Sustainable urban tourism through low carbon initiatives: Experiences from Hue and Chiang Mai

AN INVENTORY OF GREENHOUSE GAS EMISSIONS FROM TOURISM RELATED ACTIVITIES IN CHIANG MAI MUNICIPALITY, THAILAND

July 2012

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ABBREVIATIONS AND ACRONYMS

ADEME	French Agency for Environment and Energy Management
GHGs	Greenhouse Gases
GPP	Gross Provincial Products
PEA	Provincial Electricity Authority
LPG	Liquid Petroleum Gas
NGV	Natural Gas Vehicle
N/A	Not available
NGOs	Non-Governmental Organizations
BOD	Biochemical Oxygen Demand
PCD	Pollution Control Department
TAT	Tourism Authority of Thailand

EXECUTIVE SUMMARY

Bilan Carbone spreadsheet as a tool developed by ADAME is used to calculate emission from any greenhouse gas from tourism sector in administrative area of Chiang Mai municipality. The analysis shows that Chiang Mai tourism sector activities emitted around 4,417,510 tons of CO_2 equ. in the year 2011.

Travel (including visitor travel by other Thai cities and abroad) is the largest source that generates the most of GHG emissions (4,228,702 tons of CO_2 equ). Two other sources which contribute most of GHG emissions in tourism sector are the electricity used and the infrastructure and assets respectively.

In Chiang Mai, the large hotel is the major tourism business that produces the most of GHG emissions compared with other activities. The restaurant is the second business which share most GHG emissions in the tourism sector. The third business which contributes most of GHG emission is local transportation.

The results from this study are very useful for the next step. These results can use to find the options to mitigate the GHG emissions, and it can be used to plan for the low carbon tourism in the administrative area of Chiang Mai municipality. Furthermore, this study also helps to create green or decent job for men and women in communities. Actually, almost of this study are benefit for policy maker to develop any strategic and action plan related to sustainable urban tourism sector in the future.

1 Introduction

1.1 Information about City

This sector describes basic information about urban area of Chiang Mai province that Chiang Mai municipality is responsible. The administrative area of the Chiang Mai municipality is a scope of this study.

1.1.1 Graphical characteristic

Area and Boundary

Chiang Mai is located around 700kms north of Bangkok and 250 kms south of the Myanmar (Burmese) border. It sits well within the tropics - located 18 degrees north - and is surrounded by mountain ranges, forming the tail end of the Himalayan range[1].

The administration of the Chiang Mai municipality is responsible for areas that cover approximately 40.216 square kilometers and consist of 4 municipal districts, 14 sub districts, 90 municipal communities, and approximate 70,000 households (a population of 146,800 inhabitants).

The city's boundaries are connected to other sub-districts and national park as follows:

North: Muang and Mae Rim district, San Pheesua sub-district.
South: Nong Hoi and Pa Dad sub-district
East: Nong Pakrang and Fa Ham sub-district
West: Doi Suthep-Pui National Park

[1] http://www.1stopchiangmai.com/about_cm/facts/ [accessed 15 October 2012]

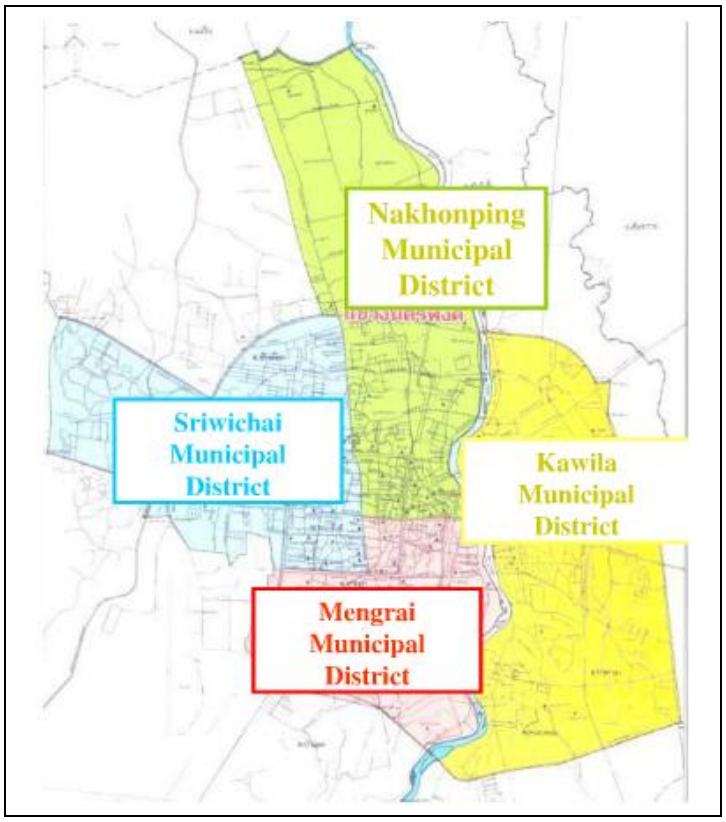

Figure 1:1: Administrative area of the Chiang Mai municipality

Road and Bridge

There are 3 types of roads in the administrative area of the Chiang Mai municipality consist of Macadamized Road (197.8 kilometers), Concrete Road (58.4 kilometers) and Block concrete Road (2.3 kilometers).There are 15 bridges and 9 footbridges in the areas.

1.1.2 Demographic characteristics

Population within the administrative area of the Chiang Mai municipality has shown in Table 1.1.

Table 1.1: Citizen Registration in Chiang Mai Municipality 1999-2008

Year	Male	Female	Total	+/- (%)	No. of Houses	+/- (%)
1999	81,836	89,252	171,088	-0.02	65,564	+0.71
2000	81,847	89,865	171,712	+0.37	66,399	+1.28
2002	82,525	91,331	173,856	+1.05	67,178	+1.18
2002	74,819	84,584	159,403	-8.31	67,809	+0.94
2003	74,401	84,305	158,706	-0.43	69,073	+1.87
2004	78,835	87,937	166,772	+5.09	68,053	-1.47
2005	70,403	80,608	151,011	-9.45	69,253	+1.77
2006	69,989	80,483	150,472	-0.35	70,090	+1.21
2007	69,122	79,188	148,310	-1.44	70,973	+1.26
2008	67,958	78,388	146,346	-1.32	74,601	+5.11
2009	66,564	76,406	142,970	-1.12	75,255	+0.87
2010	66,030	75,325	14,1361	-1.12	75,878	+0.83
2011	64,493	73,300	137,793	-2.52	75,910	+0.42

Source: Citizen Registration, Department of Administration, Office of Clerk of Municipality

1.1.3 Economic

Chiang Mai is a center of the economic and investment in north of Thailand. Chiang Mai had Gross Provincial Products (GPP) around 138,112 million Baht, and Gross Provincial Products per capital was 86,212 Baht in 2010 (OSM North, 2011). Major incomes are from Real-estate, education, agriculture, commerce and finance sectors. The rate of economic growth is around 2-3%.

1.1.4 Tourism sector

In the past decade tourism has become an increasingly important economic growth point for the city. Table 1.2 shows summary information of the tourism sectors in Chiang Mai.

Table 1.2: Summary information of tourism sectors in Chiang Mai

Year / Type	2008	2009	2010	2011[2]
Visitor	**5,311,552**	**4,343,090**	**5,040,917**	**5,545,009**
Thai	3,842,549	3,101,790	3,345,629	3,680,192
Foreigners	1,470,802	1,241,300	1,695,288	1,864,817
Revenue (Million Baht)	**38,135.33**	**32,605.79**	**39,507.03**	
Thai	22,928.84 (47.97%)	19,112.02 (58.61%)	20,975.55 (53.09%)	**N/A**
Foreigners	15,206.49 (52.03%)	13,493.77 (41.39%)	18,531.48 (46.91%)	
Average Length of Stay (Day)	**2.65**	**3.5**	**3.39**	**3.6**

Source: Chiang Mai Provincial Office, 2011

1.1.5 Business and Industrialization units

Businesses that register with Chiang Mai municipality are 2,068 units (Chiang Mai municipality, 2009). Table 1.3 shows the number of businesses within the administrative area of Chiang Mai municipality.

Table 1.3: Business units within the administrative area of Chiang Mai municipality

Type	Number of units
Hospital	18
Clinic	333
Bank	94
Condominium	47
Hotel	192

[2] The official number of visitors in 2011 is not available at this time. This number is approximated by Chiang Mai municipality

Apartment	981
Department store	14
Market	23
Restaurant	321
Gas station	32
Cemetery	13
Total	**2,068**

Source: Chiang Mai Municipality, 2009 and 2008[3]

Industries located within the administrative area of Chiang Mai municipality are 209 units.

1.1.6 Green area

Total green areas in Chiang Mai municipality area are 1.28 km^2. Chiang Mai municipality classifies green area into 4 categories. First is the recreation and visualization area (0.44 km^2). Second is a public benefit area (0.78 km^2). Third is the preservation of the nature area (0.03 km^2) and the last is green area along the roads (0.03 km^2). (Chiang Mai municipality, 2010)

The ratio between green area and populations that registered in the Chiang Mai municipality is 3 m^2 per capita. This ratio is less than the standard value that should have green area 4 m^2 per capita (Chiang Mai municipality, 2011).

1.1.7 Water quality

There are 4 sources of surface water which are the Ping River, Phayakum canal, Mae Kha canal and Lum ku wai canal. Additionally there is a 1 different water resource that is called “Ku Muang” or Chiang Mai moat.

The water quality of the Ping River and Phayakum canal is good. The water can use for an agriculture. The water quality of the Mae Kha canal and Lum Kuwai canal is not good, because these canals are contaminated by direct discharge of waste water from the local

[3] http://www.cmcity.go.th/

communities. The water quality of Chiang Mai moat is fair compare to other water sources that can use for water sports.

1.1.8 State of society

Education

There are 11 schools and 1 nursery school belongs to Chiang Mai municipality. There are 162 classrooms, 273 teachers and 4,101 students (Chiang Mai municipality, 2009)[4].

There are 8 universities, 10 technical colleges, 7 international schools and 20 high schools located within the administrative area of the Chiang Mai municipality.

Religion

The proportion of population classified by religion is following (Chiang Mai provincial office, 2010):

Buddhism	91.80%
Christian	5.60 %
Muslim	1.17 %
Hindu, Sikh	0.02 %
Other	1.41 %

Community

There are 90 communities in administrative area of the Chiang Mai municipality (Chiang Mai municipality, 2010)[3].

1.2 Structure of tourism activities in Chiang Mai municipality

1.2.1 Administrative structure

Chiang Mai municipality has a Board of municipality. The mayor of Board is elected from the people in the Chiang Mai administrative area. The mayor can authorize 4 deputy mayors to help to manage the

[4] http://www.cmcity.go.th/

municipality agencies. The board has a duty to make a policy, control and take a responsibility of the administration of the municipality (Figure 1:2).

Chiang Mai municipality has also a Council which has 24 members. The members of Council come from election of the people in the administrative area. The council has a duty to make the municipal law and monitor the work of the board of the municipality.

1.2.2 Municipal agencies involve with tourism

Office clerk of municipality

This agency has responsibility to develop, plan and support the tourism in administrative area of the Chiang Mai municipality.

The Public works Bureau of municipality

The main duties of this agency are construction and improvement of infrastructures, management of the city plan and environment. This agency develops the infrastructure for the people in the area and also for the tourists. This agency has a big role to develop tourism because the infrastructure is a main factor that attracts the tourist to visit the city.

