Climate Change has correlation with various activities, thus being referred in many parts in the Development Plan, while in the Development Plan of Ubon Ratchathani Province (2023-2027), the Provincial Office focuses on Climate Change in Target 1, in which the Provincial Office stated a follow:

4) Statement in Target 1 of Development Plan, while in the Development Plan

Challenges (Target in Development)

① Promote healthy lives and well-being for citizens
② Develop and upgrading the quality of education at all levels
③ Ensure adequate, modern, environmentally friendly and hygienic basic public utilities and facilities
④ Develop and use environmentally friendly energy
⑤ Security of life and property

Activities to tackle with challenges

Objective		Targets & Indicators	2023	2024	2025	2026	2027
3	Modern, Environmentally friendly, and hygienic Public utilities and	Percentage of infrastructure and public utilities raise to standards to enhance the quality of life of the people in Ubon	3	3	3	3	3

Objective		Targets & Indicators	2023	2024	2025	2026	2027
	facilities	Ratchathani Province.					
		Percentage of networks for conservation of natural resources and the environment that develop to recover knowledge and skills in conservation of natural resources and the environment		60	60	60	60
		Hotspots are reduced compared to the average of the past 3 years.		20	20	20	20
4	Development and utilization of environmentally friendly energy	Zero waste to low carbon community, 25 communities per year (1 community per district)		25	25	25	25
		Utilization ratio of renewable energy is increased.	1	1	1	1	1

Outline of the Project

(Implementation Plan 6: Alternative & Clean Energy Development)

Objective	:	1. To promote clean energy technology in developing smart cities. 2. To be a learning center for renewable energy and clean energy in the future.
Indicator & Target	:	1. Utilization ratio of renewable energy is increased 0.5% per year. 2. The use of gasoline per unit of GPP is decreased 1.5% per year.
Target area	:	Ubon Ratchathani Province
Activities	:	1. Clean energy project for Integrated development 2. Solar energy for better life project

(Implementation Plan 7: Natural Resources and Environment Management)

Objective	:	To manage natural resources and the environment corresponding with modern livable city.
Indicator & Target	:	1. Natural resources and the environment are managed efficiently and sustainably. 2. The modern livable city goes together with natural resources and the environment management
Target area	:	Ubon Ratchathani Province

Activities	:	1. Zero foam and plastic bag project 2. Project on promotion of conservation, restoration, and sustainable development of forest resources 3. Solar energy for better life project 4. Increasing efficiency in protecting forest resources and wildlife and solving social problems along the border between Thai and Lao PDR at Chong Ta U in the Buntharik-Yod Mon wildlife sanctuary, Ubon Ratchathani Province 5. Project to strengthen networks to cope with climate change and solve forest fires and smoke problems in Ubon Ratchathani Province 6. Youth Participation in Forest Protection and Environmental Conservation 7. Promoting Three Forests, Four Benefits according to according to the royal initiative in increasing forests to generate community income

The activities listed in the Table above are also reported in Appendix B. Summary of the Review of the Provincial Development Plan (2023-2027) Revised Edition for Fiscal Year 2024, of which details are as per **Table 4-5** below.

Table 4-5. Details of the Activities in Appendix B of the Development Plan

Activity	Budget (THB K)	Responsible Agency	Cooperating Agency	Duration	Outcome
Clean energy project for Integrated development	7,200	Provincial Office of Energy (POE)	Department of Energy Business (DEB) and Energy Policy & Planning Office (EPPO), Ministry of Energy		
Solar energy for better life project	1,500	POE	DEB & EPPO	2024-2027	1. Energy cost saving 2. Increase of power generation from Renewable & Clean Energy in the province 3. Learning center for Smart City 1. PV system with capacity less than 300KW 2. EV charger in Smart Energy
Zero foam and plastic bag project	1,009.6	PONRE			
water sources development to conserve natural resources and ecosystem	3,500	Forest Resource Management Office No.7			

Solar energy for better life project	2,100	POE			
Increasing efficiency in protecting forest resources and wildlife and solving social problems along the Thai-Lao PDR border area at Chong Ta U in the Buntharik-Yod Mon wildlife sanctuary	4,300	Buntharik-Yod Mon Wildlife Sanctuary			
Project to strengthen networks to cope with climate change and solve forest fires and smoke problems	2,073	Buntharik-Yod Mon Wildlife Sanctuary			
Youth Participation in Forest Protection and Environmental Conservation	2,608	1. Pha Taem National Park 2. Kaeng Tana National Park 3. Buntharik-Yodmon Wildlife Sanctuary 4. Pha Taem Forest Fire Control Station 5. Buntharik-Yodmon Forest Fire Control Station			
Promoting Three Forests, Four Benefits	2,791	1. Buntharik-Yodmon Wildlife Sanctuary			

according to the royal initiative in increasing forests to generate community income		2. Pha Taem Forest Fire Control Station 3. Buntharik-Yodmon Forest Fire Control Station 4. Dong Na Tham Community Forest Management Project			
Zero waste to Low carbon Community	500	Ubon Ratchathani Rajabhat University		2024	1. 1. Natural resources and the environment are managed efficiently and sustainably. 2. The modern livable city goes together with natural resources and the environment management

(2) The Project on development of Guideline for GHG emission reduction for Ubon Ratchathani province

The Project on development of Guideline for GHG emission reduction for Ubon Ratchathani province (hereinafter referred to as "**the Guideline development Project Ubon Ratchathani**") has been launched as a part of "the Guideline development Project" stated in 4-1-1(3)2) by Ubon Ratchatani province since January 2023, with assignment letter for the Working Group (hereinafter referred to as "**WG**") issued by the Governor of the province. Outline of the project is as described below.

There is no description as for the Guideline development Project Ubon Ratchathani, Since most of the Provincial Office's activities are conducted as a part of project implemented by the Central Government,

Table 4-6. Status of WG meetings

Date	Outline
2023.03	1st Meeting: Establishment of Working Group for the Guideline development Project Ubon Ratchathani & briefing of the project, including base year & data sources
2023.05	2nd Meeting: Discussion on GHG emission and mitigation actions, assessment & data collection for Adaptation and risk assessment
2023.08	3rd Meeting: Acceptance of GHG emission in Base Year (2019), estimation of BAU GHG emission in 2030, mitigation actions & discussion on vulnerability in the province covering water resources management, agriculture, agricultural security, tourism, public health, natural resources and residence)
2023.10	4th Meeting: Discussion on Adaptation Plan for the province, including Adaptation Activities and Action plan
2023.11	5th Meeting: Acceptance of Adaptation plan for the province and closure of WG

Source: by the Contractor based on information shared by the Ubon Ratchathani province

Working Group for the Guideline Development Project		
• Governor (Chairman)	• Chief Clerk	• Forest Management 7
• PONRE (Secretariat)	• Transportation Office	• National Part 9
• Energy Office	• Port Office	• PEA
• ERC 5	• Ubon Ratchatani Station	• Water Office
• Industry Office	• Ubon Ratchatani Airport	• POLA
• FTI	• Agriculture Office	• Public Health Office
• Land Development	• Livestock Office	• Chiefs of LAOs
• Ubon Ratchatani Zoo	• Agricultural Economy 11	Others
• Forest Association	• Public Work & Planning	45 members in total

Figure 4-4. Members in WG and WG meeting

Source: by the Contractor based on information shared by the Ubon Ratchathani province

4.1.3. GHG emission in Thailand & Ubon Ratchathani province

(1) GHG emission in Thailand

Thailand signed & ratified UNFCCC in 1991, then participated in Kyoto Protocol in 2012 and Paris Agreement in 2016.and submit National Communication as well as Biennial Report to UNFCCC in accordance with the Agreement. Thailand 4th National Communication, submitted as of December 27, 2022, by Thai Government is the latest, and description as for GHG emission in the Report is as follows.

- Thailand National Greenhouse Gas Inventory reported in this NC4 was prepared using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
- In 2018, total GHG emissions (excluding those from LULUCF) were 372,648.77 GgCO2 eq and Net GHG emissions were 286,680.47 GgCO2 eq (including those from LULUCF).
- The Energy sector remained the most significant contributor to Thailand's GHG emissions, accounting for 69.06 % of the total GHG emissions. The share of emissions from the Agriculture, IPPU, and Waste sectors were 15.69%, 10.77 %, and 4.48%, respectively.
- LULUCF contributed to a net removal of -85,968.30 GgCO2 eq.
- Total GHG emissions (excluding those from LULUCF) increased from 245,899.56 GgCO2 eq in 2000 to 372,648.77 GgCO2 eq in 2018, with an average annual increase of 2.34%.
- The net removal of CO2 increased from -45,443.60 GgCO2 eq in 2000 to -85,968.30 GgCO2 eq in 2018. Net GHG emissions therefore increased overall from 200,455.96 GgCO2 eq in 2000 to 286,680.47 GgCO2 eq in 2018, with an average annual increase of 2.01% (Table 2-4, Figure 2-1). Between 2000-2018,
- the main source of GHG emissions was the Energy sector, which saw an increase of

55.88% from 165,092.40 GgCO2 eq in 2000 to 257,340.89 GgCO2 eq in 2018. The proportion of GHG emissions in the Energy sector accounted for 67.14% of total emission sources in 2000, increasing to comprise 69.06% of total emission sources in 2018.

- In the same period, the share of emissions from the Agriculture sector decreased from 19.95% in 2000 to 15.69% in 2018,
- The IPPU sector increased from 8.65% in 2000 to 10.77% in 2018.
- The shares of emissions from the Waste sectors slightly increased from 4.26% in 2000 to 4.48% in 2018. (Figure 2-2).

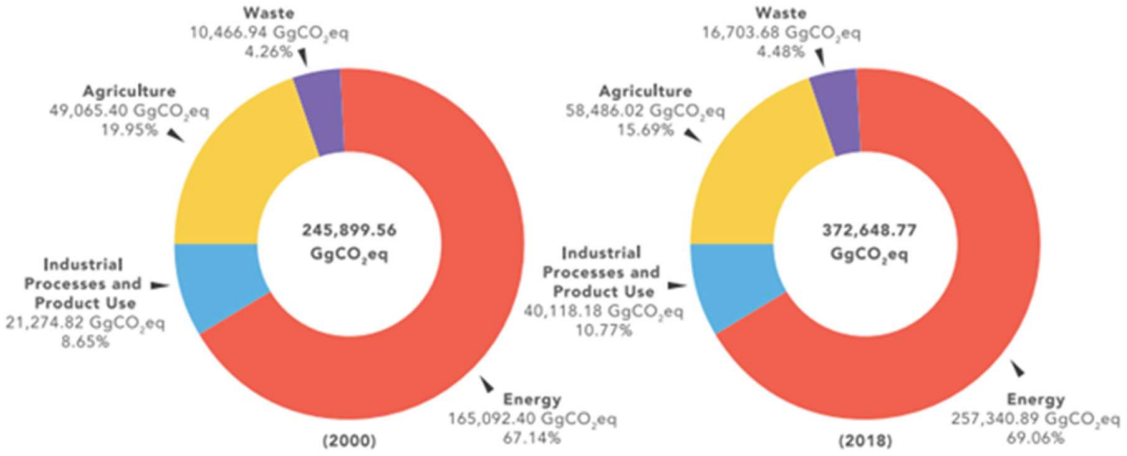


Figure 4-5. GHG emission in Thailand by Sector / (Left) 2000 & (Right) 2018

Source: Thailand 4th National Communication

(2) GHG emission in Ubon Ratchathani province

1) the Guideline development Project for the Province

Upon implementation of the Guideline development Project, TGO published Handbook for the Guideline development (hereinafter referred to as "**TGO Handbook**"). The TGO Handbook is said to developed based on Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (hereinafter referred to as "**GPC**") developed by ICLEI – Local Governments for Sustainability, World Resources Institute, C40 Cities Climate Leadership Group with concept of T-VER added by TGO. It consists of main part and spread sheet, and all the provinces in Thailand prepare or under preparation for the Guideline for the

Province, including GHG emission, estimated BAU GHG emission in 2030. .

There are 5 sectors, i.e., “Stationary Energy”, “Transportation”, “Waste” and “AFOLU”, 3 scopes, i.e. “Scope 1”, “Scope 2” & “Scope 3” and 2 boundaries, i.e.,” BASIC” for under developing cities and “BASIC+”. for developed cities in TGO Handbook, and TGO Handbook guides to quantify & estimate GHG emission either BASIC or BASIC + depending on the status of the province.

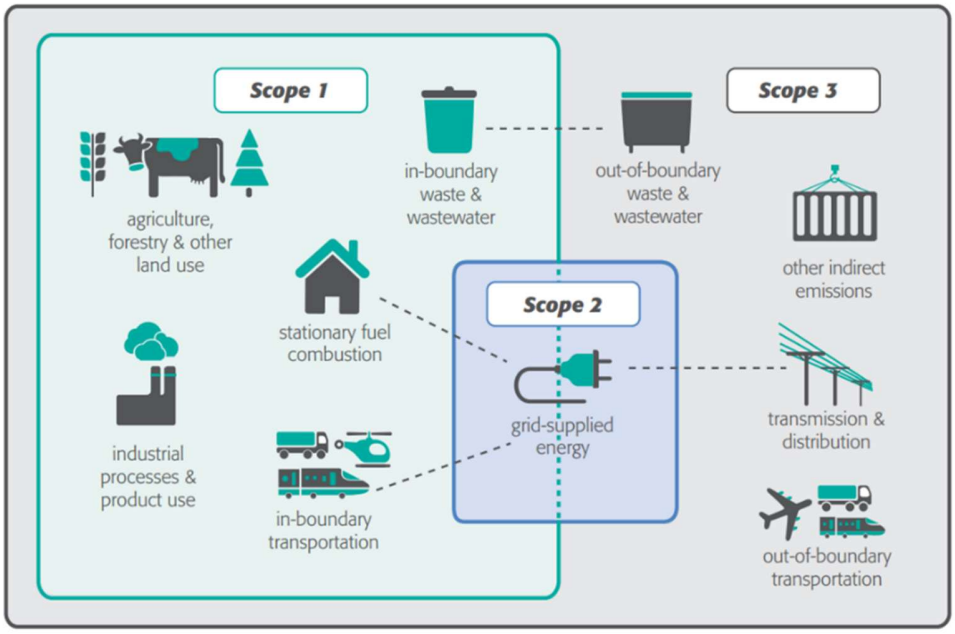


Figure 4-6. Image of the Scope in TGO Handbook

Source: GPC

2) GHG emission in the Province

WG for “the Guideline development Project Ubon Ratchathani” in cooperation with Rajabhat University, set up 2019 as base year, collected data as for GHG emission and quantified GHG emission in 2019. GHG emission in 2019 reached to 1,054,624 tCO2 in Stationary Energy Sector of which 838,547tCO2 was emitted from Grid supplied energy, followed by 850,439 tCO2 from Transportation Sector. GHG emission from Waste Sector reached to 384,500 tCO2, that from AFOLU Sector is -647,931 tCO2, because of carbon absorption by Forest. GHG emission in the Province in 2019 is as per indicated in **Table 4-7** below.

Table 4-7. GHG emission by sector in Ubon Ratchathani

Sector		2019				
		Scope 1	Scope 2	Scope 3	BASIC	BASIC+
Stationary Energy	All type of Fuel	216,077	838,547		**1,054,624**	**1,054,624**
	Grid supply power (Fossil Fuel)					
Transport	All type of Fuel	850,439		74,676	**850,439**	**925,115**
Waste	MSW(Landfill)	156,603			**156,603**	**156,603**
	MSW(RDF)	-			-	-
	MSW (Incineration)	783			**783**	**783**
	Wastewater	227,113			**227,113**	**227,113**
	MSW(outside of area)	165,458				
IPPU	All					
AFOLU	Livestock	509,395				**509,395**
	Land Use	(3,933,577)				**(3,933,577)**
	Open Burning	356,841				**356,841**
	Rice Cultivation	2,420,110				**2,420,110**
Total		969,242	838,547	74,676	**2,289,562**	**1,717,007**

Table 4-8. GHG emission from Sector 1. Stationary Energy in the Province

Sub Sector		GHG emission (t CO_2eq)			
		Scope 1	Scope 2	Scope 3	Total
I. Stationary Energy					
I.1	Residential Energy	18,694	347,482	NO	366,177
I.2	Energy in commerce and government	68,278	161,793	NO	230,071
I.3	Energy in industry and construction	39,161	285,240	NO	324,401
I.4.1/2/3	Energy to produce energy	273	347,482	NO	273
I.4.4	Energy to produce electricity	NO	-	-	0
I.5	Energy in agriculture, forestry and fisheries	49,116	7,909	NO	57,025
I.6	Energy from an unidentified source	40,553	36,123	NO	76,676
I.7	GHG emissions from coal mining, storage and transport processes	NO			0
I.8	Greenhouse gas leaks from oil and natural gas systems.	NO			0
計		**216,077**	**838,547**	**0**	**1,054,624**

Table 4-9. GHG emission from Sector 2. Transportation

Sub Sector		GHG emission (t CO_2eq)			
		Scope 1	Scope 2	Scope 3	計
II. Transportation					
2.1	On Road Transportation	813,151	NO	14,864	**828,015**
2.2	Railway	4,552	NO	27,187	31,740
2.3	Waterborne Navigation	111	NO	NO	111
2.4	Aviation	32,625	NO	32,625	65,250
2.5	Off-road Transportation	IE	NO	NO	0
Total		**850,439**	**0**	**74,676**	**925,115**

Table 4-10. GHG emission from Sector 3. Waste

Sub-Sector		GHG emission (t CO_2eq)			
		Scope 1	Scope 2	Scope 3	Total
III. 廃棄物					
III.1	Management of Waste generated in the area by landfill	156,603			156,603
III.2	Management of Waste generated in the area by biological methods	NE			0
III.3	Management of Waste generated in the area by burning	783		NO	783
III.4	Management of Wastewater generated in the area by treatment method	227,113			227,113
III.5	Management of Waste generated outside by landfill	165,458			
III.6	Management of Waste generated outside by biological methods	-			
III.7	Management of Waste generated outside by burning	-			
III.8	Management of wastewater generated outside the area by treatment method	-			
Total		**383,249**		**0**	**384,500**

Table 4-11. GHG emission from Sector 5. AFOLU

Sub Sector		GHG emission (t CO_2eq)			
		Scope 1	Scope 2	Scope 3	Total
V. Agriculture, Forestry and Other Land Use (AFOLU)					
V.1	Livestock Management	509,395			509,395
V.2	land use, land use change	-3,933,577			-3,933,577
V.3	Agricultural materials and non-CO2 emission sources.	2,776,952		IE	2,776,952
	- Burning biomass	356,841			356,841
	- Rice cultivation	2,420,110			2,420,110
Total		**-647,231**	-	**0**	**-647,231**

(3) Estimated BAU GHG emission by 2030

WG estimated BAU GHG emission from that in 2019 or base year and trend during 2015 -2019 (except for some sub sector) . Estimated GHG emission for the period is as per shown in **Table 4-12** below.

