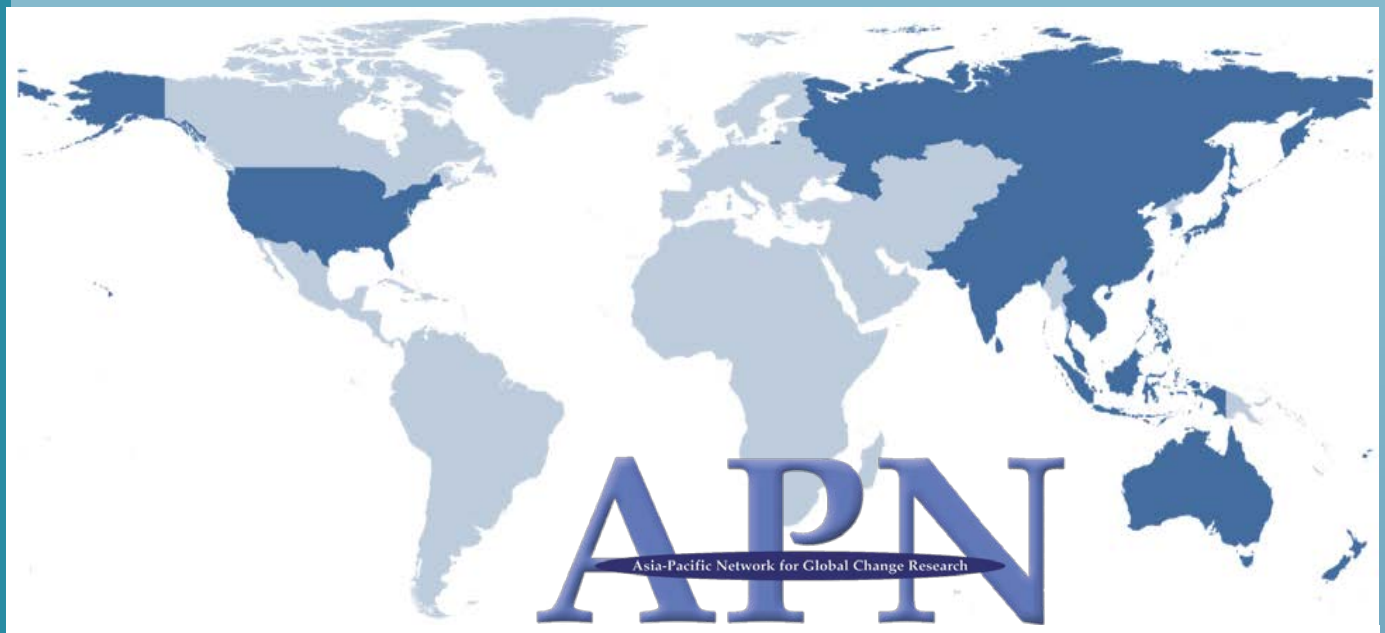
Final Report for APN LCI PROJECT
....Project Reference Number: LCI2012-01NSY(C)-Maeda

"Capacity Building for Implementing a 'Measurable, Verifiable and Reportable (MRV)' Model in a Mid-Sized Thai Municipality"



Low Carbon Initiatives Framework

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“Capacity Building for Implementing a ‘Measurable, Verifiable and Reportable (MRV)’ Model in a Mid-Sized Thai Municipality”

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Progress Report for Continued Funding from the APN

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

This project had the primary objective of **building the capacity of local government officers** in a medium-sized Thai municipality, Phitsanulok Municipality (approximate population size of 100,000 – 120,000 persons) to **develop and implement a 'Measuring/Monitoring, Reporting and Verification' (MRV) framework for quantifying city-level greenhouse gas (GHG) emissions**. In the process, a **pilot global standard**[1] **for city-level greenhouse gas (GHG) accounting was tested**. Phitsanulok Municipality also **exchanged their experience with a peer municipality** (Nonthaburi Municipality).

The tangible outputs are as follows: (i) a **draft *municipal-level* GHG Inventory** was developed (in the forms of an **online database** and a **public report), with routine data collection practices among municipality staff strengthened and enhanced**; (ii) **Preliminary data** was collected **for a higher-order, more complicated *city-level* GHG Inventory**; (iii) Deeper understanding of **local government perspectives and practical challenges of raising local government capacity on MRV.**

These outputs provide a **crucial foundation for future research work and practical projects relating to sustainable, green, low carbon city development in Phitsanulok City**. In addition, the findings may be helpful to researchers, policymakers and other supporting stakeholders involved in capacity building activities for local governments on the topics of local-level GHG-accounting and MRV.

Keywords

Capacity building, low carbon city development, MRV, local governments, city-level GHG accounting and inventory.

Objectives

This project aims to:

1. **Raise the capacity of local government officers** of a mid-sized Thai city (Phitsanulok Municipality) – who have no/limited prior experience with MRV – to implement a MRV framework to account for municipal and city-level GHG emissions;
2. Through objective (1), **establish a baseline municipal/city-level GHG Inventory**; in relation to this, to explore and establish **feasible institutional arrangements** for sustaining and improving MRV actions at both inventory and project levels.
3. Through process of (1) and (2), to **understand the gaps between assumptions/expectations behind global MRV frameworks/standards and the challenges encountered in practical application by a Thai local government with limited experience on MRV,** as well as **the**

[1] The Global Protocol for Community-Scale GHG Emissions (GPC), a project initiated in 2012 by the World Resources Institute (WRI), UN-HABITAT, ICLEI and partners.

challenges for building capacity.

Amount received and number years supported

The grant awarded to this project was: USD29,755 for one year.

Activities undertaken

Activity	Date	Outcomes
Inception Workshop	30 May 2013	• Obtained high-level commitment of Phitsanulok Municipality to implement the project; a formal cross-department project Working Group was established. • Developed an understanding of city's baseline condition, including attitudes to, and awareness on climate change and MRV of municipality officers. • Introduced basic concepts and principles of MRV to municipality officers, particularly on GHG inventory development.
JICA Regional Training on NAMA and MRV	23 Jun. – 4 Jul. 2013	Two senior municipality staff attended a 10-day regional training on Nationally Appropriate Mitigation Actions (NAMAs) and MRV conducted by Japan International Cooperation Agency (JICA), in Kitakyushu, Japan[2]
Baseline data collection and consultative meetings	• 1 – 3 May 2013 • 29 Jul. – 3 Aug. 2013 • 19 Sep. 2013 • 12 – 16 May 2014	• Gathered data on: (i) city's socio-economic and environmental profile; (ii) Phitsanulok Municipality's institutional structure and existing data management systems relevant to GHG Inventory; and (iii) baseline activity data (municipal and city level) • Developed a pilot in-house online energy reporting system which hosts the database for GHG Inventory.
Mid-term Workshop and Training	25 – 26 Nov. 2013	• Introduced intermediate concepts, principles and lessons learnt (from other cities' experience) for MRV of GHG emissions. • Introduced basics of project-level MRV and potential mitigation projects that could be implemented by local governments. • Provided a lecture on bicycle rental schemes and MRV in the transport sector. • Identified gaps in data collection for GHG inventory development at the municipality and city level, and agreed on further methods to estimate or acquire those data. • Review the progress of the pilot in-house online energy reporting system within Phitsanulok Municipality.
Project Completion Workshop	19 Jun. 2014	• Developed a draft GHG Municipality GHG Inventory (FY2012) and collected preliminary data for City-level GHG Inventory (FY2013).

[2] The training covered MRV for key urban sectors, such as transport, energy management, building & housing, recycling industries & renewable energy, solid waste management, waterworks & sewerage system, REDD/REDD+, disaster management, parks management and forestry conservation.

Results

Objective 1 – Capacity building on MRV of municipality staff:

- Approximately **50 municipality staff were involved in the capacity building activities**. These staff acquired a basic understanding on climate change issues, MRV and data collection for municipality- and city-level GHG inventory.
- **Two senior municipality staff received more comprehensive 10-day training on NAMAs and MRV** conducted by the Japanese International Cooperation Agency (JICA).
- **Exchange of experience and cooperative relationships were facilitated** between Phitsanulok Municipality and Nonthaburi Municipality.

Objective 2 – Municipality and City-level GHG Inventory Development

- **A draft municipality-level GHG Inventory (covering emissions arising from municipal operations)** for Phitsanulok Municipality (FY2013) was developed.
- **Preliminary baseline data for city-level a GHG Inventory for FY2012 (covering emissions arising within the geo-political boundary of the municipality)** were collected. This provides a stepping stone towards a complete city-level inventory in the future.
- A **model for systematic collection of GHG relevant data** was established, and a **good practice (online energy reporting system within the municipality)** was also piloted.

Objective 3 – Gaining Practical Perspectives on Applying Global Standards/Frameworks and Capacity Building for MRV and City-level GHG Accounting

- **The GPC, a pilot global protocol for reporting city-level GHG emissions was tested. Some suggestions are made on the practicality of the protocol**, when applied in the context of a municipality like Phitsanulok Municipality (mid-sized Thai city with limited experience on GHG accounting).

Relevance to the APN Goals, Science Agenda and to Policy Processes

- This project has particular relevance to APN's LCI Focus Activity in: **Training opportunity and baseline research to operationalise a MRV model for local policies; South-south cooperation among APN member countries** and **dissemination of practical messages to policy makers**.

- A broader policy issue addressed by this project is to **contribute to a deeper understanding on local actions and contexts in relation to MRV and local GHG Inventory development**, which would be helpful for informing national policies on climate change, as well as the design of domestic/regional/global market mechanisms that incorporate MRV principles. It is also hoped that this project's findings will also **contribute to a wider effort by many stakeholders to raise local government capacity in addressing climate change and implement MRV frameworks.**

Self evaluation

With the exemplary cooperation and commitment of Phitsanulok and Nonthaburi Municipality, as well as other collaborating partners, this project has fulfilled its objectives and has generated

meaningful and innovative outputs that would merit further support by APN, as well as other organisations involved in developing city-level GHG inventory and raising capacity of local governments on this subject.

Potential for further work

The recommended future work are as follows:

- Improve the quality (especially the **completeness and accuracy**) of data for municipality-wide and city-level GHG Inventory towards enabling Phitsanulok Municipality to maintain the data collection process sustainably.
- Related to the above, improve the usability and functions of the pilot **in-house Online Energy Reporting System** developed during this project, so that it can be expanded to a comprehensive online GHG Inventory database (covering data for all GHG emission sources) and be **replicated to other municipalities**.
- Strengthen the capacity of the established **Working Group on Low Carbon City** within the municipality, especially policymakeers, working-level coordinators and IT department, to be capable of utilising collected data for designing and implementing effective low-carbon city pilot policies and projects.

Publications

- IGES and Phitsanulok Municipality (Forthcoming; 2014 (TBC)). Inaugural GHG Inventory of Phistanulok Municipality 2013/14.
- Teoh, Maeda, Akagi, Tubkrai and Gilby. (Forthcoming; 2015 (TBC)). IGES Policy Report. Recommendations for Capacity Building of MRV in Thai Municipalities based on Case Studies in Phitsanulok and Nonthaburi Municipality.

Presentations

- 12th Workshop on GHG Inventories in Asia (WGIA12) (4 – 6 August 2014, Bangkok, Thailand) (TBC)

Acknowledgments

Low carbon city and city-level GHG inventory development is an extensive exercise involving many persons and stakeholders within the local government, as well as non-government stakeholders such as the private sector.

The cooperation and active support of the following persons in Phitsanulok Municipality were essential: Ms. Premruadee Charmpoonod (Chief Advisor to the Mayor), Mr. Boonsong Tantanee (Mayor), Dr. Suthi Huntrakul (Deputy Mayor), Mr. Charoenkiat Charienchunsap (Municipal Clerk), Mrs. Tantawan Phongtang (Deputy Municipal Clerk), Mr. Chavalit Jannarumol (Director, Division of Technical Services & Planning), Mrs. Sukanya Junsingha (Director, Bureau of Public Health & Environment), Mrs. Prathana Booranakhet (Director, Bureau of Finance), Mr. Chaichana Meesiri (Director, Division of Construction Control and City Planning), Mr. Boontham Prommat (Director, Division of Water Supply) and Dr. Noppadon Sinpaisansomboon (Director, Division of Sanitary Works). In addition, the following municipality staff had also contributed significantly to the successful outcomes of this project: Ms. Phiangpen Sriwiroj, Mrs. Janyaluck Petchanit, Ms. Chanida Chankitnapus, Mr. Chusak Raksanau, the entire IT Department team (comprising but not limited to Mr. Kitti Sripothong, Mr. Mim, Ms. Kamonwan Intrarapadit, Mr. Cherd Dessatan) and Mr. Pongchai. We regret not being able to name all of the municipality staff who had supported the data collection process, but we would like to acknowledge their efforts and spirit with heartfelt appreciation.

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TECHNICAL REPORT

Preface

The latest findings from the international scientific community suggests that global warming is steadily advancing in spite of existing mitigation efforts.[3] With widespread acknowledgement that roughly two-thirds of global greenhouse gas (GHG) emissions from anthropogenic sources may be attributed to the activities in cities and urban areas, it is crucial to be able to measure/monitor, report and verify (MRV) GHG emissions, as well as efforts of GHG mitigation, in cities. In line with this, it is also important to strengthen and empower local governments as key actors implementing national climate change mitigation policies.

This project's research covers two issues – MRV capacity building for local governments and testing current and upcoming global MRV frameworks and standards in actual practice, through cooperation with Phitsanulok Municipality, Thailand.

[3] IPCC Fifth Assessment Report. Summary for Policymakers. Page 8.
(http://report.mitigation2014.org/spm/ipcc_wg3_ar5_summary-for-policymakers_approved.pdf)

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1.0 Introduction

Local governments are important actors in mitigating climate change in cities. They engage consumers (citizens) directly to mobilise actions based on policies set by national governments. In addition, they also wield a significant degree of influence over several high-emission sectors such as buildings, transport, waste management and others.

Yet, many local governments especially in developing Asia, are relatively new to MRV and have limited capacity in designing low-carbon city policies and projects for mitigating GHG. Hence, it is critical to build the capacity of local governments and domestic actors in a sustainable manner towards enabling local mitigation policies and actions to contribute meaningfully to national and global goals. This would cover capacity for the fundamental stage of establishing baselines through the development of GHG emissions inventory, which would inform the design and implementation of realistic and evidence-based mitigation projects.

There are few local governments in the world who have been able to account for GHG emissions at the municipal and city-level, through the development of local GHG inventories. Related to this, globally consistent and comparable standards for city-level GHG accounting are under development and their practicality needs to be tested. Since 2012, a global standard for city-level GHG inventory (the first step for Measuring/Monitoring and Reporting) is being developed by the World Resources Institute (WRI) in partnership with ICLEI – Local Governments for Sustainability (ICLEI), C40 Cities Climate Leadership Group (C40), the World Bank, UN-HABITAT, and United Nations Environment Program (UNEP). How practical and relevant is this standard when applied to the real world context, particularly in the case of a mid-sized local government in Thailand with no prior experience of MRV? This requires a deeper understanding of local governments' baseline capacity, responsibilities, institutional structures and governance context – a key part of this project's investigation.

Phitsanulok Municipality, Thailand, views itself as a progressive municipality which is actively engaged in global issues such as climate change. There is pride in being recognised for being a national, regional and global policy innovator and that participation in this project this has a positive impact on the morale of municipality staff and citizens, beyond raising staff capacity. Hence, it has agreed to work with IGES on this project supported by APN.

2.0 Methodology

Objective 1 – Capacity building on MRV of municipality staff:

- This project employed both **theoretical (lectures and discussions in workshops) and practical forms of capacity building ('learning by doing' and consultations)**.
  - Figure 1 provides an illustration of the timeline of actions that the project team implemented to arrive at the final outputs. It shows how the theoretical and practical activities of capacity building were implemented in parallel.

- A Project Inception Workshop introduced the basic concepts of climate change, MRV and low-carbon city was conducted.
  - A **survey of baseline attitudes and perceptions of municipality staff on climate change** was conducted. **Training needs assessment** was conducted during discussion at the Inception Workshop.

- Based on the above, **lectures were provided on the requested training topics** at subsequent workshops (Mid-term Workshop and Project Completion Workshop).