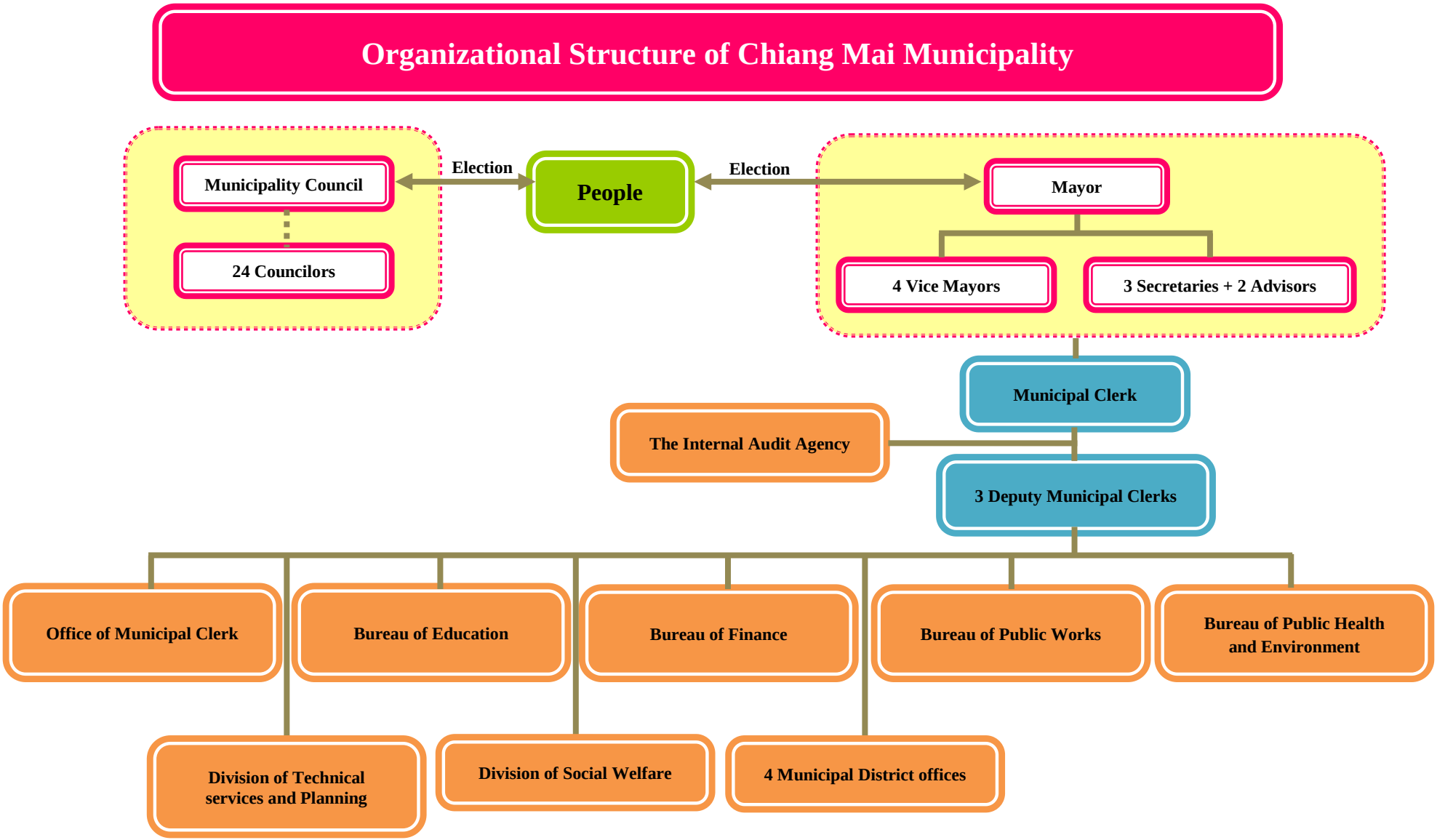

Figure 1:2: Organizational Structure of Chiang Mai municipality

1.3 Objective and benefit of the study

1.3.1 Objective of the study

- Estimation GHG emission in tourism sector in the administrative area of Chiang Mai municipality by using Bilan Carbone tool developed by ADEME

1.3.2 Benefit of the study

- Results from GHG analysis can be used to find the mitigation options in tourism activities in the city.
- Results from GHG analysis can be used to establish the sustainable tourism policy in the city
- Improve understanding and assist in the reduction of carbon emissions in the urban tourism sector
- Explore how various alternative options to reduce carbon emissions, and how these alternatives can be used to promote employment by creating decent jobs, and thus contribute to the well-being of the poor in urban areas.

1.4 Scope and limitation of the study

- This study analysis GHG emission from tourism activities within the administrative area of Chiang Mai municipality. Figure 1.1 shows the boundary of study area.
- This study analysis GHG emission at 7 sectors of tourism activities including small hotels (less than 30 rooms), medium hotels (31 – 100 rooms), large hotels (more than 100 rooms), tourism agencies, car rentals, spa and restaurants. The infrastructure for tourism sector, Local transportation for the visitors, and sewage generated by visitors are also calculated emission in this study.

- The number of business units which were considered to calculate the emissions in this study are as follows:
  - 68 Small hotels (less than 30 rooms),
  - 74 Medium hotels (31 – 100 rooms),
  - 33 Large hotels (more than 100 rooms)
  - 100 tourism agencies
  - 50 Car rentals
  - 39 spa
  - 321 restaurants (In this study, GHG emissions from the restaurant assume 70% of total emission is from the tourism sector and 30% is from local people.
  - 30% of total road within the administrative area of Chiang Mai municipality
  - 70% of fuel used in local transportation
- The emission factors are used in this study based on emission factors in Bilan Carbone spreadsheet and Thailand greenhouse gas organization (TGO).

1.5 Methodology

This section presents the methodology about data collection, assumption, Bilan Carbone analysis and report preparation.

Step 1: Selecting the area and tourism activities boundary

- This step selected the area of urban city in Chiang Mai for the study which is presented in Figure 1.1.
- The tourism activities were chosen for the GHG analysis that were small hotels(less than 30 rooms), medium hotels (31–100 rooms), large hotels (more than 100 rooms), tourism agencies, car rental agencies, spa and restaurants.

Step 2: Study Bilan Carbone spreadsheets

- Bilan Carbone spreadsheets were studied by collecting the data requirements, input the data to the spreadsheets, and analysis the results.

Step 3: Data collection

- Samples for each tourism activities were selected for data collection. The total survey samples were 84 entities (12 entities in each business). The samples were selected from different scale, so the data could cover approximately the whole scale businesses.
- Questionnaire was developed according to Bilan Carbone spreadsheets for data collection. Eight young staffs (3 men and 5 women) were assigned to collect the data by using questionnaire.
- Assumption was made by using sample data to cover the whole scale activities. The data analysis was made as follows:
    - The data used in every unit in each tourism business was based on the average value from the sample survey data.

Because the city has many units each tourism business, this study could not collect the data from every unit.

- The data that needed for the analysis but could not get from the questionnaire survey were collected from the other sources such as website, previous publications, etc.

- The collected sample survey data from each tourism activities was analyzed to get the value for Bilan Carbone spreadsheet and averaged the value to use for whole scale activities selected for the analysis.

Step 4: GHG analysis using Bilan Carbone spreadsheets

- Analysis GHG emission in tourism activities from Bilan Carbone spreadsheets used the data in step 3
- Getting the results from Bilan Carbone spreadsheets.

Step 5: Report preparation

- Getting the basic information about the city, tourism activities to write the report.
- Analysis the results from step 4 to write the report.
- Summary of analysis and recommendations for this study.

2 Results of the study

2.1 Energy used in tourism sector

This sector separates in two categories. The first is fossil fuel used in the tourism sectors for cooking, power generation and other machines such as a boiler (not include fossil fuels used for a travel and freight) and second is electricity used for lighting and various tourism related activities.

2.1.1 Fossil fuels used

The amount of fossil fuels used in tourism sector is for cooking because city of Chiang Mai has number of restaurants. The fossil fuel that used for power generation is very low because the city has stable electricity supplied from Provincial Electricity Authority (PEA). Normally, the fossil fuels used in generators to produce electricity or in boiler for hot water at hotels and restaurants. The GHG emission from fossil fuel used is 6,694 tons of CO_2 equ. (Figure 2:1). The fossil fuel data is collected in ton of LPG, Liter of Diesel oil (Table 2.1). This analysis does not include the fossil fuels used for travel and freight in the municipality area.

Table 2.1: Fossil fuel used in different Business units within the administrative area of Chiang Mai municipality to generate energy

Fuel type	**Unit**	**Amount**
Diesel oil	liter	43,979
LPG	ton	2,306

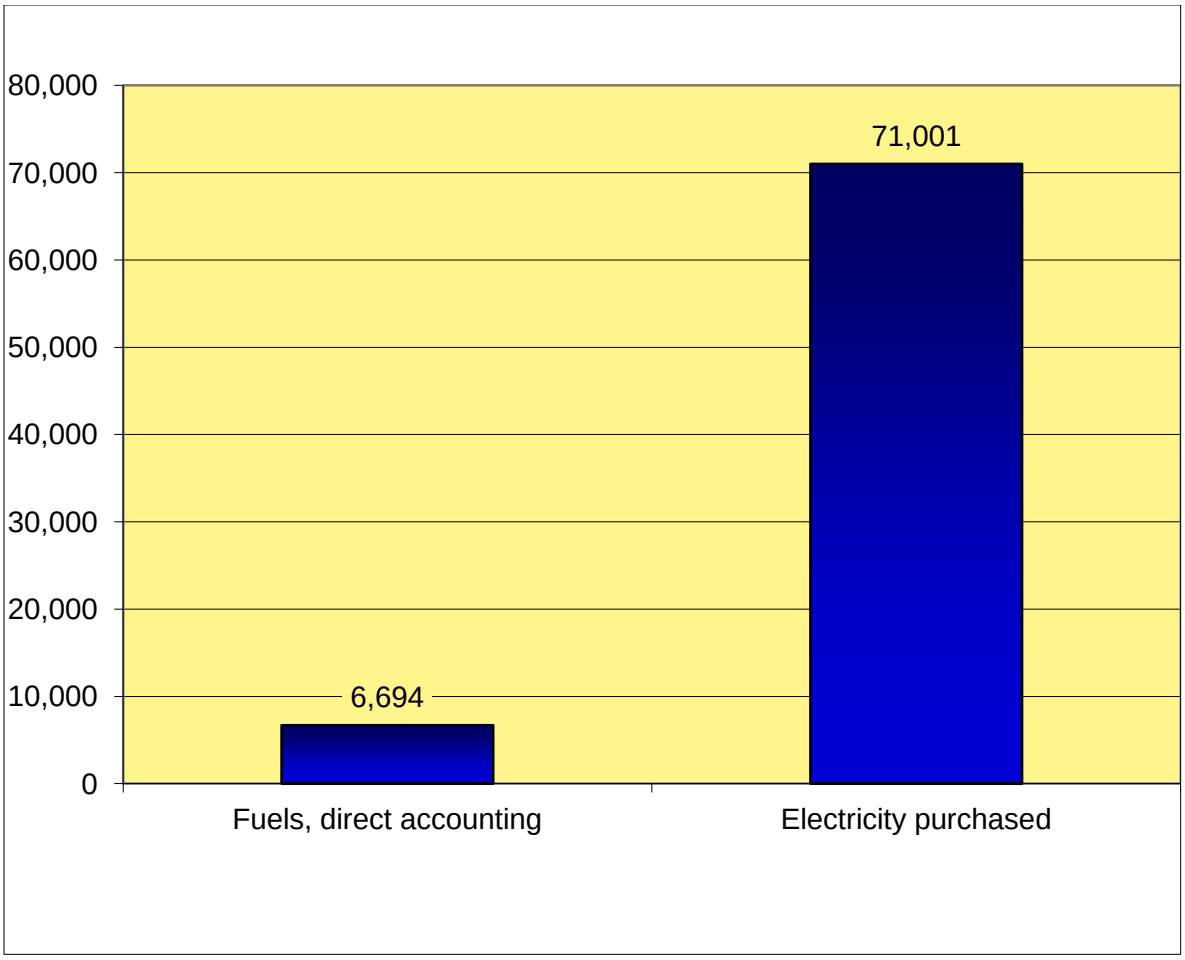

Figure 2:1: GHG emissions from fossil fuel and electricity used within the administrative area of Chiang Mai municipality in 2011. (tons of CO_2 equ.)

2.1.2 Electricity used in tourism sector

Electricity is a major energy that uses in tourism sector in Chiang Mai, because the almost all sectors use electricity to serve the visitors, especially in the hotels. The data of electricity used is collected from the electricity bill which is 129,633,229kWh (Table 2.2). The GHG emission that is produced from electricity used is also included the GHG emission from the electricity losing in line. The GHG emission from electricity used is 71,001 tons of CO_2 equ. Total GHG emission from electricity used within the administrative area of Chiang Mai municipality in 2011 is shown in Figure 2:1.

Table 2.2: Electricity consumption in different Business units within the administrative area of Chiang Mai municipality in 2011

S. No.	Business units	Number	Electricity used per unit (kWh)/year	Electricity used (kWh)/year	tons CO_2 equ. emission per unit/year
1.	Car Rental service	50	11,687	584,350	7
2.	Spas	39	24,842	968,838	15
3.	Tourism Agencies	100	28,275	2,827,500	17
4.	Big Hotels (more than 100 rooms)	33	2,086,360	68,849,880	1,264
5.	Medium Hotels (31-100 rooms)	74	157,283	11,638,947	95
6.	Small Hotels (less than 30 rooms)	68	48,135	3,273,180	29
7.	Restaurants	321	129,254	41,490,534	78
Total (kWh)				**129,633,229**	

2.2 Excluding energy

In this sector the GHG emission is from the leakage of refrigerant. The main refrigerant in Kyoto halocarbon is R134a. The R134a is normally used in the refrigerators in city of Chiang Mai. The Kyoto halocarbon emits the GHG emission around 703 tons of CO_2 equ.