Table 4-12. Estimated GHG emission for 2020-2030 (unit: 1,000 tCO2)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
GHG	1,642	1,862	2,005	2,212	2,445	2,714	3,079	3,430	3,830	4,286	4,807	5,346
Change		13.4%	7.7%	10.3%	10.6%	11.0%	13.4%	11.4%	11.7%	11.9%	12.2%	11.2%

As shown in the Table 4-12, BAU GHG emission in the Province is estimated to increase at the rate of 11.3% per year on average for the period.

4.1.4. Mitigation plan in Thailand and Ubon Ratchathani Province

(1) Mitigation plan in Thailand

Thai Government referred actions and measures for the eight sectors in Strategy 2 "Mitigation and low carbon development" in The Climate Change Mitigation Plan.

Sector		Actions & Measures
Power generation and energy supply	:	To decrease fossil fuel consumption, increasing/developing renewable energy production, and developing infrastructure which facilitates low carbon development while simultaneously lowering GHG emissions
Transport	:	To increase the efficiency of transport and logistics, developing low carbon transport infrastructure, and applying sustainable principles to manage transport demand
Energy consumption in buildings		To improve energy conservation and efficiency in buildings
Industry	:	To improve the performance of machinery, energy efficiency, and waste reduction through measures such as the promotion of renewable energy production and consumption, and investments in low-carbon and environmentally friendly industries
Waste management	:	To realize integrated life cycle waste management by prioritizing source reduction and the 3R (Reduce, Reuse, Recycle) in accordance

		with the waste hierarchy. Waste management efficiency will be increased by supporting waste-to-energy programs.
Agriculture	:	To realize low emission agricultural practices with environmental and financial co-benefits; increasing the capacity of farmers to accommodate GHG reduction technologies and management systems
Forestry	:	To create carbon sinks via forest conservation, restoration, reforestation, and afforestation. Measures that affect communities in forested areas should be evaluated on the merits of their environmental and social impact via public hearings of sufficient duration and transparency, which will ultimately aid the decision and policy-making processes
Urban management	:	focusing on increasing urban green spaces to act as carbon and pollution sinks which can also help mitigate GHG emissions from human activities in major cities

(2) Mitigation plan in Ubon Ratchathani province

Mitigation plan under planning and/or consideration by the Province are as per shown in the Table below.

	Type of Activity	No. of Activities	GHG emission reduction (tCO_2)
1	Energy Efficiency	3	145,487
2	Alternative Energy	2	10,684
3	Waste Management	3	257,812
4	Transportation Management	5	492,564
5	Forest & Green Area	3	391,205
6	Agriculture	2	1,065,507

4.1.5. Discussion on Road Map for Decarbonization for the Province

In this activity, the Contractor conducted interview with the relevant government agencies and organizations as for their mitigation actions under planning and/or consideration and surveyed GHG emission sources as well as Renewable Energy related sites and make it in order.

(1) Estimated BAU GHG emission and GHG emission with mitigation actions

Estimated BAU GHG emission and GHG emission with mitigation actions in the Province is as per shown in **Table 4-13** below.

Table 4-13. Estimated BAU GHG emission & GHG emission with mitigation actions in 2030

Sector		2019		2030(BAU)						2030(Target)					
				Amount(tCO2)		Change				Amount(tCO2)		Change			
						Amount(tCO2)		%				2019		BAU	
		BASIC	BASIC+	BASIC	BASIC+	BASIC	BASIC+	BASIC	BASIC+	BASIC	BASIC+	BASIC	BASIC+	BASIC	BASIC+
Stationary Energy	All type of Fuel	1,054,624	1,054,624	1,365,093	1,365,093	310,469	310,469	29.4%	29.4%	1,208,958	1,208,958	14.6%	14.6%	-11.4%	-11.4%
	Grid supply power (Fossil Fuel)				-	-					-				
	Total	1,054,624	1,054,624	1,365,093	1,365,093	310,469	310,469			1,208,958	1,208,958	14.6%	14.6%	-11.4%	-11.4%
Transport	**Transport**	850,439	925,115	1,067,878	1,067,878	217,439	142,763	25.6%	15.4%	575,314	575,314	-32.4%	-37.8%	-46.1%	-46.1%
Waste	MSW(Landfill)	156,603	156,603	6,780	6,780	-149,823	-149,823	-95.7%	-95.7%	0	0	-100.0%	-100.0%	-100.0%	-100.0%
	MSW(RDF)	-	-	-	-	-	-			-	-	-	-	-	-
	MSW (Incineration)	783	783	3,498	3,498	2,715	2,715	346.7%	346.7%	1,132	1,132	44.6%	44.6%	-67.6%	-67.6%
	Wastewater	227,113	227,113	1,014,123	1,014,123	787,010	787,010	346.5%	346.5%	**957,484**	**957,484**	**321.6%**	**321.6%**	-5.6%	-5.6%
	MSW(outside of area)					-	-								
	Total	384,499	384,499	1,024,401	1,024,401	639,902	639,902	166.4%	166.4%	958,616	958,616	149.3%	149.3%	-6.4%	-6.4%
IPPU	All					-	-								
AFOLU	Livestock		509,395		854,780	-	345,385		67.8%		854,780		67.8%		0.0%
	Land Use		-3,933,577		-3,706,130	-	227,447		5.8%		-4,097,335		-4.2%		-10.6%
	Open Burning		356,841		2,320,874	-	1,964,033		550.4%		**1,680,780**		**371.0%**		-27.6%
	Rice Cultivation		2,420,110		2,419,538	-	-572		-0.02%		1,994,125		-17.6%		-17.6%
	Total		-647,231		1,889,062		2,536,293				432,350		-166.8%		-77.1%
Total		2,289,562	1,717,007	3,457,372	5,346,434	1,167,810	3,629,427	51.0%	211.4%	2,742,888	3,175,238	19.8%	84.9%	-20.7%	-40.6%

(2) Discussion on Road Map for Decarbonization for the Province

Thai Government committed 30% of GHG emission reduction and 40% with appropriate international support in comparison with BAU by 2030. Since Thailand is middle - income country, LAOs in Thailand are recommended to submit its report in BASIC+ format. Although estimated GHG emission in BASIC+ in Ubon Ratchathani in 2030 is – 40.6% in comparison with BAU and already reached to the target level, It is recommended for the Province to examine report in detail in order to have exact data for further consideration, to ensure implementation of exiting plan and find more mitigation actions to contribute for GHG emission reduction in the Province. In this activity, including the issues stated above, parties involved in the Study discussed how to draft Road Map for Decarbonization for the Province.

1) GHG emission related data for the Province

GHG emission disclosed by the Province is as per 4.1.3 (2) above, while parties involved in the Study recognize that there are at least a few values, seems be incorrect and need to re-check data source and quotation for those. In addition, parties expect to have more accurate data by adding data in and after 2021 into database. The parties involved in the Study agreed to review existing report on GHG emission in the province to update.

2) Interviews with relevant government agencies & organizations

In this activity, the Contractor conduct interviews with relevant government agencies & organizations to collect further information as for mitigation actions under planning and/or consideration in the Province in 4.1.4 (2) above.

Provincial Office for Energy

Venue	:	Provincial Office for Energy
Date	:	January 17, 2024
Responder	:	Mr. Chairat Pongphira, Director & 2 others

Findings from the Interview:

Information shared and comment & advises given by the Provincial Office for Energy (hereinafter referred to as “POE”) are as follows.

- POE is a provincial office of Ministry of Energy (hereinafter referred to as "MOE") and engage in coordination work for MOE in the Province.
- POE engages in awareness raising as for energy saving and energy efficiency in Climate Change in the Province, including recommend switching electric appliances with less power consumption.
- MOE promotes Renewable Energy and launches new project, in which MOE will install PV system to households and small shops conditionally, for free of charge and collect installation cost from electricity bills. Although the project has not yet started in the Province, POE expect the project will be started within a few years in the Province.
- Regarding to the New Power System, There are some pilot projects going on and some, such as Hybrid Power generation system at Sirindhorn Dam and Microgrid at Wat Pha Sri Sen Tham are ongoing in the Province, but not sure as for transmission, and it seems be taken time to be opened up.

Provincial office of Agriculture

Venue	:	Provincial Office of Agriculture
Date	:	January 17, 2024
Responder	:	Mrs. Namphet Karavipat Expert Professional Level & other

Findings from the Interview:

Information shared and comment & advises given by the Provincial Office of Agriculture (hereinafter referred to as "**POA**") are as follows.

- POA is one of the organizations under Ministry of Agriculture (hereinafter referred to as **"MOAC")** in the Province and support MOAC's activities in the Province level.
- MOAC participates in WG for the Guideline Development Project and information is shared in MOAC.
- MOAC engage in various activities related to Climate Change, for example,
  - MOAC conduct pilot project of "Green Fertilizer for Rice Cultivation" with National Science & Technology Development Authority (hereinafter referred to as "NSTDA") in Chian Rai province, Nakon Panom Province, Lamphan province and Udon Thani province and planning to expand to other areas, once MOAC get good result from the project.

- MOAC also implement 3Rs (Re-Habit, Realize & Recycle) promotion in agricultural field, through which MOAC promotes changing practices, such as conversion from field burning to decomposition by microorganisms, utilization of sub products from cultivation, e.g. mushroom cultivation by rice straw & etc.

- However, POA does not recognize how the Province take above activities into account of mitigation plan for the Province

Electricity Generation Authority of Thailand (EGAT)

Venue	:	EGAT Sirindhorn Power Station
Date	:	January 18, 2024
Responder	:	Mr. Paiwan Vivekwin　Director in charge of Safety

Findings from the Interview:

Information shared and comment & advises given by EGAT Sirindhorn Power Station (hereinafter referred to as "**Sirindhorn PS**") are as follows.

- Sirindhorn PS is one of site offices under EGAT operate and manage Sirindhorn Power Station owned by EGAT
- Sirindhorn PS engages 2 types of operations, i.e., Power Generation and Environment related operation.
- (Power Generation)　Operate & manager 5 power plants below.
  - Sirindhorn hydro power plant　Capacity (36MW)
  - Flow of the River power generation　(136MW)
  - Tracking PV power generation system　(1MW)
  - Floating Solar　（250KW）
  - Hybrid Power Generation Floating Solor & Hydro　(45MW)

  (Environment related operation (Sirindhorn model))
  - Project to upgrade life level of local resident in the area, in line with principal of The late king of RAMA IX & Doi Tung model of Mae Far Luang
- Hybrid Power Generation Floating Solor & Hydro (45MW) is the largest in Capacity in its kind in the world. Tracking PV power generation system　(1MW) is under implementation as a pilot project.
- Climate Change in Power sub sector in Thailand with roles to be played by EGAT are as follows.

- Thai Government published "Power Development Plan (2018-2037) (hereinafter referred to as "PDP2018") as the latest
  - Thai Government foresee capacity of power generation required as 77,211MW
  - Thai Government plans to have 32.5% or 25,086MW of power generation capacity in energy mix from renewable energy. 75% or 18,696MW of renewable energy power plant, consist of 8,740MW of solar, 2,780MW of biomass, 400MW of biogas, 1,485MW of wind, 2,725MW or hybrid (floating solar & hydro) and etc., will be newly constructed
  - 2,725MW of Floating Solar is be divided into 16 projects and Hybrid Power Generation Floating Solor & Hydro of Sirindhorn PS is the first project
- Although some delay incurred but Power Development in Thailand is proceeded as per the PDP2018 and Thai will be able to achieve its goal stated in the PDP2018.

Regional Forest Management Office No. 9

Venue	:	Regional Forest Management Office No. 9
Date	:	January 19, 2024
Responder	:	Mr. Prasong Suwannachot, Acting Director and other 2 members

Findings from the Interview:

Information shared and comment & advises given by the Regional Forest Management Office No. 9 (hereinafter referred to as "**RFMO9**") are as follows.

- RFMO9 is regional office of Royal Forest Department (hereinafter referred as "**RFD**") and manage 9 forest conservation areas in the Province.
- RFD is responsible for the following activities in Climate Change
  - To increase CO2 absorption by forest through appropriate forest management
  - To save energy & utilize solar power in forest management
- There are some hotspots along the boarders, but RFD understands no serious impact on the Climate Change in the Province

Regional Environment Office No. 12

Venue	:	Regional Environment Office No. 12
Date	:	February 19 & 22, 2024
Responder	:	Mr. Praderm Parkkaew Director and Other members

Findings from the Interview:

Information shared and comment & advises given by the Regional Environment Office No. 12 (hereinafter referred to as "**REO12**") are as follows.

- REO12 is a regional office under PCD and engage in waste, water, air quality management in 5 provinces in Northeastern part of Thailand.
- REO12 keep on monitoring waste disposal sites located in 5 provinces including GHG emission from those sites, as only accredit body for GHG emission in waste sector.
- REO12 has ISO17025 certified laboratory and conduct various types of analysis.
- REO12 has started Carbon Footprint Offset (hereinafter referred to as "**CFO**") in Climate Change
- REO supports Dept. of Local Administration (hereinafter referred to as "**DLA**")'s project on Waste separation for composting in which DLA promote wet waste separation and composting at waste generation sources in Thailand.

Meeting with POA (Left) & Meeting with Sirindhorn PS


Meeting with RFMO9 (Left) & Meeting with POE (Right)


Meeting with REO12 / with Director (Left) & Practical Level(Right)

3) Other project contribute for decarbonization

<u>Biomass & Biogas Power Plant</u>

Thai Government includes Climate Change in policies and projects to realize “Bio Circular and Green Economy “ (hereinafter referred to as “BCG Economy” and on the contrary, includes other issues, such as vitalization of rural economy, income growth in rural are, in the project focusing on Climate Change.

As a part of promotion of Renewable Energy, Thai Government introduced Feed in

Tariff (hereinafter referred as "FiT") in 2017 and published power procurement plan from Renewable Energy based power plants in PDP2018.

Thai Government regards "Community Power Plant" which is a kind of Renewable power plant utilize biomass to be procured by farmers in the area on the contract base, as a model project, and stated that the Thai Government would realize "vitalization of rural economy" and "income growth in rural are" through implementation of the Community Power Plant project. Development plan for the Community Power Plant indicated in Alternative Energy Development Plan (hereinafter referred as "AEDP2018)" & "PDP2018" is as per shown in the table below.

Power Development plan for Community Power Plant in AEDP2018 & PDP2018

(Unit: MW in capacity)

Year	2020	2021	2022	2023	2024	Total
Target	200[3]	100	100	100	100	600

Thai Government invited interesting parties to participate in public selection of Power Generators under the Community Power Plant as 1st Quick Win project in 2021 with condition below.

Power Purchasing Price

Type & Capacity (MW)	FIT (THB/Unit)			Contract (Year)	FIT premium (THB/unit)
	FiT_F	$FiT_{V.2564}$	FiT (1)		For Deep South Area(2) (during operation period)
1. Biomass *(Combustion)*					
Capacity 1-3 MW	2.61	2.2563	4.8663	20	0.50
Capacity > 3 MW	2.39	1.8888	4.2788	20	0.50

Remarks :

1. Revised from 2019 by utilizing core inflation rate of 0.29% in 2020
2. Applicable for the project to be developed in all area in Yala province, Pattani province, Narathiwat province and Chana district, Tepa,Sabayaoi district and Na Thawi district Songklar province.

175 projects applied for power generation concession in the public selection under the 1st Quick Win project and 43 projects, consist of 27 biogas projects with capacity of 74.5MW and 16 biomass projects with capacity of 75MW, were selected as the parties entitle the right to negotiate for Power Purchase Agreement (hereinafter referred as "PPA").

There were 7 projects listed in below from Ubon Ratchathani province entered into the public selection, but all were failed.

[3] 150MW from 200MW of Quota in total has been implemented as Pilot project under 1st QUICK WIN

Table 4-14. List of projects from Ubon Ratchathani entered into public selection

No	Project Name	Type of Technology	Location
1	ETE Energy 9 Co., Ltd.	Biomass	Dome Pradit Subdistrict Nam Yuen District
2	Kaokham Power Co., Ltd.	Biogas	Kao Kham Subdistrict Nam Yuen District
3	Ubon Bioenergy Pulu Co., Ltd.	Biogas	Dome Pradit Subdistrict Nam Yuen District
4	Song Power Co.,Ltd.	Biogas	Song Subdistrict Nam Yuen District
5	Dom Pradit Power Co., Ltd.	Biogas	Dome Pradit Subdistrict Nam Yuen District
6	E U Biogas Co., Ltd.	Biogas	Song Subdistrict Nam Yuen District
7	T Y T S (Thailand) Co., Ltd.	Biogas	Bung Wai Subdistrict Warin Chamrap District

There are still 450MW of quota remaining for the Community Power Plant in Power Development Plan and Thai Government will continue to invite interesting parties for the project, Parties involved in the Study agreed to study the cases and possibility to develop such projects, including the power generation sources for Distributed Energy Resources in the Province.

MSW based WtE

There are 5 Clusters in the Province, and 4 clusters, except for that of Warin Chamrap Town Municipality, have already received approval for development 9.9MW Waste to Energy project (hereinafter referred to as "**WtE**") from the central government. Detail of the Cluster is as per shown in the **Figure 4-7** below.