- Municipality was exposed to the established methodologies of GHG Inventory development and standard data collection practices conforming to MRV principles. **Guidance and feedback to improve capacity were provided to the staff based on observations of weak areas and consultations.**

Objective 2 – Municipality and City-level GHG Inventory Development

- Methodology for city-level GHG Inventory was based on the **GPC Pilot Version 1.0.** (http://www.ghgprotocol.org/city-accounting).
- Methodology for municipality-level GHG was based on http://www.theclimateregistry.org/downloads/2010/05/2010-05-06-LGO-1.1.pdf **'ICLEI Local Government Operations Protocol for the quantification and reporting of GHG inventories'** (Version 1.1; May 2010) and **Guidelines on Municipal Carbon Footprint** developed by the Thailand Greenhouse Gas Management Organization (TGO).
- Primary and secondary data was collected by the Working Group members within Phitsanulok Municipality, and checked by IGES as well as a 3rd party expert.

Objective 3 – Gaining Practical Perspectives on Applying Global Standards/Frameworks and Capacity Building for MRV and City-level GHG Accounting

- The perspectives were gathered through an **iterative process of observation and exchange of viewpoints** with municipality staff throughout this project.

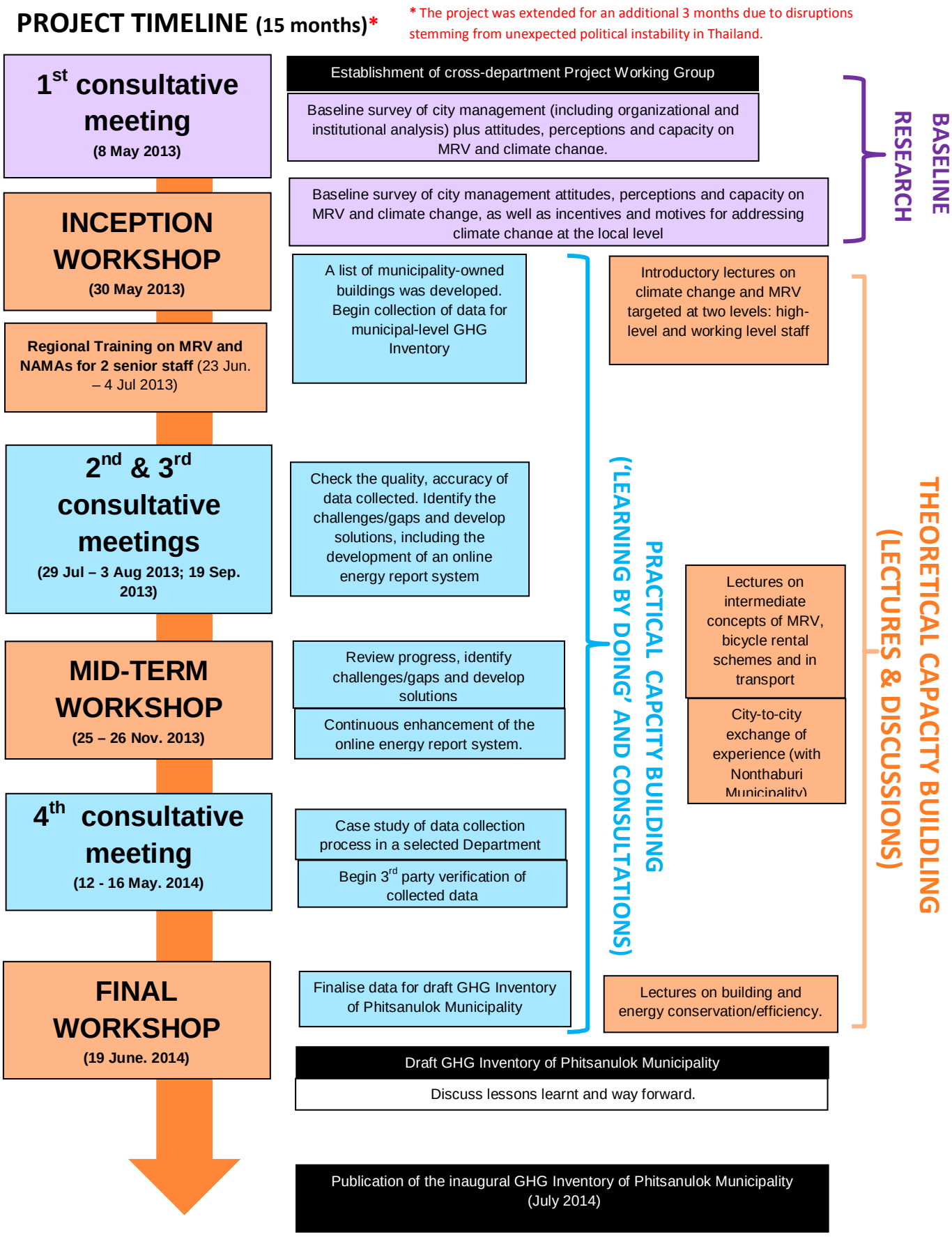


Figure 1: Key Project Activities and Milestones

3.0 Results & Discussion

3.1 Capacity Building on MRV of Municipality Staff

Context

For the purposes of understanding the context of findings presented in this main part of the report, readers should note the following about Phitsanulok Municipality:

- Phitsanulok Municipality administrates a geo-political area of **18.26km^2** with a population of around **100,000 – 120,000 persons** (including unregistered citizens).
- It is the **capital of Phitsanulok Province**, located in **lower northern Thailand**, and surrounded by other districts which have agriculture-oriented economies.
- Approximately 400km from Bangkok and 300km from Chiang Mai. the city has a **steadily growing population and economy**. Phitsanulok's economy is mainly based on **services, trade, tourism, education and administration centre the Lower Northern Region.** Some industries, a large military base, universities are located in the city and surrounding districts.
- It is being developed as a **transport and logistics hub** under Thailand's national long-term development plan. The state-run **railways** (operated daily from Bangkok to Chiang Mai) and **main highway routes running through it**. The province has an **airport**.
- It is home to Wat Yai, a famous temple in Thailand. **Many tourists stay in Phitsanulok City** when visiting the historical sites of the ancient Sukhothai city in the neighbouring Sukhothai Province.
- The **Nan River** intersects the city and is the city's sole source of treated water supply.
- The weather is **hot and sunny, with a distinct dry and wet season**. The city is susceptible to flooding.
- Phitsanulok Municipality has an established reputation as **a progressive, well-governed municipality within Thailand**. It has more than a decade of **experience in international cooperation projects** especially on sustainable cities and environmental management focusing on community-based so lid waste management. However, it is **relatively new to projects related to climate change, GHG accounting and MRV**.

For the detailed context of the municipality and city, refer to the more comprehensive report in **Appendix A**.

Baseline of Perceptions, Attitudes, Incentives and Capacity

The baseline perceptions and attitudes of municipality staff towards climate change was ascertained through two means:

a) A written survey in Thai language (The summary of the results are in **Appendix B**).
   - The survey's design and framework was **adapted from a World Bank-commissioned multi-country poll on public attitudes on climate change**[4] to suit the local government context.
   - The survey was administered to **participants of the project's Inception Workshop (37 persons)**, which comprised representatives from the municipality's 8 departments, as well as representatives from non-government entities such as schools/universities and citizen volunteers.
   - The survey covered four dimensions: **'level of concern', 'beliefs about climate change', 'attitude to international climate change cooperation'** and '**willingness to bear economic costs to support national actions'.**

[4] http://siteresources.worldbank.org/INTWDR2010/Resources/Background-report.pdf

b) Consultations with the high-level and senior representatives of Phitsanulok Municipality (Mayor, Deputy Mayor and staff experienced in implementing international cooperation projects).

From (a) , it was found that respondents had a **high level of concern towards climate change**:

- All respondents thought of climate change as either a 'very serious' or 'somewhat serious' challenge.
- A majority (about 80%) of respondents thought that climate change impacts are already causing harm in the present.
- Most (about 90%) believed that climate change, if left unchecked, will lead to significant negative impacts in terms of natural disasters, water availability, biodiversity, prices of products/services, food diversity and river systems.

These results reflect a **high level of motivation among municipality staff** in terms of domestic efforts and international cooperation targeting climate change:

- Nearly 90% of respondents stated that the municipality should bear responsibility for dealing with climate change, with most respondents (about 80%) thinking that local governments should be willing to commit to limiting GHG emissions as part of international agreements. Moreover, about 80% think that the responsibility is warranted even in the absence of an international agreement.
- About 65% of respondents felt that the current level of efforts addressing climate change by the municipality is 'insufficient'.
- Furthermore, approximately half of the respondents thought that Phitsanulok Municipality's efforts on climate change will influence other municipalities to also undertake similar actions.
- Nearly 70% of respondents felt that Phitsanulok Municipality has a duty to help local governments in other countries to deal with climate change .

Most (about 90%) agreed that the municipality should preserve green areas, increase the use of renewable energy and improve access and quality of public transport as part of climate change mitigation measures. The respondents also expressed a **fairly high level of willingness to bear economic costs to deal with climate change:**

- About 40% of respondents thought that it is necessary to increase the cost of energy to encourage energy conservation and to promote the uptake of renewable energy.
- Respondents stated a willingness to pay up to 0.5% (about 50% of respondents) or 1% (about 25% of respondents) of their monthly income for 'green' energy and products as part of measures to address climate change.

From (b), the following points were noted on the municipality's **incentives for participating in this project and capacity on MRV**:

- In general, awareness on climate change issues has strongly permeated Thai society in general due to intensive public awareness campaigns by the national government in the past

decade. However, **efforts have generally stagnated at awareness-raising while tangible actions have lagged behind**, due to lack of resources and capacity.

- The management cited the following incentives and motivational factors for participating in this project:

    - Phitsanulok Municipality has **already developed a strong reputation** (both domestically and internationally) as an outstanding local government with model/good practices in the health and environmental management sector (particularly for community-based solid waste management, which have been recognised by the national government as a good model for nationwide replication).
        - **It is keen to extend its portfolio of achievements** to include climate change, of which municipality staff has thus far limited exposure to. Capacity building on climate change has been limited to dispatching staff from the Public Health and Environment Department to training workshops organised by national agencies (TGO and the Ministry of Interior through the National Municipality League of Thailand), which is not strong on follow-up support and actions.
    - **The management has adopted a policy of high receptivity to international good practices and encouraging cross-department teamwork** as key factors for high organisational performance. **Efforts to combat 'silo' mentality among departments is a priority of the management.**
        - The management considers **routine data collection capacity**[5] **at the municipality to be weak**. It has been a constant challenge for the municipality to respond to requests for data by the provincial and central agencies. Data collection is difficult to enforce in a consistent, systematic and regular manner, as municipality staff often do not understand the purposes and reasons behind collecting data.
        - The management is **anticipating the central government's future requests for data collection in relation to the national climate change strategy**. They expect this project to help: **(i) improve existing data collection and management capacity and systems**, which the management acknowledges as fundamental for good urban and city planning, particularly **to enable evidence-based evaluation of the effectiveness of pilot projects and policies**; and (ii) **strengthen cross-departmental interaction and collaboration**, which leads to improved staff morale and organisational performance.
        - The **role of an external and international 3rd party like IGES was appreciated** as a 'trigger' for leading and facilitating the cross-department collaboration process as well as for introducing new ideas, good practices and policies from abroad. It is felt that staff are more receptive to changes in working culture and trying new methods of working with the involvement of a neutral 3rd party.

    - The management is also savvy in recognising the **co-benefits of mitigating climate change in the local context**, especially in terms of improving public health and welfare towards improved quality of life of citizens. In other words, the management sees MRV as one of many 'frames' to draw support to its existing

[5] The Deputy Mayor emphasises the principle of 'Routine into Research'. (R2R)

initiatives to which do not necessary have the primary motive for mitigating climate change.

3.2 Municipality-level GHG Inventory Development

Institutional Structure, Data Collection Process and Data Sources

At the Project Inception Workshop (30 May 2013), IGES researchers held two sessions to introduce the basic concepts of climate change, low carbon city policies and main MRV frameworks to be applied in this project (i.e. ICLEI's Five Milestone Framework, the GPC and TGO's National Municipality Carbon Footprint Guidelines). The content of each session was tailored to suit the target audience.

- The first session in the morning **targeted the high-level staff** (Mayors, Deputy Mayors, Municipal Clerk and the head of departments/divisions);
- The second session **was targeted at working level officers who would be primarily involved in the actual data collection for the municipal and city-level GHG inventory**.

Since the **scope of data collection is smaller for a municipality-level GHG inventory (only covering activities of municipal operations**), it was agreed that the project would focus first to collect the data for a municipal GHG inventory, at least for the first quarter of the project duration.

The project discussed **feasible institutional arrangements for data collection, taking into account the project's goal of establishing a sustainable approach** (i.e. the municipality should be able to continue to collect independently (with technical guidance from IGES or other organisations, when required) the necessary data even after the project has closed.

It was assumed that in order for the process and system to be sustained, it had to be **harmonised and integrated within existing institutional structures and processes, as far as possible**. Since the organisational structure of Thai local governments are required to conform to guidance set by the central government, the **institutional arrangements piloted by this project are conjectured to be replicable to other municipalities** which are in the equivalent class of Phitsanulok Municipality.

Therefore, IGES researchers first conducted an institutional review of the municipality's organisational structure (Figure 2) and sought to **understand the pre-existing procurement processes and rules relevant to key emission categories**.

Based on that understanding, IGES researchers requested the Project Working Group to **create a complete list of buildings/facilities under municipality control**, and to **indicate the buildings/facilities according to the jurisdiction of each department/divisions/bureau[6].**

As a result, **a total of 53 buildings were identified and listed according to their jurisdiction under each division (The complete list can be seen in Appendix C)**.[7] An **excel form** (a standard template) specifying all required data for reporting municipal-level GHG Inventory was issued to each building focal point for data collection.

[6] The terms 'Department', 'Division' and 'Unit' have connotations of relative size in the local government context, but this report will not attempt to be specific in this aspect due to language barriers when communicating with the municipality staff. (This, though, may be worth clarifying in the future stage of research).

[7] This output was particularly valued by the management, as the municipality has never attempted to compile its list of buildings/facilities before.

The **data collection process took many months**, during which the Project Working Group held regular meetings to share experience and discuss the progress. IGES researchers kept track of the process remotely (via telephone meetings) and through on-site a total of 4 consultative meetings.

Towards the end of the project, the following **two potential approaches for sustainable data collection within the municipality were considered**:

Option A: Centralised Approach (Figure 3)

- Most of the paper-based records containing the required data of a municipal GHG inventory (especially for energy (fuel) and electricity use) were recorded, as a matter of standard routine, in both soft (excel file and scanned documents) and hard copies (photocopies)[8] as required the rules of the central government.
- Originals of documents are then submitted by the finance/admin. desk of each department/bureau/division on a monthly basis to the Bureau of Finance. Such records have to be filed and stored for up 10 years.
- However, the Bureau of Finance is mainly concerned with processing payments and collating financial data (i.e. how much is spent, as opposed to units of consumption which is required for GHG inventory).
- The mandate for compiling and analysing the consumption data actually lies with the Division of Technical Services & Planning (which is akin to a 'Research and Development' or Statistical Unit conducting overall research to support policy decisions of the municipality);
- In this approach, the Bureau of Finance would need to coordinate with the Division of Technical Services and Planning, which will extract the relevant consumption-based data from financial documents.
- In addition, the Division of Technical Services & Planning would need to request data related to non-energy sources (solid waste, wastewater, material use, vehicle/equipment inventory etc.) which are not able to be derived from existing financial documents from the relevant departments, and to establish a procedure to update those data on a periodical basis.

[8] However, the consistency of this practice is uneven across departments. Some departments with low-level staff face challenges.