Gas excluding Kyoto halocarbon used in city of Chiang Mai is R22 and R12. R22 is a common refrigerant that use in the air conditioners for a split type and a chiller water. In an average, the Chiang Mai has a hot

climate, so, the air conditioners are mostly used in every tourism sectors, especially in the hotels. The Gas excluding Kyoto halocarbon generate the GHG emission around 5,126 tons of CO_2 equ. Figure 2:2 shows the GHG emission from excluding energy within the administrative area of Chiang Mai municipality in 2011.

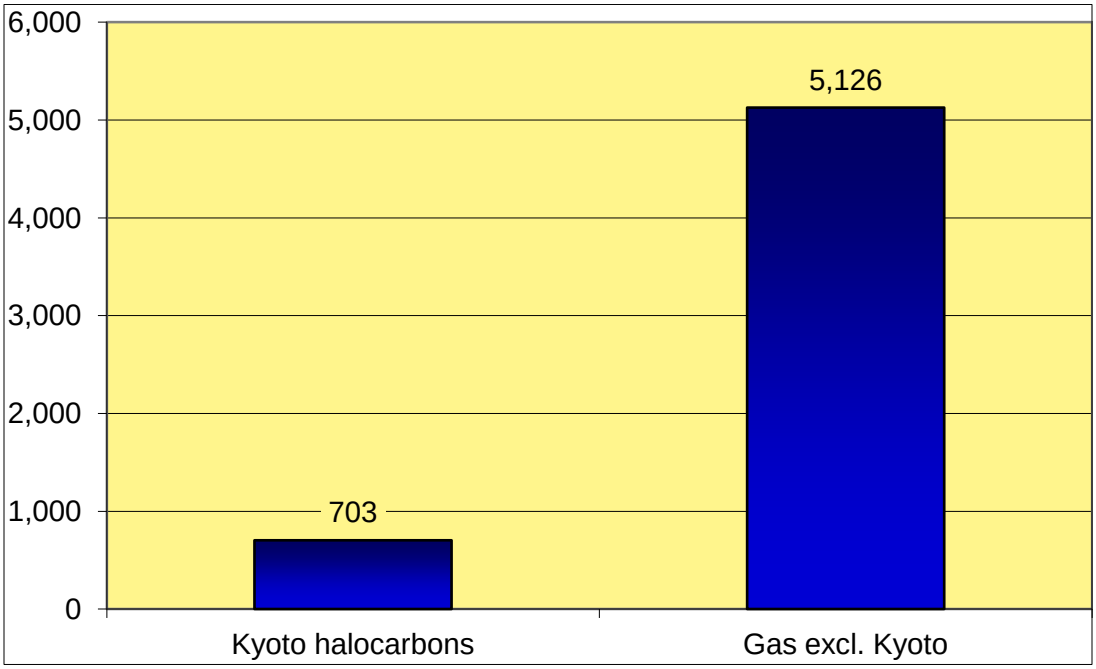

Figure 2:2: GHG emission from excluding energy within the administrative area of Chiang Mai municipality in 2011. (tons of CO_2 equ.)

The GHG emission from gas excluding Kyoto halocarbon is high because the most of air conditioners in Chiang Mai use R22 refrigerant and some hotels still use the refrigerators that use R12 refrigerant. R12 refrigerant produces a lot of GHG emission when it leaks (10.9 tons of CO_2 equ per kg of R12 (ADEME, 2007).

2.3 Incoming materials

The main GHG emission of the incoming material is from the agriculture product. Because the number of restaurant is very high, they consume

a lot of agriculture products to run the business. The agriculture products estimate the GHG emission based on quantity of product incoming (in tone). The agriculture products produce the GHG emission around 20,256 tons of CO_2 equ.

The paper and the plastic are the common product that use for many activities, so the tourism sector consume a lot these products for their businesses. The glass and the metal are also used in the tourism sector. The data used to estimate the GHG emission are collected in tone of product. Figure 2:3 shows the GHG emission from incoming material in administrative area of Chiang Mai municipality in 2011.

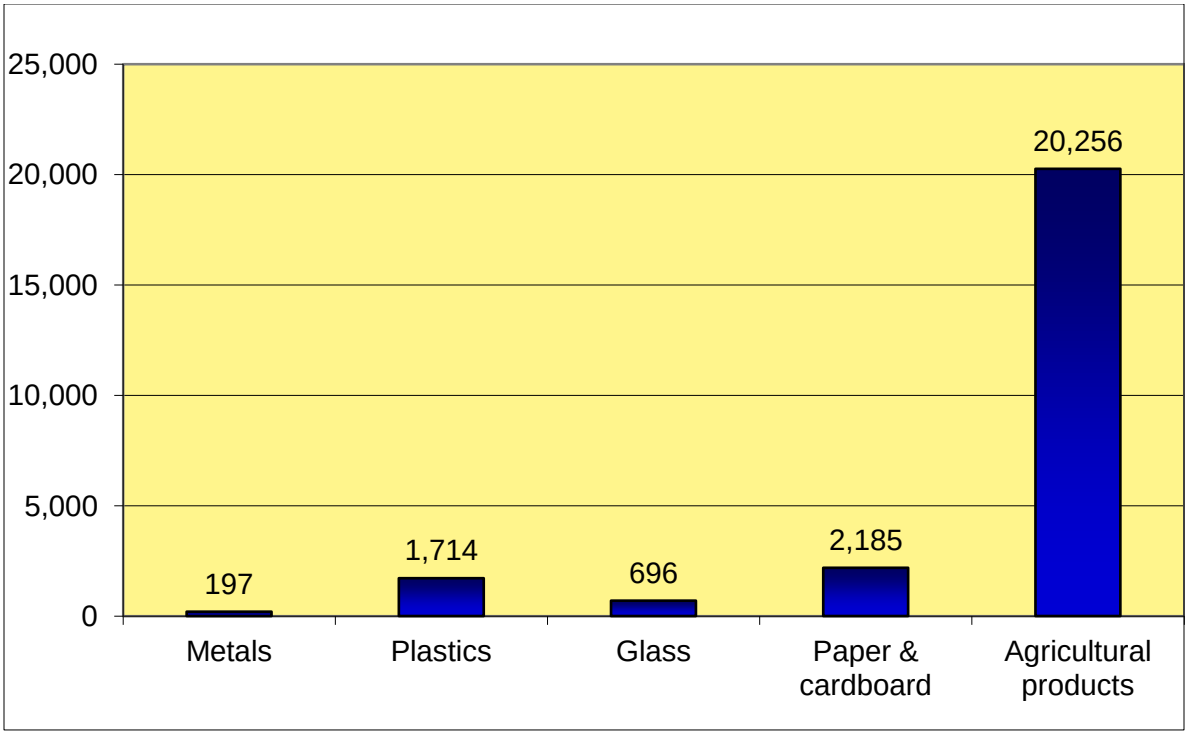

Figure 2:3: GHG emission from incoming materials within the administrative area of Chiang Mai municipality in 2011. (tons of CO_2 equ.)

2.4 Freight

In this study, the emission generated by freight in tourism sector comes from transportation of incoming materials. This study does not include transportation of the people for any purposes in the freight. The freight

is categorized into 3 types, i.e. internal freight, incoming freight and outgoing freight. This study assumes that all of goods are transport to site, so the emission comes from incoming freight. The data used to estimate the GHG emission comes from the fuel consumption of the vehicles which use to transport the goods. The GHG emission from freight within the administrative area of Chiang Mai municipality in 2011 is around 4,601 tons of CO_2 equ.

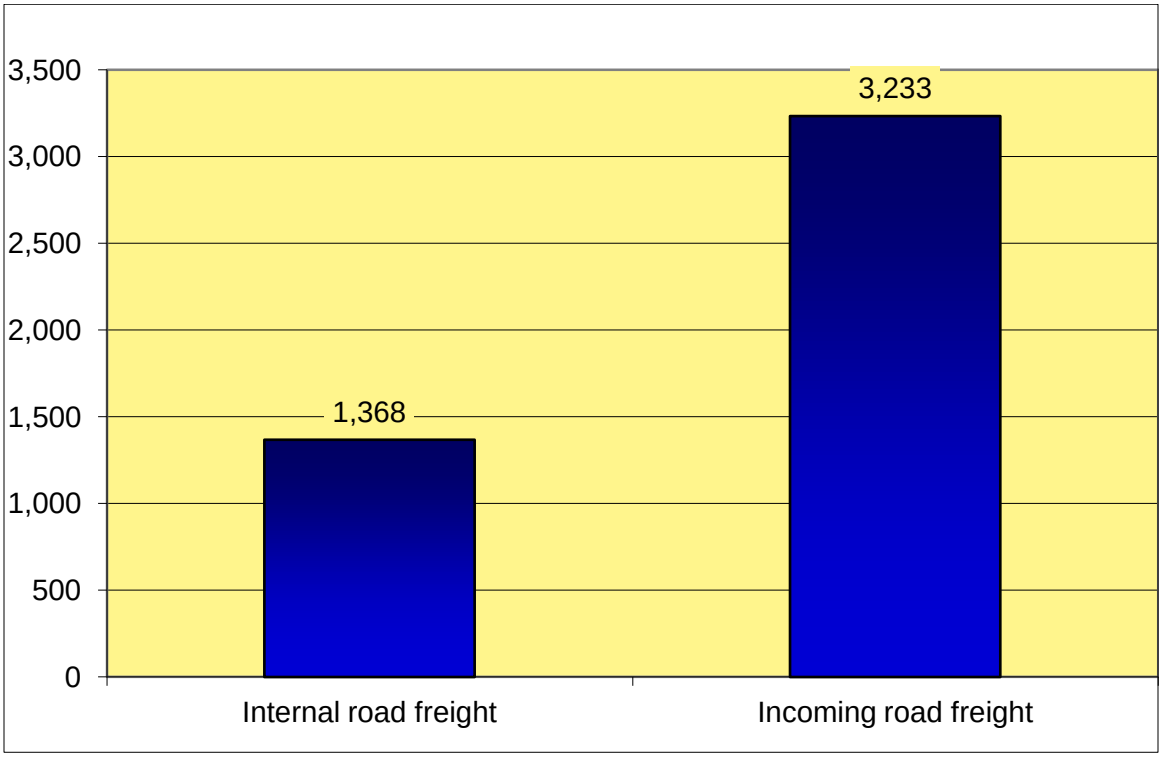

Figure 2:4: GHG emission from freight within the administrative area of Chiang Mai municipality in 2011. (tons of CO_2 equ.)

2.5 Travel

This study calculated GHG emission from 3 types of journey, e.i., within a city and from other cities to Chiang Mai and from abroad to Chiang Mai. The calculation shows that Chiang Mai municipality emitted total **4,228,703** tons of CO_2 equ. from travel related to tourism activities in 2011 which are described as follows:

2.5.1 Home - work travel by employees

This journey estimates the GHG emission from the employees travel between their home and the work place within a city. The emission is calculated based on total distance in kilometers that employees travel. The most of employees in tourism sector use motorcycle to travel between their home and the work place. There are some employees who use the car to travel. The GHG emission in this activity is around 7,765 tons of CO_2 equ.

2.5.2 Travel by employees in the context of working hours

This journey finds the GHG emission from the employees who travel at the working hours. The total distance in kilometers uses to estimate the emission in this journey. The employees who travel in context of work normally use car or motorcycles. The GHG emission in this activity is around 597 tons of CO_2 equ.

2.5.3 Travel by visitors

This study is separated into 2 categories, a) visitor visit within a city and b) visitors come from the other cities and abroad to Chiang Mai municipality. This will make easy for the decision make to develop GHG mitigation options as city specific because travel from other cities and aboard, where Chiang Mai city authorities do not have any control.

Travel by visitors within the city

This journey estimates the GHG emission based on the visitor travel around the city only. Visitors travel between the city (Chiang Mai and other city) and abroad do not include in Figure 2:5. The GHG emission

from visitor travel around the administrative area of Chiang Mai municipality in 2011 is around 51,065 tons of CO_2 equ.

The visitors travel around the city produces a lot of the GHG emission, because the number of visitors who travel within the administrative area of Chiang Mai municipality is very high (Table 1.2). This section includes the travel from the car rental, travel provided from tourism agencies and local transports.