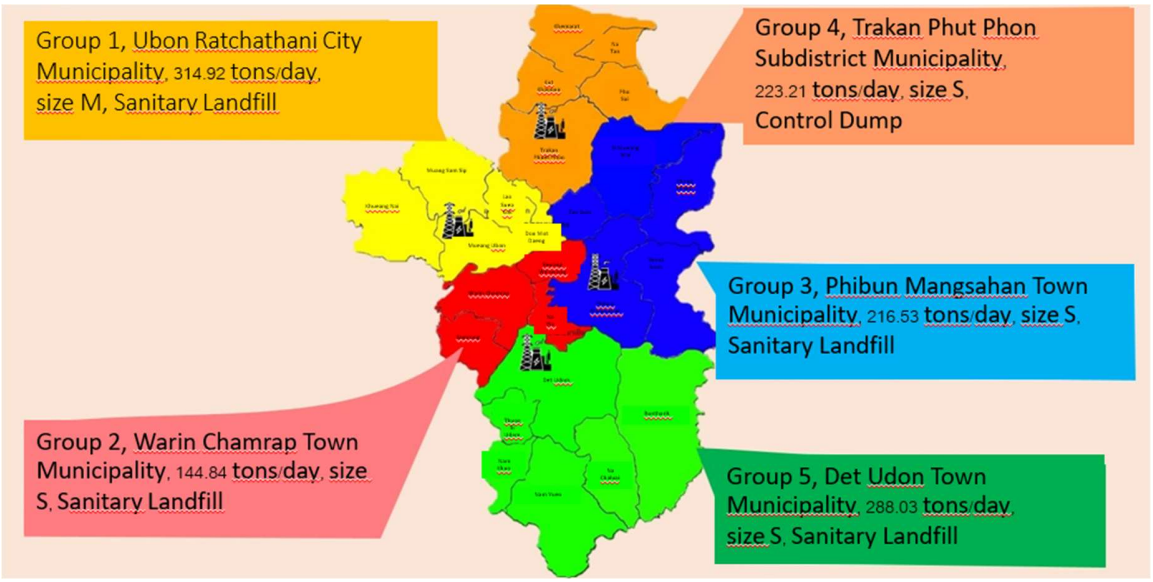


Figure 4-7. Clusters in Ubon Ratchathani Province with amount of MSW in Cluster

Source: Provincial Office of Local Development, Ubon Ratchathani

The parties involved in the Study agreed to add other projects in the Province as target in addition to the MSW processing plant at Warin Chamrap, which Contractor set as target.

Wastewater

PCD published "Handbook for Construction of Wastewater Treatment Facility at target area" in 2020. In the Handbool, PCD selected target where wastewater treatment facility might be constructed in 20 years period of 2018-2037 from the points of views of "importance of the area", "water quality in the past 5 years" and "population". There are 742 sites are selected as target, including 4 sites from the Province, including Ban Don Khon Chan Sub-District City and Seng Suk Sub District City. Other than 2 cities mentioned above, there are some cities in the Province express their concern as for water quality, the parties involved in the Study agreed to target wastewater treatment as additional target in the Study.

100% Renewable Energy for Public Facilities

"100% Renewable Energy for Public Facilities" (herein after referred to as "**100% RE project**") is one of the projects contribute for decarbonization and set as target in the Study, and therefore I project and could built up consent with REZI, one of the leading Distributed Energy Resources (hereinafter referred as "DER") business operators in Japan as for their participation in the Study in 2024 and presentation at the Workshop organized under the Study in 2023.

At the Workshop, REZIL introduced themselves as well as their business models in Japan. Participant commented that Thai is expecting for decentralization of power management. Although Thai has not yet done it, Thai Government has already stated it in National Policy. The Province expect REZIL to participate in the Study in 2024 and expend its operation, including pilot project for DERs in Thailand in the Province.

The Contractor will study the possibility on business expansion of REZIL, such as installation of PV and Battery as a part of DERs in Ubon Ratchatani in the Study in 2024.

Forest Fire Management

The Contractor confirmed that the Province could successfully reduce no. of hotspot as well as mitigate impact on environment by forest fire through interview with RFMO9.

The parties participated in the Workshop organized under the Study committed that hotspots in the Province are rather in filed, but not forest. Therefore, the Province might no require using Eco-Friendly Soap Fire Extinguish Agent in the Province after having presentation for the product. Consequently, the parties involved in the Study will stop studying the mitigation of forest fire by utilization of the Agent above.

4.1.6. General Information & Development Plan of Warin TM

Development Plan of Warin Chamrap Town Municipality (2023-2027) was formulated by Warin TM in accordance with Determining Plan and Process of Decentralization to Local Government Organization Act, B.E. 2542 (1999). Development Plan covers 5 years and revised annually. Latest Version of the Development Plan of Warin TM is that of 2023 – 2027 consists of 174 pages in 4 chapters, of which outline is as per described below.

Chapter	Content	Page
1	General Information	1
2	Strategy	28
3	Project Implementation	79
4	Monitoring & Assessment	167

Source: Warin TM website

(1) Vision & Target in Area Development

Vision

To be a nice city with infrastructure, eco-friendly & high economic growth, citizen with unity, order and inheriting features of the city.

Misson

1) Infrastructure Development
2) Human Resource Development
3) Development of Educational system & management process
4) Improvement of public health
5) Natural Resources & Environment Management
6) Inheriting of religion, culture, tradition and wisdoms of ages & past
7) Democracy, Human Right, Freedom & equal opportunity
8) Capacity building for administration and improvement of public service

(2) General Information of Warin TM

Geographic Information

Warin Chamrap TM is located in Warin Chamrap District, Ubon Ratchathani Province, Thailand with 15° 12′ 02″ N and 104° 51′ 41″ E. It is situated 2 kilometers south of Ubon Ratchathani. Land Area administrated by the TM is 12.9 square kilometers to encompass the entire Warin Chamrap subdistrict.

The north adjacent to the Mun River, the south & east adjacent to Saen Suk Subdistrict, Warin Chamrap District, and the west adjacent to Khana Saap Subdistrict, Warin Chamrap District.

Population

In 2023, population in Warin Chamrap Town Municipality is 24,839, containing 11,656 of male, 13,183 of female and number of households is 11,054.

Administrative Division & Administration

Warin Chamrap TM is divided into 3 Areas according to the election law and 28 communities, each led by a community leader. There is a mayor and council members elected by the citizen and administrative office consists of 9 division, i.e., Secretary's Office, Financial Division, Public Work Division, Public Health & Environment Division, Planning

Division, Education Division, Social Welfare Division and Public Facility Division and Administrative Division.

Socio-Ecnomy

Main industry in Warin TM is those in small scale related to primary industry and no factory in large scale is existing in Warin TM. Rice Mill is one of the important industry in Warin TM. There are 6 educational institutes, 3 medical centers, 8 religious institutes and 2 fresh markets in Warin TM.

Environment & Climate Change

Warin TM set 5 strategies in its Development Plan and strategies related to Environment & Climate Change are stated in No. 4 in the strategies.

Development Strategies

1) Infrastructure Development
2) Economy Growth
3) Social Development
4) Environmental Conservation
5) Administrative Service

Objectives

1) Infrastructure Development for Socio-Economic Growth
2) Capacity Building for citizen
3) Citizen's health & happiness and Accessibility to health service
4) Upgrading educational level and accessibility to education
5) Management of Natural Resources and Environment and Participation by all sectors
6) Conservation & inheriting of religion, culture, tradition and wisdom of the age & past.
7) Recognition of Nation and participation in democracy.
8) Public Services based on principal of Good Governance

(2) Activities in Environment & Climate Change

Activities in Environment & Climate Change listed in the Warin TM's Development Plan are as per shown in

Table 4-15. Activities in Environment & Climate Change listed in the Warin TM's Development Plan

No.	Project	Objective	Goal / Outcome	Budget (MTHB)					KPI	Expected result	Responsible party
				2023	2024	2025	2026	2027			
A. Province's Development Strategy 1. Modern & Active Province B. Wain TM's Development Strategy 5. Conservation of Natural Resources & Environment											
4. Environmental Development Strategy 4.1 Domestic Development Plan											
4	Project for the Construction of an Infectious Waste Incineration System Phase 2	To increase the efficiency of infectious waste disposal	To construct an infectious waste incinerator with a capacity of not less than 500 kg per hour, together with a set of equipment and other works as specified by the Municipality's blueprint.	-	68.02	-	-	-	Construction of an infectious waste incinerator with a capacity of not less than 500 kg per hour, together with a set of equipment.	The problem of infectious waste disposal is completely solved.	Ditto
7	Wastewater Collection and Treatment System Construction Project Phase 2	1) To increase the efficiency of wastewater collection to cover the entire area of responsibility. 2) To procure vacuum trucks and sewer flushing equipment to maintain the efficiency of the wastewater collection system within the municipality.	1) Construction of the wastewater collection system (remaining from Phase 1) 2) Procurement of vacuum trucks and sewer flushing equipment 3) Procurement of wastewater pump flow meter equipment	-	100.46	-	-	-	1) The wastewater collection system (remaining from Phase 1) has been constructed. 2) Vacuum trucks and sewer flushing equipment have been procured. 3) Wastewater pump flow meter equipment has been procured.	1) The wastewater collection system is more efficient and covers the entire area of responsibility. 2) The wastewater collection system within the municipality has been cleaned and maintained, resulting in improved efficiency.	Ditto

Project	Objective	Outcome	Budget (THB)					KPI	Expected result	Source	Responsible organization
			2023	2024	2025	2026	2027				
A. Provincial Strategy 1: Modern livable city B. Development Strategy for Local Administrative Organization in the Province No.1 Infrastructure											
1. Infrastructure Development Strategy											
28: Improvement of community drainage system	Improve the drainage system and Others	To improve community drainage system (size diameter: 0.40 -0.80 m., long: not less than 500 m.) and other works	-	-	-	1,500,000	1,500,000	the length of drainage system is not less than 500 m.	To improve the efficiency of drainage system	Community plan: Don Ngio community / Ban Suan Wa Rin community / Hat Suan Suk community/ Kham Nam Sap community/ Wat Wa Rin community/ Nong Bok community	Division of Sanitary Works

4.1.7. GHG emission, Mitigation Actions & Road Map for Decarbonization

In this activity, the Contractor conduct interview with deputy chief clerk, director of public health & environment division and public facility division from Warin TM as for GHG emission, mitigation actions and road map for decarbonization for the Warin TM. Findings from the discussion are as follows.

- Warin TM has not yet obtained data necessary to quantify GHG emission in base year as well as estimation of BAU GHG emission in Warin TM, despite of their request placed to relevant government agencies as of February 2024.
- Warin TM recognizes Climate Change in Warin TM as follows.

Stationary Energy	:	• GHG emission from Stationary Energy Sector is mainly from Grid supplied energy consumed at domestic. Warin TM consider reducing GHG emission in the sector by development of renewable energy in the municipality to substitute grid supplied energy.
Transportation	:	• Warin TM is satellite city, located next to Ubon Ratchathani City Municipality, and is richer than other LAOs in the Province. As a result, vehicle ownership ratio is higher than other LAOs and it might cause higher GHG emission in this sector. • There are EV manufacturers opened their showrooms in the Province and sale of EV is increasing year by year. Warin TM understands that GHG emission in this sector will decrease in line with Thai National policy of EV30@30
Waste	:	• Warin TM received and landfilled approx. 350t/d of MSW from LAOs inside and outside of the Province at the landfill owned. Although the landfill is sanitary landfill, there might be some methane emitted, as the landfill operation might not be appropriate, due to full capacity. • Warin TM has wastewater collecting & treatment system covering all the area in the municipality. Wastewater is collected by wastewater pipeline and sent to wastewater treatment ponds for treatment. Since COD of wastewater is not high, there might be less GHG emission from wastewater sub sector
AFOLU	:	• There are less forest area and unutilized land in the municipality, and therefore Warin TM will not be able to expect to carbon absorption by forest.

- Warin TM has already decided to participate in Carbon Footprint Offset Program promoted by Thai Government and started collecting Climate Change related data & information. Warin TM committed that the City would share data & information to be obtained to the Study team for further cooperation in the Study.

4.2. MSW based Biogas Power Plant at Warin TM

4.2.1. Governing Laws & Regulations

In this Study, the Contractor set "MSW based Biogas Power Plant" as one of the target projects to be developed through implementation of the Study. In Thailand, all kind of business is governed by the Commercial Act, then other Laws & Regulations depending on the type of business to be established. As the target project in the Study falls on that related to MSW and Energy, BE2570 National Cleanliness and Maintain Order Act (2017) (hereinafter referred as "**2017 Act**)" will be the main act governing such type of business.

National Cleanliness and Maintain Order Act was enacted in 1992 (hereinafter referred to as "**1992 Act**") then revised to the 2017 Act as 2nd Edition.

(1) BE2570 National Cleanliness and Maintain Order Act (2017)

2017 Act, consist of Preamble and 12 Articles, is revoked, or revised a part of provision add new provisions in 1992 Act and except for the provision revised or added in 1992 Act are remained effective. **Table 4-16** shows outline of the 2017 Act.

Table 4-16. BE2570 National Cleanliness and Maintain Order Act (2017)

Article	Provision
4	Patial revision of "Definition" in 1992 Act
5	Revision on Tariff prescribed in 1992 Act and added provisions related to payment exemption and policy on tariff
6	Added Section 2, 3 & 4 in Article 34 of 1992 Act
7	Added Article 42 in 1992 Act and revised Article 43
8	Added Section 1 & 2 in Article 58 of 1992 Act

The Article No. 4 (Definition) in the 2017 Act is prescribed revision of definition of the words used in the 2017 Act. Article No 7 is almost as the same as the Article No 42 & 43 of 1992 Act, except for the definition of the words used.

Article No. 5 of the 2017 Act prescribes service charge for MSW management and authorize the Minister of Interior and the Ministry of Health to set up tariff for the services.

Article No. 6 of the 2017 Act refer to Article No. 34 of the 1992 Act, which prescribes prohibition of excretion in public and less relevant with the provision added in the 2017 Act, while Chapter 3 of the 1992 Act prescribes prohibition of waste in public and relevant to the provision added as Article No. 34 (2), (3) & (4). Since Article No. 58 prescribes penalty for the violator of the provision in Article No. 34, Article No. 34 (2), (3) & (4) are the main revision in the 2017 Act. Among 3 additional provisions, extract provision in the Article No. 34 (2) as below.

Article No. 34 (2)

LAO, except for PAO, has authority & duty for wastewater & waste management in its administrative areas. LAO, in order to fulfill its duty, manage wastewater and waste in its administrative area in cooperation with other LAO(s) and/or consign government agencies, other LAO(s) including PAO and/or Private company under the regulations, procedure and condition prescribed by Ministry of Interior (MOI) by its notification. Consignment of private company or Joint Implementation may not regard as co-investment and therefore exempt from "BE2562 Public and Private Partnership Act (2019)", while MOI shall ensure that the regulations, procedure and condition prescribed by MOI shall keep contingency with the Act as follow.

LAO, Government Agency and Private Company may collect and store MSW by receiving authority transfer in accordance with the paragraph 2, and party received authority transfer may utilize or reuse MSW based on the agreement which shall be in accordance with the regulations, procedure and condition prescribed by MOI.

The case of LAO or PAO, in accordance with the paragraph 2, received authority transfer from other LAOs as a responsible party shall be exempt from Determining Plan and Process of Decentralization to Local Government Organization Act, B.E. 2542 (1999).

LAO shall be responsible for collection of service charge levied on collection & transportation and processing & disposal of MSW from relevant parties in its administrative area. LAO shall announce such service charge by LAO's ordinance and shall be excess the ceiling charge prescribed by Ministerial Order.

Collection & treatment or processing methods for wastewater and/or MSW shall be in accordance with those announced by MOI. However LAO may adopt regulations, methods

and standard prescribed by Act, if any.

In Thailand, MSW related projects are developed based on the Act mentioned above with procedure described in 4.2.2 below.

4.2.2. Project Development Process

As stated above, Thai Government accepted the Road Map for Solid and Hazardous Waste Management in 2014. Thai Government expressed its policy & plan for MSW management in the Road Map and "Establishment the Cluster for proper MSW management is one among others, such as "Promotion of 3Rs". Thai Government also recommend developing waste processing facility, especially WtE, by utilization of Public Private Partnership (hereinafter referred to as "**PPP**"), which is said to optimize project by utilization of vitality of private sector, creation of business & job opportunity, as it requires which require much investment with high technology.

With promotion of MSW based WtE as PPP project by Thai Government, Many companies, including ESCO under PTT, have expressed their interest in participation in the project and tried to develop project but did not success at that time, as there still be a lot of challenges in project development. Absence of clear guideline procedure) for project development is one among them to prevent the interesting parties to develop project. Under such circumstance, DLA published "14 steps to develop MSW related project under PPP".as per **Figure 4-8** below.

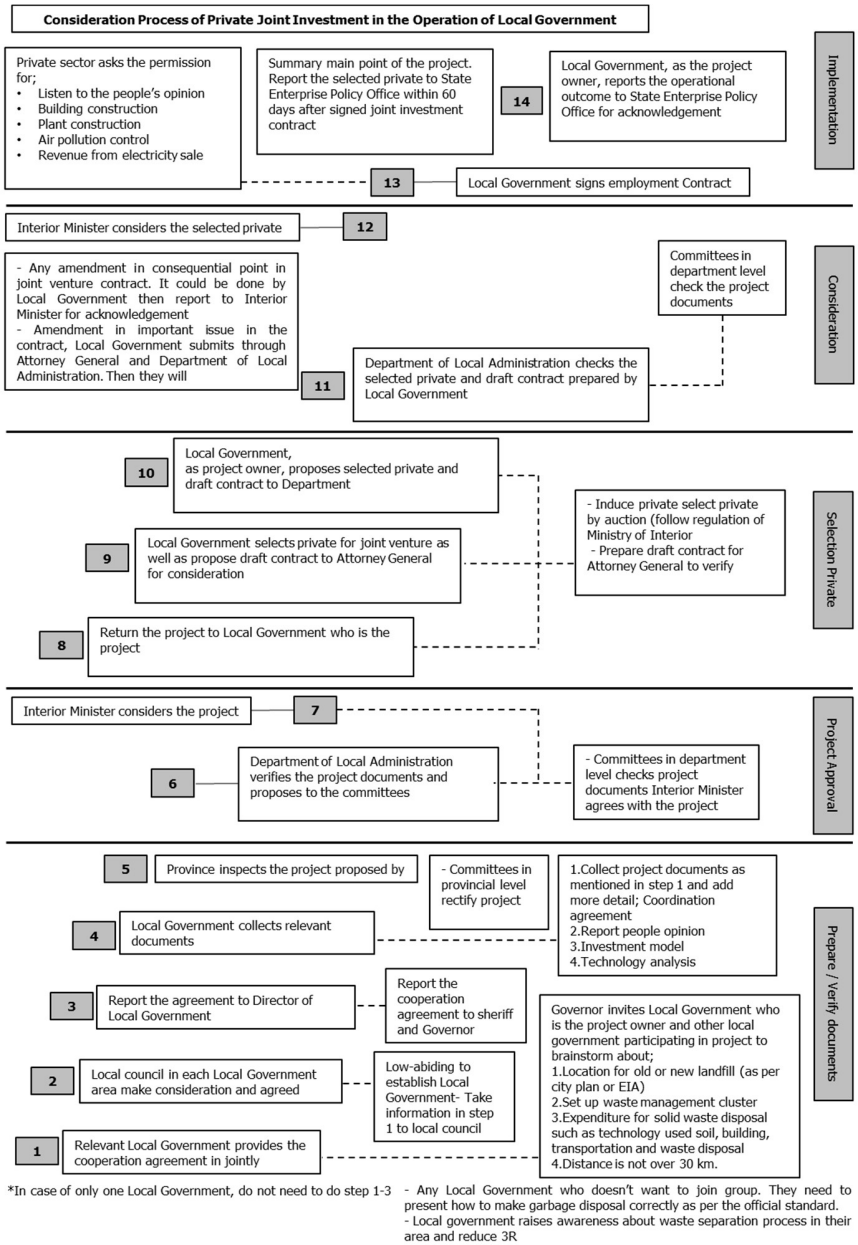


Figure 4-8. 14 steps to develop MSW related project under Public – Private Partnership

Source: by the Contractor based on Information disclosed by Ministry of Interior

DLA published "14 steps to develop MSW related project under PPP" as "2nd version of procedure to develop MSW related project under PPP soon after the enactment of the 2017 Act, of which outline is as per shown in **Figure 4-9** below.