Figure 2: Organisational Chart of Phitsanulok Municipality

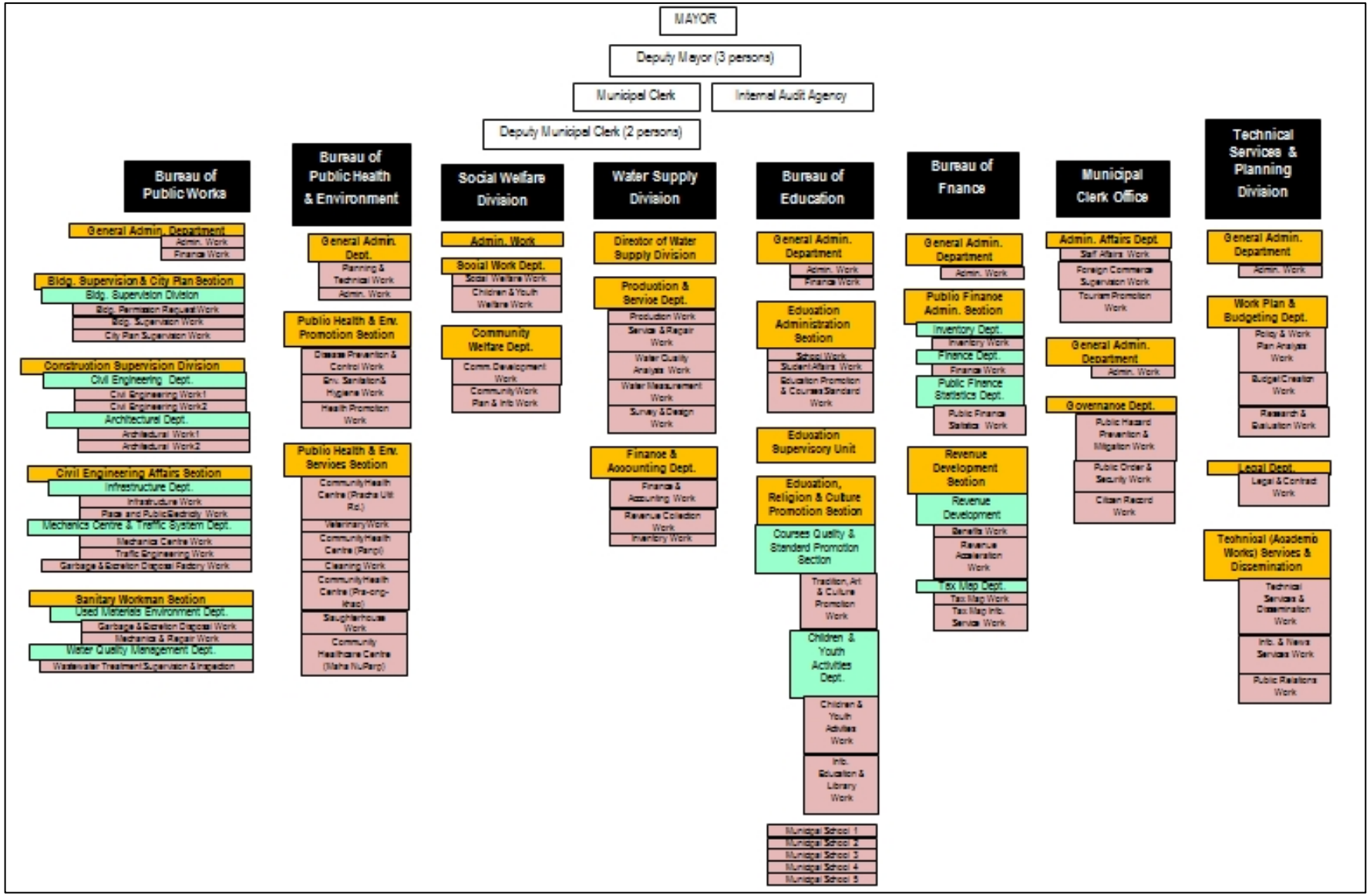


Figure 3: Centralised Approach of Data Collection

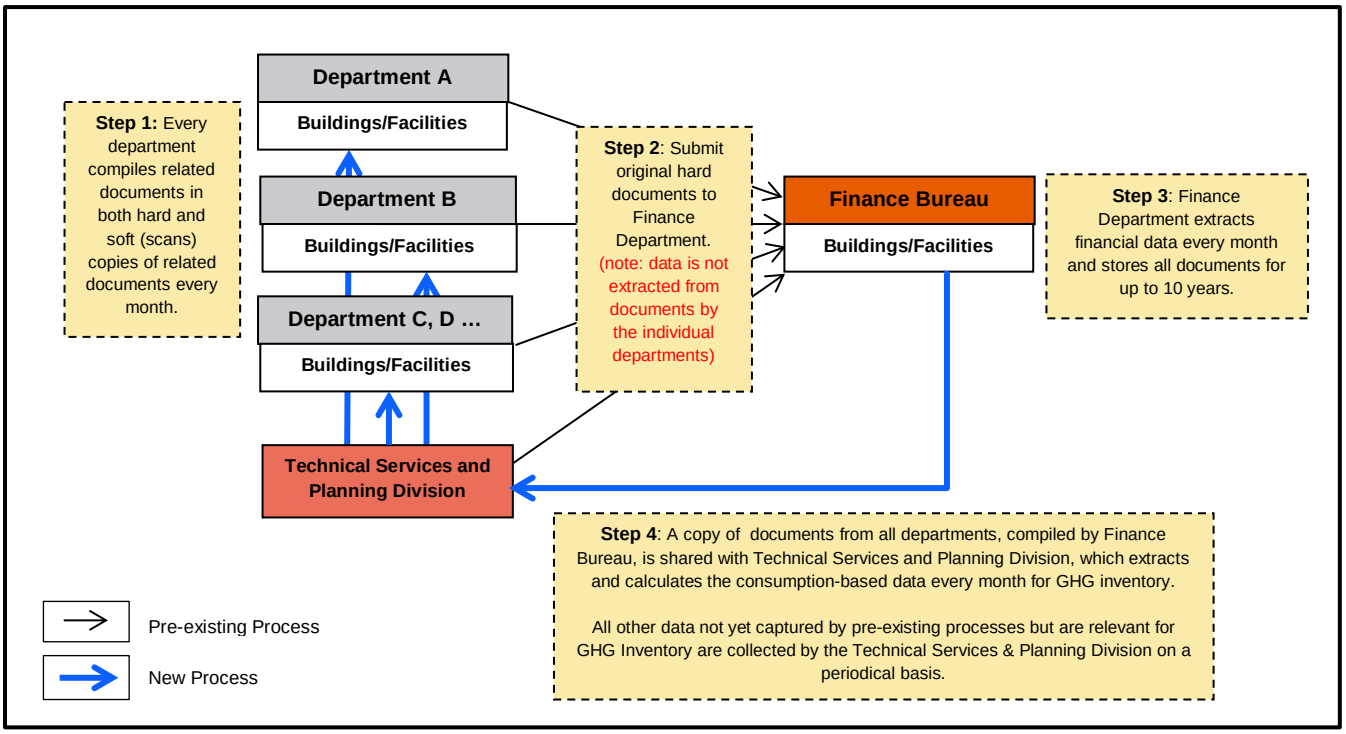
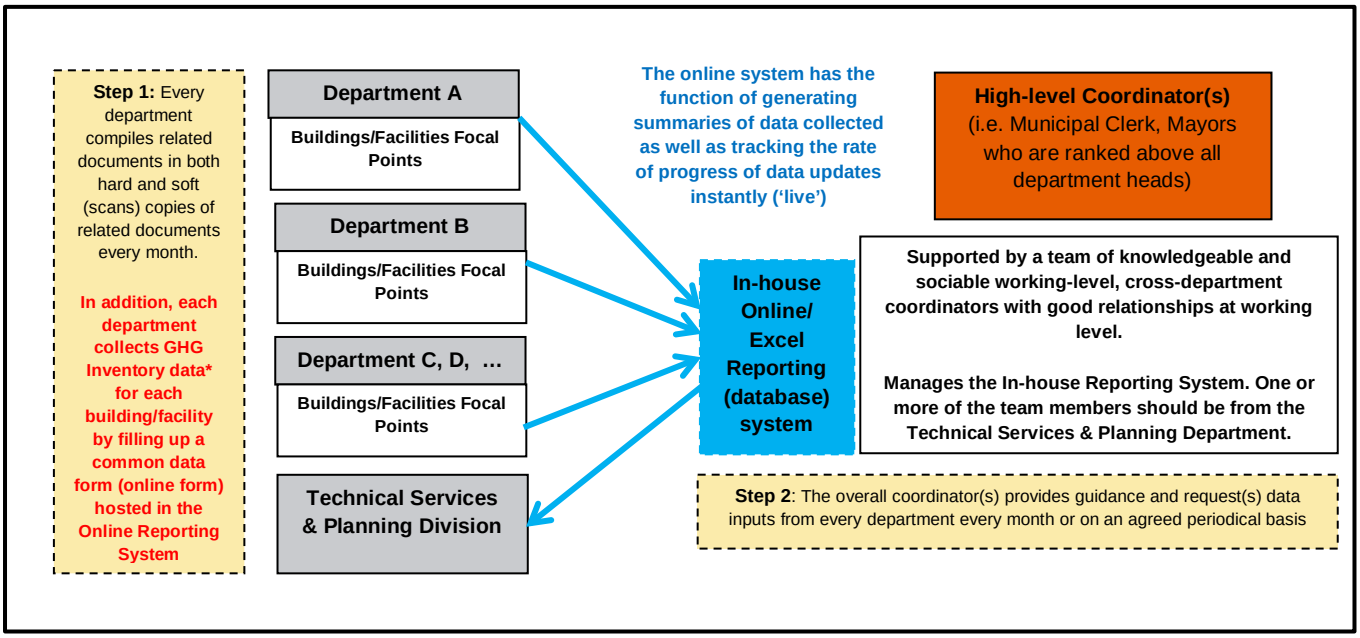


Figure 4: Decentralised Approach of Data Collection



Option B: Decentralised Approach (Figure 4)

- This approach was innovated under this project, where focal persons in each of the 8 main departments/divisions were appointed and held responsible appointing supporting staff in each building/facility for data collection.
- Focal persons would use a standardised data collection form (in the initial stage of the project, it was an excel form. After the pilot Energy Reporting System was developed, it became an online form) for each building/facility, which was designed by IGES specifically for this project.
- Although this approach is decentralised, it still requires several overall coordinators from different departments/divisions/bureaus who would guide and persuade department/building focal points to cooperate with the regular and systematic data collection process.
- To address the issue of competing authority (department/division/bureau heads may not necessarily feel motivated to conform to the requests of other department heads of a similar or lower rank), an overall high-level coordinator position has to reside in a higher level above each department i.e. the Municipal Clerk, with the endorsement of the Mayor.
- The high-level coordinator should also be supported by several active and responsible working-level staff who are knowledgeable about MRV and systematic data collection approaches, as well as possessing positive social skills (ability to interact and persuade other working level staff to cooperate with the additional responsibilities of data collection, since there is no real concrete incentives for working level staff to conform to data collection duties, which are additional to existing formal duties.)

After a few months of trial, it was observed that Option B (Decentralised Approach) was more amenable in the case of Phitsanulok Municipality. Furthermore, the IT department, which is located in the Technical Services & Planning Division, created an in-house pilot online energy reporting system, where building/facility focal points could log in online to key in data more easily as compared to collecting data via numerous excel files.

Challenges Encountered

In general, **much of the data required for municipality-level GHG inventory can be accessed or are already being collected in existing processes**. The broad challenges were encountered as follows:

- **Financial data, not consumption data** are usually recorded (e.g. for electricity, only the amount paid as billed is recorded.)
- **Some data are missing** due to lack of routine and proper filing and storage practices.
- A de-centralised approach **requires cooperation from staff to collect data**, who may perceive such work as an added burden to their existing workload. 'Silo mentality' (in the case of high-level staff) and lack of understanding of the purposes and helpfulness for such data collection (in the case of working-level staff) are also barriers.
- **Lack of technical knowledge**, in certain cases, may lead to incorrect data being collected. This depends on how well the overall coordinator explains the type of data that is required, and the quality control capacity of the coordinator to check and ensure that wrong data is not collected.

Table 1: Types of Data Collected, Linkagse to Existing Process/Sources and Particular Challenges

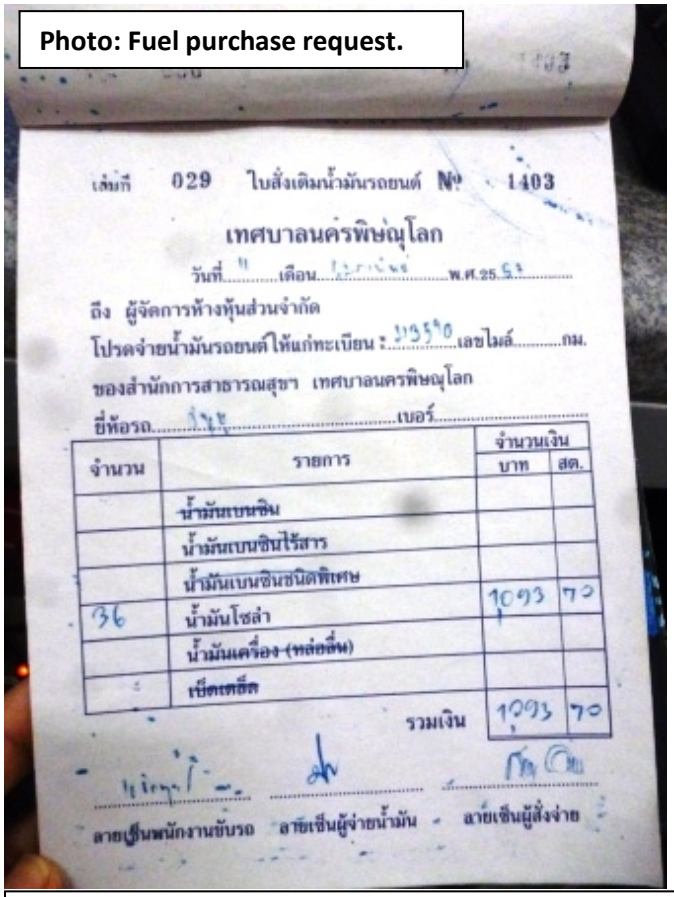
Type of Data	Linkages with existing process and sources of data	Adjustment to existing data/procedures required for collection for GHG Inventory	Particular Challenges for Collecting Data
Electricity Consumption (Buildings / Stationary Sources)	• Monthly electricity bills (which are linked to electricity meters of buildings) • Only financial data is collected, not number of units consumed	• Record the number of units consumed • Scanning of electricity bill as evidence for verification by 3rd party.	• Electricity meters are not necessarily installed for each building/facility. In some cases, several buildings shared one meter. Some effort is required to clarify this. • It is actually not possible to capture total electricity consumption of municipality operations from electricity bills of buildings, since the municipality is subsidized for a large portion of its electricity expenses (up to 10% of total consumption of electricity by the household sector within the city). This subsidy is applied to buildings offering public services. • Hence, the total electricity consumption needs to be requested from the Provincial Electricity Authority (PEA)[9], by supplying the list of metres in municipality buildings/facilities. PEA's database system does not allow easy and quick scaling down of data limited to only the municipality's buildings/facilities/operations.
Fugitive Emissions (Buildings and Stationary Sources)	• Bills when air-conditioning units, vehicle air-condition and fire extinguishers are serviced.	• Same as above	• Municipality staff were not knowledgeable about the type of refrigerants being used. • It is not customary for the amount of refrigerant to be indicated on the service bill. This has to be enquired and requested of the service provider.