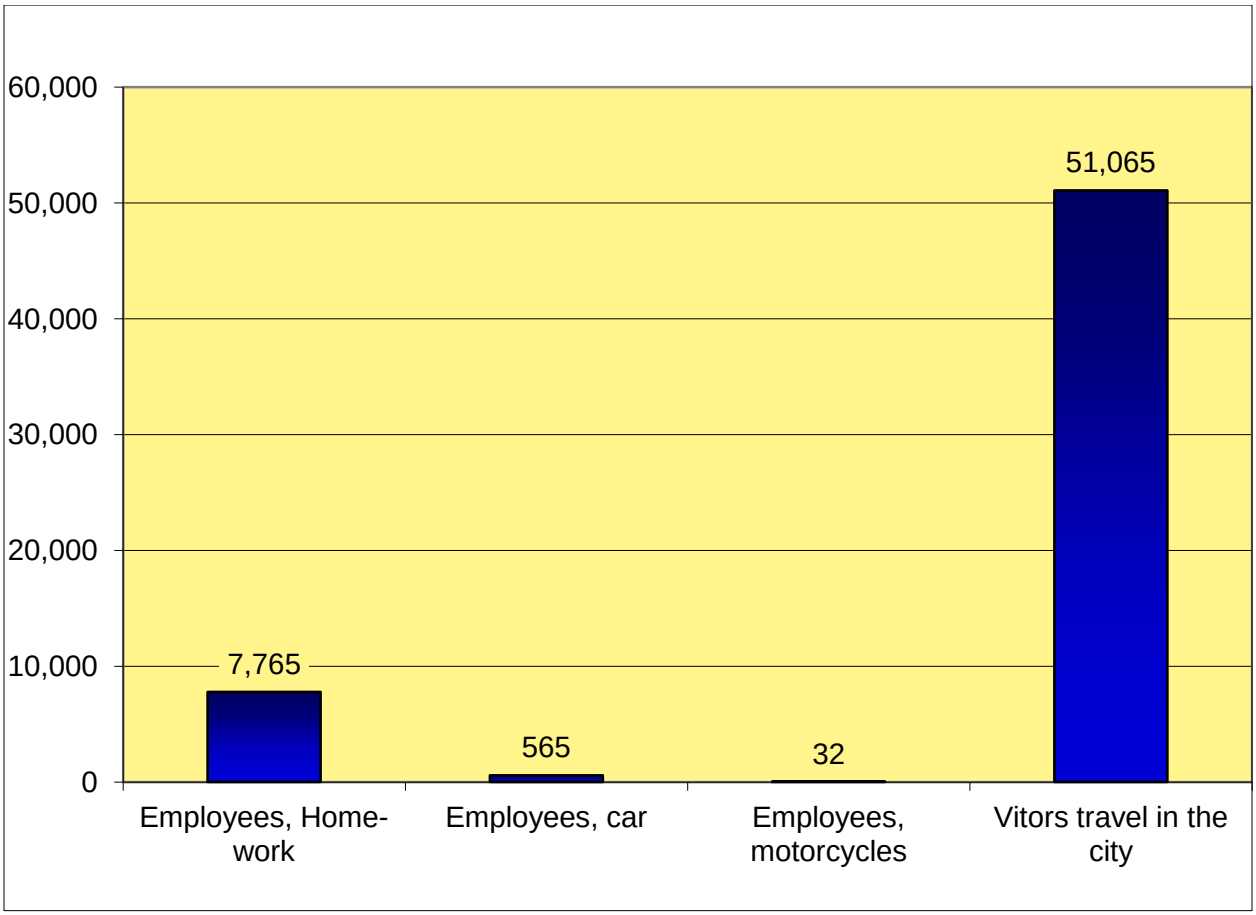

Figure 2:5: GHG emission from travel within the administrative area of Chiang Mai municipality in 2011. (Tons of CO_2 equ)

Travel by visitors from other cities and countries

This section presents the GHG emission from visitors travel between Chiang Mai and other Thai cities & abroad. The emission is calculated based on the distance between visitor's cities/countries and Chiang Mai. The number of visitors in each city/countries collected from the data of Department of tourism, 2010. For the Thai visitors, this study assumes all the visitors travel from Bangkok to Chiang Mai. Figure 2:6 shows the GHG emission from visitors traveled from other Thai cities/countries to Chiang Mai municipality in 2011.

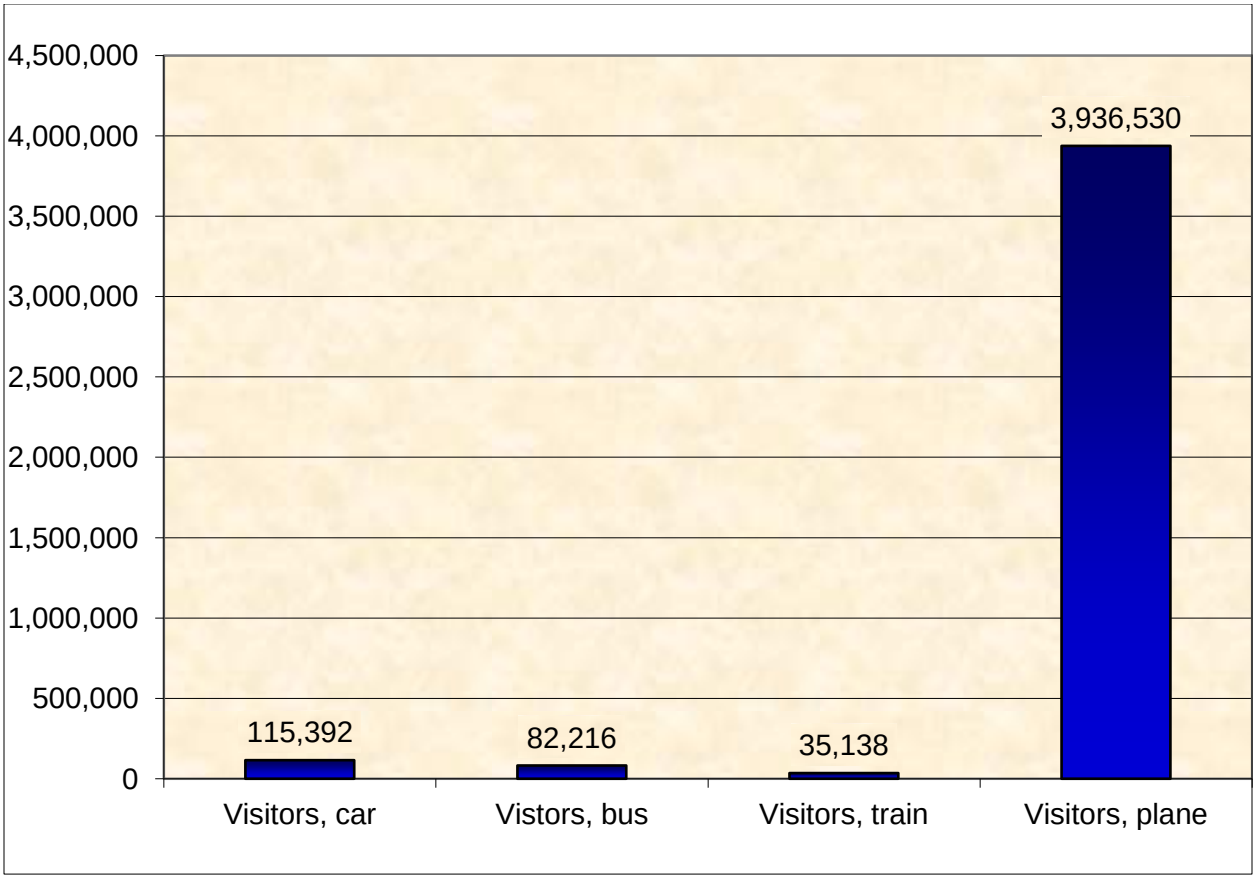

Figure 2:6: GHG emission from visitors travel from other cities/abroad to Chiang Mai in 2011

The visitors travel by plane generates most of emission because almost all visitors who come from the other countries usually travel by plane to visit Chiang Mai. For GHG emission calculation by plane, the study

assumes that visitors first visit Bangkok and go to Chiang Mai. In this case the total GHG emission from the plane travel has been shared with two cities (Chiang Mai and Bangkok).

The foreign visitors who travel by the car, the bus and the train are almost the same as Thai visitors. Therefore, total GHG emission from travel between the cities & abroad is around 4,169,276 tons of CO_2 equ. This source generates more emission compared to other sources in Chiang Mai.

2.6 Direct waste and wastewater produced

The direct wastes almost dispose by landfill. Tourism sector produce a lot of the food waste because there are a lot of the restaurants and the hotels which produce the food for visitor. The food waste generates a lot of GHG emission because dumping the food wastes produce methane.

The wastewater data cannot be collected from the questionnaire. Therefore, the GHG emission of sewage is estimated based on the data from Pollution Control Department. The visitors generate BOD around 38 grams per visitor/day (Pollution Control Department, 2002). The number of visitor in 2011 is shown in Table 1.2 (5,545,009 visitors) and length of stay is 3.6 days. So, the total BOD generates by visitors in 2011 is 758,557 kg of BOD. Figure 2:6 presents the GHG emission from direct wastes within the administrative area of Chiang Mai municipality.

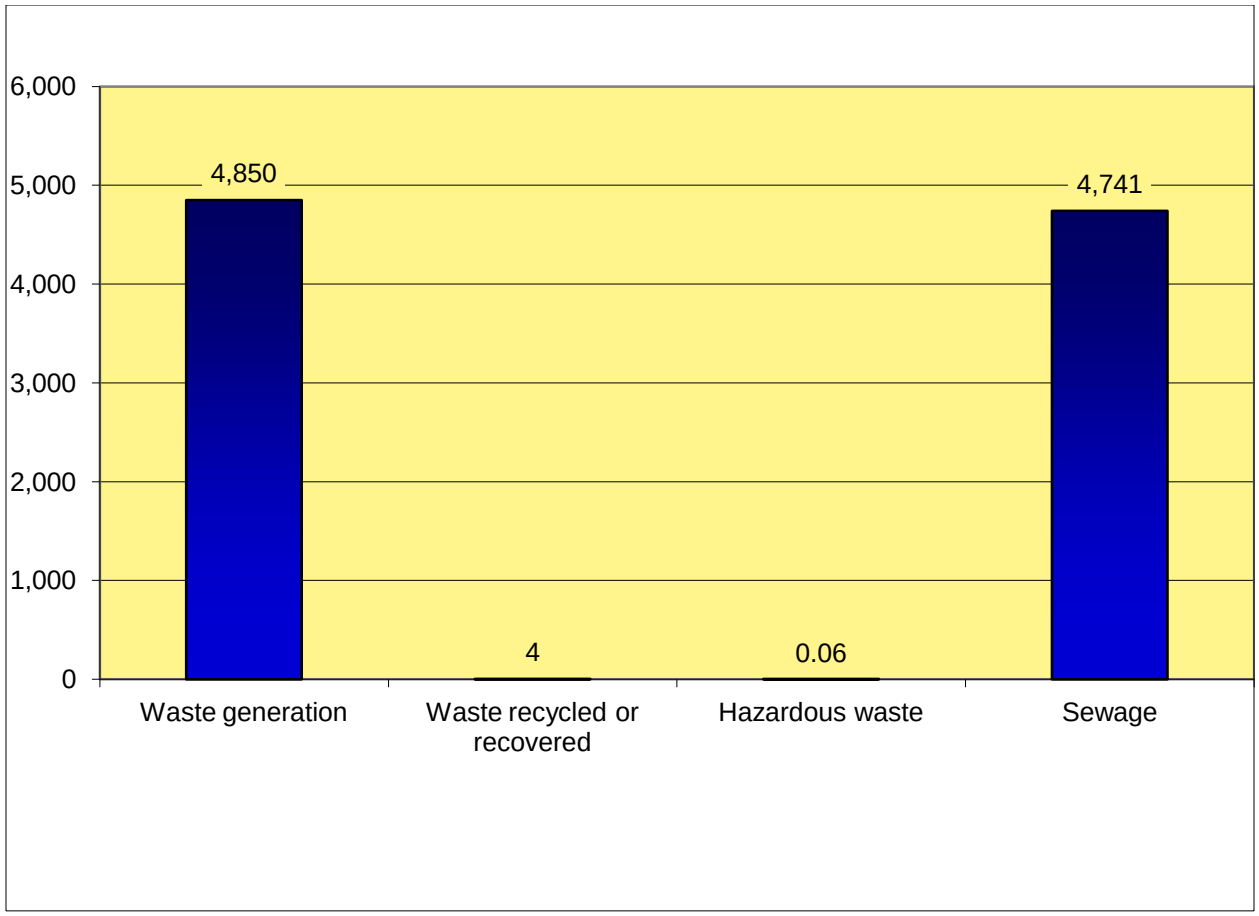

Figure 2:6: GHG emission from direct wastes within administrative area of Chiang Mai municipality in 2011. (Tons of CO_2 equ)

2.7 Infrastructure and assets

The infrastructure and assets that produces the GHG emissions in tourism sector based on Bilan Carbone tools are 4 categories following:

2.7.1 Building

In this study, the building sector includes the building and parking area of the tourism business. The methodology that used to estimate the GHG emission in this study is approximation based on surface area of buildings including ceiling, four walls and ground floor (basement), and parking places. The GHG emission in this section is 48,390 tons of CO_2

equ. However, the GHG emission has uncertainty range between 24,195 (minimum) and 72,585 (maximum) tons of CO_2 equ.

2.7.2 Infrastructure excluding building

Infrastructure that used to calculate in this study is the road within the administrative area of Chiang Mai municipality. The road 30% of the total road is approximated for all tourism activities. Total road is presented in graphical characteristic. The GHG emission in this section is 5,515 tons of CO_2 equ.