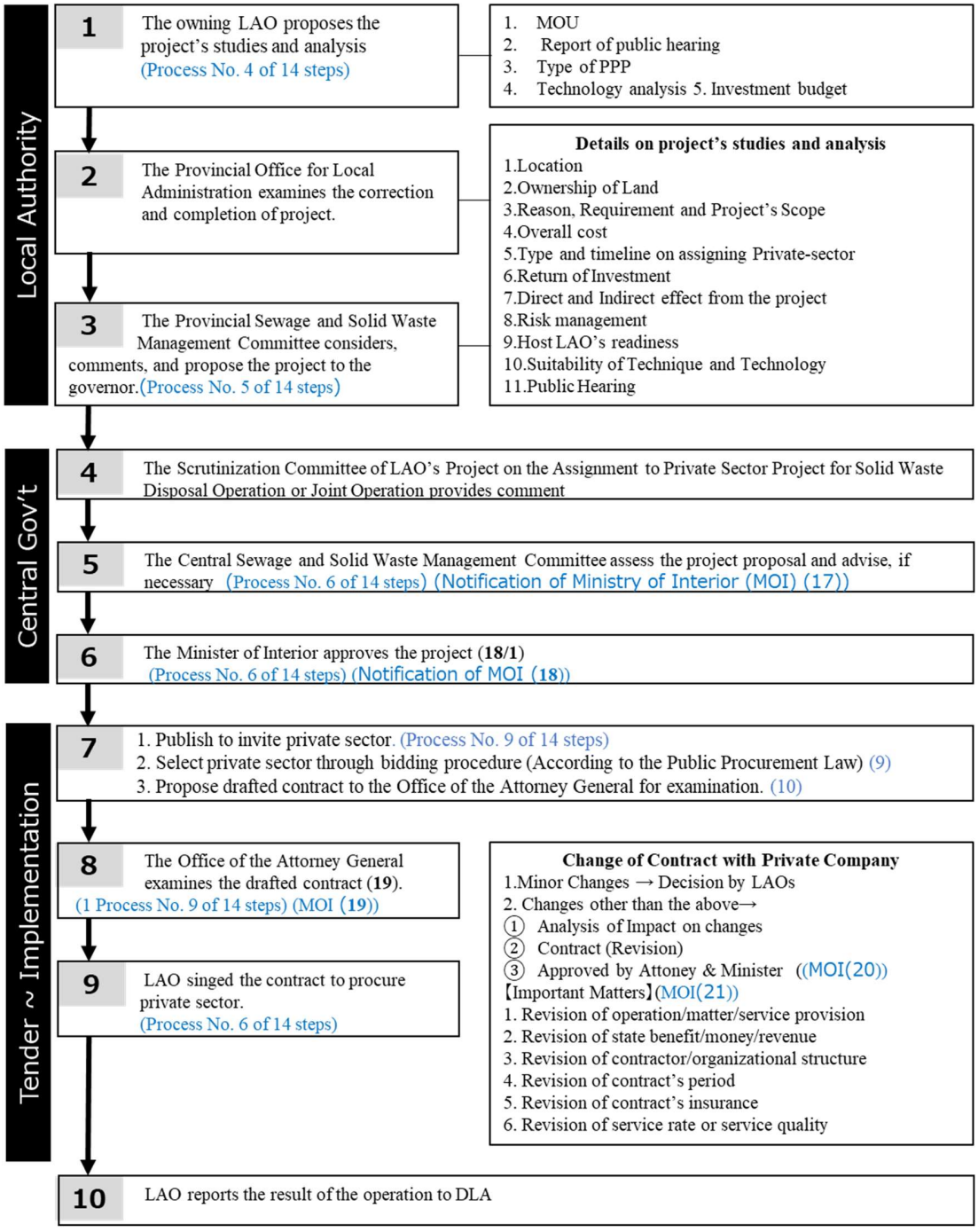


Figure 4-9. 10 steps to develop MSW related project under Public – Private Partnership

Source: by the Contractor based on Information disclosed by Ministry of Interior

4.2.3. Criteria for Project Development

In consideration of development of the target, the interesting party shall study various issues, such as intention of Warin TM as the host of the cluster, project site, MSW, technology can be applicable for the target project, feasibility, finance and risk. In this Activity, the Contractor reviewed relevant data & information shared by Warin TM as well as collected additions and make it in order. t

(1) Amount of MSW

In cooperation with Warin TM, the Contractor obtained and reviewed data & information related to MSW transported to the landfill in 2022 (October 2022 – September 2023). The Contractor found that there were 114,239 tons/year of MSW, collected from 52 LAOs and others, such as hospitals, military base & market, was transported to the landfill. Consequently, the Contractor confirmed there is 313 tons / day on average of MSW is transported to the landfill, means the project site have enough amount of waste for the project development and operation. Summary of MSW transported to the landfill at Warin TM is as per shown in Table 4-17 below.

Table 4-17. Amount of MSW transported to the Landfill in Warin TM

Group	Total (t/y)	2022			2023								
		Oct	Nov	Dec	Jan	Feb	Mar-23	Apr	May	Jun	Jul	Aug	Sep
Local Administrative Organization													
Amount of MSW (t/m)	109,543.72	9,147.98	8,799.90	8,620.35	8,940.38	7,970.52	8,774.99	8,460.35	9,686.48	9,700.98	9,551.14	10,222.19	9,668.46
MSW (t/d)		295.10	293.33	278.08	288.40	284.66	283.06	282.01	312.47	323.37	308.10	340.74	311.89
No. of LAO	**52**	43	44	44	44	45	45	46	46	46	47	47	47
Others													
Amount of MSW (t/m)	4,715.39	186.01	202.52	187.23	210.87	364.23	363.17	411.41	506.51	576.74	564.90	545.77	596.03
MSW (t/d)		6.00	6.75	6.04	6.80	13.01	11.72	13.71	16.34	19.22	18.22	17.61	19.87
No. of Party	**43**	26	23	16	19	19	18	19	19	17	22	21	19
MSW in Total (t/d)		301.10	300.08	284.12	295.20	297.67	294.78	295.73	328.81	342.59	326.32	358.35	331.75

Source: by the Contractor based on data & information shared by Warin TM

(2) Waste Quality

The Contractor together with the parties involved in waste analysis work (hereinafter referred to as "**the Waste Analysis Team**") conducted analysis of MSW transported to the Landfill at Warin TM as follow.

1) Analysis Method

The Waste Analysis Team set up a plan for waste analysis as per shown in **Figure 4-10** below.

Date	2023/11/25 (Sat) – 2023/12/01 (Fri) (7 consecutive days)	Sampling Time	8.00 ~ 14.00 (6 hours+)
Project Owner	City-City Cooperation among Warin Chamrap TM, Provincial Office of Natural Resources & Environment in Ubon Ratchathani Province & City of Kitakyushu		
Implementation	EX Research Institute (EXRI ASIA) & Ubon Ratchathani Rajabhat University		
Process & Items to be analyzed	Process: Data Collection → Planning → Pre-Meeting (11.24) → On-Site Meeting (11.24) → Sampling (2 steps) → Sample Preparation → On-Site Analysis → Analysis (Laboratory)		Items analyzed (No. of Sample/day) 1. Specific Gravity (3) 2. Waste Composition (Wet & Dry) (3) 3. Proximate Analysis (Moisture, Ash, Combustible) (1) 4. Chemical Analysis (C, H. N. O + S) (1) 5. COD 7 (1)

Figure 4-10. Samling & Analysis Plan

the Data Collection in the Process in **Figure 4-10**, The Waste Analysis Team obtained data for MSW transportation covering for latest 3 months period (July 1, 2023 – October 31, 2023) for review and found that there were 41,172 tons of MSW in total, or 334 tons/day on average transported to the landfill at Warin TM. Amount of MSW and No, of Trip by time zone are as per shown in **Figure 4-11** below.

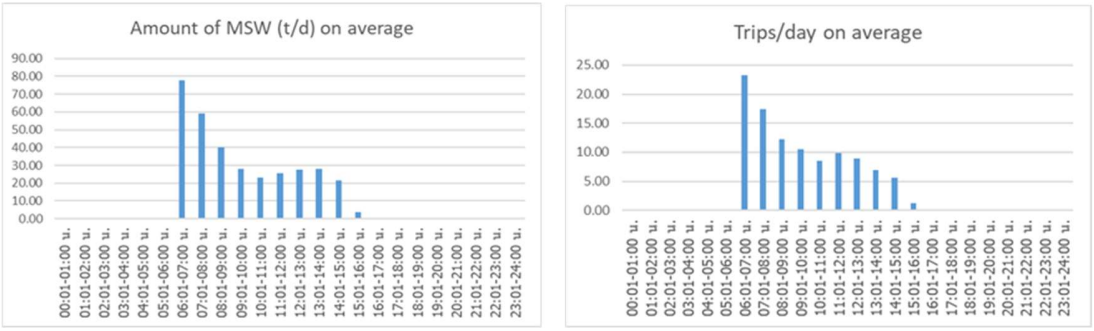


Figure 4-11. Amount of Waste transported & No. of Trip by Time Zone

According to the members of staff manage the landfill, the landfill is open from 6 AM to 4 PM. Majority of LAOs transport MSW to the landfill collect MSW during nighttime, and therefore most conjected time zones are those soon after open the landfill. Some of LAO collect many times a day and this might be one of the reasons why MSW transporter transport MSW from early in the morning.

Figure 4-12indicates Amount of MSW transported and No. of Trip by Day;

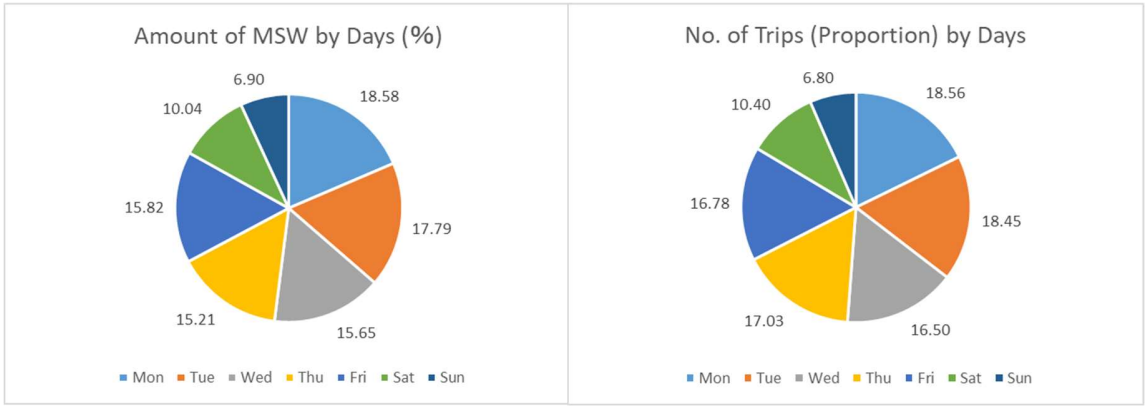


Figure 4-12. Amount of MSW transported& No. of trip by Day (%)

Source: by the Contractor based on data shared by Warin TM

Referring to the summary report shown below, The Waste Analysis Team finalized 8 AM to 2 PM (hereinafter referred to as "Core Time") as Waste Sampling hours.

Time	Amount	Amount (t/min)	OP1	OP2	OP3	OP4
06:01-07:00 น.	77.62	1.29				
07:01-08:00 น.	59.13	0.99				
08:01-09:00 น.	40.15	0.67				
09:01-10:00 น.	28.04	0.47				
10:01-11:00 น.	23.25	0.39				
11:01-12:00 น.	25.59	0.43				
12:01-13:00 น.	27.37	0.46				
13:01-14:00 น.	27.88	0.46				
14:01-15:00 น.	21.36	0.36	252.78	193.64	231.41	172.28
			75.5%	57.8%	69.1%	51.5%

Time	No. of Truck	Min/truck	OP1	OP2	OP3	OP4
06:01-07:00 น.	23.24	2.58				
07:01-08:00 น.	17.36	3.46				
08:01-09:00 น.	12.28	4.89				
09:01-10:00 น.	10.56	5.68				
10:01-11:00 น.	8.48	7.08				
11:01-12:00 น.	9.79	6.13				
12:01-13:00 น.	8.97	6.69				
13:01-14:00 น.	6.89	8.71				
14:01-15:00 น.	5.61	10.70	53.33	49.87	42.63	42.63
			51.0%	47.7%	40.8%	40.8%

Figure 4-13. Reference Amount of MSW (Left) and No. of Trip by time zone (Right)

Meeting with the Waste Analysis Team at Office (Left) & at landfill (Right)
Source: Photos taken by the Contractor

The Waste Analysis Team collected & prepared samples as follows.

Site sample collection & Preparation of samples for onsite analysis

1. Recording of Base Data (Time, Car No. Sample No. with weight)
2. Pictures (Transporter, Waste & Waste Sample collected)
3. Picked up samples collected through sampling on site randomly (up to 400kg)
4. Quartering for Sample for onsite analysis (<200kg)

Onsite Analysis

There are 2 types of analysis to be conducted onsite, i.e., Specific Gravity and Waste Composition analysis on wet base. Methodology for Specific Gravity analysis is as per the Announcement of the Ministry of the Environment of Japan (No. 95), while Waste Composition Analysis is composition of different types of waste, i.e., Food waste, Paper Waste, Biomass (branch & leave), wood waste, plastic waste, rubber & leather waste, scrap metal, glass & ceramic waste and others.

Other Analysis

To carry a part of onsite sample back to laboratory in Rajabhat University for other analysis, Process flow at the laboratory is as per shown in **Figure 4-14** below.

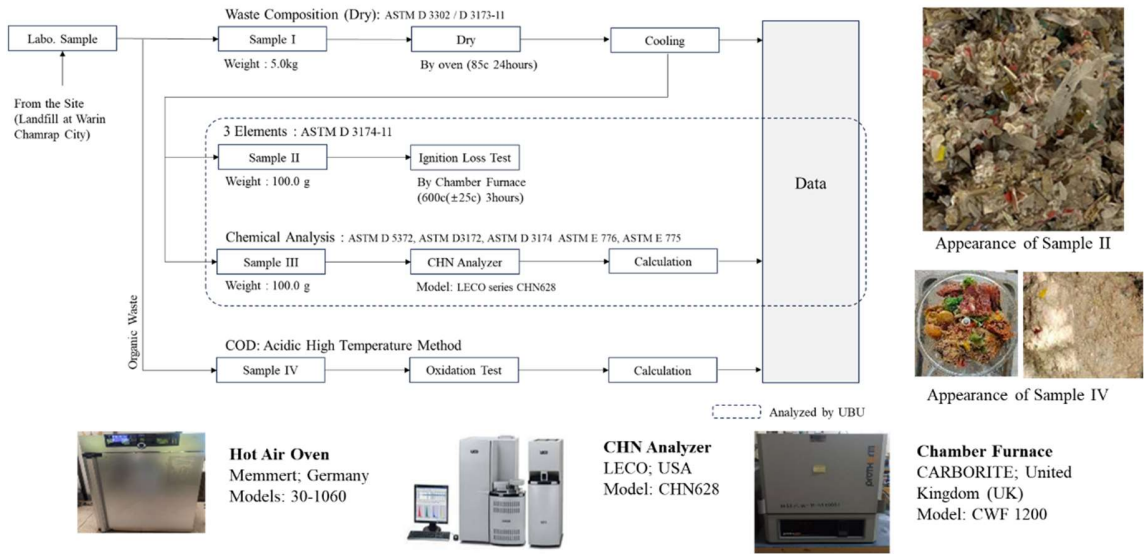


Figure 4-14. Process Chart for Analysis at the Laboratory

2) Sample Collection, Preparation & Analysis

Table below shows detail of the landfill operation during sample collection.

Date (2023)	11-25	11-26	11-27	11-28	11-29	11-30	12-01
MSW (ton)	206.34	125.97	381.16	357	340.65	313.77	353.27
Trip	70	44	130	127	118	122	123

Amount of MSW transported to the landfill and No. of Trip during sample collection, including day distribution were as per understanding of the Waste Analysis Team. (Left: Amount of MSW and No. of Trip during sample collection)

Performance

Performance of Rajabhat University is as follow:

Sample Collection

Description	Landfill operation	Sample collected	%
Amount of MSW	2,078.16 ton	2,550.20kg	-
No. of Trip	734	362	49.3%
No. of Trip in core time	392	362	92.3%

As shown in the table above, the University could collect sample from 49.3% of the trips in total in comparison with 40.8 % in plan, while 92,3 % of the trips in core time. A bag of Sample was collected from each waste transport, closed, weighted, labeled transporters' no. and weight, and kept on the plastic sheet (hereinafter referred to as "the site sample").