[9] PEA is a Government Enterprise in the utility sector attached to the Interior Ministry, was established on 28 September 1960 under the Provincial Electricity Authority Act B.E. 1960. The Provincial Electricity Authority's primary responsibilities include generation, procurement, distribution and sale of electricity to the public, business and industrial sectors in 74 provinces, over a nationwide area of 510,000 square kilometers or 99.4% of Thailand, with the exception of Bangkok, Nonthaburi and samut Prakarn provinces

Fuel consumption (Buildings and Stationary Sources)	• None	• Please see explanation on the right.	• Fuel purchase records are not available for fuel used in off-road/non-travel vehicles such as fogging machines, grass cutting and water pumping trucks. Fuel is bought in bulk and not tracked by vehicle/machine. Therefore, the data has to be estimated on a per use basis.
Fuel Consumption – Mobile (Municipality Vehicle Fleet)	• Fuel purchase records (please see photo and translation in the next page) contain the amount and type of fuel purchased.	• None	• The data collected in this project did not include the data of fuel consumed by outsourced waste collection company covering the West side of the city. • The municipality did not conduct a Staff Commuting Survey as recommended by standard protocols of ICLEI and TGO.
List of electric/electronic appliances, equipment and devices (including air-conditioners and fire extinguishers) **List of vehicles**	• Municipalities are already required to maintain a list of municipality assets which should be updated on an annual basis. • The list of assets include electric/electronic appliances, as well as vehicles.	• Operating hours of lights and air-conditions • Brand, capacity and other more technical specifications of appliances/equipment and devices	• The consistency of the type of information recorded for each equipment/device/vehicle was uneven across departments.
Consumption of products with embedded upstream emissions (e.g. paper)	• Purchase records	• See right.	• The purchase and consumption of paper and other products are not routinely monitored in most cases, so measures have to be introduced to collect this data.
Waste generated from municipality operations and city	• Weighbridge at landfill	• None in particular	• None in particular as the municipality has relatively good data collection system (weighbridge) for waste management.
Amount of wastewater generated from municipality operations	• The municipality has no wastewater treatment systems. Hence emission data has to be derived from	• None in particular	• The size of septic tanks were estimated. This information is not available for some buildings, as building plans for old buildings were lost. • The accuracy of the data should be properly verified and enhanced over time.

	amount of water supplied to municipal operations, and also estimated from the size of septic tanks for each building.		
Fertiliser Use	Purchase records of fertilizers.	None in particular	None in particular
Tree Inventory	The municipality does not conduct a tree inventory as part of its normal operations. However, Phitsanulok Municipality has a very comprehensive tree inventory which was developed in its bid to compete for the ASEAN ESC Awards 2011.	Tree inventory has to be adopted as part of municipal tasks.	Conducting tree inventory is basically extremely time consuming and does not serve any easily understood purposes for working-level staff, hence is not likely to be prioritised. Skills for tree inventory may not be available within the municipality. However, this does nto seem to be a problem for Phitsanulok Municipality staff.

Photo: Fuel purchase request.



เล่มที่ 029 ใบสั่งเติมน้ำมันรถยนต์ No 1403

เทศบาลนครพิษณุโลก

วันที่ 11 เดือน [illegible] พ.ศ. 25[illegible]

ถึง ผู้จัดการห้างหุ้นส่วนจำกัด

โปรดจ่ายน้ำมันรถยนต์ให้แก่ทะเบียน : [illegible] เลขไมล์ ..... กม.

ของสำนักการสาธารณสุขฯ เทศบาลนครพิษณุโลก

ยี่ห้อรถ [illegible] เบอร์ .....

จำนวน	รายการ	จำนวนเงิน บาท	สต.
	น้ำมันเบนซิน		
	น้ำมันเบนซินไร้สาร		
	น้ำมันเบนซินชนิดพิเศษ		
36	น้ำมันโซล่า	1093	70
	น้ำมันเครื่อง (หล่อลื่น)		
	เบ็ดเตล็ด		
	รวมเงิน	1093	70

ลายเซ็นพนักงานขับรถ ลายเซ็นผู้จ่ายน้ำมัน ลายเซ็นผู้สั่งจ่าย

Translation to English

Fuel request

PHS Municipality

D/m/y

To Manager of gas station

Please fill in the petrol to vehicle no. _____which belongs to Public Health and Environment Bureau.

Type of vehicle__i.e.Isuzu___

Quantity, type of fuel , amount in baht and signed by the driver, the director and the Gas station's manager.

Note: The drivers have this request bill and have to submit to their Director for approval. After obtaining the signature of the director, the driver bring the request form to the contracted gas station. The gas station will issue an invoice and collect cash payment every 15 days from the municipality. Based on the payment, Municipality will record the purchase in a paper logbook.

Case Study of Data Collection Work in one Department

To better understand the actual process of data collection, data sources as well as the practical challenges, the research team conducted a focused interview with the focal point for the Department of Education.

The Department of Education is in charge of the management and operations of 11 buildings/facilities, comprising 5 municipal schools, a public basketball court, a public badminton court, football court, public library, ICT Centre and Child Development Centre.

Ms. Katsanee Praison oversees the management of 3 out of 11 buildings. Although her position does not oversee all 11 buildings of the Department of Education, she has been assigned the role of the overall Department Focal Point by her superiors, due to her high capacity and initiative in low carbon city related activities.

She coordinates and seeks the cooperation of each building's focal points to collect the required data covering: (a) electricity consumption; (b) on-site fuel consumption; (c) list of electronic/electric

appliances and equipment; and (d) list of vehicles. These data are actually accessible or collected via existing rules/procedures prescribed by the central government.

According to Ms. Praison, it is not difficult to collect the additional data required for GHG Inventory with the cooperation of her staff. The admin clerks of the department or building can usually handle the data collection, with proper explanation.

She cites the following factors for effective data collection within her department:

- She **takes a personal interes**t in sustainable, low-carbon city development and is willing to take the initiative to support this project;
- She **works closely with the working-level staff from the IT department**, who help to provide support and reminders to motivate staff to collect the data and input into the online reporting system;
- The IT department appears to be a 'natural coordinator' for such data collection, for the following reasons:
    - They have a **neutral service provision role** within the municipality (setting up networks, computer/IT systems for all municipality operations). Through this, they become acquainted and interact with the staff of all 8 departments on a regular basis. This helps to establish trust and good relationships, which is conducive for eliciting cooperation in the data collection process.
    - They reside within the Technical Services & Planning Division of the municipality, which has the mandate of conducting research to support development policy of the municipality
    - The IT department staff are **professionally trained in systematic approaches of collecting and handling data**, hence they are **able to grasp the concepts and principles of MRV easily**, and to design the systems to support the MRV process. This resulted in the in-house energy data reporting system.
    - A reflection of the IT department's initiative and skill is demonstrated in how they designed step-by-step instructions to staff for data collection, shown in the photo below for guiding staff on extracting data from electricity bills.

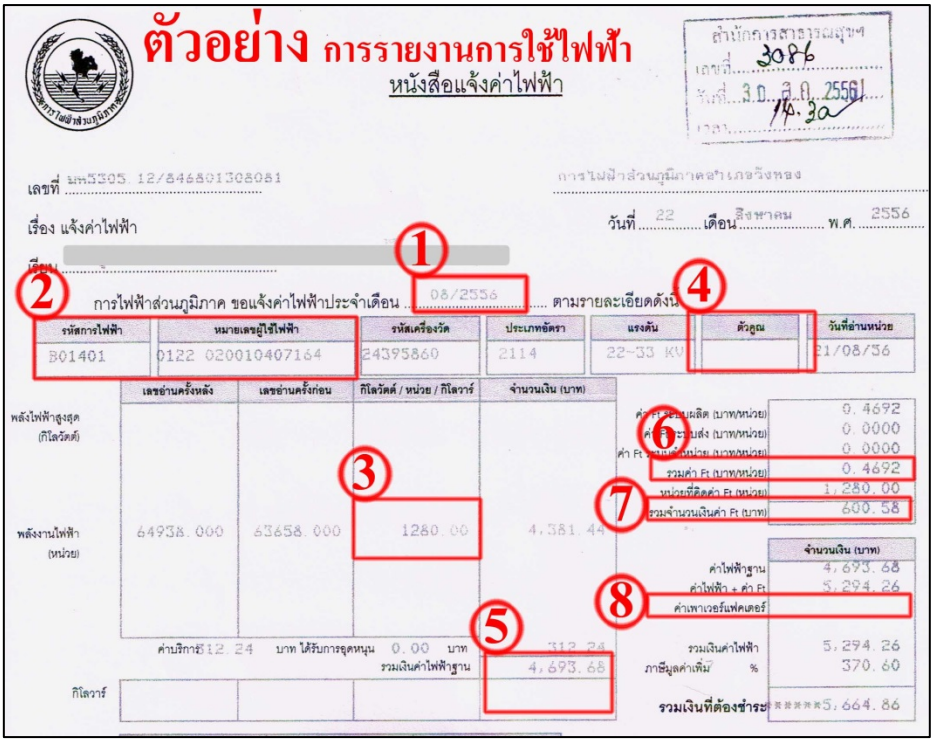


Photo: The step-by-step instructions designed by the IT Department to guide building/department focal points on data entry via the Pilot Online Energy Reporting System

When asked of the benefits of data collection introduced through this project, Ms. Praison cited the following:

- **Improved technical knowledge** about specifications of electric/electronic equipment and vehicles. For example after this project, she was sensitised to concepts such as the brands, power/capacity of air-conditions and lighting, and she did her own research to learn how such information could be related to energy conservation and efficiency.
- Previously, the **routine collection of data**, including the types and depth of data, was not well enforced. After this project, the regularity and depth of data was improved.
- The data collected (both the consumption data and list of equipment/appliances/lighting/vehicles) and was perceived as useful as **quantitative information to justify the purchase of more costly, yet higher quality** (longer-lasting, more energy-efficient) lights, for example. Previously, without such data there was no objective evidence to justify the one purchasing decision over another. Hence, cost was the sole factor for making purchases (buying the cheapest choice, but those may often break down).

Status of Data as of 23 June 2014 - Draft GHG Inventory for Municipal Operations FY2013

By the 23 June 2014, the data shown in Table 2 were collected. Data for 'Energy' has mostly been checked and verified by a 3rd party expert, who will continue the verification process in consultation with IGES researchers until 23 July 2014.

Table 2: Data Collected for Municipal Level GHG Inventory as of 23 June 2014

Category	Emission Sources	Total in FY2013	Unit	Remarks	
Energy	Electricity - Stationary Sources (Buildings)	14,464, 110.89	kwH		0
	Diesel	534,681.00	L	Off-road consumption needs to be differentiated from mobile consumption (vehicles).	2.
	Benzene	3,873.00	L		2.
	Gasohol	31,376.00	L		2.
	CNG	77,151.00	Cu. Ft.		2.
Waste/Wastewater	Solid waste landfilled	22,538.50	t	Based on methane commitment method (present year). Calculations still need to consider the MBT process which was initiated at full scale since Oct 2013.	
	Biological Treatment / Composting	9.00	t	Not including community-level composting	
	Incineration	N/A			
	Wastewater Treatment & Discharge	180,291	m3	Needs to be reduced based on an assumption of how much of water supplied is eventually discharged into septic tanks.	
Others	Fertiliser Use (16-16-16)	0.6	t	Estimated from 50kg x 12 packs per month.	
	Fugitive Emissions (N-22)	TBC		As there are no consumption-based purchase records, estimation needs to be done based on the number of fire extinguishers, vehicle fleet and air-conditioning units.	

Category	Emission Sources	Total in FY2013	Unit	Remarks
Energy	Electricity - Stationary Sources (Buildings)	14,464, 110.89	kwH	
	Diesel	534,681.00	L	Off-road consumption needs to be differentiated from mobile consumption (vehicles).
	Benzene	3,873.00	L	
	Gasohol	31,376.00	L	
	CNG	77,151.00	Cu. Ft.	
Waste/Waste water	Solid waste landfilled	42,676,325.00	kg	Based on methane commitment method (present year). Calculations still need to consider the MBT process which was initiated at full scale since Oct 2013.
	Biological Treatment / Composting	9.00	t	Not including community-level composting and small-scale biogas at the municipal slaughterhouse.
	Incineration	N/A		
	Wastewater Treatment & Discharge	71,233	m^3	Needs to be reduced based on an assumption of how much of water supplied is eventually discharged into septic tanks.
Others	Fertiliser Use (16-16-16)	0.6	t	Estimated from 50kg x 12 packs per month.
	Fugitive Emissions (N-22)	TBC		As there are no consumption-based purchase records, estimation needs to be done based on the number of fire extinguishers, vehicle fleet and air-conditioning units.

Table 3: Total Units of Electricity Used by Phitsanulok Municipality's Operations (FY2013)

Jan	1,241,012.27
Feb	1,132,156.15
Mar	1,281,187.87
Apr	1,219,655.90
May	1,177,516.80
Jun	1,179,846.59
Jul	1,180,294.00
Aug	1,167,195.16
Sep	1,235,921.58
Oct	1,198,804.15
Nov	1,198,804.15
Dec	1,272,434.22
Total (KwH)	**14,484,828.84**

Source: PEA and Phitsanulok Municipality (2014)

Table 4: Total Fuel Consumption by Phitsanulok Municipality's Operations (FY2013)

Fuel	Amount	Unit
Diesel	531,382	L
Benzebe	3,873	L
Gasohol	31,376	L
	566,631	L
NGV/CNG	77,151	cu ft.

Source: Phitsanulok Municipality (2014)

Table 5: Total Amount of Water Used by Phitsanulok Municipality's Operations (FY2013)

Month	Amount Used by Municipal Operations (30 users) (m^3)
Jan.	7,236
Feb.	6,226
Mar.	6,247
Apr.	6,059
May.	5,846
Jun.	6,896
Jul.	5,849
Aug.	5,669
Sep.	5,701
Oct.	5,103
Nov.	4,677
Dec.	5,724
Total	**71,233**

Source: Phitsanulok Municipality (2014)

Table 6: Total Amount of Waste Deposited in Landfill FY2013

Month	In Municipality (kg)		Outside Municipality (kg)	Total
	By Municipality	By Private		
Jan	2,040,380	345,410	989,830	3,375,620
Feb	1,733,157	300,405	855,235	2,888,797
Mar	1,910,030	256,530	1,040,665	3,207,225
Apr	1,806,454	331,510	955,070	3,093,034
May	1,995,092	392,123	1,136,304	3,523,519
Jun	2,110,155	431,060	1,107,185	3,648,400
Jul	2,060,371	406,725	3,566,079	6,033,175
Aug	1,174,825	400,930	3,254,545	4,830,300
Sep	2,081,000	360,320	1,738,295	4,179,615
Oct	1,652,914	237,930	422,885	2,313,729
Nov	2,071,921	269,510	488,290	2,829,721
Dec	1,902,205	251,300	599,685	2,753,190
Total	22,538,504	3,983,753	16,154,068	**42,676,325**
Average/month	*1,878,208.67*	*331,979.42*	*1,346,172.33*	***3,556,360.42***

Source: Phitsanulok Municipality (2014)

About the Pilot In-house Online Energy Report System

Picture: Screenshot of the Pilot Online Energy Report System developed by Phitsanulok Municipality's IT Department through this project

The pilot in-house (intranet) Online Energy Report System was developed by the IT Department halfway through the project as a means of data collection for the municipal GHG inventory, as a substitute for the excel form developed by IGES researchers.

It is currently in a prototype phase and covers data from energy (electricity and energy) as well as the list of electric/electronic appliances and vehicles for each building, organised by each Department/Bureau/Division.

It is accessible with the following information:

URL: http://energyreport.phsmun.go.th/
Username: shom
Password: 123456

For future development, the system would could incorporate the following functions:

- Cover all information relevant to GHG Inventory (ideally, it should be a 'live' municipal level GHG inventory database)
- Be bilingual (Thai-English; an external consultant is hired to assist with this)
- Have selected data accessible for public viewing
- Include the function to view the supporting documents for the data provided (such as purchase records, electricity bills etc. in scanned format) to fulfil the 'V' (verification) process by 3rd party.

3.3 City-Level GHG Inventory Development

The types of data for a city-level GHG Inventory are similar to that required a municipality-level GHG Inventory, except that the boundary is larger (i.e. within the geo-political jurisdiction of the local government). This project attempted to collect such data in parallel with municipality-level GHG Inventory and this section will explain the key findings and lessons learnt.

Institutional Structure, Data Collection Process and Data Sources

In an ideal scenario, all local governments would attempt to collect data in their geo-political sphere of authority to inform their policy decisions and development plans. However, naturally, the capacity and priority for such comprehensive data collection is weak in most local governments in developing countries. In the case of Thai municipalities (probably with the exception of Bangkok Metropolitan Authority), **such data collection responsibilities are not formally institutionalized and assigned to specific staff. Hence, data is disorganized and scattered in numerous sources.**

In the case of Phitsanulok Municipality (and it is hypothesised, in most Thai municipalities of equivalent class to Phitsanulok Municipality), it was perceived that **such data collection function would most feasibly reside within the Technical & Planning Department**.