2.7.3 Vehicles, machines and furniture

This covers the furniture, the vehicles and the machines that use in the tourism activities. The GHG emission is calculated based on the material weight. This section generates the GHG emission around 10,809 tons of CO_2.

2.7.4 IT

This sector estimates the GHG emission from the IT products. The method is provided to estimate the emission in this study from the number of appliances. The GHG emission in this sector is around 1,326 tons of CO_2 equ.

The summary of the GHG emission from the infrastructure and assets within the administrative area of Chiang Mai municipality 2011 is shown in Figure 2:7.

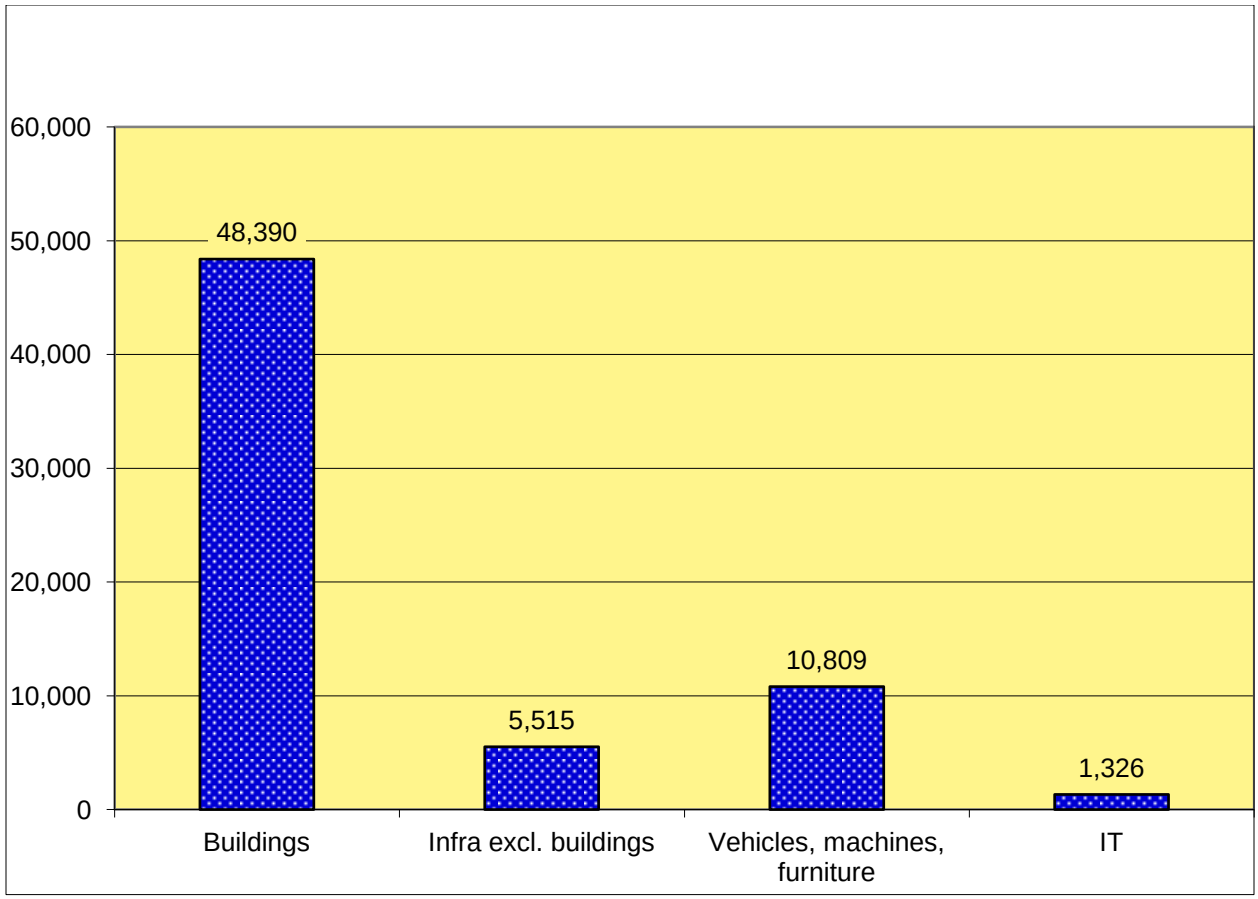

Figure 2:7: GHG emission from infrastructure and assets within administrative area of Chiang Mai municipality in 2011. (Tons of CO_2 equ)

2.8 Summary of analysis

Tourism sector activities of Chiang Mai municipality produce the GHG emissions around **4,417,510** tons of CO_2 equ. This study summaries the GHG emission from the tourism sector in 2 categories. First is that the GHG emissions are presented in the sources of emissions including and excluding travel from other cities & abroad to Chiang Mai. Figure 2.8a and Figure 2.8b municipality in 2011. The second is that the GHG emissions are described by tourism activities including and excluding travel from other Thai cities & abroad to Chiang Mai Figure 2:3a and Figure 2:3b).

2.8.1 Summary of the GHG emission by source of emissions

The GHG emissions and percentage of contribution from the tourism sector activities are categorized in Table 2.3.

Table 2.3: Emission from Tourism Sectors Activities of Chiang Mai municipality in 2011

Source	tons of CO_2 equivalent	Percentage of contribution
Electricity	71,001	1.61
Fossil fuels	6,694	0.15
Excluding energy (refrigerant & air conditioning)	5,829	0.13
Inputs (materials and food consumption)	25,048	0.57
Freight	4,601	0.10
Travel	4,228,703	95.73
Direct waste	9,595	0.22
infrastructure and assets	66,040	1.49
TOTAL	4,417,511	100

It is confirmed that the travel is main source of GHG emission in the tourism sector. In the case of Chiang Mai, the travel emissions are categorized in two stages, a) Travel emission within the administrative boundary of Chiang Mai municipality and b) Travel emission outside the boundary of Chiang Mai municipality. The first travel emission covers the visitors travel around the city and employees, who work in tourism related organizations' travel by using local vehicles such as private car, motorcycle, public vehicles, etc. The calculation shows that the GHG

emission from visitor travel around the administrative area of Chiang Mai municipality in 2011 is around 51,065 tons of CO_2 equ. which is only 1.2% of total travel emission i.e. 4,228,702 tons of CO_2 equ. Therefore, the large portions of emission contribute from visitors travel from other Thai cities & abroad to Chiang Mai municipality by using public buses, train and plane.

The second largest source of GHG emission is electricity used, because the most tourism activities in the city of Chiang Mai provide electricity to service their visitors. The large hotels are the major business place that generates the GHG emissions by using electricity. The reason is that the hotels are a business service that operates 24 hours a day and 365 days per year. In addition, the climate in Chiang Mai is hot in an average. Usually, the electricity is supplied to the air conditioning system for the cooling purpose at the hotels. The air conditioning system consumes more than half of total electricity at the hotels. Furthermore, the other tourism activities such as restaurants, tourism agencies, spa, etc. also use electricity for air conditioning to provide the comfortable service for their visitors. Therefore, the electricity used produces the more GHG emission in tourism sector within the administrative area of Chiang Mai municipality.

The infrastructure and assets source is the third share of GHG emissions. It covers whole infrastructure development, i.e. buildings, road, bridge, footpath, parking places, etc., assets such as vehicles, IT equipment, etc. in Chiang Mai municipality. According to visitors data (Table 1.2) the number of tourist is very high, so the tourism sector provides the infrastructure and assets for the visitors.

The large hotels emit huge amount of GHG emission in the infrastructure and assets, because the building and parking space of the large hotel is very huge. The other size of the hotels also produces a lot of the GHG emissions due to the buildings and parking spaces. In addition, the number of restaurant is also increased in Chiang Mai that generates GHG emission from the infrastructure and assets.

The study has also assumed that the road within the administrative area of Chiang Mai municipality approximated 30% of total road areas is considered for tourism sector, and the GHG emission from the road is also included for this source.

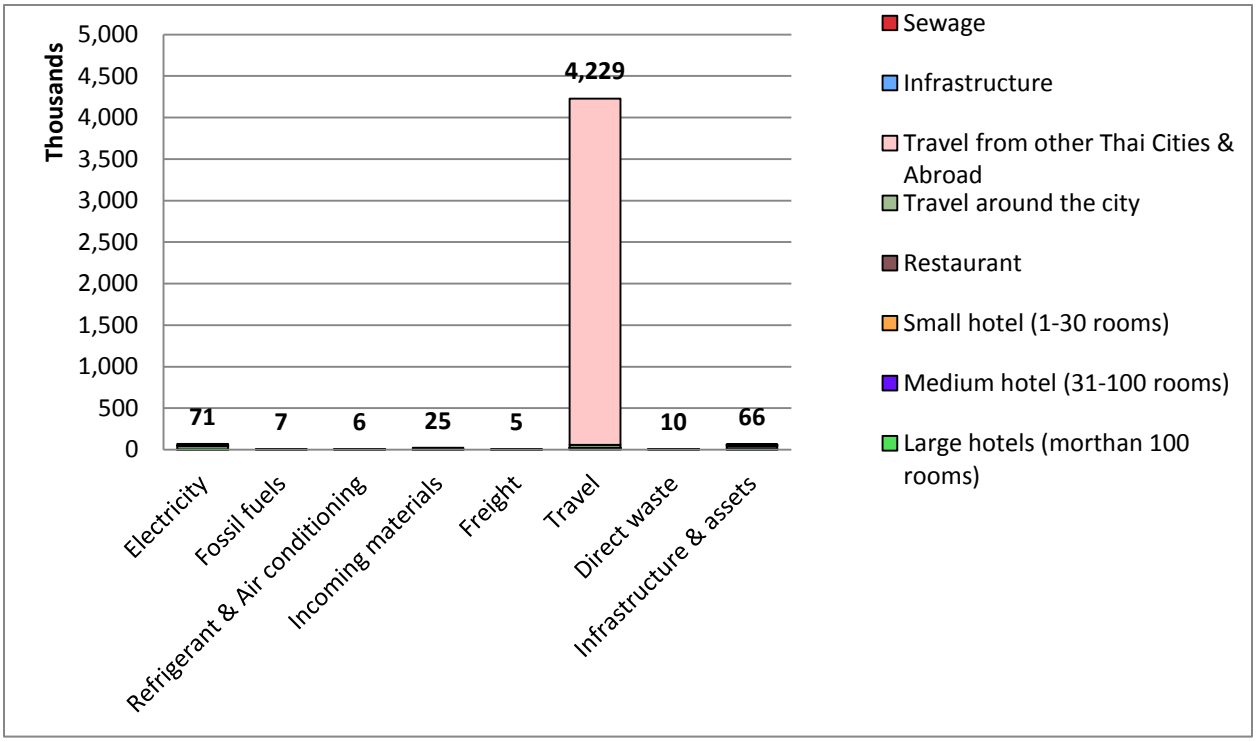

Figure 2:8a: Summary of GHG emissions from the tourism sector's activities of Chiang Mai categorized by sources of emission ***including travel from other Thai cities & abroad to Chiang Mai***, in 2011. (Tons of CO_2 equ)

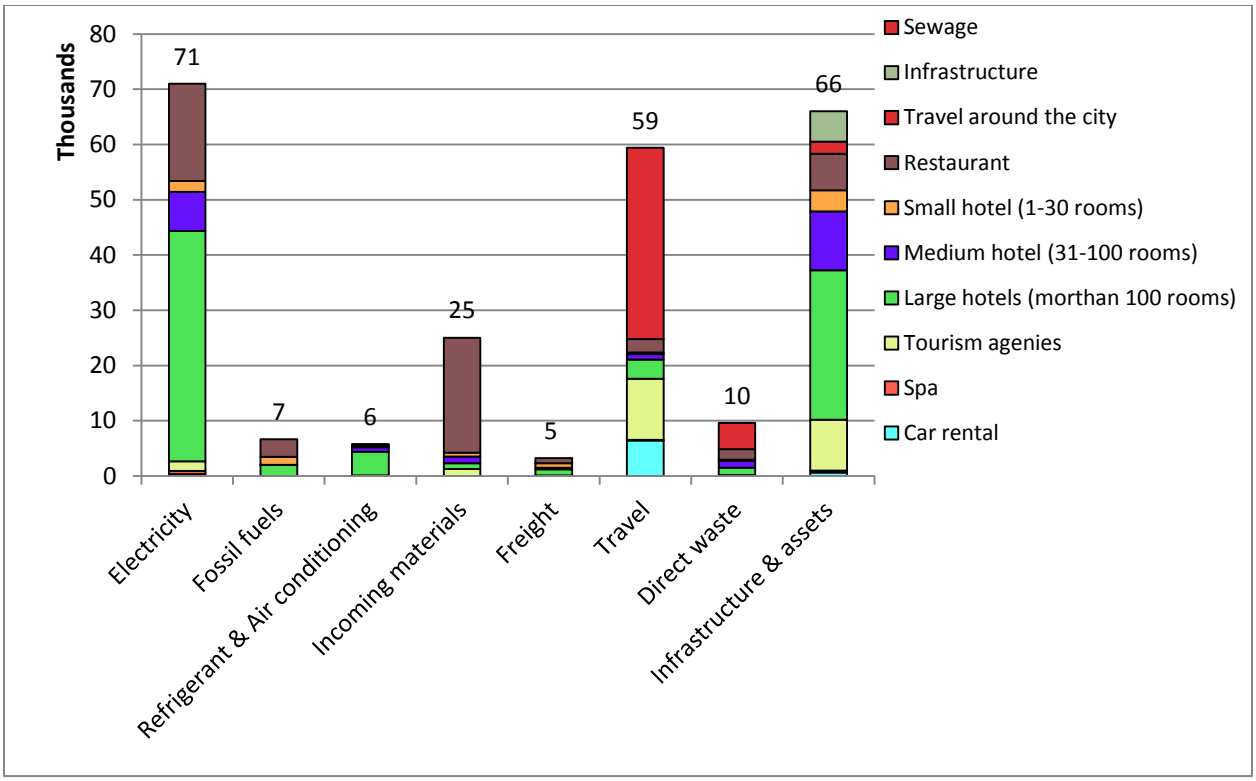

Figure 2:8b: Summary of GHG emissions from the tourism sector categorized by sources of emission within the administrative area of Chiang Mai municipality in 2011. (Tons of CO_2 equ)
(Excluding travel from other Thai cities and abroad to Chiang Mai)