Sample for onsite analysis was prepared from approx. 400 kg of the site sample randomly picked up, by utilization of quartering method.

Site Sample collection & preparation of sample for onsite analysis
Photo taken by the Waste Analysis Team

Result of onsite analysis

Specific Gravity Analysis and Waste Composition Analysis were conducted with the sample for onsite analysis prepared through the process stated above. Values obtained from the Specific Gravity are 0.11 as average and 0.10 as median, and smaller than that on average, or 0.15-0.20 in Thailand. Result of the analysis on daily basis is asper shown in **Table 4-18** below**.** Analysis for both Specific Gravity and Waste Composition were conducted for 3 times a day with the same sample for onsite analysis prepared for the day.

Table 4-18. Result of Specific Gravity Analysis

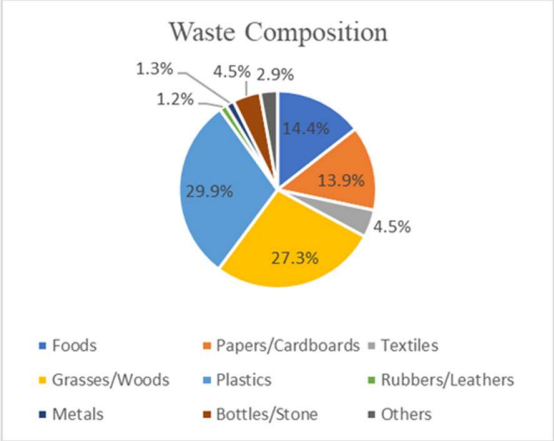
Date	Average	Max	Min	Median
11-25	0.09	0.10	0.07	
11-26	0.10	0.10	0.10	
11-27	0.13	0.14	0.12	
11-28	0.10	0.12	0.09	
11-29	0.10	0.11	0.10	
11-30	0.12	0.12	0.11	
12-01	0.10	0.11	0.09	
Average	**0.11**	**0.14**	**0.07**	**0.10**

Table 4-19 shows result of Waste Composition Analysis (wet basis), in which the Waste Analysis Team conducted 3 times of analysis per day. Values obtained from the analysis, i.e., Food Waste 14.4%, Paper Waste 13.9%, Biomass Waste 27.3%, seems have some difference from the values which PCD published, i.e., Food Waste 40%, Plastic Waste 28%, Paper

Waste 6%, Biomass Waste 10%. As ratio on average obtained from their waste analysis conducted in 2022.

Table 4-19. Result of Waste Composition Analysis (wet basis)

Waste Type	Average (%)	Max (%)	Min
Food Waste	**14.4**	31.64	11.9
Paper Waste	**13.9**	20.02	13.2
Fabric Waste	**4.5**	13.28	2.6
Biomass waste	**27.3**	43.55	16.9
Plastic Waste	**29.9**	47.53	18.4
Rubber Waste	**1.2**	4.43	0.1
Scrap Metal	**1.3**	3.04	0.5
Glass waste	**4.5**	7.89	2.2
Others	**2.9**	10.75	0.0
Total	**100.0**		



Rajabhat University commented that Thai traditional festival of "Loy Krathong", held during the waste sampling period, might give some impact on quality of waste, possibility of miscounting of some food waste as biomass waste and DLA's project on waste separation for composting campaign reduce wet waste at generation sources.

The Waste Analysis Team recognize challenges not only in sampling works but also quartering works, as the situation was not as per what the Waste Analysis Team understood beforehand of conducting sampling works, such as No. of waste transporter transport MSW was more than expectation in some time zones, location of dumping were scatters and not enough time for the Waste Sampling Team to collect samples as per plan, and manual homogenization might cause in-homogenization of the sample for onsite analysis.

Offsite Analysis

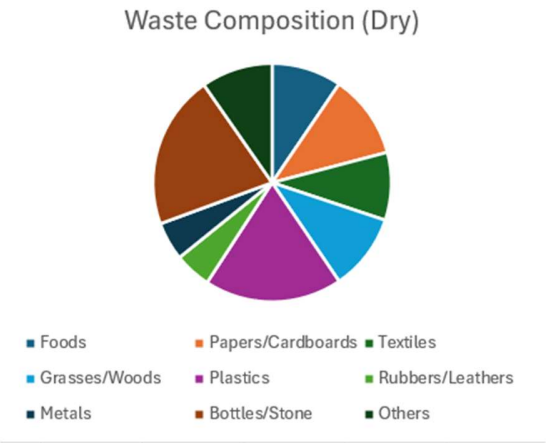
Rajabhat University carried 5 kg of sample extracted from sample for onsite analysis as sample for offsite analysis to its laboratory for analysis.

Waste Composition Analysis (dry base)

Result of Waste Composition Analysis reported by Rajabhat University s as per **Table 4-20** below.

Table 4-20. Result of Waste Composition Analysis (dry base)

Waste Type	Average (%)	Max (%)	Min
Food Waste	9.5	21.0	3.6
Paper Waste	11.4	22.9	6.3
Fabric Waste	9.2	13.7	3.9
Biomass waste	10.4	22.6	4.4
Plastic Waste	18.7	25.1	12.8
Rubber Waste	5.0	11.1	1.1
Scrap Metal	5.2	9.8	2.2
Glass waste	20.9	41.2	6.9
Others	9.7	18.7	2.2
Total	**100.0**		



3 Elements Analysis

Rajabhat University reported result of 3 element analysis as per **Table 4-21**, however the values reported by the University is different from moisture content of 40-60%, published by PCD.

Table 4-21. Result of 3 Elements Analysis

Element	Average	Max	Mix
Moisture	26.0%	41.1%	20.2%
Ash	50.4%	60.1%	38.3%
Combustible	23.5%	36.7%	17.0%

Chemical Analysis

Rajabhat University reported result of Chemical Analysis as per Table 4-22 below.

Table 4-22. Result of Chemical Analysis

	C	H	N	S	O	Ash
Average	11.77	2.26	0.23	0.37	17.92	67.44

Max	29.63	4.48	0.41	0.45	23.43	77.17
Min	4.44	0.77	0.12	0.30	8.23	51.60

Chemical Oxidation Demand (COD)

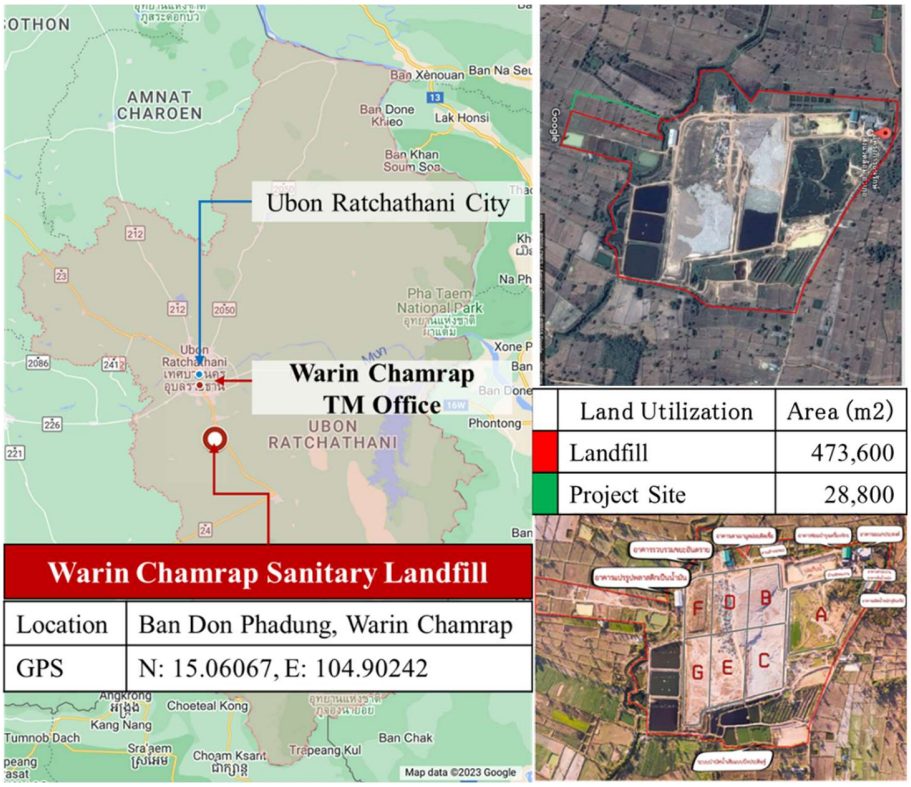
Rajabhat University reported result of COD as follow.

	Average	Max	Mix
CoD (ppm)	1,397.26	1,691.69	1,079.17

Rajabhat University consigned 3 elements analysis and chemical analysis to Ubon Ratchathani University. The Waste Analysis Team shared result of Waste Analysis to the parties involved in the Study, including participants to the Workshop organized under the Study. Expert committed that since the quality of waste varies depending on the condition, it is recommended to continue to conduct Waste Analysis for having more accurate data. The Contractor found that the interesting party had better to carefully study feasibility of the project, as the composition of organic waste found less than that expected.

(3) Project Site

The project site with land area of 28.8 thousand m2 is located west side to the landfill own by Warin TM in Ban Dom Paduen subdistrict, approx. 20 km south from central part of Warin TM. Ownership of the landfill is Warin TM and Warin TM said they were willing to acquire more land area, if necessary.



The Contractor collected additional data & information through conducting interview with responsible person for landfill management at site. Information shared by the responsible person is as follow.

- The Landfill was constructed as sanitary landfill at the land area own by Warin TM by Warin TM in 1988. Development cost is THB 220 million.
- Land area is 314 rai at that time, then Warin TM acquired land area next to the landfill many times.
- There are 7 pits for landfilling MSW. 1st layers of all 7 pits are full already, and landfill MSW in 2 layer at pit A at present.
- Once MSW transported to the landfill, waste pickers at the landfill pick recyclable waste up first, then Warin TM push MSW dumped into the allocated places, spread, cover by soil and compact the area where landfill MSW on the day.
- EM is used for deodorization at the landfill.
- No. of waste picker working at the landfill is about 200. Those are from villages around the landfill.
- Landfill is open at 6 AM and close about 4 PM. Congesting time zones are 6 AM to 8 AM. Warin TM received MSW from LAOs, hospitals, military base, markets in the Province and LAOs from Surin province.

- There is an Incinerators for Infectious Waste (Rotary Kiln & Batch Incinerator) and abandoned pyrolysis plant.
- Leachate discharged from the landfill is sent to wastewater treatment ponds next to the landfill. 1st treatment pond has aeration system connected to solar power system.
- Treated wastewater, after final treatment done at the 3rd wastewater treatment pond, is kept at water reservoir then utilized as car wash water.
- There is no record of natural disaster incurred in the area, except for flooding in small scale incurred once in a few years, with which wastewater keep in the wastewater treatment pond is overflowed to the area nearby.
- Main road nearby is National Route No. 24 and access to the landfill via approx. 2km of unpaved small path to the landfill. The path has 1 lane each for a direction and difficult to pass through due to muddy condition in rainy season.

(4) Potential Partner from Thai side

The Contractor plans to select potential partners from Thai side among those show their interest in involving into the target project(s) after having discussion with Warin TM, as one of main business entities. In the selection of the potential partners, the Contractor put priority in those from the Province as per consent with parties from the Province, as the Study aim to realize Carbon Neutral for the Province.

The Contractor, therefore, contacted companies engage in Renewable Energy related business belong to the Federation of Thai Industry (hereinafter referred to as "FTI") Ubon Ratchatani Branch, introduce the Study and discuss the possibility of their participation of the Study as potential business partner from Thai side. Summary of the meetings with parties are as per described below.

1) FTI Ubon Ratchathani Branch

General Information

Venue	:	FTI Ubon Ratchathani Branch Office
Date	:	January 15, 2024
Responder	:	Chairman and others

FTI Ubon Ratchathani

- There are 62 members consists of 50 industry members, 8 non-industry members and 4 individual members.

- There is no large-scale industry in the Province and most of the industry in the Province are those related to the primary industry.
- Since the Province is located at east edge of the country, the Industry in the Province has geographical disadvantage, such as over 600km of transportation to Lem Chabang port, is a main port in Thailand. FTI Ubon Ratchathani is lobbying Thai Government as for construction of new Mekong bridge and expect that the construction would start within a in few years. Once the bridge would be constructed, transportation distance to Danan Port in Vietnam would be half and benefit industry in the Province.

FTI's Climate Change related activities

- FTI Ubon Ratchatani is a member of WG for the Guideline development Project for the Province
- FTI Ubon Ratchathani promotes Afforestation in unutilized land areas with purpose of tax saving and creation of carbon credit, but it will take long time to create carbon credit and concerns whether there will be any buyers for
- The Province is famous for Candle Festival, while participants consume 4-5 tons of coal in creating articles. Therefore, FTI proposes to the Provincial Office to award the other prize from the point of view of low carbon.
- FTI has keen interest in Carbon Credit, since EU has introduced CBAM, their carbon tax scheme in importing products into the EU market and FTI established Carbon Credit Exchange in Thailand.

Comments on the Study

- Climate Change is urgent and important issue and FTI Ubon Ratchathani has interest in the Study.
- Some activities in Climate Change are not commercially feasible, therefore people expect both financial & technical support to be provided by developed countries, including Japan.
- FTI Ubon Ratchathani expects the Province to move decarbonization ahead with the Study.

2) Ubon Bio Power Co., Ltd.

General Information

Venue	:	FTI Ubon Ratchathani Branch Office
Date	:	November 23, 2023
Responder	:	Mr. Sitthikun Thiamprasert, Owner & President and others

Ubon Bio Power Co., Ltd. (UBP)

- UBP is operating biogas power plant in which UBP collect organic waste generated in Warin TM and surrounding area. Power generation capacity is 1MW and supply power to Provincial Electric Authority (hereinafter referred to as "PEA"). Biogas is generated at covered lagoon in the factory.
- UBP will sign up MOU with Charungsri Fresh Market as for procurement of vegetable waste generating at the market for biogas generation and expect to kick of the project within the year.

Target Project in the Study

- The landfill belong to Warin TM is said to be full within 5 years period and UBP proposed projects to Warin TM several times already. UBP understands it would be difficult to develop a project in Warin TM as resident in the area oppose the project.
- As far as UBP knows Pibun Mangsahan TM (hereinafter referred as "Pibun TM" has already received approval for WtE project and Warin TM and Pibun TW have started discussion for joint MSW processing.
- FTI Ubon Ratchathani is involved in the development of WtE project in Pibun TM by providing advises and recommendations. Pibun TM will invite interesting parties to an open selection of ta partner from private sector within the year.
- UBP has interest in the target project in the Study, as far as Warin TM agrees to develop and feasible, while it might take a bit more time to develop "landfill waste-based biogas project", as the landfill must be closed for landfill gas collection.
- Most of the Renewable Energy is utilized for power generation for sale to Electric Authorities. As there are some conditions given in power supply to the Electric Authority, UBP interests in power to ammonium project.
- UBP interest in JCM and will study the possibility of project development with JCM.

3) Ubon Bio Ethanol PCL

General Information

Venue	:	**Ubon Bio Ethanol PCL**
Date	:	February 21, 2024
Responder	:	Ms. Pranatda Khamphupong, General Manger, Environment Dept.

Ubon Bio Ethanol PCL

- UBE is a joint venture among Thai Oil and Bang Chak PCL manufactures bio ethanol from cassava, established in 2011.
- UBE manufactures 400 thousand litter od bio ethanol and is one of the largest bio ethanol manufacturers in Thailand.
- UBE group operate other businesses, i.e., manufacturers cassava products and generates power from wastewater discharged from factories.
- UBE group adopted "Zero Waste Policy" and manufacturers and sell animal feed and soil conditioner from residue from cassava products manufacturing process. Soil Conditioner is utilized in cassava farming and called for "Ubon Model

UBE's activities in Climate Change

- UBE has started CFO related activity and keep on collecting relevant data & information.
- UBE has keen interest in Climate Change and might contact the Study Team in future.
- UBE welcomes any suggestions & proposes from the Japanese side.

Meeting with FTI Ubon Ratchathani (Left) &UBE (Right)

(5) Technology to be employed in the Project

In the Study, the Contractor, in reference to the Biogas plant in Fuji city of KOBELCO ECO-SOLUTION Co., Ltd, (hereinafter referred to as "KOBELCO") planned to discuss as for technology to be employed to the target project with Engineer, Procurement & Construction (hereinafter referred to as "EPC)" and/or Technical Advisor (hereinafter referred to as "T/A") in Thailand, but could not do it, as the Contractor could not select potential Thai partner, composition of organic waste is less than expectation and etc..

4.3. Other projects contribute for decarbonization in the Province

In this activity, the Contractor conducted found potential project for decarbonization through interview to relevant parties in the Province.

As stated, there are 4 clusters with WtE project under planning in the Province. As WtE is one of the technologies which Japanese EPC have advantage, and therefore, might have high possibility to participate in. The contractor regards WtE in other 4 clusters as one of the potential projects in the Province.

Wastewater treatment is other potential project, which KOBELCO expresses their interest in. The Contractor also will study the possibility of DERs business of REZIL INC (hereinafter referred to as "**REZIL**") as the other potential project in the Province.