Under this project, the staff of this department began to collect data relevant to city-level GHG Inventory with the guidance of IGES researchers. The most updated data was presented to IGES researchers at the Project Completion Workshop on 19 June 2014, as shown in **Appendix G**.

IGES researchers will work with the 3rd party external expert to verify the data until 23 July 2014, so that the clearest possible information may be presented in the planned official publication (Inaugural Phitsanulok Municipality Annual Inventory GHG Report 2012/13), in terms of the quality of data and the gaps that need to be addressed.

Challenges Encountered

Meanwhile, Table 7 below explains the results of these efforts and the challenges encountered as of 23 June 2014.

Table 7: Data Collected for City-level GHG Inventory as of 23 June 2014

Type of Data	Challenges of data collection	Sources of Data Explored by Phitsanulok Municipality
Stationary Units – Electricity		
- Residential - Commercial/institutional - Industrial	Such data has to be requested from the Provincial Electricity Authority (PEA). PEA does not necessarily have the breakdown of users according to the categories prescribed by GPC. In fact, it was highly challenging as data could only be extracted on a per-user account basis. The exact situation needs to be investigated by future researchers in order to make proper recommendations for a feasible solution to support data collection at the city level.	In the future, it may be possible to use a bottom-up approach of sampling electricity consumption from a selected number of households, commercial buildings and factories. However this needs proper guidance on acceptable sampling rates and methodology. However, Phitsanulok Municipality needs to have the statistics of the number of users in each category.
Stationary Units - Fugitive Emissions	There is no existing data on the total number of HFCs within the city boundary	Survey of sales from HFC shops within the city boundaries.
Mobile Units – Fuel		
On-Road Transportation	Such data could be collected from petrol stations within the city boundary. The assumption that the sales of fuel within the municipality corresponds to the consumption of fuel within municipality boundaries. However, petrol stations were found to be reluctant to reveal such data due to factors related to fuel tax.	The Mayor and Deputy Mayor requested data from 4 out of the 10 petrol stations within the city, who agreed to provide such data on the condition of anonymity and non-disclosure of data specific to each petrol station.
Railways	The data from interview still needs to be verified and checked against empirical evidence.	Interview with State Railway Authority officers.
Water-borne Navigation	The data from interview still needs to be verified and checked against empirical evidence.	Survey of boat operators in Nan River.
Aviation	No applicable to Phitsanulok Municipality as the airport is located outside city's boundary	
Off-Road	The data from manufacturing and sales sources need to be further investigated in terms of differentiating off-road and mobile unit consumption.	Sale data for CNG and LPG could be obtained from the manufacturing sources.
Waste		
Solid Waste Disposal	No particular challenges as the municipality has a system to record such data.	Weighbridge records at landfill.
Biological Treatment of Waste	This data should be similar to data gathered for municipal-level GHG inventory data. There are no agricultural	Community-based composting was estimated.

	sites which may conduct	Records of biological treatment of waste conducted at the municipality landfill
Incineration and Open Burning	Lack of information on cremation activities (if relevant).	Incineration of waste is not conducted within municipality boundaries, except for incineration of human bodies (cremation) which is conducted in templates. This may need to be investigated further.
Wastewater Treatment and discharge	None in particular beyond data quality issues.	Estimated from the amount of treated water supplied to the city.
Industrial Processes and Product Use	None in particular. Not relevant to Phitsanulok Municipality	See left.
Agriculture, Forestry and Land Use	The data from interview still needs to be verified and checked against empirical evidence.	Fertiliser use within the city was estimated by surveying sales at small shops targeted at non-industrial and non-commercial users.
Other Indirect Emissions	The data from interview still needs to be verified and checked against empirical evidence.	Refrigerant and paper use within the city was estimated by surveying sales at shops.

3.4 Practical Perspectives on Applying Global Standards/Frameworks and Capacity Building for MRV and Local-level GHG Accounting

In an ideal scenario, local governments would be able to read and initiate data collection for GHG inventory based on the guidelines developed by international and national agencies. However, this is very unlikely to happen due to the lack of practical incentives (regulatory and otherwise) for local governments to invest such efforts.

As mentioned earlier, data collection and technical capacity of local governments are weak in general, and this is compounded by the fact of the language barrier in many developing Asian countries. Hence, it is viable for national governments who wish to promote the development of municipal and city-level GHG inventories to translate international guidelines into local languages and to develop training materials suitable for the national context as demonstrated by TGO in the case of Thailand.

In terms of municipal-level GHG inventory, one key observation from this project is that data collection forms prescribed by both international agencies and national agencies **request the summative data (total amount for the entire municipality operations, or the entire city). It leaves the question of how to collect scattered and fragmented subsidiary data to the municipality, which is actually the most challenge part of the process.** Unless there is guidance and support from a 3rd party and high motivation, it is unlikely that a municipality, especially one with limited capacity and experience on GHG accounting, will have sufficient capacity to establish a systematic and sustainable process to collect such data on a regular basis. In the case of Phitsanulok Municipality, IGES suggested the approach of breaking down the data collection duties to each building for the municipal-level GHG inventory using an excel form, which was then adopted and innovated upon by hihgly motivated working-level staff into an online form via the Online Energy Reporting System.

In terms of city-level GHG inventory, what is evident from the case of Phitsanulok Municipality is that **much of the data required are not directly accessible for two main reasons:** (i**) such data collection duties are not formally assigned and instituted at the working level**, even if the management appreciates and wishes to possess such data; (ii) the **data that is readily available are at higher-level boundaries (e.g. provincial level) or private sector** (such as for the data on fuel consumption in the transport sector). Obtaining such data, especially on a regular basis as expected in developing an annual GHG Inventory, **requires considerable efforts to 'open up' and maintain the channels of data provision.** Furthermore**, significant expertise or system capacity (i.e. database systems used by PEA, as an example) is also required to derive such higher-order data to lower-level data within the municipal's geo-physical boundary of administration**. Such expertise is lacking not only within the local government, but may also be lacking within other relevant agencies who collect or manage such data.

4.0 Conclusions

There are not many local governments in the world who have attempted to develop municipal and city-level GHG Inventory. This project allows an in-depth view of the actual process and challenges involved in the capacity building and data collection, in the context of a Thai municipality with limited experience but with high a level of motivation and considerable strong experience in international cooperation. The outcomes and findings suggest the following:

Capacity development of local governments on MRV and climate change

- In Thailand, basic knowledge and awareness about climate change among local government officers is quite high, but capacity for systematic data collection, as well as for basic project management (essential for sustaining the process of developing and maintaining a city-level GHG inventory and MRV of mitigation projects based in cities) is weak.
- Cross-department collaboration is also a related challenge. Existing institutional structures within local governments do not support cross-departmental data collection, so a new working group which is backed by a strong internal coordinator withy high-level leadership is necessary.
    - **The real challenge is to institute a sustained and systematic process. Training all municipality staff is important, but the cross-department 'champion' and the coordinating person(s) need to be the target of capacity building efforts.**
- Besides that, in reality there are no concrete incentives or mandate for local governments to undertake MRV actions or establish either a municipal- or a city-level GHG inventory. So, the **framing of co-benefits to the municipality itself, as well as to the local environment, economy and society is important.** Benefits that could appeal to the municipality include:
    - **Creating a more robust and modernized routine data management system** to facilitate better local development planning and policy-making for sustainable development. This is desirable in the interest of better organizational performance;
    - The **reputational benefits** for the local government to be involved in a global and emerging issue can also be appealed to (being a 'progressive' city with international reputation and projects). This may attract further attention from various international organisations who may provide resources to help develop the city.
    - Increase **'readiness' to comply with eventual directives from the central government** when national policy on climate change is fully enforced, especially legally, following the lead of developed countries. For example, it is most likely that central government will mandate all local governments to report energy and electricity consumption regularly and to formulate low-carbon city development. **This 'readiness' may also extend to 'readiness' to avail of centrally-provided opportunities of assistance to the municipality, such as subsidies, technical assistance and pilot project implementation.**
    - However, it must be noted that **relevant central and provincial agencies, such as PEA and provincial authorities, should also be capacitated along with local government staff on the required data collection needs, and to make enhancements to their existing data management systems to cope with these needs.**
- In general, it was also observed that **there was limited knowledge of policies and technical assistance programmes offered by national government through current policies related to climate change and MRV**, such as on energy efficiency/conservation/renewable energy and buildings. This reflects a **weak vertical linkage of policy at the central level with the level of awareness ad implementation at the local level**, and suggests much more need to be done by the national government agencies.

Municipality and City-level GHG Inventory Development

- **Most of the key data for municipal-level GHG Inventory is already available in some forms and the collection process is already embedded within pre-existing organizational procedures** within the municipality, as prescribed by standards from the central government. **The challenge is to create and maintain systematic/routine approach to compile all these data, and this needs to consider the existing organizational culture and working relationships within the municipality (a tailored approach is required).** The model

demonstrated in Phitsanulok Municipality may be a useful reference for other municipalities of a similar class and organisational characteristics (progressive-thinking and aspirational management with motivated working-level staff).

  - **This project's experience suggests that it may be possible to sustain and motivate data collection by decentralising the data collection process to individual departments/buildings with assigned focal points for each building/department.** An in-house online energy management system could be a good practice to support routine and cross-department data collection, as demonstrated in the case of Phitsanulok Municipality.

- **In contrast, (in the case of Thailand) most of the data required for city-level GHG Inventory are not easily available** - they need to be derived from higher-level, provincial-level data (top-down approach), or special requests need to be made to particular organisations for sampling (bottom-up approach) data. In the case of Phitsanulok Municipality, **special efforts need to be exerted by the municipality to open up new channels of data reporting** (e.g. requesting information about fuel sales from the private sector, sampling data from households and commercial buildings). Motivated high-level and working-level staff are essential for this.
  - **Calculating citywide transport-related emissions may require the support of a 3rd party expert,** as the guidelines provided by the GPC is extremely complicated. Most municipalities in developing nations are unlikely to possess such capacity, even at the central government level.
- **It is pragmatic to divide the inventory development into two stages, and the case of Phitsanulok Municipality suggests the two stages can be eventually implemented in parallel:**
  - Stage 1 for developing municipality-level GHG Inventory (covering emissions from municipality operations), which helps to nurture basic capacity on data collection towards Stage 2.
  - Stage 2 for developing city-level GHG inventory (covering emissions which are emitted within the geo-political administrative boundary of the local government).

Practicality and Usability of Global Standards for GHG inventory

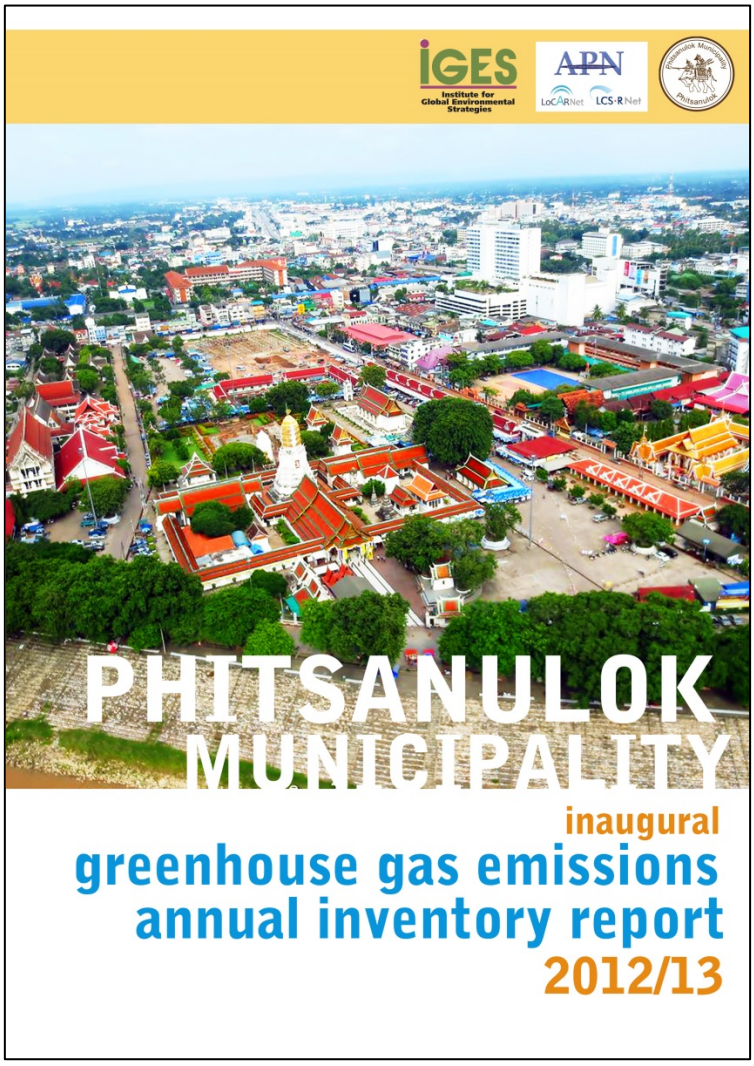
- Due to weak capacity (including English language capacity) and lack of incentives, it is **not likely that medium and small local governments (in developing countries where English is not native) are able to develop municipal or city-level GHG inventory merely by independently reading the guidelines issued by national and international organisations**,
  - International organisations and national agencies like TGO may address this by **developing guidelines in local languages and simplify global standards to suit local capacity of local government** in order to encourage more local governments to consider developing GHG inventories.
  - Considering the constraints, **it may be more practical and more meaningful to aim for comparability at the country level rather than at the global level**.
    - National agencies and supporting organisations may need to **develop more detailed guidance on decentralised/micro-level data reporting forms** (building/department level)**, as well as on data surveying/sampling methodology** to supplement the overall data reporting form as prescribed by GPC guidelines.
  - **More detailed guidance or in-depth technical support on methodology** than what is provided in the current GPC guidelines is needed to **enable accounting for citywide emissions in the transport sector.**

5.0 Future Directions

The overall future major direction of this project is to move towards Phitsanulok Municipality **being able to publish their annual GHG Inventory (both municipality-level and city-level) as a core element of a MRV 'model' framework (an inspiration and adaptable reference for other municipalities) for accounting GHG emissions and mitigation efforts at the local level.**

The annual publication should be used a informational and fund-raising tool to attract further technical support from APN and other supporting organisations for implementing pilot projects (for example, MRV in schools/colleges/universities, bicycle rental schemes, green building – see **Appendix F** for the Phitsanulok Municipality's future plans) and policies in Phitsanulok Municipality that actually contribute towards actual mitigation of GHG emissions, as well as improving the well-being of citizens in a sustainable manner.

The inaugural publication will be developed through this project and is planned for completion by 23 July 2014, and the draft publication cover is shown below.



In order to achieve the overall future direction, the specific future actions are as follows:

- Improve the quality (especially the **completeness and accuracy**) of data for municipality-wide and city-level GHG Inventory towards enabling Phitsanulok Municipality.
- Related to the above, improve the usability and functions of the pilot **in-house Online**

Energy Reporting System developed during this project, so that it can be expanded to a comprehensive online GHG Inventory database (covering data for all GHG emission sources) and be **replicated to other municipalities**.

- Strengthen the capacity of the established **Working Group on Low Carbon City** within the municipality, especially policymakeers, working-level coordinators and IT department, to be capable of utilising collected data for designing and implementing effective low-carbon city pilot policies and projects.

Appendices

A. Baseline information about National Climate Change Policy in Thailand and City Management in Phitsanulok Municipality
B. Summary of Results – Survey on Phitsanulok Municipality Staff's Attitude and Perception of Climate Change
C. List of Municipality Buildings
D. Summary of Inception Workshop (Presentations will be included in CD-ROM)
E. Summary of Mid-term Workshop and Presentations (Presentations will be included in CD-ROM)
F. Summary of Project Completion Workshop and Presentations (Presentations will be included in CD-ROM)
G. Preliminary Data Relevant to City-level GHG Inventory Collected as of 24 June 2013

APPENDIX A

A) Climate Change Policy and MRV in Thailand

National Climate Change Policy

The Thai national government has established national institutional and policy frameworks to address climate change. The **National Climate Change Committee**, with the assistance of various partners, has formulated a **National Strategic Plan on Climate Change** (2008 – 2012), while a longer-term, 40-year National Climate Change Master Plan (2013 – 2050) has undergone the final rounds of public consultation in 2012 and is in the process of being endorsed by the Thai Cabinet. [1] The 11th National Economic and Social Development Plan (2012 – 2016) places greater emphasis on economic stability and development of resilience to external factors. It also places the transiation towards a 'low carbon and climate resilient society' as one of the six key development strategies.