2.8.2 Summary of the GHG emission by tourism activities

Figure 2.9 presents the proportion of GHG emissions by tourism activities within the administrative area of Chiang Mai municipality. *This figure does not include 'travel from other Thai cities and abroad to Chiang Mai' because this activity emits huge amount of GHG emission where Chiang Mai municipality has no direct control to reduce the emission.* However, the large hotels, restaurants and local transportations are the most tourism businesses that generate the GHG emission in tourism sector in Chiang Mai municipality respectively, where municipality can able to make intervention to reduce GHG emission. Therefore, the Figure2:9 will help to find the options to

mitigate the GHG mission at the Chiang Mai city level related to tourism sector.

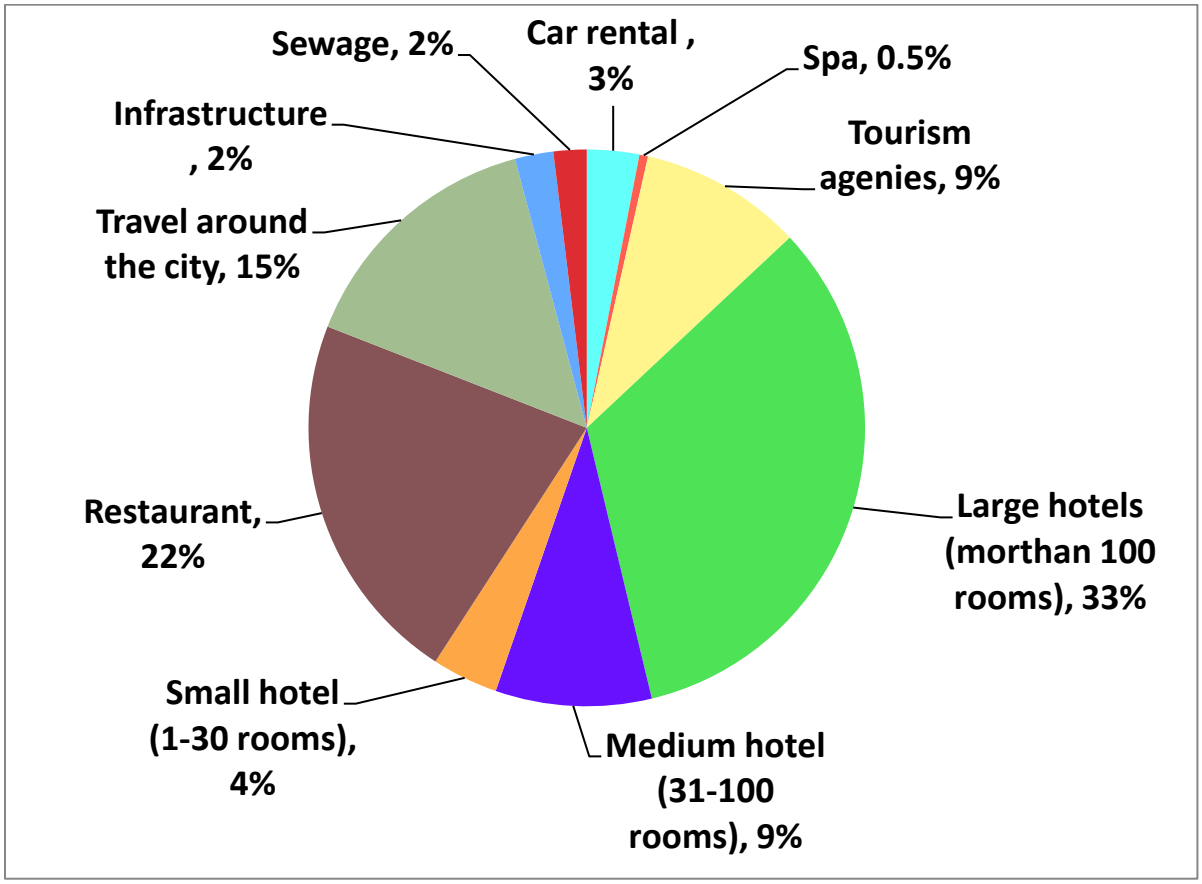

Figure 2:9: Proportion of GHG emissions by tourism activities
(Excluding travel from other cities and abroad to Chiang Mai)

The large hotel is the tourism business which produces the largest of GHG emission. This can be explainable, because the large hotel consumes a lot of energy especially electricity due to the nature of business. In this reason, the large hotel generates more GHG emission. Nevertheless, the large hotel has a big building to provide the service for the visitors which contributes a lot of GHG emissions.

The second tourism business which creates the more GHG emissions is the restaurants. There are a lot of restaurants within the administrative area of Chiang Mai municipality (Table 1.3). The restaurant consumes a

lot of agriculture products to produce food for the visitors. The agriculture products are the main source that produces the GHG emissions in the restaurant. In addition, this business also consumes lot of electricity to run the daily activities.

The third tourism business which creates the more GHG emissions is the local transportation. In 2011, the number of visitor in Chiang Mai was very high (Table 1.2). The visitors who use the car rent and travel with the tourism agencies is very small compared with total visitors. Many visitors use local transports to travel around the city and produce more GHG emission. The GHG emissions in each tourism activities are presented in Figure 2:3a (including travel from other Thai cities & abroad to Chiang Mai) and Figure 2:3b (Excluding travel from other Thai cities and abroad to Chiang Mai).

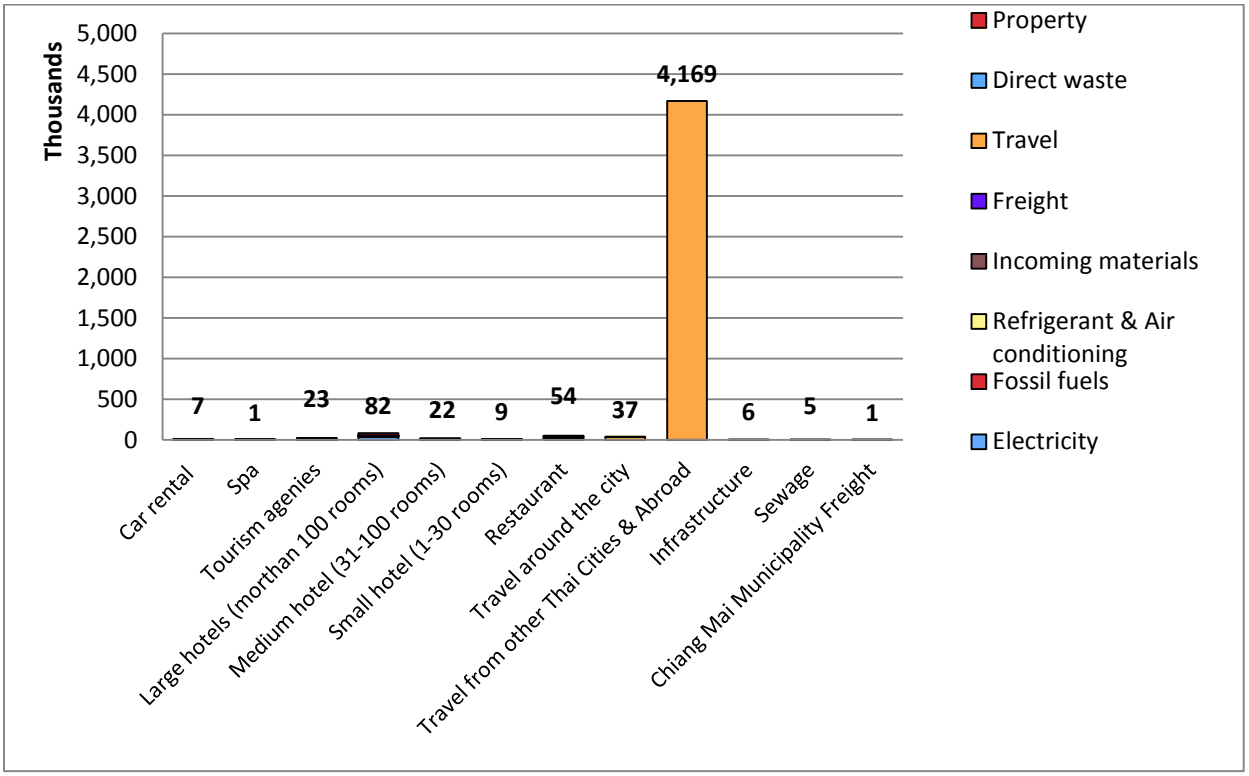

Figure 2:2a: Summary of GHG emissions from the tourism sector's activities of Chiang Mai categorized by tourism businesses ***including travel from other Thai cities & abroad to Chiang Mai***, in 2011. (Tons of CO_2 equ)

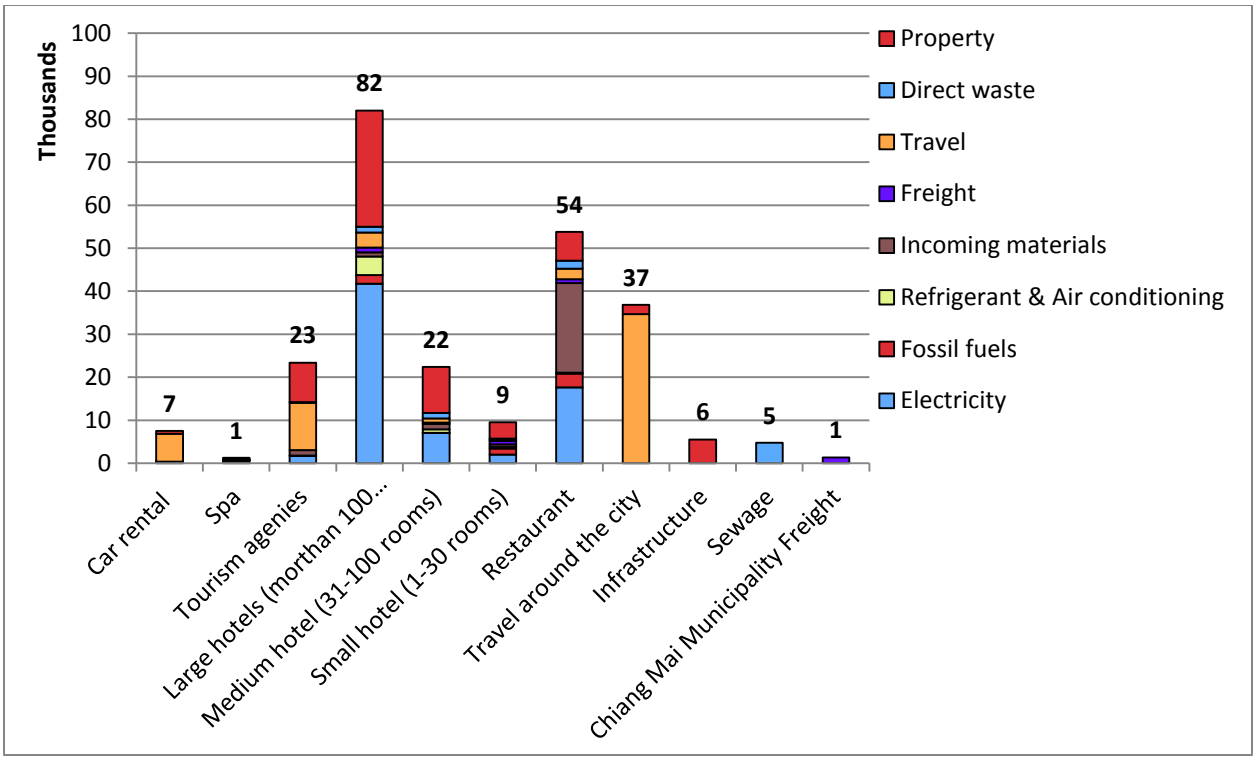

Figure 2:3b: Summary of GHG emissions from the tourism sector categorized by tourism businesses within the administrative area of Chiang Mai municipality in 2011. (Tons of CO_2 equ) **(Excluding travel from other Thai cities and abroad to Chiang Mai)**

3 Recommendation

The recommendation gives some options to mitigate the GHG emission and some low carbon jobs for the local people in tourism sectors within the administrative area of Chiang Mai municipality. The mitigation options are generated from the results of GHG emission analysis. The mitigation options are presented in short term and long term activities. These options probably help to create the "Green tourism in Chiang Mai".