(Wastewater Treatment Facility of Warin TM)

- Wastewater Treatment Facility consists of 3 components, i.e. Wastewater collecting pipe (pumping station), wastewater collecting pits and wastewater treatment ponds (lagoon)
- Wastewater collection system is combined wastewater system and covers 80% of Warin TM
- There are 4 pumping stations in Warin TM
- 3 wastewaters treatment ponds in the area with 150 rai

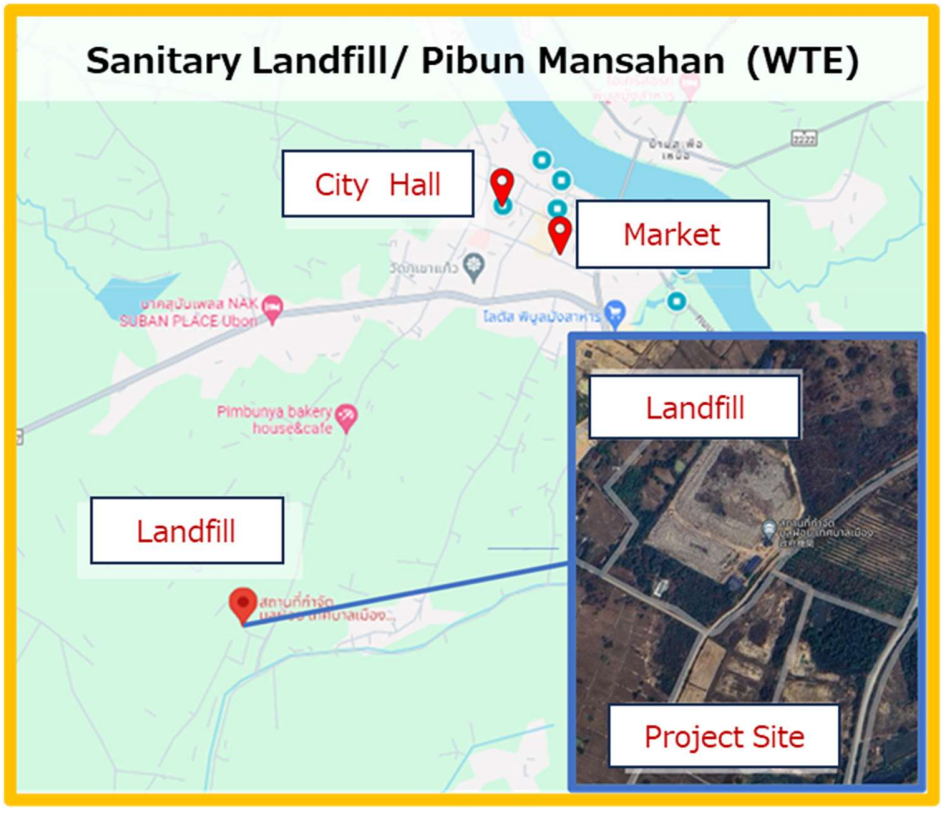
1st Treatment Pond （1st Sedimentation pond）	131,537m3
2nd Treatment Pond （2nd Sedimentation Pond）	93,580 m3
Final Treatment Pond	121,997 m3

- Capacity is 18,000m3/day
- Started operation in 2002
- Project cost was THB320 million financed by Ministry of Science & Technology (at that time & merged with another ministry)
- There are 13,000m3 of wastewater discharged per day
- Wastewater is collected by wastewater collecting pipe, send to 4 wastewater collecting pits, wastewater collecting pit No. 1 then wastewater treatment ponds. It takes about 30 days for wastewater treatment at the ponds, then discharge to Moon.
- Waste contaminated in wastewater is removed at wastewater collecting station. Amount of waste removed is approx. 1,000 liter or 4 buckets of 240litter per day on average.
- Warin TM checks water quality at 1st pond, where Warin TM receive wastewater from wastewater collecting system and 3rd pond where Warin TM discharge treated wastewater to the river.

Wastewater collecting pit (Left) & Treatment pond (Right)
Photo by the Contractor

(WtE project site at Pibun TM)

Project Name	:	Pibun TM WtE
Owner of the Project	:	Pibun TM (3rd Cluster in the Province)
Capacity	:	9.9MW
PPA	:	8.0MW
Technology	:	Mass Burning by Stoker Furnace
Amount of MSW	:	350 ton/day + Landfill Waste 150t (from landfills in Warin TM & Pibun TM)
Status	:	Approved by MOI
Schedule	:	Call for Tender within 2024
Others ·	:	F/S was conducted by Pibun TM & a few private companies approaching to Pibun TM



4.4. Horizontal expansion of the Study in the Province

In this activity, the Contractor organized the Workshop and did public relation for inviting interesting parties to participate in the Study. Regional Environment Office No. 12 expressed their interest in participation in the Study and the Contractor had discussion with the office as for co-operation for the Study. Outline of the Workshop mentioned above is as per explanation given in 4.5.2 below.

4.5. Meeting with Thai parties

4.5.1. Meeting with Thai parties

(1) 1st & Kickoff Meeting

The Contractor organized 1st & Kickoff meeting as follow.

1) General Information

Venue	:	Meeting Room at Warin TM city hall
Date	:	November 22, 2023 13:30-
Agenda	:	JCM Project Development Study for Realization of Carbon Neutral in Ubon Rachatani Province, Thailand 1st & kick off meeting
Participant	:	Director, PONRE Mayor, Warin TM Director, Environmental Bureau, City of Kitakyushu Lecturer, Chemical Dept., Rajabhat University General Manager, Overseas Dept. KOBELCO Expert, KITA Rep. Bangkok Office, EX Research Institute Limited (hereinafter referred as "**EXRI**") And others (Participants' List is as per **Appendix 1-1**)
Program	:	1. Opening (Mayor, Warin TM, Director, PONRE & Director, City of Kitakyushu 2. Climate Change in the Province 3. Introduction of the Study 4. Questions & Answers 5. Conclusion & Closing of the meeting
Document	:	Presentation (English & Thai) As per Appendix 1-2 * electric file only

2) Conclusion

- Ubon Ratchathani province welcome City of Kitakyushu & the Study and will provide best support to the Study.
- Warin TM welcome City of Kitakyushu & the Study and will provide best support to the Study.
- City of Kitakyushu will do the best to achieve the target in the Study.

Minutes of the meeting is as per **Appendix 1**.

(2) 2nd & Wrap-up Meeting

The Contractor organized 2nd & Wrap-Up meeting as follow.

1) General Information

Venue	:	Meeting Room at Warin TM city hall
Date	:	February 21, 2024 14:00-
Agenda	:	JCM Project Development Study for Realization of Carbon Neutral in Ubon Rachatani Province, Thailand 2nd & Wrap-up meeting
Participant	:	Director of Environment, PONRE Director, Public Health & Environment Divisiio, Warin TM Chief, Environmental Bureau, City of Kitakyushu Lecturer, Chemical Dept., Rajabhat University General Manager, Overseas Dept. KOBELCO EXRI And others (Participants' List is as per **Appendix 2-1**)
Program	:	1. Opening 2. Output of the Study 2023 3. Activities in the Study 2014 (subject to confirmation) 4. Questions & Answers 5. Conclusion & Closing
Document	:	Presentation (English & Thai) As per Appendix 2-2 * electric file only

2) Conclusion

- Ubon Ratchathani Province and Warin TM confirmed that both Japanese party and Thai party shared understanding on status & challenges in the Province.
- Ubon Ratchathani Province and Warin TM agreed on activities in the Study in 2024 and committed their continued best support for the Study.

- City of Kitakyushu committed its best effort for realization of the goal in the Study, which Thai party needs.

Minutes of the meeting is as per **Appendix 2**.

4.5.2. Workshop

The Contractor organized Workshop as follow.

(1) General Information

Date	February 20, 2024 09:30-16:00 (TST)
Venue	Hybrid with Meeting Room at Warin TM city hall
Program	09:30- Opening Remarks by Vice Mayor, Warin TM 09:40- Keynote Address by Director, PONRE 09:50- Short Speech Director, City of Kitakyushu 10:00- Introduction of the Study (including Output & Activities under planning in the Study in 2024) 11:00- Introduction of technologies, activities for decarbonization (1) Introduction of MSW& Wastewater treatment technologies and activities of KOBELCO in the region General Manager, Oversea Dept. KOBELCO 12:00- Break 13:00- Introduction of technologies, activities for decarbonization (2) City's activities forwarding to Carbon Neutral Environment Bureau, City of Kitakyushu 13:50- Introduction of technologies, activities for decarbonization (3) Introduction of DERs General Manager, REZIL 14:40- Break 14:50- Introduction of technologies, activities for decarbonization (4) Introduction of Eco-Friendly Fire Extinguish Agent Director, Shabondama Soap Co., Ltd. 15:40- Questions & Answers 16:00- Lessons learnt from City of Kitakyushu 17:00- Conclusion & Closing the Workshop
Language	Thai – Japanese consecutive Interpreting service
Document	1. Program 2. Presentation 2.1 Introduction of the Study (as per **Appendix 3-1**) 2.2 Introduction of MSW& Wastewater treatment technologies and activities of KOBELCO in the region 2.3 City's activities forwarding to Carbon Neutral (**Appendix 3-2**) 2.4 Introduction of DERs 2.5 Introduction of Eco-Friendly Fire Extinguish Agent (**Appendix 3-3**)

(2) Summary of the Workshop
1) Opening Session

At the opening session of the Workshop, Vice Mayor of Warin TM delivered welcome address stated that Warin TM express its warm welcome and gratitude to City of Kitakyushu, experts and PONRE for their support for the Study. This is the 3rd visit in the Study, Warin TM expect all success of the Study.

Director, PONRE deliver keynote address stated that the Province accelerates activities in Climate Change in order to realize National goal of "30 percent of GHG emission reduction by 2030", "Carbon Neutral by 2050" & "Net Zero Emission by 2065"and the Province expects to achieve it through the cooperation between the Province and City of Kitakyushu and willing y of Kitakyushu to support for the Study.

Director, International Environment Strategy Division, Environment Bureau, City of Kitakyushu stated that the Study kicked off November 2023 as new activity after conducting several cooperation between the Province and City of Kitakyushu. In 2019 both the Province and City of Kitakyushu organized awareness raising in Environment conservation, then expanded to waste management through CLAIR project. In CLAIR project, City of Kitakyushu received members from the Province participated in the Technical Tour to Japan in Kitakyushu. City of Kitakyushu expect the Study, not only end as study, could develop project. City of Kitakyushu understand that strengthen relationship among City of Kitakyushu and Thai parties is important and therefore City of Kitakyushu will continue to dispatch members to the Province and welcome Thai parties to Kitakyushu.

2) Introduction of the Study

In this session, EXRI introduced the Study, explained output from the Study in 2023 and Activities under planning in the Study 2024, the answered to the questions raised by the participants to the Workshop.

In the introduction, introduced "to realize Carbon Neutral in Ubon Ratchathani by 2050" as the goal of study and "to develop Road Map for Carbon Neutral for the Province" and "Development of project contribute for decarbonization with Japanese knowledge, experience & financial scheme" as main activities in the Study.

In the report of output from the Study in 2023, reported "sharing common understanding on current situation and challenges as for Climate Change in the Province through reviewing data & information related to GHG emission, mitigation actions etc." and collecting data & information related to target project, such as waste quality at landfill in

Warin TM.

In the presentation for activities under planning in the Study 2024, explained “to study the possibility of project development focusing on “landfill waste-based biogas power plant” instead of “MSW based biogas plant” at landfill in Warin TM, WtE project at landfill in Pibun TM and DERs of REZIL, as proposed activities from the Japanese side.

PONRE commented that since the Province is working for goals set up by 2030, the Province expect City of Kitakyushu to continue to support the Province for long term.

3) Knowledge Sharing

In this session, KOBELCO introduced MSW processing and wastewater treatment technologies, including WtE for MSW processing. KOBELCO introduced their activities in the region focusing on wastewater treatment by introduction of Prefabricated Oxidation Ditch (hereinafter referred to as “PDF”) as small size wastewater treatment system, which KOBELCO has many references in the area, including Vietnam. There were some questions from the participants and KOBELCO answered to the questions.

City of Kitakyushu introduced the city, Environment related activities, then project on 100% Renewable Energy for Public Facilities and pilot project on EV sharing. The participants to the Workshop requested to City of Kitakyushu to share its experience how to improve environment in the city, and City of Kitakyushu together with expert from KITA advised that Environmental education is one of the keys in improvement of environment in the area.

REZIL introduced themselves, their business models in Japan and possible business models in the Province, with concept of Power with DX and DX with regeneration of the area. The Participants commented that It might take a bit more time for Thai to develop business like what REZIL introduced, as Thai Government shas not yet opened power market to the third parties, while the Province has interest in new business model contribute for decarbonization and hope REZIL participate in the Study for consideration of business expansion in the Province.

Shabondama Soap Co., Ltd. introduced themselves, their products and eco-friendly Form Fire Extinguish Agent for Forest Fire as with high efficiency and safe in use (manufacturing from natural material and no persistence) the Workshop. The participant questioned as for demonstration in Thailand and Shabondama answer that they have already done in Chiang Mai province.

4) Conclusion & Closing of the Workshop

At the end of the Workshop, Director of PONRE concluded that PONRE appreciate much for all participants to the Workshop, experts who share knowledge & experience in the Workshop, City of Kitakyushu and Warin TM who offered venue for the Workshop today. PONRE thought all the participants might know new knowledge through participation in the workshop and PONRE hope any of such knowledge would be utilized in Province's activities in future.

4.5.3. Site Visit

Japanese Party conducted site visit with purpose of survey Climate Change related sites as well as having meetings with relevant parties in the Province. Details of the site visits are as per described below.

（1） 1st Visit

1）Excursion period & program

November 18, 2023 ～ December 1, 2023

Date	Itinerary & Program,	Remarks (Purpose & etc.)
2023.11.18	Travelling	Sapporo - Bangkok
2023.11.19	Travelling	Bangkok - Ubon Ratchathani
	Sirindhorn PS	Site Survey
	Large Scale Facilities in the Province (Government Office, Hospital, Academic Institute etc.)	Site Survey
2023.11.20	PONRE	Courtesy call on Director
	Warin TM Wastewater Treatment Facility	Site Survey
	Warin TM　Landfill	Site Survey
	Don Far Huang National Park	Site Survey
2023.11.21	Pibun TM	Courtesy call on Mayor
	Pra Sri Sean Tham Temple	Site Survey
2023.11.22	Warin TM	Waste Analysis
		1at & kick-off meeting
	Warin TM　Landfill	Waste Analysis (site meeting)
2023.11.23	Pibun TM　Landfill	Site Survey
	Pibun TM　Wastewater discharge point	Site Survey
2023.11.24	FTI Ubon Ratchathani	Courtesy call on Chairman
	Warin TM　Landfill	Waste Analysis (practice)
2023.11.25 2023.12.01	Warin TM　Landfill Waste Analysis	Warin TM Landfill

2）Participants

	Name	Organization	Duration & Purpose
1	Mr. Satoshi Takagi	EXRI	Participation in meetings GHG Inventory & visit potential sites （2023.11.19-24） and Waste Analysis (2023.11.25-27)
2	Mr. Yugo Kono	EXRI	GHG Inventory & visit potential sites （2023.11.18-22）
3	Ms. Kanokwan Olanringreang	EXRI	Participation in meetings GHG Inventory & visit potential sites (2023.11.20-24）
4	Ms. Punisa Kitlumluekul	EXRI	Waste Analysis (2023.11.27-12.01)

3）Activities in the visit

The Contractor organized 1st & Kick Off Meeting among Ubon Ratchathani province, Warin TM and City of Kitakyushu. Beside the Contractor held meetings with others and conducted visit on sites relevant to GHG emission and Renewable Energy. The Contractor also conducted waste analysis for MSW at landfill owned, operated by Warin TM

(2) 2nd Visit

1）Excursion period & program

January 14-20, 2024

Date	Itinerary & Program	Remarks (Purpose & etc.)
2024.1.14	Travelling	Kitakyushu – Bangkok
2024.1.15	Travelling	Bangkok – Ubon Ratchathani
	PONRE	Report on 1st visit
	FTI Ubon Ratchathani	Report on 1st visit
	REO12	Introduction of the Study
	Rajabhat University	Climate Change
2024.1.16	Pibun TM	Report on 1st visit
	Pibun TM Landfill	Site Survey
	Pibun TM Wastewater	Site Survey
2024.1.17	Chonrapatan Community	Site Survey (Mr. Hamada, Mr. Kondo & Mr. Yamaguchi)
	POD	Interview (Takagi & Ms, Kanokwan)
	POE	Interview (Takagi & Ms, Kanokwan)
	Warin TM	Report on Waste Analysis
	Warin TM　Landfill	Site Survey
2024.1.18	Pra Sri Sean Tham Temple	Site Survey
	Sirindhorn PS	Site Survey
2024.1.19	RFMO9	Interview

	Internal Discussion (Japanese)	Wrap up for 2nd visit
	Travelling	Ubon Ratchatani – Bangkok
2024.1.20	Travelling	Bangkok-Kitakyushu

2）Participants

	Name	Organization	Duration & Purpose
1	Mr. Yoshimitsu Hamada	City of Kitakyushu	Discussion with Thai parties and site survey
2	Mr. Yasumitsu Kondo	KITA	
3	Mr. Shinichi Yamaguchi	KOBELCO	
4	Mr. Satoshi Takagi	EXRI	
5	Ms. Kanokwan Olanringreang	EXRI	

3) Activities in the visit

A member from City of Kitakyushu, experts from KITA & KOBELOCO participated in the 2nd visit. Participants to the 2nd visit, participated in the meeting with Thai parties, and conducted interviews as well as sites visit

(3）3rd Visit

1）Excursion period & program

February 19-22, 2024

Date	Itinerary & Program	Remarks (Purpose & etc.)
2024.2.19	Travelling	Bangkok – Ubon Ratchathani
	REO12	2nd visit
	PONRE	2nd visit
	Internation Meeting (Japanese)	
2024.2.20	Workshop	
	Internation Meeting (Japanese)	
2024.2.21	UBE	Introduction of the Study
	2nd & Wrap up Meeting	
2024.2.22	PONRE	JCM Seminar in Tokyo
	REO12	The Study in 2024
	Travelling	Ubon Ratchatani – Bangkok

2）Participants

	Name	Organization	Duration & Purpose
1	Mr. Shinichi Yamaguchi	KOBELCO	Organized the Workshop and 2nd & Wrap up meeting and meetings with other parties (exchange ideas for cooperation in 2024)
2	Mr. Hiroki Ueno	REZIL[4]	
3	Mr. Satoshi Takagi	EXRI	
4	Ms. Kanokwan Olanringreang	EXRI	

3) Activities in the visit

Experts from KOBELCO and REZIL together with members from the Contractor participated in the visit. The Contractor organized Workshop and 2nd & Wrap-up meeting other than meetings with other relevant parties from the Province. It is remarkable that UBE, one of the largest Renewable Energy manufacturers shows their interest in participation in the Study.

5. Conclusion

The Contractor could collect base data related to Climate Change in the Province & shared common understandings as for current situation and challenges among Thai & Japanese parties through implementation the Study (1st year). Thai parties express their keen interest in the Study and realization of Carbon Neutral through continued implementation of the Study and the Study team, in cooperation with Thai party will continue to support decarbonization for the Province.