So far, Thailand has yet to adopt any national reduction targets or NAMA, but has adopted several **sector-based/sub-national targets**. These include:

- Climate Change Mitigation Plan for Agriculture and an Energy Resolution Strategy;
- Energy Conservation Plan (2008 – 2011), which included targets for industry and transport and equipment and appliance standards;
- National Alternative Energy Development Plan (2008 – 2022), which aims to increase the share of alternative energy to 20% of total energy consumption by 2022 compared to 2007.

Sub-national and Local Actions

The national-level frameworks have helped to promote various initiatives at the sub-national level. For example:

The Bangkok Metropolitan Adminsitration (BMA) is among the earliest Thai local authorities that has adoptd a city-level climate change action plan and targets related to climate change. BMA's Action Plan on Global Warming Mitigation (2007-2012) aimed at reducing GHG emission by at least 15% under business as usual projections in 2012. BMA is now developing a comprehensive long term master plan, while considering the lessons learnt from the previous Action Plan to ensure effective implementation and sustainability. The Master Plan will include 5 important components, namely: (i) environmentally sustainable transport, (ii) energy efficiency and alternative energy, (iii) efficient solid waste management and wastewater treatment, (iv) green urban planning, and (v) adaptation planning.

[1] http://www.undp.org/content/thailand/en/home/presscenter/articles/2012/08/10/thailand-s-climate-change-master-plan-nears-completion/

The Provinces of Nan and Rayong were selected as pilot project sites during the development of the National Climate Change Master Plan, while the Municipality of Nan and MuangKlaeng were the pilot agencies.

The project 'Low Carbon Municipalities in Celebration of His Majesty's 84th Birthday', implemented by the National Municipality League of Thailand, has developed the Thai 'Low Carbon City Framework' which promotes the four strategies: City of Trees, City of Waste Minimization, City of Energy Efficiency and City of Sustainable Consumption and Produciton. These strategies not only aim at in lowering carbon emissions but also at improving the quality of life in cities. The project has helped to engage some 168 Thai municipalities in pilot projects.

The Thailand Greenhouse Gas Management Organization (The Designated National Authority) has been conducting capacity building for local authorities as well as developing guidelines and tools through its 'Promotion of Carbon Footprint Measurement for Local Governments Programme' since 2011. The programme was expanded in partnership with the National Municipality League in 2013 to systematically apply GHG calculation methodologies in 19 pilot municipalities and to nurture a pool of voluntary trainers to help sustain capacity building beyond the project.

B) City Management in Phitsanulok Municipality

Overall City Background

Phitsanulok City, administrated by the Phitsanulok Municipality, is the **capital of Phitsanulok Province** and has a strategic location in lower northern Thailand. Established more than 600 years ago, Phitsanulok was a provincial centre for the Kingdom of Angkor, briefly the capital of Thailand and well known as the birthplace of King Naresuan, who conquered Burmese rulers.

The hierarchy of geographical administrative units in Thailand follows the order of **province** (*changwat*), **districts** (*mueang*), **tambon** (*sub-district*) and **villages** (*muban*). In each province, there is one capital district (*Mueang*).

There are 9 districts in Phitsanulok Province, and the capital district (*Mueang Phitsanulok*) is further sub-divided into 19 sub-districts. Phitsanulok Municipality administrates one of the sub-district units within the capital district, called '**Tambon Nai Mueang'.** It is classified as a 'city municipality' (*thesaban nakhon*), which applies to municipalities with a population of at least 50,000 and a population density of 3,000 persons per square kilometer (DEQP, 2013).[2]

Covering a total land area of **18.26km^2,** the city has a total registered population of 72,233 (32,459 households), while the **total population including unregistered citizens is estimated at 100,000 – 120,000 persons**.

According to the National Government Organisation Act, BE 2534 (1991), the administrative services of the executive branch are divided into three levels, that is, central, provincial and local. The provincial government consists of provinces. Currently, there are 7X provinces.

The main economic sectors of Phitsanulok City are services and tourism. Sitting at the intersection of several major highways linked between Northern, Northeastern and Central region of Thailand, the city is **key transit point in Thailand** and to neighbouring countries, such as Laos and Myanmar. It is also **a distribution and trading hub for surrounding agricultural districts such as Petchabun**. The city is also the base of five to six major recycling trading companies, notably, Wongpanit Corporation which operates one of South East Asia's largest transboundary recycling business.

[2] There are three classes of municipalities in Thailand:
- A city municipality (*thesabannakhon*)
- A town municipality (*thesabanmuang*) with a population of at least 10,000 and a population density of 3,000 persons per square kilometer
- A township or sub-district municipality (*thesabantambon*) with a population of at least 7,000 and a population density of 1,500 persons per square kilometre, a gross income of at least 1 million baht, and the consensus of the people in the area to be recognised as such.

Phitsanulok's climate is **tropical, with a distinct dry and rainy season**. Geographically, Phitsanulok is situated at the juncture of the Nan and Yom River, and terrain is generally flat. The Nan River – one of Thailand's four major rivers – is the city's primary source of drinking water, and divides the city into the East and West section. The city is susceptible to flooding during the annual rainy season. In the 2011 Thailand Great Flood, the water level reached nearly 11 metres. On the other hand, the city experiences water stress during the dry season.

Phitsanulok is home to Naresuan University and Pibulsongkram Rajabhat University, as well as to a major Royal Thai Army base. There are 6 hospitals and a significant number of healthcare facilities.

Municipality Management

The municipality's vision is for Phitsanulok to become a **'City of Beautiful Landscape and Cheerful People',** based on the following strategies, according to the Phitsanulok Municipality Annual Report 2011:

- Expanding its environmental management system, geographical information system and traffic management system;
- Upgrading public service and healthy security;
- Expanding learning places and upgrading the quality, innovation and intellectual property
- Promoting and conserving arts, culture, tradition to raise proper consciousness according to the King's Sufficiency Economy Philosophy;
- Expanding social capital development, job creation, welfare and community building;
- Developing best quality public management according to good governance principle.

Municipality Budget FY2012 and 2013

Description	FY2012	FY2013
Income collected by the Municipality		
Taxes	54,655,902.02	63,027,633.13
Fee, fine, permits	22,482,823.30	20,874,953.32
Income from property	14,866,379.42	16,784,829.78
Income from facilities and enterprises	8,594,443.44	9,431,955.66
Misc.	4,263,709.00	3,278,570.00
Income from other sources	899,395.00	63,765.00
Total 1	**105,762,652.18**	**113,461,706.89**
Income from central government		
Tax allocated from government	248,986,326.34	287,848,476.74
Total 2	**248,986,326.34**	**287,848,476.74**
Subsidies by central government		
General subsidies	78,271,613.00	202,284,355.55
Total 3	**78,271,613.00**	**202,284,355.55**
Total 1+2+3	**433,020,591.52**	**603,594,539.18**
Other income		
Loan	59,184,643.44	
Ad hoc subsidy	181,234,692.00	115,800,061.22
Total 4	**240,419,335.44**	**115,800,061.22**
Total 1+2+3+4	**673,439,926.96**	**719,394,600.40**

Source: Phitsanulok Municipality (2014)

Air Quality Management

Environmental quality management is task of Public Health and Environment Bureau and the Public Works Bureau. As Factory type 1 and 2 have been decentralized from the Ministry of Industry to local authority, site inspections are conducted as part of the procedures for obtaining the factory/building permit and repeated when they renew the permit. Throughout the year, local government staff may conduct inspections if any complaint are filed. The aspects of monitoring includes horsepower, sanitation, air circulation and general safety measures.

In a serious cases of pollution, the municipal staff will contact the Provincial Industry Office for assistance. For air quality monitoring, the municipality does not own and operate any special technical equipment.

Solid Waste Management (SWM)

The municipality operates the **waste collection services for residential and commercial waste for the East (of Nan River)** side, while services for the **East side has been contracted to a private company** (contractring on an annual basis since 2005) as a measure for benchmarking performance.

There is **one transfer station** located within the city, which brings compacted waste to the landfill located in a neighbouring sub-district (**BuengKok Landfill**). Opened in 1999, the one-hectare landfill is currently undergoing rehabilitation and upgrading under a private-public partnership arrangement for incorporating **Material Biological Treatment (MBT) facilities**. The facility was planned to treat and stabilise deposited waste to produce the following outputs**: i) compost; ii) landfill daily cover iii) feedstock for production of Refused-Derived Fuels (RDF)** for a cement company and the Provincial Electricity Authority.

In the mechanical process, recyclable materials as well as large-sized of materials are removed (car battery, tire, etc. which have potential to damage a machine in next stage). Sorting is done both manually and by machine. As wastes are always contained in plastic bags, the Homogenizer machine has been designed with many teeth to tear off plastic bags.

Waste after homogenizing is placed into piles onto branched wooden pallet layers, like compost making. Perforate - corrugated tubes and special punched plastic pipes are placed throughout the waste pile for air circulation based on the passive aerated static method. The finished waste pile is then covered with a layer of 'biofilter' which can be coconut sheet or any local brown material left from field in the area so as to protect bad odor and avoid waste from animal.

It takes about 9 months to achieve completion of the stabilization process, where the organic matter is completely digested and about 20% of the original volume remains. The resulting outputs from MBT is screened by size with an air blowing machine according to 3 sizes: (i) large-size, high calorific plastic segment which can be processed into Refuse Derived Fuel (RDF); (ii) as biomass fuel for gasification, a process to transform waste as biomass fuel to power; and (iii) inert, compost-like substance for landfill cover.

Phitsanulok Municipality has made an agreement with Siam Cement Group (SCG), a Thai Cement company, for an experimental RDF plant at the landfill and to accept the RDF segment as fossil fuel substitute for cement located in Saraburi or Lampang Province. The plant is still at an experimental phase where the thermal calorific value and moisture content of RDF are being monitored. It has been agreed that SCG will accept and pay for all RDF with 5000 Kcal/kg thermal calorific value. However, the actual thermal calorific value of RDF segment has not been consistently at the desired calorific value level.

Hazardous wastes, such as infectious wastes from hospitals and clinics, require separate collection and treatment. Phitsanulok Municipality has specified 89 spots as drop off points for specified 4 categories of hazardous waste in communities, educational institution and business places.

There are also 61 spots in 5 shopping centers as drop off for mobile phone batteries.

- 15 spots at Topland Arcade
- 2 spots at Topland Plaza
- 4 spots at Makro
- 35 spots at BigC
- 5 spots at Pathumthong

Hazardous waste is collected from the drop off spots by a special truck and transferred to storage rooms at the transfer station of Phitsanulok municipality. The wastes is then handled by a private company by Better World Green Co.,Ltd. which is recommended by the Pollution Control Department, Ministry of Natural Resources and the Environment.

The municipality has a small-scale incinerator which has temporarily suspended operations due to challenges in cost recovery in operations. Hence, infectious waste, generated in hospitals and clinics, is collected at present by a private company and delivered to an incineration plant in Ayudhaya Province.

Table 1: Recent solid waste management figures in Phitsanulok Municipality

Average Daily Landfilled Waste	100t
Daily Landfilled waste (Phitsanulok Municipality only)	74t
Average treatment costs (without MBT)	THB 2,000/t (about USD67)*
Average treatment costs (without MBT, projected)	THB 7,000/t (USD230)
Average collection cost	THB 700/t (about USD23)
Cost recovery rate	20%
Landfill charge	THB385/t (about USD13)
Transfer station charge	THB100/t (about USD3)

* at an exchange rate of USD1:THB30

Source: Phitsanulok Municipality (2013)

Phitsanulok Municipality is well-known in Thailand and in the region for its innovative and successful approaches to urban environment management, particularly solid waste management.

The '**Phitsanulok Model' of community-based waste management,** which emphasizes the people's participation, was developed from 1999 – 2007 with GIZ's assistance (formerly GTZ). The model has been adopted by the national government (Department of Environmental Quality Promotion (DEQP)) for national replication under the Local Agenda 21 programme. From 1996 - 2012, waste generation was reduced by around 47% (142t to 74t per day; 1.8kg 0.96kg daily per capita).

The municipality has garnered numerous national, regional and international awards (Table 2), and is recognised by ASEAN as a Model Environmentally Sustainable City.

Table 2: Awards won by Phitsanulok Municipality in Environmental Management (1998 – 2012)

Prizes Won	Period/Year	Details
First Prize, Energy Reduction Campaign Contest	1998	Awarded by the Department of Local Administration (DoLA) and the National Municipality League of Thailand (NMLT)
First Prize PCD Award for Solid Waste Management 2000	2000	Awarded by Pollution Control Department (PCD), Ministry of Science and Environment
H.M. the King's Golden Pin and Symbolic Plaque	1997-2002	For a reforestation Programme at the city's former landfill, to honor the 50th Anniversary of the King's Ascension to the Throne.
First Prize cleanliness Contest	2002	Awarded by NMLTandDoLA.
PCD Awards 2002 for local Administration Organization with Efficient Solid Waste Management	2002	Awarded by PCD, Ministry of Science and Environment
Dubai International Awards, Best Practice Certificate for Community-Base Solid Waste Management(CBM)	2006	Awarded by the Dubai Municipality, Dubai-United Arab Emirates and the United Nations Human Settlements Programme (UN-HABITAT).
Local Administration Organization with Outstanding Environment Management Award	2007	Awarded by the Institute of Research and Consultation, Thammasat University under the sponsorship from Health Promotion Fund and National Public Health Foundation
Honorary plaque for supporting outstanding performances by two local communities (Srasonghong, Baromtilokanart 21 and DeeinPattana) which won awards under the national Zero Waste Management Contest	2009 - 2012	Awarded by the Department of Environmental Quality Promotion (DEQP), Ministry of Natural Resources and Environment (MONRE). Srasonghon Community won First Prize with Trophy given by Crown Princess Sirinthon. Baromtrilokanart 21 Community won a runner-up prize with an honorary plaque.
Honorary plaque for passing all of six categories of efficiency evaluations for solid waste management	2009 - 2011	Awarded by PCD, Ministry of Science and Environment
ASEAN Environmentally Sustainable Cities Awards - Certificate of Recognition, Clean Land (small city category)	2011	Awarded by ASEAN

Residential communities in Phitsanulok are categorised in three sizes: large (> 300 households), medium (100 – 300 households) and small (< 100 households). Through the

Phitsanulok community-based SWM approach, 5 out of the 58 communities within the city have community-based composting centres.

Some of these centres also act as deposit centres for recyclables (plastics, paper, metals etc.). These are usually managed by the village committee and also accepts waste from outside their own community. Income from the sales of recyclables are used for social welfare activities. For example, in Srasonghong community, the income is managed as a community fund and used for financial contributions to community members' funerals and newborns. Proceeds have also been used to purchase a banana drying equipment to produce dried bananas, which further generates income for the community funds.

Table 3: Local Communities Active in 3Rs

Community	Category size	No. of Composting Centres
DieenPattana	Large	4
ChanwachakitPattana	Large	4
BorommatriLokanard 21	Medium	2
NongBua	Medium	4
Srasonghong	Small	1

Organic and food waste from markets is informally sold as animal feed, estimated at about 324t per day. The city is planning to implement a pilot project to expand composting for food wastes from hotels and markets.

A **demonstration-scale biogas facility** is located at the municipal slaughterhouse, which processes about 240 pigs per day. About 200m^3 of biogas is generated per day to substitute 50kg of LPG, which amounts to a saving of THB300,000 (about USD10,000)per year.

The municipality is also implementing a project to **recycle waste cooking oil into biodiesel** in cooperation with the Royal Air Force and PTT Group. The production capacity is 2000litres per month. The waste oil is collected from households and restaurants within the municipality.

Water Supply

The Wat Po water treatment plant was built with a World Bank loan in 1999. The plant sources from the Nan River. It has a capacity of 21,295,014m^3 per day, and supplies water to the entire city as well as neighbouring districts. The non-revenue water rate is estimated at 30 - 40%. The plant's capacity to serve an ever increasing population and rising water demand is straining the plant's provision capacity.