The results from Bilan Carbone analysis show that the travel, electricity and infrastructure and assets are the largest sources of GHG emission related to tourism sector of Chiang Mai municipality respectively. The tourism activities that contribute the most GHG emission in tourism

sector are the large hotels, the restaurants and local transportation respectively in the municipality area. This recommendation also gives some mitigation options for the 3 largest sources in tourism sector.

3.1 Short term options

The options could help to reduce the GHG emission in the short period, so the options should be the easy method to reduce the GHG emissions. The short term options are very important, because the results will be encouraged the people towards the low carbon initiatives. It will help to carry on the long term options to mitigate GHG emission.

3.1.1 Short term mitigation option for electricity

Chiang Mai municipality should establish the “electricity saving award in tourism sector” campaign. This campaign will encourage the tourism activities to reduce electricity used, that will help to reduce GHG emission as well as save the money. So this option is very easy and useful for the first step to reduce the GHG emission in energy consumption. The very important thing in this option is that the Chiang Mai municipality can show the benefit in tourism businesses, and can provide the knowledge about how to minimize the electricity consumption in tourism activities. Obviously, the business units focus on their benefit if they do not see any benefit they will not join the campaign.

3.1.2 Short-term mitigation option for large hotels

The mitigation option for electricity can be used for the large hotels because the larger hotels consume more electricity and contribute more GHG emission. Therefore, this option could encourage the large

hotels to minimize electricity used and reduce the GHG emission from electricity use.

3.1.3 Short term mitigation option for infrastructure and assets

Encourage the tourism businesses to use green furniture. The tourism businesses frequently buy new and comfortable furniture to attract their visitors. The municipality needs to promote the furniture made from recycle materials in the tourism sector. This option can help to reduce GHG emission from the infrastructure and assets. Nevertheless, this also helps to create the green jobs for the local people. The local people can get the job by producing the recycle furniture to sell in the tourism sector.

3.1.4 Short-term mitigation option for travel

The municipality should provide route trip to travel around the city for the travelers. This will help the visitors to travel easily around the city. The municipality should set-up the cooperative for local transports and motivates them to join the cooperative. This will help the local transports to reduce fuel used to find their passengers. Nowadays, the local transport drives around the city spend lot of time to find the passengers, and send them to their destination. This practice of local transport consumes a lot of fuel and produces more GHG emissions.

3.1.5 Short-term mitigation option for restaurant

The food wastes management is a good option for the restaurants. The municipality should encourage the restaurants to manage the food wastes. If the waste can be managed properly the food wastes can be used as feed for the animals such as pigs. This will help to reduce the GHG emission from the direct wastes, furthermore this also generate a profit from selling feed to the farms.

The “electricity saving award in tourism sector” is also helpful to reduce GHG emission in the restaurants. Restaurants consume a lot of electricity in their businesses. This option help to reduce the emission by using electricity and reduce operation cost from using electricity.

3.1.6 Short-term mitigation option for local transportation

The short term option for travel is also used for local transportation. Another one option is that to encourage the local transport to maintain their vehicles properly. This will help to save fuel use in the vehicles and help to reduce the GHG emission. Nevertheless, this option also help to reduce the cost due to reducing fuel used.

3.2 Long-term mitigation

In long term, the green tourism needs to be promoted in the city of Chiang Mai. There are 7 green concepts in green tourism as follows (TAT, 2012):

Green heart:

It relates to people whose hearts have a great passion, faith and care for environment. They do not only think or speak but they “act”

Who: Everybody concerned both directly and indirectly in tourism industry.

How: To be aware and take care of the impact to occur for every tourism activity.

Green activity:

It aims to promote activities friendly to environment.

Who: Tourist and operator providing tourism activities.

How: To operate tourism activities with happiness and care, at the same time create an opportunity to learn and experience about the environment and resource conservation.

Green community

It encourages local tourism communities to be aware of keeping balance between tourism generated benefit and uniqueness of their communities.

Who: Organization, group and persons in the communities in the area which are tourist destinations.

How: To be aware, understand and participate in showing the great power of the community in tourism resource protection and management in the way that it is in harmony with the local life-style.

Green logistics

It refers to transport to any preferred destination base on environmentally friendly concepts.

Who: Tourism transport operators

How: To create options for patterns and modes of travel focus on energy saving and using renewable energy as well as reducing GHG

Green service

It urges tourism service to select natural based material and control their treated waste back to nature

Who: All tourism business operators

How: To provide quality standard services and taking the environment into account in every process of tourism services.

Green attraction

It reinforces the combination of the use of tourist attractions for tourism business purposes and maintaining their local environment by means of quality management.

Who: Owner of tourist attraction, organizations that are responsible for tourist attractions.

How: To manage tourist attractions with the main aim to create sustainability of tourism resource.

Green plus

It focuses on giving back to society by assuming greater responsibility for the environment through their choices of activities.

Who: Everyone

How: Do not wait for the opportunity to save the world from the changing situation but create the opportunity to take care the world continually.

This could be the future picture of tourism sector in the city of Chiang Mai. All people, who involve with tourism sector to mitigate GHG emission, will care the environment.

4 Conclusion

Bilan Carbone tool presents that the GHG emission from tourism sector of Chiang Mai municipality is around **4,417,510** tons of CO_2 equ. Travel sector is the largest source that generates the most of GHG emissions (4,228,702 tons of CO_2 equ). This sector covers both internal city travel as well as travel from other Thai city & abroad to Chiang Mai by plane, bus and train. Two other sources which contribute most of GHG

emissions in tourism sector are the electricity used and infrastructure and assets respectively.

The large hotel is the major tourism business that produces the most of GHG emissions compared with other activities in the Chiang Mai municipality. The restaurant is the second business which share most GHG emissions in the tourism sector. The third business which contributes most of GHG emission is local transportation.

The results from this study are very useful for the next step to find the GHG emissions mitigation options. The outputs of this research can be used to plan for the low carbon tourism initiatives in the administrative area of Chiang Mai municipality. Furthermore, this study also helps to recommend green jobs in tourism sector for the local people.

5 Reference

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Website

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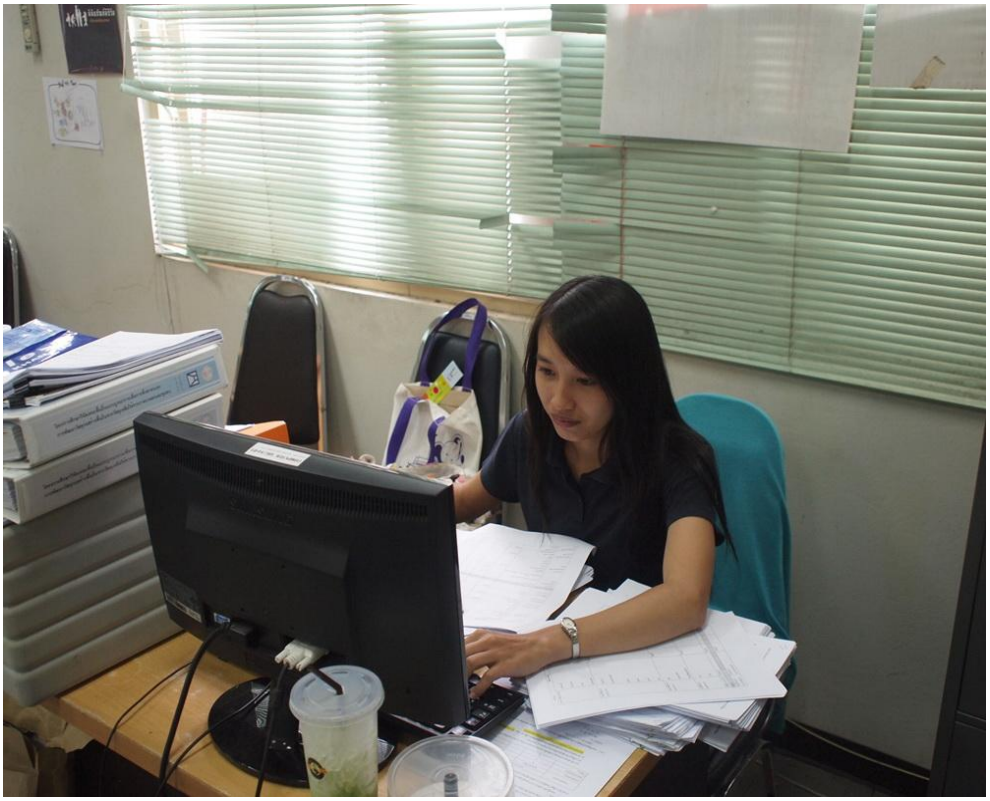
APPENDICES

Appendix A: Pictures

Data collection at car-rental-shop

Compiling data for Bilan Carbone Input



Data input process

Group discussion

Appendix B:

1. Energy 1 (Fossil Fuels and Electricity)

This source covers: Direct use of fuels, of fossil or organic origin (bio-fuels) for heating, industrial processes or the production of electricity for the entity's own use

Item	Require Data/units/year	Data units/year	Remarks
Direct accounting of fuels			
1. **Fossil fuels**, fixed sources	**Fuel** *(tonnes/KW.h/Toe/litters)* **Diesel oil** **Petrol** Natural gas Domestic fuel oil **LPG (Liquefied Petroleum Gas)** Cooking coal (PCS>23,865 kJ/kg) Coal (PCS>23,865 kJ/kg)		
2. Fuels of **organic origin,** fixed sources	**Fuel** *(tonnes/KW.h/Toe/litters)* Bark, sawdust, ground straw @ 30% hum. Forestry chips @40% hum. Straw @10% humidity		
Purchases of electricity			
1 - Electricity purchased, average by country	**Country of the electricity consumption** Thailand or Vietnam *(KW.h)*		

2. Excl energy 1 (Activities excluding use of energy)

Chemical reactions other than combustion for energy purpose, for eg. Decarbonation by cement manufactures; flaring gases by refiners; N2O emission by nitrogenous fertilizers used and Air-conditioning.

Example: Types of process concern
Construction material production (carbon removal)
Petrochemicals (flare pits, etc.)
Sanitation (decomposition)

Item	Require Data/units/year	Data units/year	Remarks
CO_2 emissions excluding energy	*(tonnes/year)* CO_2 excluding the use of energy		
N_2O emissions by nitrogenous fertilizers used, animal farming and other activities			
1 - N_2O emissions, weight of N in fertilizers	*(tonnes/year)* Nitrous oxide		
2-N_2O emissions from animals	*(Number of animals)* Bulls; Goats; Billy goats; Grazing lambs draught horses		
3 - Other N_2O emissions	*(tonnes/year)* Nitrous oxide		
Methane emissions Methane (CH4) emissions concern essentially: • The farming of animals • The use of solid (coal) or liquid (oil and gas) hydrocarbons, • The processing of fermentable waste (miscellaneous organic waste, including products manufactures from organic matter, such as paper, cardboard, natural textiles, etc.)			
1 - Methane emissions from animals	*(Number of animals)* Bulls; Goats; Billy goats; Grazing lambs draught horses		
2 - Other methane emissions	*(tonnes/year)* Methane		

Kyoto halocarbon emissions For example (R134a or R404a): Building's air conditioning circuit, or a cooling installation to preserve food. These installations often have small leaks. Types of process concern for HFC PFC: Cold chain Alumina electrolysis emissions Semi-conductor industry Types of process concern for SF6 Double glazing Manufacture of electrical equipment			
1 - Kyoto halocarbons	*(tones/year)* R134a/R407/R410a/		
Gas excl. Kyoto			
1-Gas excl. Kyoto	*(tonnes/year)* **R22 - HCFC excl. Kyoto** R408a -HCFC excl. Kyoto		

3. Inputs: Materials, products and services purchased
Materials used for own consumption and production in the company, such as chemical or reactive products, paper, toner cartridges, plastics, metals, glass, food products & used by the company restaurant etc. This table only counts the raw materials, consumables and purchases that are directly incorporated into production.