Appendix

1. Minutes of 1st & Kick off meeting
2. Minutes of 2nd & Wrap up Meeting
3. Report on Workshop

Annex

1. Site visit report
2. Completion Report from Outsourcing parties

[4] Voluntary participation

Appendix 1. Minutes of 1st & Kick off Meeting

1. General Information

Venue	:	Office of Warin chamrap town municipality +ONLINE
Date & Time	:	November 22nd, 2023 13:30-14:30 (TST)
Invitation	:	URL for Online Meeting Zoom Meeting ID: 859 9161 9053 / Passcode: 711654
Program	:	As per "Program of the Meeting" below
Participant	:	As Per Appendix. 1
Language	:	Thai – Japanese Consecutive Interpreting Service by Japanese Side
Distribution	:	1. Program of the meeting 2. Introduction of the Project

2. Program

Time	Program
13:30	**Opening of the Meeting**
13:30-13:35	**Welcome Address** By Mr. Jeerachai Kaikungwan, Mayor of Warin Chamrap Town Municipality
13:35-13:40	**Keynote** By Mr.Yodsawat Thiansawad, Director of Provincial Office of Natural Resources and Environment Ubon Ratchathani
13:40-13:45	**Short Speech** By Mr. Takafumi Hibako, Director, Environment Bureau, City of Kitakyushu
13:45-13:50	**Introduction of the Participants from Thai Side & Japanese Side**
13:50-14:15	**Introduction of the Project** By Mr. Satoshi Takagi, Representative from EX Research Institute (EXRI)
14:15-14:25	**Questions & Answers + Free Discussion**
14:25-14:30	**Conclusion & Closing of the Meeting** By Mr. Takafumi Hibako, Director, Environment Bureau, City of Kitakyushu & Mr.Yodsawat Thiansawad, Director of Provincial Office of Natural Resources and Environment Ubon Ratchathani

3. Opening

3-1. Welcome Address by Warin Chamrap Town Municipality

Mr. Jeerachai Kaikungwan, Mayor of Warin Chamrap Town Municipality (hereinafter referred as "Warin Chamrap TM") welcomed Provincial Office for Natural Resource & Environment (hereinafter referred as "PONRE"), City of Kitakyushu (hereinafter referred as "the City") and participants to the kick-off meeting. The mayor expressed his gratitude to have been selected as a member of the project

3-2. Keynote by PONRE

Mr.Yodsawat Thiansawad, Director of Provincial Office of Natural Resources and Environment Ubon Ratchathani expressed his gratitude and stated that

Ubon Ratchathani Province was collaborated with the City of Kitakyushu and Partner parties i.e., Provincial Office of Local Administration, Warin Chamrap TM, Chaeramae Town Municipality, Ban Kok Subdistrict Municipality, Yang Khi Nok Subdistrict Administrative Organization (hereinafter referred as "Yang Khi Nok SAO"), Ubon Ratchathani University, and Ubon Ratchathani Rajabhat University(hereinafter referred as "UBRU") to enhancement on Municipal Solid Waste Management in the area since 2019. In the first phase, we were jointly implemented "the Enhancement of Municipal Solid Waste Management project" namely, World Clean - Up Day 2019 activity to collect garbage in the Mun River at Kudua Beach, Chaeramae Subdistrict, Mueang District, Ubon Ratchathani Province on October 27th, 2019. to prevent the leakage of plastic waste from river into the sea and analyze plastic waste composition that is dumped into water sources.

In 2023, we were implemented "the Enhancement of Municipal Solid Waste Management project in Ubon Ratchathani province to increase efficiency in waste management of organic waste and polyurethane waste (PU foam), and set the target area for analyzing composition & properties of the product that is

processed from oil by Pyrolysis Method as well as interview the farmer in Warin Chamrap TM, Ban Kok Subdistrict Municipality, and Yang Khi Nok SAO, who are interested in organic waste disposal by fertilizer production. The activities mentioned above are under implementation.

the current Global environmental issue is climate change adaptation. In this year, The Meteorological Department announced that Thailand has officially entered the winter season on November 14th, 2023, and expected to continue into the end of February 2024. The Meteorological Department has noted that Thailand entered the winter season two weeks later than usual, and they have expected that Thailand will be warmer by 1.5 degrees Celsius compared with last year due to the effect of El Nino. The impact of climate change and global warming is no longer a far-off threat. Many countries committed to reach carbon neutrality by 2050 and net zero GHG emissions by 2065 at COP27 on November 15th, 2022, as well as expressed their willingness to cooperate with other countries on GHGs reduction emissions.

Ubon Ratchathani Province was collaborated with UBRU and relevant agencies to prepare GHG inventory and Action plan for Reducing GHGs Emissions under the project to develop provincial climate change plans according to Thailand's Goal to reduce GHG emissions by 30-40% in 2030 as usual (BAU) from the base year of 2019 (due to without any cases of COVID-19 spread). From the result on 10 Year Forecast (2019 - 2030), GHGs emission would be increased from 1.5 million tCO2eq to 4.6 million tCO2eq, up to approximately 300%. Top 4 sectors in greenhouse gas emissions are:

1. Agriculture, land use and forestry (2.7 million tCO2eq from Rice Cultivation and 2.2 million tCO2eq from biomass burning)
2. Transportation (1.1 million tCO2eq from On-road transportation)
3. Energy (720,000 tCO2eq from Energy consumption in households)
4. Waste Management (530,000 tCO2eq from MSW management & Wastewater treatment)

Today, Ubon Ratchathani Province and partner parties ready to cooperate with the city to study on the JCM project development towards carbon neutrality and willing to support related information to achieve its goals for the benefit of the people. Last, I hope that objectives of the project have been achieved.

3-3 Short Speech by City of Kitakyushu

Mr. Takafumi Hibako, Director of Environment Bureau expressed his gratitude participants from PONRE, Mr. Jirachai, Mayor of Warin Chamrap Town Municipality and all the participants and stated that City of Kitakyushu appreciate for holding this 1st & kick off meeting for the Study and expect to have fruitful discussion today.

3-4 Introduction of the Participants

Introduction the Participants from Thai side & Japan side.

4. Presentation

Mr. Satoshi Takagi, Representative from EX Research Institute (EXRI), explained the project concept & overview for the Study on JCM project development under City-City Cooperation in 2023 as per Appendix 1-2 * omitted to attach to the report

5. Questions & Answers and Discussion

Questions & Answers and Free Discussion was held among the participants as follow.

PONRE	:	We are ready to cooperate and implement the project as per presented. Other LAOs in Ubon Ratchathani Province have a readiness too. However, our projects must be achieved the goals before being expanded to other areas. The Successful project is not difficult to expanded.

6. Closing Remarks

6.1 The Warin Chamrap Town Municipality

The Municipality thanks again to the City and PONRE for their intention to initiate a project for the environment and start this project. The Municipality. Thank you for everyone who participated in and we

hope that our project can success and expected our project can be expanded to other areas.

6.2 City of Kitakyushu

Thank you for attending our meeting today. Our activity don't just visit the area, we are do my best to achieve the goal. The team from the city will visit Ubon Ratchathani in January to February. Thank you in advance for your kind cooperation.

1st & Kick Off Meeting for the Study

APPENDIX 1-1. List of Participants

1. Provincial Office of Natural Resources and Environment Ubon Ratchathani

	Name	Position	Dept. / Bureau
1	Mr. Mr.Yodsawat Thiansawad	Director	Provincial office of Natural Resources and Environment Ubon Ratchathani
2	Mr. Noppadon Thanathamsathit	Director	Environment Subdivision, Strategy and Planning Subdivision
3	Ms. Pornampha Surapakdee	Environmentalist, Professional level	Environment Subdivision

2. Warin Chamrap Town Municipality

	Name	Position	Dept. / Bureau
1	Mr. Jeerachai Kaikungwan	Mayor	Warin Chamrap Town Municipality
2	Mr. Narongchai Prasitphuriprecha	Deputy Mayor	Warin Chamrap Town Municipality
3	Mr. Boonyong Jintanakul	Deputy Mayor	Warin Chamrap Town Municipality
4	Mr. Uthai Warong	Municipal Clerk	Warin Chamrap Town Municipality
5	Dr. Thamrong Chumnum	Deputy Municipal Clerk	Warin Chamrap Town Municipality
6	Mrs. Thitima Ungprasert	Director	Division of Sanitary Works
7	Mr. Nitipun Sansuk	Chief of the Subdivision	Subdivision of Used Materials Management, Division of Sanitary Works
8	Mr. Kasemphan Kanchanee	Sanitation Technical Officer, Practitioner level	Ditto

3. Ubon Ratchathani Rajabhat University

	Name	Position	Dept. / Bureau
1	Mr. Wattanachai Malai	Processor	Department of Environmental science, Faculty of Science

4. City of Kitakyushu & KITA

	Name	Position	Dept. / Bureau
1	Mr. Takafumi Hibako	Director	Environment Bureau, City of Kitakyushu
2	Ms. Miwa Katsuhara	Deputy Director	Ditto
3	Mr.Mitsuyoshi Hamada	Chief Officer	Ditto
4	Mr. Yasumitsu Kondo	Senior Technical Expert	Kitakyushu International Techno-cooperative Association (KITA)

5. KOBELCO Solution Co., Ltd.

	Name	Position	Dept. / Bureau
5	Mr. Shinichi Yamaguchi	General Manager	Oversea Sales Dept.

6. EX Research Institute

	Name	Position	Dept. / Bureau
1	Mr. Satoshi Takagi	Representative	EX Research Institute Thai Office (EXRI ASIA)
2	Ms. Punisa Kitlumluekul	Assist. Researcher	
3	Ms. Kanokwan Olanrungreang	Assist. Researcher	

Appendix 2. Minutes of 2nd & Wrap up Meeting

1. General Information

Venue	:	Meeting Room at Warin Chamrap Town Municipality Ubon Ratchathani + online participants
Date & Time	:	February 21st, 2024, 14:00-15:30 (TST)
Participant	:	As Per Annex 1
Language	:	Thai – Japanese Consecutive Interpreting Service by Japanese Side
Distribution	:	Presentation for concept of project implementation

2. Opening session

2-1 Keynote by City of Kitakyushu

Mr. Mitsuyoshi Hamada, Chief Officer, as a representative of City of Kitakyushu, expressed his gratitude to the related agencies in Ubon Ratchathani province for participated our activities both of Workshop hold at Warin Chamrap TM yesterday & the wrap up meeting today, thank again for your kind cooperation, and hope that our project will continuously develop in further year.

3. Presentation

3-1 Overview of Project development

Mr. Satoshi Takagi, Representative from EX Research Institute (EXRI), explained the overview for JCM project development under City-City Cooperation in 2023 and activities & achievement of the project as well as briefly explained about concept for project development in the next phase as per Appendix 1

4. Questions & Answers and Discussion

Questions & Answers and Free Discussion was held among the participants as follow.

PONRE	DLA has already requested data on incinerator technology from Japan and requested EXA to propose the project, right?
EXA	Just knowledge sharing, DLA want to know about waste management in medium-small cluster (for large cluster, DLA promote to be WtE plant). The Japan has a model and collect data for prepare as a guideline. EXA is under translating into Thai. Then, we will share to you later.
TM	The proposed plans, such as the biogas plant, need to be presented to the mayor to review the municipality's policies before considering further actions.
PONRE	• It's a good idea to work together and manage the environment and use the pilot area in Warin Chamrap Municipality which is a leading potential organization in Ubon Ratchathani Province • Currently, we have comprehensive data for the province. However, the key issue in driving the project is community collaboration and providing information & knowledge in detail, especially, actions to achieve the Carbon Neutral by 2050. • The GHG inventory data for 2019 is being revised by TGO to be as meet with the IPCC2006 standard. However, this dataset for the province only. While our project implemented in Warin Chamrap TM. Therefore, we shall set targets for Warin Chamrap TM as well. • PONRE suggests that we should consider preparing on data for Warin Chamrap' s GHG inventory as well. (This is just an opinion.)

	• PONRE agree with Japan team to revise data for provincial GHG inventory
EXA	We are not sure about data source. we have a calculation model & formular, If there is complete information used for estimation, we can calculate, it shouldn't be difficult. While we should make sure that the information to be used is correct.
PONRE	In 2024, we should collect data and revise GHG inventory to review overview of project development and used as a reference
EXA	As I understand, Warin Chamrap TM participate in Carbon Footprint of Organization (CFO) project. The result from this project can used as a reference source for our project development
PONRE	Warin Chamrap District is the largest district in the province. It is possible to calculate the amount of greenhouse gases emission within the area
EXA	First of all, data source should be clarified and make sure that is correct
PONRE	PONRE agree with Japan team regarding concept of project development in 2024 and hope that is a good model for further development
EXA	Our project set a target in Ubon Ratchathani province. therefore, we will try my best to support local organization in the province as well
PONRE	• In Thailand, all cost for developing power plant project invested by private investors. After 15 years, it was owned by the local government. How can we develop to match with the policy? • Technology issues are important topic as well. we must be clearly for present to executive board and provide information to the public
EXA	We think to collaborate with Thai company that have been selected by LAO. technology from Japan has just one of options for considering
TM	TM recommended that if the quality of the power plant (or biogas plant) is poor and pollution occurs, further projects will be more difficult.
E	• EXA emphasized that Technology from Japan as a one of options for considering only • JCM will support the project development and I hope that we can buy the Technology from Japan in the same price as Technology from China • the Technology from Japan is high efficiency and low pollution. • After project finished, we can use as a model for further development
PONRE	For example, a power plant in Khon Kaen uses technology from China and has a problem in operating process.
PONRE	The operation in TM has never a complaint in environment issue
EXA	We focus in 2 topics: (1) waste management: we think amount of accumulated waste is large, this site can emit a lot of GHGs (2) Energy sector: a lot of GHGs emission from this sector as well, I think the model of VPP can solve this issue
PONRE	the model of VPP is interesting, it's a good idea for demonstrate in our province
UBRE	UBRU hope that we can support the project by establishing Guideline & plan with the team

5. Closing Remarks

5.1 City of Kitakyushu

Mr. Mitsuyoshi Hamada stated that the city is waiting for meeting agreement for further project development in the next phase and hope that the city of Kitakyushu & Ubon Ratchathani province can cooperate for achieving our target.

APPENDIX 2-1. List of Participants

1. Provincial Office of Natural Resources and Environment Ubon Ratchathani

	Name	Position	Dept. / Bureau
1	Mr. Noppadon Thanathamsathit	Director	Environment Subdivision, Strategy and Planning Subdivision, PONRE

2. Warin Chamrap Town Municipality

	Name	Position	Dept. / Bureau
1	Mrs. Thitima Ungprasert	Director	Division of Sanitary Works
2	Mr. Nitipun Sansuk	Chief of the Subdivision	Subdivision of Used Materials Management, Division of Sanitary Works

3. Ubon Ratchathani Rajabhat University

	Name	Position	Dept. / Bureau
1	Mr. Wattanachai Malai	Processor	Department of Environmental science, Faculty of Science

4. City of Kitakyushu & KITA

	Name	Position	Dept. / Bureau
1	Mr. Mitsuyoshi Hamada	Chief Officer	City of Kitakyushu

5. Others

	Name	Position	Dept. / Bureau
1	Mr. Shinichi Yamaguchi	General Manager	Oversea Sales Dept., KOBELCO Solution Co., Ltd.
2	Ms. Thunyaporn Tangaromsuk		Interpreter

6. EX Research Institute

	Name	Position	Dept. / Bureau
1	Mr. Satoshi Takagi	Representative	EX Research Institute Thai Office (EXRI ASIA)
2	Ms. Kanokwan Olanrungreang	Assist. Researcher	

Appendix 3. Record of Workshop

1. General Information

Venue	:	Meeting Room at Warin Chamrap Town Municipality Ubon Ratchathani + online participants
Date & Time	:	February 20th, 2024 9:30-16:30 (TST)
Participant	:	As Per Annex 1
Language	:	Thai – Japanese Consecutive Interpreting Service by Japanese Side
Distribution	:	7. Program 8. Presentation 2.1 Presentation (1) Introduction of the Project 2.2 Presentation (2) Introduction Activities for Carbon Neutral the case of City of Kitakyushu 2.3 Presentation (3) Our Technology & Our Activities in the Mekong region 2.4 Presentation (4) We make Decarbonization Effortless 2.5 Presentation (5) Possible Countermeasure against Forest Fire

2. Opening session

2-1 Welcome Address by Warin Chamrap Town Municipality
Mr. Narongchai Prasitphuriprecha, Deputy Mayor of Warin Chamrap Town Municipality (hereinafter referred as "Warin Chamrap TM") welcomed Provincial Office for Natural Resource & Environment (hereinafter referred as "PONRE"), City of Kitakyushu (hereinafter referred as "the City") and participants to the workshop today. The mayor expressed his gratitude to the lecturer for sharing knowledge to us today and hope that this activity is the first step for project implementation to realize in the next step.

2-2 Keynote by PONRE
Mr.Yodsawat Thiansawad, Director of Provincial Office of Natural Resources and Environment Ubon Ratchathani expressed his gratitude and stated that

In 2019, Ubon Ratchathani Province was collaborated with the City of Kitakyushu to conduct a Joint Clean Up activity for collecting waste in the Mun River at Kudua Beach, Chaeramae Subdistrict, Mueang District, Ubon Ratchathani Province, those project hope to promote awareness, and prevent the spread of plastic waste from rivers to the sea.

In 2023, the Clair project was launched to enhance MSW management in community-level as well as organic waste & polyurethane (PU) waste in Ubon Ratchathani Province. The project set a target for project implementation at the Warin Chamrap Town Municipality (hereinafter referred as "Warin Chamrap TM"), Ban Kok Subdistrict Municipality (hereinafter referred as "Ban Kok SDM"), and Yang Khi Nok Subdistrict Administrative Organization (hereinafter referred as "Yang Khi Nok SAO"). Outcomes of the project implementation as follows:

1) Results of farmer interview regarding organic waste management by composting found that 81 respondents can divided into 2 groups. Group 1: consisted of 47 farmers who use compost or use compost with chemical fertilizers or interested to use compost in the future. They want to use compost to improve soil quality, reduce the cost of chemical fertilizers, consideration for the environment, and have a sustainable agricultural goal. Animal manure, litter, weed, and waste from agricultural sector can use as a material for composting. Currently, composting in household is insufficient for use. The important of compost characteristics is high NPK content, efficient microorganisms, safety, free harmful substances, specified raw material source, reliable production sources, affordable prices, and compliance with composting standards. Group 2: consisting of 34 farmers, expressed that chemical fertilizers are easy to use, and can

be selected for the plant growth steps, resulting in high yield & production. The utilization of composting is more challenge due to it requires area and time for composting, despite chemical fertilizers causing soil compaction. From the summarized opinions, we found that Most of them accept and efforts to promote community composting. Therefore, the City of Kitakyushu support resource circular by sending farmers' produce to sell in the city on the other hand communities separate food waste for composting and sending it to rural farming communities as well. This is a circular economy concept (BCG).