Wastewater Treatment/Sanitation

Wastewater treatment is under the purview of the provincial and central government (Ministry of Interior, Department of Public Works and Town Planning). A project to build a centralized

wastewater treatment facility about 20km away from the city around 1997 was discontinued due to unfeasibly high operation costs to operate the pumps.

There is no waste treatment facility in the city, except at the waste transfer station and landfill, hence all wastewater runs into the Nan River and collection ponds. Under local regulations, all buildings must be fitted with septic tanks, which are maintained by owners and de-sludged by the private sector.

Transport

The main modes of transport in Phitsanulok Municipality comprise **roads, water and train**. There are 317,700 cars and 19,276 registered in the province. Traffic congestion at peak hours is becoming an issue and a significant source of air pollution within the city. On-road traffic is regulated and enforced by the police while the municipality has jurisdiction over the pedestrian and walkways.

The **normal train** operated by the State Railway Authority passes through the city from Bangkok to ChiengRai, runs 35 trips per day, with a length of 4.65km within the city boundary.

Public transport in the city consists of **public buses, jeepneys, water vehicles (limited) and about 50 taxis** mainly serving the airport. The public transport is not comprehensive, so **most people prefer to use private vehicles.**

The construction of three bridges across River Nan has significantly reduced the demand for water transport. In former time there were peers to facilitate people in crossing the Nan River.

The **length of river within city boundary is 8.93km**. Two types of boat are used: (i) municipality boat serviced for cremation scattering ashes over water, 2 trips a day (400 horsepower, 10 days per year, 200litres fuel consumed per year); and (ii) private boats (30 small fishing boats (40 horsepower, 5litres per day per boat); 3 tour boats (one with 200 horsepower and other two with 270 horsepower, each consumes 60ltres diesel per day).

The **airport of Phitsanulok** is located at Aranyik Subdistrict, Muang District, Phitsanulok at LAT 16 46 58.56111, LONG 100 16 44.84842, ELEV 44.2129 M. The total space for passengers is 16,406 m^2 (sufficient for 8,000 passengers per day). Its runway is 137.5 x 300m, capable of receiving 24 flights per day. The total airport area is 1,380 rais.

Table 4:
Summary of Projects/Initiatives by Phitsanlok Municipality that might contribute it towards being a low-carbon city

Sector	Policies/Actions
Energy – Buildings	• The municipality aims to reduce electricity consumption of municipal buildings by 10% (This is just a general directive from the central government with no stringent enforcement or detailed guidance). • Electricity conservation campaign at pilot community (DieenPattana) with the support of Toyota (2012 – 2013)
Energy – Transport	• Bicycle sharing and promotion campaign at pilot communities (DieenPattana and Srasonghong) • Electric tram system (conducting feasibility study) • Biodiesel production for agricultural sector and in municipal vehicles. About 2,000 litres of used cooking oil is collected every month from 6 markets and about 10% of restaurants in the city. • Substituting petrol with NGV for waste collection trucks, water trucks and municipal vehicles.
SWM	• Waste-to-energy (RDF) at the landfill • Centralised composting at landfill • Biogas at municipal slaughterhouse • Community-based and centralized composting (MBT at landfill site) • Promotion of waste segregation at source and community-based composting
Urban Greenery	• Public park development (a new development is Chom Nam Memorial Park by the Nan riverbank) • Afforestation at former landfill site • Promotion of tree planting throughout the city

Phitsanulok APN/MRV Low Carbon City
Inception Workshop
Survey

Your Gender: □ Male (37.8%, 14 replies)
□ Female (54.1%, 20 replies)
Blank (8.1%, 3 replies)

Division/Bureau: _____

Please describe your level of knowledge about 'climate change'

□ I think I know a lot about climate change and feel confident to share with my friends. (10.8%, 4 replies)
□ I know some things about climate change, but not deeply. (35.1%, 13 replies)
□ 'Climate change' is just a keyword I heard from media and friends, I don't know much. (21.6%, 8 replies)
□ I have never heard of 'climate change' before joining this workshop.

Blank (32.4%, 12 replies)

Instructions: Please answer the questions below by ticking ONLY ONE of the boxes

1) In your opinion, how serious a problem is climate change?
□ Very Serious (64.9%, 24 replies)
□ Somewhat serious (35.1%, 13 replies)
□ Not too serious □ Not a problem □ Don't know

2) Do you agree that dealing with the problem of climate change should be given priority even if it causes slower economic growth and some loss of jobs?
□ Agree strongly (62.2%, 23 replies)
□ Agree somewhat (37.8%, 14 replies)
□ Disagree somewhat
□ Disagree strongly
□ Don't know

3) In your opinion when will climate change harm people substantially?
□ Now (78.3.8%, 29 replies)
□ 10 years (10.8%, 4 replies)
□ 25 years (5.4%, 2 replies)
□ 50 years (5.4%, 2 replies)
□ 100 years
□ Never

4) If climate change is left unchecked worldwide, how much do you think climate change will affect each of the following matters in your city?

a) Likelihood of natural disasters
- A lot/Some (100.0%, 37 replies)
- None at all/Not very much
- Don't know

b) Rainfall and available water
- A lot/Some (97.3%, 36 replies)
- None at all/Not very much (2.7%, 1 reply)
- Don't know

c) Types of plants and animals that live here
- A lot/Some (94.6%, 36 replies)
- None at all/Not very much (5.4%, 2 replies)
- Don't know

d) Price of food and other essential goods
- A lot/Some (97.3%, 36 replies)
- None at all/Not very much
- Don't know (2.7%, 1 reply)

e) Types of food we produce
- A lot/Some (91.9%, 34 replies)
- None at all/Not very much (2.7%, 1 reply)
- Don't know (2.7%, 1 reply)

Blank (2.7%, 1 reply)

f) Our river system
- A lot/Some (94.6%, 36 replies)
- None at all/Not very much
- Don't know (2.7%, 1 reply)

g) People's need to move their homes
- A lot/Some (81.1%, 30 replies)
- None at all/Not very much (16.2%, 6 replies)
- Don't know (2.7%, 1 reply)

5) In your opinion, what do scientists think about climate change?
- Most think the problem is urgent and enough is known for action (75.7%, 28 replies)
- Views are pretty evenly divided (16.2%, 6 replies)
- Most think the problem is not urgent and not enough is known for action (5.4%, 2 replies)
- Don't know / none of the above (2.7%, 1 reply)

6) If our country does not do things differently in the future, do you think that the amount of greenhouse gases that we produce will:
- Increase (94.6%, 35 replies)
- Stay the same

 Decrease
 Don't know
Blank (5.4%, 2 replies)

7) Thinking about the different impacts on wealthy and poor countries, do you think that climate change will be

 More harmful to wealthy countries (10.8%, 4 replies)
 About equally harmful (53.1%, 20 replies)
 Both affected differently (24.3%, 9 replies)
 More harmful to poor countries (5.4%, 2 replies)
 Don't know
Blank (5.4%, 2 replies)

8) Do you think Phitsanulok Municipality has a responsibility to take steps to deal with climate change?

 Yes (89.2%, 33 replies)
 No (2.7%, 1 reply)
 Don't know / Not sure (5.4%, 2 replies)
Blank (2.7%, 1 reply)

9) How do you rate the level of efforts by Phitsanulok Municipality for dealing with the problem of climate change?

 Not enough (64.9%, 24 replies)
 Right amount (27.0%, 10 replies)
 Too much
 Don't know (5.4%, 2 replies)
Blank (2.7%, 1 reply)

10) Do you think that if Phitsanulok Municipality takes steps to deal with the problem of climate change, other Municipalities will be more willing to do the same?

 Yes (51.4%, 19 replies)
 No (2.7%, 1 reply)
 Maybe / not sure (40.5.7%, 15 replies)
Blank (5.4%, 2 replies)

11) Should local governments be willing to commit to limiting its greenhouse gas emissions as part of international agreements?

 Yes (78.4.%, 29 replies)
 No (2.7%, 1 reply)
 Don't know / not sure (16.2%, 6 replies)
Blank (2.7%, 1 reply)

12) If the international community does not come an international agreement to lower greenhouse gas emissions, do you think Phitsanulok Municipality would have a responsibility to take steps against climate change?

 Yes (75.7%, 28 replies)
 No (2.7%, 1 reply)
 Don't know / not sure (18.9%, 7 replies)
Blank (2.7%, 1 reply)

13) Do you think it will be necessary to increase the cost of energy, to encourage individuals and businesses to conserve energy more or to use alternative forms of energy?

- Yes (37.8%, 14 replies)
- No (40..5%, 15 replies)
- Don't know / not sure (18.9%, 7 replies)

Blank (2.7%, 1 reply)

14) Would you be willing to pay (i) 0.5% or (ii) 1% of your monthly income for more 'green' energy and other products as part of taking steps against climate change?

- 0.5% of monthly income (51.4%, 19 replies)
- 1% of monthly income (24.3%, 9 replies)
- Not willing (2.7%, 1 reply)
- Don't know / not sure (21.6%, 8 replies)

15) Looking at the following categories, are you agreeable if Phitsanulok Municipality takes each of the following steps to help deal with climate change?

a) Preserving or expanding green and forest areas

- Strongly agree (62.2%, 23 replies)
- Agree (35.1%, 13 replies)
- Neutral/Not sure
- Disagree
- Strongly disagree

Blank (2.7%, 1 reply

b) Increasing the use of renewable energy (solar power, biogas, biofuels etc.)

- Strongly agree (62.2%, 23 replies)
- Agree (32.4%, 12 replies)
- Neutral/Not sure (2.7%, 1 reply)
- Disagree
- Strongly disagree

Blank (2.7%, 1 reply)

c) Improving the access and quality of public transport (bus) to reduce use of private vehicles (cars)

- Strongly agree (67.6%, 25 replies)
- Agree (18.9%, 7 replies)
- Neutral/Not sure (13.5%, 5 replies)
- Disagree
- Strongly disagree

16) Do you think that Phitsanulok Municipality should help other Thai municipalities and local governments in other countries to help deal with climate change?

- Yes (62.2%, 23 replies)
- No (5.4%, 2 replies)
- Don't know / not sure (29.7%, 11 replies)

Blank (2.7%, 1 reply)

THANK YOU FOR YOUR COOPERATION! ☺

- end of survey -

APPENDIX C

List of Building and Facilities Under Phitsanulok Municipality				
No.	Buildings & Facilities	Estimated Septic Tank Volume (m^3)	Total Area (m^2)	Number of Staff
A. Bureau of Pubilc Health and Environment				
1	Market 1	12	4,150	120
2	Market 2	8	3,577	44
3	Market 3	48	3,615	119
4	Market 4	16	5,000	253
5	Market 5	4	4,658	211
6	Market 6	12	4,255	429
7	municiple slaughterhouse	128	16,800	35
8	Pracha-utit Health Center	12	365	20
9	Animal Hospital rabies Center	2	40	3
10	Night plaza	8	4,430	340
11	Food Market	8	1,200	11
12	Panpee Health Center	2	240	12
13	Praongkhaw Health Center	8	281	11
14	Mahanupap Health Center	12	437	10
15	Parking lot	3		100
16	Pet Shelter	1		6
17	Massage Center	1	180	14
18	Fitness Center	4	435	3
B. Bureau of Public Works				
1	Transferlation	8	96,000	8
2	Landfill	15	368,000	15
3	Sewage disposal station	156	3,200	2

4	Traffic Lights			
5	Street lights			
6	Mechanical maintenance center	5	3,200	18
7	Section of Public Utilities	5	1,938	97
8	Nan river Public park 1		22,000	10
9	Nan river Public park 2		22,000	10
10	Nan river Public park 3		7,500	10
11	Chaloem Phrakiat Public Park		240,000	20
C. Bureau of Finance				
No.	Buildings & Facilities	Estimated Septic Tank Volume (m3)	Total Area	Number of Staff
D. Bureau of Education				
1	School 1		5,576	37
2	School 2		16,706	664
3	School 3		1,890	677
4	School 4	57	16,021	822
5	School 5	46	3,570	562
6	Basketball Court		1,232	35-50
7	Badminton Court		500	40
8	Football Court	4	8,819	50
9	Library		2,000	14
10	ICT Centre		2,202	8
11	Child Development Centre	24	3,200	11
E. Office of the Municipal Clerk				
1	Municipal Office Building	60	3,000	244
2	Civil Registration and Identification Card	16	330	18
3	Tourist Information Centre1	2	40	3
4	Tourist Information Centre2	2	60	3

5	Fire station2		240	16
6	Bus Terminal		6,000	8
7	Fire station1	15	1,611	46
8	Section of Safety and Security	2	150	35
F. Division of Water Supply				
1	Division of Water Supply	16	951	62
2	Pump station at Watpothiyan		11,210	3
3	(Water distribution station at Watmai		303,550	3
4	Subdivision of Production and service		2,482,920	39
G. Division of social Welfare				
1	Center of distribution and product community	1	128	30

APPENDIX D

Summary of Inception Workshop for Capacity Building on MRV in Phitsanulok Municipality

30th May 2013, Phitsanulok, Thailand

The Inception Workshop for the project "Capacity Building for Implementing a 'Measurable, Verifiable and Reportable (MRV)' Model in a Mid-Sized Thai Municipality" (funded by APN Low Carbon Initiatives (LCI) Programme) was jointly organised by IGES and Phitsanulok Municipality in Phitsanulok, Thailand on 30th May 2013. The project aims to build the Municipality's capacity in developing and implementing a MRV framework, particularly to: (i) set up and maintain a GHG emission inventory; (ii) design and implement effective low carbon city policies and projects, as well as account for potential and actual GHG reductions.

The workshop was attended by about 80 persons representing bureaus and divisions across the municipality. It began in the morning with welcome remarks by Mayor Boonsong Tantatee and Dr. Premrudee Champounood (former Mayor and current Advisor to the Mayor). They expressed Phitsanulok Municipality's strong support for the project and hope that it would build on the Municipality's previous environmental achievements in solid waste management. Subsequently, IGES researchers (Ms. Shom Teoh, Mr. Shiko Hayashi and Mr. Simon Gilby) each made presentations to introduce the basic concepts of MRV as well as best practices in Japan and the West.

In the afternoon, IGES researchers organised an informal session with the project working group members. An active discussion was held on how to collect baseline data in the areas of solid waste management, water supply and wastewater treatment, energy/electricity, transport, buildings and urban greenery.

Prior to the workshop, IGES researchers took the opportunity to conduct some field trips to further their understanding on Phitsanulok's environmental management. They visited the headquarters of Wongpanit Corporation (a prominent recycling business based in Thailand with increasing regional reach), two city parks, Srasonghong Zero Waste Community (a residential community with impressive achievements in reducing, reusing and recycling waste) and the Wing 46 Biodiesel production facility (a Royal Project implemented by the Thai military).

The staff were impressed by the dedication to the environment by all parts of Phitsanulok - the public sector represented by the municipal government and the military; the private sector represented by Wongpanit and the general public represented by Srasonghong. Engagement by all of society is a vital component of environmental work - Phitsanulok has strong foundations on which to build.

Wongpanit Materials Recycling Facility

Wing 46 Biodiesel Project

Inception Workshop Photo

ANNEX E – SUMMARY OF MID-TERM WORKSHOP

The Mid-term Workshop of the project was held from 25 – 26 November 2013, with the following **objectives:**

- To present the **outputs and progress** of the project;
- To identify **challenges and future steps for the achieving the final project goal** towards March 2014;
- To **increase Phitsanulok Municipality's knowledge and capacity** on MRV, particularly on collection and reporting of baseline data;
- To discuss and obtain **initial ideas on the activities beyond Year 1.**

Agenda

0830 – 0900	**Registration**
0900 – 0945	**Welcome Greetings**, Mr. Boonsong Tantanee, Mayor, Phitsanulok Municipality (10 min.) **Progress Sharing & Feedback**, Dr. Suthi Huntrakul, Deputy Mayor, Phitsanulok Municipality (15 min.) **Presentation** by IT Team (15 min.)
0945 – 1045	• **How to calculate GHG emissions using the data collected by working group and lessons learnt from other cities in the world** (Ms. Shom Teoh, Policy Researcher, IGES) • **Peer experience sharing** (Mr. Permpong Pumwiset, Head, Health & Environment, Nonthaburi Municipality) *With Q&A and discussion on the above*
	Coffee Break is served within the session during presentation/discussions
1045 – 1200	• **MRV for Bicycle scheme and sustainable transport – lessons from Japan** (Asst. Prof. Hiroki Nakamura, Kyushu University) • **Project method MRV** (Ms. Junko Akagi, Policy Researcher, IGES) *With Q&A and discussion (especially on challenges, solutions and the way forward)*
1200 - 1300	**Lunch Dialogue with Policymakers**
1330 - 1430	**Open Discussion with Working Group**

It was found that Phitsanulok takes this MRV project seriously and has been making significant progress on data collection for an inventory (baseline data). They also succeeded to develop a good database and internal collaboration system. This is definitely a good progress for sustainable and systematic data collection system.