2) Results of Converting plastic waste & PU foam:

2.1) About 20 kg of PU foam (from Yang Khi Nok SAO) can be converted into approx. 20 L of oil, and 10-20% of residue waste to be disposed

2.2) 200 kg of non-recycle plastic waste, such as colored plastic bottles, labels, food trays, etc. (from Ban Kok SDM) can be converted into approx. 20 L of oil, and 10% of residue waste to be disposed

2.3) Additionally, 100 kg of MSW collected from the landfill in Warin Chamrap TM can be converted into approx. 30 L of oil, and 30% of residue waste to be disposed

the City of Kitakyushu thinks this is possibility project for further development focusing on waste management business. In the next phase, the produced oil will be tested with boilers.

3) Lastly, analysis result of Waste composition from landfill at the Warin Chamrap TM, was conducted by collecting waste samples from vehicles entering into landfill between November 25th to December 1st, 2023, during 08:00 to 14:00, about 6-8 kg of samples per vehicle, collected 7 days in total. we found that the waste consisted of 29.9% of plastic, 27.3% of glass and wood, 14.4% of food waste, 13.9% of paper, and 14.5% others. the City of Kitakyushu will consider for appropriate waste management methods and propose to us for further action.

Therefore, to drive the project under city-city cooperation in 2024, Ubon Ratchathani Province is pleased and ready to support the JCM project development for achieving Carbon Neutrality, of which according to the Thailand's 3-level goals to reduce GHG emissions by 30-40% from BAU by 2030, achieve carbon neutrality by 2050, and Net-zero greenhouse gas emissions by 2065. It is expected that the project implementation with the city of Kitakyushu will accelerate Ubon Ratchathani province towards carbon reduction goals. In this regard, the province thanks to all parties who are involved in JCM project development and support data to the city of Kitakyushu for further implementation.

2-3 Short Speech by City of Kitakyushu

Mr. Takafumi Hibako, Director of Environment Bureau expressed his gratitude participants from PONRE, Mr. Jirachai, Mayor of Warin Chamrap Town Municipality and all the participants and stated that City of Kitakyushu has expanded its cooperation with Ubon Ratchathani province starting from awareness raising in 2019, then waste management to climate change. City of Kitakyushu will continue to support Ubon Ratchathani province.

3. Presentation

3-1 Introduction of the Project

Mr. Satoshi Takagi, Representative from EX Research Institute (EXRI), explained the background of the project, concept & overview for the Study on JCM project development under City-City Cooperation in 2023 as will as report activities & achievement of the project and briefly concept for further implementation as per Appendix 2 (1)

3-2 Our Technology & Our Activities in the Mekong region

Mr. Shinichi Yamaguchi, General Manger, KOBELCO ECO-SOLUTION Co., Ltd., explained Technologies for MSW management & wastewater treatment as well as the project in Mekong Region. as per Appendix 2 (2)

3-3 Introduction of Activities for Carbon Neutral the case of City of Kitakyushu
Mr. Mitsuyoshi Hamada, Environment Bureau, City of Kitakyushu, explained the concept of decarbonization activities in the city, including model for 100% Renewable Energy city, EV & Car Sharing Demonstration, Wind Power Industry zone, as well as the project cooperation with other country as per Appendix 2 (3)

3-4 We make Decarbonization Effortless
Mr. Hiroki Ueno, General Manager, Rezil inc., explained the concept of new business namely VPP for renewable energy promotion in Japan and batteries with AI technology (DERs) as well as the concept of project under study "CNaas" for accelerating carbon neutral for the local as per Appendix 2 (4)

3-5 Possible Countermeasure against Forest Fire
Mr. Takayoshi Kawahara, Director, Shabondama Soap Co., Ltd, introduced environmentally friendly soap-based Class A foam for controlling Forest fire and activities in Japan as per Appendix 2 (5)
3-6 Site tour
Ms. Pornampha Surapakdee, Environmentalist, Professional level, PONRE, presented finding from site visit tour in Japan as per Appendix 2 (6). The detail of this session as follows:

- PONRE has completed GHG inventory for Ubon Ratchathani province in January
- Amount of GHG emissions is 1.12 million tons in 2019, and estimated 2.23 million tons in 2030
- In 2019, GHGs emission from Rice cultivation is the most, about 2.7 million tons, followed by road transportation about 0.8 million tons, and 0.5 million tons from livestock
- In 2030, GHGs emission from Rice cultivation is the most, about 2.7 million tons, followed by 1.1 million tons of road transportation, and 0.8 million tons from livestock
- 30% of Ubon Ratchathani province is green area & forest, there are 4.5 million tons of carbon absorption in 2019 and estimated 4.2 million tons of carbon absorption in 2030
- Ubon Ratchathani province set a 26 mitigation action plan in 6 sectors i.e., 1) water management, 2) Agriculture and food security, 3) tourism, 4) Public health, 5) Natural Resource management & Environment, and 6) Settlement and human security
- Ubon Ratchathani province set 18 GHG emissions reduction plan in 6 sectors i.e., 1) Energy efficiency, 2) Alternative Energy, 3) waste Management, 4) transport Management, 5) Forest & Green area, and 6) Agriculture, and Ubon Ratchathani province have a target to reduce 100% of GHGs emission in 2030
- GHG emissions reduction plan from WM & FOR is 0.7 million tons in total
- PONRE support the activities and creates awareness and promoting green areas.
- PONRE visit the city of Kitakyushu for learning tech & MSW management.
- We found that the city of Kitakyushu have a database system for collecting data of waste, waste wastewater, pollution
- The people in the city are willing to involve with government for developing the city while the city effort to provide information to the people as well.
- Waste management in Japan is difference from Thailand. There are completely separated waste and recycled waste in town with low pollution technology.
- In the ecotown, plastic waste converting into oil can use as a source of energy in the tree nursery.
- PONRE can summarize that awareness creation is the best solution for waste management in the area.

5. Questions & Answers and Discussion
Questions & Answers and Free Discussion was held among the participants as follow.

Session1

PONRE	From Waste analysis result, we found that most of them consist of plastic waste & biomass, and the amount of organic waste is small. Therefore, this is the factor will impact for biogas project development or not?
Japan Expert	Of course, this is one of the factors that impact to our project. Therefore, we need to recheck the data in detail to be the most accurate
WARIN	The study team will conduct on the waste composition again, right?
EXA	Of course, The study team will recheck data in detail. However, we will consult with PONRE first.
PONRE	Our project will continue for the next 5-10 years. We believe that the good outcome will happen. Our project aims to achieve carbon neutrality by 2050, Therefore, we will achieve the Thailand's 3-level goals i.e., (1) reducing GHG emissions by 30-40% from BAU by 2030, (2) achieving carbon neutrality by 2050, and (3) Net-zero greenhouse gas emissions by 2065.
Session2	
EXA	In p.20, capacity in kWh?
Japan Expert	correct
Japan Expert	What is capacity of biogas plant?
Japan Expert	About 550 kWh
PONRE	In P.9, what is type of waste suitable for waste processing by each incinerator?
Japan Expert	All types of incinerators can be used with general waste in Thailand. However, waste contaminated with metal & large size of waste cannot use with this incinerator. Therefore, waste must be separated before processing.
PONRE	What is the basic factor of area selection for incinerator installation?
Japan Expert	in Japan, the stakeholder's opinion is the most important as same as Thailand. So, we should select an area that is away from the community.
PONRE	The model of solid waste management and technology from Japan has successfully for a long way. What is the most important factor for developing the area.
Japan Expert	the city of Kitakyushu has developed continuously for over 30 years, however, our experience will accelerate the development in Ubon Ratchathani province.
PONRE	can this technology use for infected waste processing?
Japan Expert	We do not have experience in infected waste processing. Therefore, we cannot provide information on this issue to you.
PONRE	Today, there are many LAOs participant in our workshop. Amount of waste is about 10-20 t/d. can you introduce type of incinerator of which low pollution, easy for maintenance, preliminary waste separation, and provide information on range of cost.
Japan Expert	• All Technology in Japan have low pollution. • Other factors are depend on specific spec
KITA	10-20 tons of waste is larger than the amount of waste in Japan (8 tons), so MSW management method might be similar.
EXA	We have a project cooperated with DLA to finding appreciate technology for LAOs. the finding from project study is under considering, when our project finished, we will share information to PONRE
PONRE	An important process is waste separation. In Thailand, all of waste is mixed. So, we think. combined waste incinerator is the best solution. Is there any case in Japan?
Japan Expert	In Japan, at least we shall separate metal, stone, and concrete first.
PONRE	As I visit at the Yokohashi / miwako, most Japanese systems can burn organic waste. If we can use in Thailand, it will enhance on MSW management. Can the company recommend this matter?
KITA	Plastic waste was separated first. Then, it ended up in landfill
Session 3	
PONRE	"Promoting community involved in city development is efficiently method for managing cities. What are the techniques used for promoting community collaboration?"
Japan Expert	supporting activities between government and community, prioritizing on awareness creation, establishing a learning center such as Ecotown
KITA	We support raising awareness and learning about environmental management from childhood, such as field trips at waste processing facilities.

	We have a laws for controlling behavior and promotion of knowledge for a long time
Session 4	
PONRE	• This part is very necessary for all countries in the future. at COP 28, they set a goal to reduce fossil energy by 30%. Therefore, we should consider methods for support our activities to achieve the goal • Creating a sustainable energy system is an interesting approach. • Ubon Ratchathani Province has nearly a million tons of carbon from energy consumption. If this project can be tested at Warin Chamrap TM, it would be great opportunity for us
Japan Expert	• We are willing to participate in the project • In Japan, we have developed many renewable energy projects. It should be possible to adapt for use in Thailand. • We can be a project consultant to consider how to use surplus energy. • However, our project is continuously developed to find the best solution. I hope we can use our technology in Ubon Ratchathani in the future
PONRE	• Renewable energy is very close to us and necessary for development, not exceeding 5 years from now. • The fastest changing is the budget allocation of government agencies. Currently, Related agencies within 5 sectors of climate change must prepare a mitigation plans & activities for reduce GHG emission and propose to central government. • At the next meeting, please report on the progress of this research and I hope that this project will success soon in your research. To promote faster use in Thailand
Session 5	
PARO9	type of forest is the limitation factors for the use of fire extinguishing agents?
Japan Expert	There are no limitations on operation
PONRE	This agent can use in community fire?
Japan Expert	Of course,
PONRE	This agent can use in fire at landfill?
Japan Expert	This agent can extinguish fires at landfills. We have already tested at landfill of Fukuoka City
PONRE	This agent impact in fire truck's joint or not?
Japan Expert	We also tested the effect on metals as well. our substances met the standard So, there shouldn't be a problem. However, this substance is easily biodegradable. Therefore, it is not recommended that mixed them and left for a long time.
PONRE	What is the price of the product?
Japan Expert	Price depends on shipping cost, approximately 30,000 yen.
PONRE	Have you ever tested this product in Thailand?
Japan Expert	The product has been tested in Chiang Mai province last year, it was found that amount of used water decreased by 50%, used time decreased by 50%, no effect on fish.
PONRE	Related agencies such as Department of Disaster Prevention and Mitigation, Department of National Parks, Wildlife and Plant Conservation, Royal Forest Department as well as the related agencies in 17 northern provinces know the results?
Japan Expert	After testing, we hold a workshop for share information to related agencies
PONRE	In my opinion, the northern region shall be better to use this agent In Ubon Ratchathani Province, fire may be carried out by the community with a low-cost method.
Japan Expert	Thank you for your suggestion

6. Closing Remarks

6.1 PONRE

PONRE would like to appreciate the project for inviting lecturer to provide knowledge & sharing their experiment in a workshop, especially Mr. Hamada who join with us all the time. Thank you to Warin Chamrap TM for providing the venue & equipment. I hope that the participated agencies can use the knowledge from workshop today for their action in the future.

APPENDIX 1. List of Participants

On-site participants

1. Provincial Office of Natural Resources and Environment Ubon Ratchathani

	Name	Position	Dept. / Bureau
1	Mr. Mr.Yodsawat Thiansawad	Director	Provincial office of Natural Resources and Environment Ubon Ratchathani
2	Mr. Noppadon Thanathamsathit	Director	Environment Subdivision, Strategy and Planning Subdivision, PONRE
3	Ms. Pornampha Surapakdee	Environmentalist, Professional level	Environment Subdivision, PONRE
4	Mr. Yuthasak Thani	Environmentalist, Professional level	Environment Subdivision, PONRE
5	Mr. Warayut Patichot	Environmentalist, Practitioner Level	Environment Subdivision, PONRE
6	Mrs. Atchara Nambut	Environmentalist, Practitioner Level	Environment Subdivision, PONRE

2. Warin Chamrap Town Municipality

	Name	Position	Dept. / Bureau
1	Mr. Narongchai Prasitphuriprecha	Deputy Mayor	Warin Chamrap Town Municipality
2	Mrs. Thitima Ungprasert	Director	Division of Sanitary Works
3	Mr. Nitipun Sansuk	Chief of the Subdivision	Subdivision of Used Materials Management, Division of Sanitary Works
4	Mr. Kasemphan Kanchanee	Sanitation Technical Officer, Practitioner level	Subdivision of Used Materials Management, Division of Sanitary Works
5	Mr. Chinnakrit Leecharoen	Assistant Technician	Warin Chamrap Town Municipality
6	Ms. Thanita Saithanu	Assistant Clerical Officer	Warin Chamrap Town Municipality
7	Ms. Lalita Thongburan	General employee	Warin Chamrap Town Municipality
8	Ms. Panatchathorn Thepakam	General employee	Warin Chamrap Town Municipality
9	Mr. Weerayut Songsrisuk	Mechanic, professional level	Warin Chamrap Town Municipality
10	Mr. Ekkalak Pengkasem	General employee	Warin Chamrap Town Municipality
11	Mr. Lertmongkol Singthongpat	Disaster Prevention and Relief Officer	Warin Chamrap Town Municipality
12	Mr. Niwat Nitisetthi	Disaster Prevention and Relief Officer	Warin Chamrap Town Municipality
13	Mr. Thewarit Pornthewan	Disaster Prevention and Relief Officer	Warin Chamrap Town Municipality
14	Mr. Noppadon Uwaiphana	Disaster Prevention and Relief Officer	Warin Chamrap Town Municipality

	Name	Position	Dept. / Bureau
15	Mr. Suphasit Saensrisuk	General employee	Warin Chamrap Town Municipality
16	Mr. Pramuan Bunprasit	General employee	Warin Chamrap Town Municipality
17	Mr. Chumphon Bunchai	General employee	Warin Chamrap Town Municipality
18	Mr. Somsak Bunmanee	General employee	Warin Chamrap Town Municipality
19	Mr. Songkran rothateam	General employee	Warin Chamrap Town Municipality
20	Ms. Natthisanan Bunchan	General employee	Warin Chamrap Town Municipality
21	Mr. Supachai Lamparachuch	General employee	Warin Chamrap Town Municipality
22	Ms. Raphatporn Rungritvej	Disaster Prevention and Relief Officer	Warin Chamrap Town Municipality
23	Mr. Apirat Phonprakong	General employee	Warin Chamrap Town Municipality

9. Ubon Ratchathani Rajabhat University

	Name	Position	Dept. / Bureau
1	Mr. Wattanachai Malai	Processor	Department of Environmental science, Faculty of Science

10. Lecturer

	Name	Position	Dept. / Bureau
1	Mr. Shinichi Yamaguchi	General Manager	Oversea Sales Dept., KOBELCO Solution Co., Ltd.
2	Mr. Hiroki Ueno	General Manager	Rezil inc.

11. EX Research Institute

	Name	Position	Dept. / Bureau
1	Mr. Satoshi Takagi	Representative	EX Research Institute Thai Office (EXRI ASIA)
2	Ms. Kanokwan Olanrungreang	Assist. Researcher	

12. Other

	Name	Position	Dept. / Bureau
1	Mr. Ito Hiromitsu	Senior Volunteer	JICA (As a representative from EPO12)
2	Ms. Thunyaporn Tangaromsuk		Interpreter

Online participants

13. City of Kitakyushu & KITA

	Name	Position	Dept. / Bureau
1	Mr. Takafumi Hibako	Director	Environment Bureau, City of Kitakyushu
2	Mr.Mitsuyoshi Hamada	Chief Officer	Ditto
3	Mr. Yasumitsu Kondo	Senior Technical Expert	Kitakyushu International Techno-cooperative Association (KITA)

14. Lecturer

	Name	Position	Dept. / Bureau
1	Mr. Takayoshi Kawahara	Director	R&D division, Shabondama Soap Co., Ltd

15. Other

	Name	Position	Dept. / Bureau
1	Mrs. Porntip Wannatawee	Deputy Mayor	Yang Khi Nok SAO
2	Mr. Asadayut Kukaew	Municipal Clerk	Ban kok SDM
3	Ms. Waraporn Bunluehan	Public Health Technical Officer	Ban kok SDM
4	Mr. Ranaiwat Nitrak	Energy Technical Officer, Professional level	Provincial Energy Office of Ubonratchathani
5	Mr. Sumit Chongpeng	Director	Fire control division, Protected Areas Regional Office 9 (Ubon Ratchathani)
6	Ms. Ananya Srikun	Officer	Protected Areas Regional Office 9 (Ubon Ratchathani)
7	Mrs. Rungnapha Silavanich	Subdivision Director	Waste and Hazardous Waste Management Subdivision, Environment and Pollution Control Office 12
8	Mrs. Podchanee Chansiri	Environmentalist, Professional level	Environment and Pollution Control Office 12
9	Mrs. Supaporn Kukhamsai	Environmentalist, Professional level	Environment and Pollution Control Office 12
10	Mrs. Wilasinee Nontula	Environmentalist, Professional level	Environment and Pollution Control Office 12

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