City officers' main concerns were found to be how to judge whether the collected data are appropriate to use for the inventory. They also wanted to learn how those collected data are actually utilised for supporting the low carbon city development.

It was found that Nonthaburi City has been doing a follow-up of JICA MRV training by integrating their action plans presented at the training course.

Phitsanulok City plans to develop first draft GHG inventory by the end of this fiscal year. IGES will provide technical support upon request. Explore how Phitsanulok can develop data collection scheme for private sectors (companies, household).

Photos

The Nan River (flood occasionally)

Shared bicycles at a community (used by kids)

With head of the community

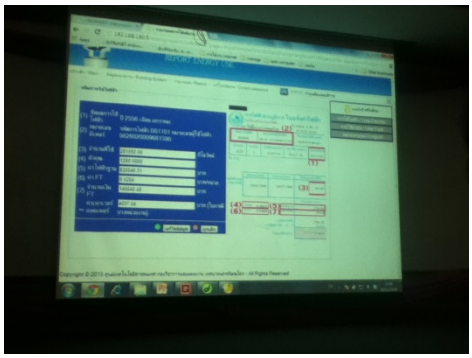
Water spray attached a bicycle (for kids)

Reception at Wongpanit

E-waste at Wongpanit

Phitsanulok mid-term workshop

Breakout group discussion



Database for energy use

Group photos at the end of the workshop

APPENDIX F – SUMMARY OF PROJECT COMPLETION WORKSHOP

1. "Capacity Building on MRV towards a Low Carbon Phitsanulok Municipality" Project Completion Workshop (19 June 2014)

- ✓ Shom Teoh, Pharot Tubkrai, Andreas Jaeger and Junko Akagi (IGES) and Prof. Atch (Chulalongkorn Univ.) attended the workshop as resource persons;
- ✓ There were about 40 people from various divisions of Phitsanulok municipality;
- ✓ The workshop was held
  - ✧ to present the final outputs and achievements of the project, including the draft calculations of GHG emissions of Phitsanulok Municipality for FY2012/13;
  - ✧ to conduct the Soft Launch of the "Inaugural Phitsanulok Municipality GHG Inventory 2012-2013";
  - ✧ to discuss the challenges and way forward beyond the project completion.
- ✓ Shom explained the overview of the APN MRV workshop and achievement made by the municipal government;
- ✓ Mr. Chavalit Jannamurol (Director, Planning and Technical Services Division) from Phitsanulok municipal government explained the data collection status;
  - ➢ <u>Municipal government level (complete)</u>
    - ✧ Electricity
    - ✧ Fuel consumption
  - ➢ <u>City-wide (not complete yet)</u>
    - ✧ Transportation (train, airplane)
    - ✧ Water
    - ✧ Waste
    - ✧ Fugitive emissions (F-gases)

  ➔ Baseline data of electricity and fuel consumption for mitigation measures is ready.
- ✓ Both Andreas and Prof. Atch are the experts on Green Building. Prof. Atch is the committee member of "Thai Green Building Institute". They shared the information on Green building in the world and specifically Thailand. Bangkok has several examples of Green building already;
- ✓ Akagi introduced the MRV menus in Japan. She stressed the importance of municipal governments to realize low-carbon city and congratulated Phitsanulok municipality for the success of setting up a sustainable data collection system in the government through the APN MRV Project;
- ✓ Municipality staff expressed considerable interests in green roofs and green walls.

Achievements:

- ✓ Development of online data collection and accounting database inside of the municipality
- ✓ Development of a sustainable data collection system inside of the municipality
- ✓ Accumulation of data for policy development
- ✓ Enhancement of the capacity of MRV among municipal staffs
- ✓ Deployment of MRV activities at a college in the city
- ✓ Supported the launch of rental bike (Pun Pun Phitsanulok) in the city
- ✓ Knowledge sharing of the concept of Green Building
- ✓ Baseline data was collected for mitigation measures (e.g., retrofitting lighting system, greening of rooftop and wall, replacement of air conditioner)

Gaps/constraints:

- Data collection of city-wide fuel consumption is not complete
  - → Most of petrol stations do not want to provide data as it is related to tax payment (they may not report all fuel sold at the station to the financial division)
  - → Using the contacts of policymakers, 4 petrol stations were willing to share their petrol sales data with the condition of anonymity as well as non-disclousure of breakdown data (by each petrol station).
- Merit explanation for data provider is difficult
- Data management is not well organized in commercial sector

Outputs:

- The 2013 GHG inventory of Phitsanulok Municipality
- Foundation of low-carbon city development (Sustainable data system for MRV)

Impact:

- MRV project was launched at the Phitsanulok Administration of Business & Technology (collage) under the guidance of Education Division of Phitsanulok (Staff of the municipality will provide technical guidance to them)

Outcome (expected):

- "Phitsanulok model" will be deployed among the cities in Asia, and turns Asian cities low-carbon;

To do until the end of the project)

- Complete accounting, analysis and reporting of the 2013 GHG inventory

Dissemination:

- Presentation at
  - the 12th Workshop on GHG Inventories in Asia (WGIA12), where many people from Thai national government and foreign donors are present;
  - the 6th high-level seminar (6th ESC HLS)
- Distribution of the GHG inventory report at
  - Smart City Week
  - 6th ESC HLS
  - workshop/meeting at MRV cities

Way forward:

- Data collection will be conducted for assessing the mitigation actions (use of rental bike)
- Data collection will be continued as a routine work for policy support purpose

MRV Final Workshop

Atch, Tom, Andreas, Akagi & Shom (L→R)

MRV T-shirts with IGES logo (Front)

T-shirts (Back)

2. Discussion on Green Building (20 June 2014)

- ✓ New municipal building of municipal government is planned.
- ✓ Reason is because more space is needed for staff;
- ✓ Design has already been established. It will be right behind of current municipal building and connected each other by bridge (16 m distance from each other);
- ✓ Budget is limited, therefore, it is not clear when it is materialized. The current plan is to confirm the building design by early 2015, and then seek funding for it, either through private sector loans or subsidies from the central government;
- ✓ Loan from government banks (there are two in Thailand) is also considered;
- ✓ Nevertheless, taking this opportunity, municipal government asked Andreas how they can make the building as "Green building";
- ✓ The core problem is that 'green building materials' and 'green building systems' are not within the budget (for example double glazed windows which costs five times more than normal glass, central air-conditioning and air ventilation system). Therefore, the municipality is only limited to making structural interventions, such as having recessed windows, limiting direct exposure to sunlight via buffer areas next to windows. It also considers incorporating a green common socializing in the open space between the old and new building and it will leave half of the roof space for future solar cell installation. Other measures to promote 'green' behavior include making available shower rooms to encourage walking and biking to office by municipality staff. Andreas suggested to consider the direction of buildings; ventilation flow inside of the building; spare some space for future retrofitting and keep some flexibility for interior;
- ✓ ESCO may be an option, but it may not be applicable to municipal buildings. Clinton foundation base in BKK may provide guidance of ESCO, as it has expertise on green building;
- ✓ For maintenance measure, it is better to consider the "Green procurement";
- ✓ Municipality staffs said that the auditor's mindset needs to be changed, i.e., consider quotation & life-cycle assessment instead of just considering quotation. Proper guidelines for auditing taking into account ecology aspect need to be established by the national government. At the same time, evidence data for life-cycle assessment should be ready for provision by the local governments, which means MRV system is needed at the municipality.

Discussion on green building

Design of a new office building

3. Phitsanulok Administration of Business and Technology (collage) (20 June 2014)

- ✓ The collage is owned by the previous Mayor of Phitsanulok;
- ✓ Two departments; business and mechanical engineering, about 700 students exist;

<u>Lecture to MRV team</u>

- ✓ College has established a cross-department team for MRV work, which means that is for data collection and implement energy conservation at the college;
- ✓ This MRV work will be conducted in cooperation with the municipal government, as the municipal government has built their MRV capacity under the APN MRV Project;
- ✓ Owner of the collage and the previous Mayor of Phitsanulok emphasized the importance of this MRV work by pointing out the climate change issue is an international agenda;
- ✓ Shom explained the overview of the APN project and stressed the importance of visualization of GHG emissions through data collection to address climate change issue;
- ✓ Andreas and Akagi pointed out that the MRV work is related to economy and this MRV work would positive influence on the students future career building;

Phitsanulok Administration of Business &

Lecture by municipal staff (Lady behind is the

Technology (collage)

previous Mayor and her right is the director? of collage)

With MRV team members

… and more team members

<u>Investigation inside of the college building</u>

- ✓ The director of college guided us around the campus;
- ✓ IGES made some recommendations for turning the building into “Green building” by looking at the real situation. The major challenges faced by the school were uncomfortable study environment, from extreme heat in the classrooms due to the facade facing East and West directly (the rooms have no air conditioning and appear to have very poor ventilation. On the other hand, the mechanical training area is a high-ceiling, warehouse with walls made from thin corrugated tin which has very poor noise insulation and protection from the rain.;
- ✓ About 10 students a day comes to the first-aid room, but they take just medicines and not for bed use. The lady at the first-aid room said the number of students visit there has not been changed so much over time (heat stroke seems not a major issue there).
- ✓ Roof top was very dead. Roof-top greening would be a saving-measure against the heat.

Investigation of inside of collage buildings

Roof top is not used

Building for auto mechanic

First-aid room

4. Rental bike "PUN PUN Phitsanulok" (20 June 2014)

- ✓ Launched in 2014, second rental bike system in Thailand after Bangkok;
- ✓ The program is sub-contracted to the same company as those for Bangkok;
- ✓ Currently there are not so many users (about 700 persons as of last month). They think that it is due to weather condition (hot, rainy), road condition (no bike lane) and lack of PR;
- ✓ They are thinking of focusing on tourists as a target user;
- ✓ IGES made some recommendations for improvements from the tourist point of view, e.g., development of a map of recommended bike roots which connects tourist attraction, and setting sign poles on roads.
- ✓ At the end of the session, there was also considerable discussion on how to measure the impacts of the Pun-Pun bicycle scheme. The key problem for this is that there is no baseline data on the existing transport use in the city, so it was proposed that the municipality start surveying the current traffic at key points to establish an estimate modal share profile (this could be useful for experts to refer to later when a more comprehensive study is conducted by 3rd party expert). It is also proposed that the municipality request the Pun-Pun scheme private company (the operator) to start surveying the registered users of Pun Pun to understand the purposes and travel patterns of using Pun-pun bicycles, and to know whether the bicycle use managed to displace fossil-based transport choices such as cars and motorbikes. The municipality would have to implement an additional study targeting other citizens who theoretically may be influenced to start using bicycles by the Pun-Pun scheme, as an indirect impact in terms of increasing the total number of bicycle users in the city thanks to an improved environment for biking.
- ✓ The method of survey will be enquired to Dr. Hiroki Nakamura, who is the expert on this area and gave a lecture in Phitsanulok last October. IGES will provide information to the municipality later on.

PR of rental bike at municipality building

Bike station

Instruction both in Thai and English

Rental bike in Bangkok (same PUN PUN)

LPG consumption for residential and commercial places

Items	ปริมาณแก๊ส LPG (หน่วยพันกิโลกรัม) (thousand kgs)			Increasing rate per year อัตราการเพิ่มเฉลี่ยร้อยละต่อปี
	2010	2011	2012	
Total (Cars +households)	2,832.353	3,937.68	6,767.7	74.96

- Municipal household utilises an average of 7.5 kgs/hh/month
- Total estimated consumed by households 248,812.50 kgs/month

หมายเหตุ Remarks

1. Data from LPG filling factory ข้อมูลปริมาณแก๊สจากโรงงานบรรจุแก๊ส
2. There are 26 LPG outlets in municipality area จำนวนร้านขายแก๊สในเขตเทศบาลฯ มีจำนวน 26 ร้าน

Citywide Electricity consumption (residential and commercial places)

Items	หน่วยนับ (ยูนิต)				Increasing rate %
	2010	2011	2012	2013	
HH บ้านเรือน	6,425,133	6,479,040	6,478,308		0.845
Big government agencies หน่วยงานราชการขนาดใหญ่				548,699.583	
Hospital โรงพยาบาล				2,250,083.28	
Big companies, banks บริษัทขนาดใหญ่ธนาคาร				671,649.6	

Remarks 1. Municipal household 1,857 baht/month

2. Electricity used baht/month

Seven (7-11) store

Type A locates at gasoline station
Type B locates as commercial building
- Cost for A 7,500 baht per month
- Cost for B 2,000 – 5,000 baht per month

Air con shop (n 22)

รายการ	QTY	n22 (per year per shop)	n22 (per month)
Air shops	77	550	3529.166667

Boats fuel consumption
- Nan River, distance through the city 8.93 kms
- 2 shifts (round trips)

1. Municipal boats with benzene engine 40 HP, **200 l/y** (10 d/y, 10 l/d)
2. Private boats
    1) Fishing boats, benzene 40 HP 30 boats (5l/d/boat)
    2) Tour boats, diesel 200 HP 1 boat (60l/d/boat)
    3) Tour boat, diesel 270 HP 2 boats (60l/d/boat)
    4) Generator, benzene 13 HP 3 units (20 l/unit/d)

Total consumption 390.55 **l/d**

Fuel used 2013 (New breakdown data available via sampling of 4 stations)

item	Total in area	Average liters sold per month	total
Gas stations	10	503,333.33	5,033,333.3

Car types	QTY	L/day
buses	81	771,359.00
City train	3	8.10
2010TAXI (ปี 2553)	50	
2011TAXI (ปี 2554)	84	
2012TAXI (ปี 2555)	49	
2012Tuk Tuk	132	

2013 fuel used

Types of vehicles	QTY	L/day
2011 motorbike	36,854	
2013 motorbike	36,133	
2011 cars	19,574	
2013 cars	20,972	
2011 agriculture and construction vehicles	216	
2011 agriculture and construction vehicles	251	
Buses terminate at bus terminal	530	
Buses pass through PHS city	281	

agriculture

Usage of fertilizer

- Tree shops 7 shops, fertilizer sold 420 tons per year

Fire extinguisher substance

3 shops

- Big shops 438 lb./month
- Medium shops 313 lb./month
- Small shops 188 lb./month

Substance used for Water supply

- 2012 alum 642 tons/year
- 2012 chlorine 16,900 tons per year

Paper sold amount ปริมาณการจำหน่ายกระดาษ

Paper shops in municipal area 16 shops by estimation

- big shop 230 Rim/month
- medium shop 50 Rim/month
- small shop 25 Rim/month
- paper used in PHS municipality activities 1,985 rim

การคำนวณหาขนาดกลุ่มตัวอย่างโดยใช้สูตรของ ยามาเน่ **(Yamane)** ได้ดังนี้

$$n = N / 1 + N(e)^2$$

$$N = 80000$$

กรณียินยอมให้คลาดเคลื่อนได้ดังนี้

1% $= 8000/(1+80000(0.01)^2)$

$= 8,888.89$

2% $= 8000/(1+80000(0.02)^2)$

$= 2,424.24$

3% $= 8000/(1+80000(0.03)^2)$

$= 1,095.89$

หมายเหตุ โดย n = ขนาดตัวอย่างที่คำนวณได้

N = จำนวนประชากรที่ทราบค่า (ในที่นี้ = 80000)

e = ค่าความคลาดเคลื่อนที่จะยอมรับได้