Item	Require Data/units/year	Data units/year	Remarks
Metals	*(tonnes/year) and (% from recycled mate.)* Aluminum; Copper(Ave); Lead (Ave) Zinc (Ave); Nickel (Ave)		
Plastics	*(tonnes/year) and (% from recycled mate.)* PET; High density polyethylene PET plastic films not recyclable; PVC		
Glass	*(tonnes/year) and (% from recycled mate.)* Flat Glass; Bottle Glass; Glass Jars (Ave		
Paper, cardboard	*(tonnes/year) and (% from recycled mate.)* Paper Cardboard		
Building materials - INIES	*(Need to select units e.g. m², ml, tone)* Masonry wall in concrete blocks Beam in prestressed concrete Simple skin steel cladding Quarry-stones		
Building materials - bulk	*(tones used and % suppl. for implementation)* Emulsion gravel, Cement, Concrete		
Chemical products & synthetic fabrics	Nylon Insecticides, per ton of active ingredients		
Agriculture Food consumption and production inside the urban area related to tourism activities			
Agricultural products	*(tones used and % suppl. for implementation)* Fish; Beef; Shrimp; Pork; Chicken; Flour; Bread; Palm oil; Sunflower oil; Cow's milk; Butter; Cheese; Yoghurts; Sugar; Eggs		Food consumption inside local authority (Hotel or Restaurant)
Evaluation based on meals	(Number of meals) Typical meal Vegetarian meal Meal mostly vegetable (with chicken) Meal mostly vegetable (with beef) Classical meal (with chicken)		

Item	Require Data/units/year	Data units/year	Remarks
	Classical meal (with beef) Meal mostly animal (with chicken) Meal mostly animal (with beef)		

Use of monetary ratios

The purchase of small goods (such as pens, folders, etc.), office consumables (ink cartridges, toners, etc.) and tertiary services (excluding transport). Tertiary services might be advertising, non equipment IT expenses (software purchases, operations by service companies, etc.), telephone bills, insurance premiums, expenses for accountants, accounts commissioners and lawyer's fees, expenses for all types of consulting, expenses for caretaking, reception and cleaning staff, etc..

Inputs accounted for by value, 1	(*K-euros spent and % suppl. for implementation*) Services with low level of equipment Services with high level of equipment IT and consumables		
Inputs accounted for by value, 2	(*K-euros spent and % suppl. for implementation*) Services with low level of equipment Services with high level of equipment IT and consumables		
Wood e.g. furniture and other goods made of woods which should be less then 10 years old	*(tones used)* Construction Timber		

4. Freight (Transporting goods)

Item	Require Data/units/year	Data units/year	Remarks
Internal road freight			
1 - Internal road freight, transport owned	**Fuel** *(tonnes/KW.h/Toe/litters/)* Diesel oil Petrol Natural gas Domestic fuel oil LPG (Liquefied Petroleum Gas) Heavy fuel oil; Coal (PCS>23,865 kJ/kg)		
2- Internal road freight, **vehicles.km**	*(vehicles.km)* - < 1.5 t petrol - 1.5 - 2.5 tonnes petrol - 2.6 - 3.5 tonnes petrol		
2b - Internal road freight, **tonnes.km**	*(tonnes.km)* MATW category - < 1.5 t petrol - 1.5 - 2.5 tonnes petrol - 2.6 - 3.5 tonnes petrol		
3-Internal freight on 2 wheels, **vehicle.km**	*(vehicle.km)* mopeds 50 cm3 motorcycles >or= 125 cm3 motorcycles < 125 cm3		
Outgoing road freight			
1 - Outgoing road freight, **vehicles owned**	**Fuel** *(tonnes/KW.h/Toe/litters/)* Diesel oil Petrol Natural gas Domestic fuel oil LPG (Liquefied Petroleum Gas)		

Item	Require Data/units/year	Data units/year	Remarks
	Heavy fuel oil Coal (PCS>23,865 kJ/kg)		
2. Outgoing road freight, **vehicles.km**	*(vehicle.km)* MATW category - < 1.5 t petrol - 1.5 - 2.5 tonnes petrol - 2.6 - 3.5 tonnes petrol		
2b - Outgoing road freight, **tonnes.km**	*(tonnes.km)* MATW category - < 1.5 t petrol - 1.5 - 2.5 tonnes petrol - 2.6 - 3.5 tonnes petrol		
3 - Outgoing freight on **2 wheels, vehicle.km**	*(Number of km)* mopeds 50 cm3 motorcycles < 125 cm3 motorcycles >or= 125 cm3		
Incoming road freight			
1 - Incoming road freight, lorries owned, direct accounting of fuel	**Fuel** *(tonnes/KW.h/Toe/litters/)* Diesel oil Petrol Natural gas Domestic fuel oil LPG (Liquefied Petroleum Gas) Heavy fuel oil Coal (PCS>23,865 kJ/kg)		
2 - Incoming road freight, calculation based on **vehicles.km**	*(vehicles.km)* - < 1.5 t petrol - 1.5 - 2.5 tonnes petrol - 2.6 - 3.5 tonnes petrol		
2b - Incoming road freight, calculation based on **tonnes.km**	*(No of Tones km)* MATW category - < 1.5 t petrol - 1.5 - 2.5 tonnes petrol - 2.6 - 3.5 tonnes petrol		
3 - Incoming freight on **2 wheels:** calculations based on **vehicle.km**	*(on vehicle.km)* mopeds 50 cm3 motorcycles < 125 cm3 motorcycles >or= 125 cm3		

5. Travel (Transporting people)

Item	Require Data/units/year	Data units/year	Remarks
Home-work travel			
1 - Home-work: fuel supplied or reimbursed (means of transport owned)	**Fuel** *(tonnes/KW.h/Toe/litters/)* **Diesel oil** Petrol Natural gas Domestic fuel oil LPG (Liquefied Petroleum Gas) Heavy fuel oil Coal (PCS>23,865 kJ/kg)		
2 - car, home - work: calculation based on **number of cars** and location of driver's home	*(Number of car used and location distance)* rural periphery town centre		
3 - car, home - work:	*(Vehicle km travel)*		

calculation based on number of **vehicle.km** and location of driver's home	rural periphery town centre		
4 - car, home - work: calculation based on fiscal ratings for **petrol passenger** vehicles	*(Vehicle km travel and types of journey)* -Taxable horse power (HP) 3,4, 5, 6, 7, 8, 11 above		
4b - car, home - work: calculation based on fiscal ratings for **diesel passenger** vehicles	*(Vehicle km travel and types of journey)* -Taxable horse power (HP) 3,4, 5, 6, 7, 8, 11 above		
5 - Bus & coach, home-work: calculation based on **vehicle.km**	*(vehicle.km)* Minibus Urban bus, Interurban coach		
5b - Bus & coach, home-work: calculation based on **person.km**	*(person.km)* Minibus Urban bus, Interurban coach		
5c - Bus & coach, home-work: calculation approached based **on number of users**	*(Number of people and average journey)* Minibus Urban bus, Interurban coach		
6 - 2-wheelers, home-work: calculations based on **vehicle.km**	*(Number of vehicle km*) motorcycles >or= 125 cm3 motorcycles < 125 cm3 mopeds 50 cm3		
Travel by employees in the context of work - car			
1 - car travel in the context of work, vehicles owned or operated by the organisation, fuel purchases	**Fuel** *(tonnes/KW.h/Toe/litters/)* **Diesel oil** Petrol Natural gas Domestic fuel oil LPG (Liquefied Petroleum Gas) Heavy fuel oil Coal (PCS>23,865 kJ/kg)		
2 - car travel in the context of work: calculation based on fiscal ratings for **petrol passenger** cars	*(Vehicle km travel and types of journey)* -Taxable horse power (HP) 3,4, 5, 6, 7, 8, 11 above		
2b - car travel in the context of work: calculation based on fiscal ratings for **diesel passenger** cars	*(Vehicle km travel and types of journey)* -Taxable horse power (HP) 3,4, 5, 6, 7, 8, 11 above		
3 - car travel in the context of work: calculation based on **kilometers travelled**	*(km travel)* urban area, rush hours urban area, other cases Mixed travel		
Travel by employees in the context of work - other road methods			
1 - Bus & coach	*(vehicle.km)*		

travel by employees: calculation based on **vehicle.km**	Minibus Urban bus, Interurban coach		
2 - Bus & coach travel by employees: calculation based on **person.km**	*(person.km)* Minibus Urban bus, Interurban coach		
3 - 2-wheeler travel by employees: calculations based on vehicle.km	*(Number of vehicle km*) motorcycles >or= 125 cm3 motorcycles < 125 cm3 mopeds 50 cm3		
Travel by employees in the context of work - **plane**			
1 - Travel by employees in planes owned or operated by the organisation, fuel purchases	**Fuel** *(tonnes/KW.h/Toe/litters/)* Natural gas; Domestic fuel oil; Diesel oil Heavy fuel oil; Coal (PCS>23,865 kJ/kg) Kerosene		
2 - Plane travel by employees, **passengers.km**	*(Cumulative distance km)* Long-haul in First Class Long-haul in Business Class Short-haul in 2nd Class Short-haul in 2nd Class		
3 - Plane travel by employees: approximate calculation based on **number of journeys**	*(Number of journey)* Long-haul in First Class Long-haul in Business Class Short-haul in 2nd Class Short-haul in 2nd Class		
Travel by visitors - all methods (here visitors are tourist who come from outside or abroad)			
1 - visitors in method owned or operated: **fuel accounting**	**Fuel** *(tonnes/KW.h/Toe/litters/)* Natural gas; Domestic fuel oil; Diesel oil Heavy fuel oil; Coal (PCS>23,865 kJ/kg) Kerosene		
2 - visitors by **car**	*(Km traveled)* urban area, rush hours urban area, other cases Mixed travel		
3a - visitors by **bus** and coach, **passengers.km**	*(passengers. Km)* Minibus Urban bus, Interurban coach		
3b - visitors by bus and coach, **vehicles.km**	*(vehicles.km)* Minibus Urban bus, Paris region Interurban coach		
4 - visitors by **2-wheelers**	*(Number of vehicle km*) motorcycles >or= 125 cm3 motorcycles < 125 cm3 mopeds 50 cm3		
5 - visitors by plane, **persons.km**	*(total persons.km)* Long-haul in First Class Long-haul in Business Class Short-haul in 2nd Class Short-haul in 2nd Class		
6 - visitors by plane, **number of journeys**	*(total number of journeys)* Long-haul in First Class Long-haul in Business Class		

	Short-haul in 2nd Class Short-haul in 2nd Class		
8 - visitors by train not owned, km	*(cumulative distance km)* Train in France, average Train in France, TGV Train en France, regional express train		

6. Direct Waste (Waste produced by the activities) it corresponds to emission cause by end of life processing such as incineration, dumping, biological processing or recycling of the waste that may find directly in dustbins as well as the waste that is generated by the fermentation of wastewater.

Item	Require Data/units/year	Data units/year	Remarks
Non-hazardous waste			
Materials from TPS utilization	*(tonnes/year)* Food waste Plastic Paper Glass Metals; *Miscellaneous*		
Materials incinerated	*(tonnes/year)* Metals; Cardboard; Paper; Glass		
Biological treatment of fermentable waste	*(tonnes/year)* All waste		
Metals **recycled or reused**	*(tonnes/year or % of recycle mate.)* Steel or sheet metal		
Plastics **recycled or reused**	*(tonnes/year or % of recycle mate.)* PVC		
Glass **recycled or reused**	*(tonnes/year or % of recycle mate.)* Bottle glass		
Paper/cardboard **recycled or reused**	*(tonnes/year or % of recycle mate.)* Cardboard Paper		
Hazardous waste (It is product with a specific level of chemical, biological or radiological toxicity e.g. batteries, old solvents, old lubricants, etc)			
Dangerous waste	*(tonnes/year)* Stabilization and storage		
End of life non-energy emissions or leaks Kyoto gas	*(tonnes/year)* CO2 excluding the use of energy Nitrous oxide Methane excl. TPS R134a; R407c; SF6		
End of life non-energy emissions or leaks Gas excl. Kyoto	*(tonnes/year)* R408a -HCFC excl. Kyoto R22 - HCFC excl. Kyoto R22 - HCFC excl. Kyoto		
Sewage (if the tourism activities have a significant amount of organic rejects in the form of wastewater then it will release methane gases)			
sewage - method by BOD weight	(Kg. BOD/year) sewage		

7. Property (The manufacture of durable goods used by the entity)
It is also called fixed assets Manufacture of which leads to GHG emissions in the same way as for all production of materials.

Item	Require Data/units/year	Data units/year	Remarks
Buildings			
1 - buildings, method by **surface areas**	*(Surface area m² and Amort period (year))* Offices (concrete) education (concrete) Dwellings		Emission can be calculated by surface area or weight of materials uses during

Item	Require Data/units/year	Data units/year	Remarks
	leisure health (concrete)		construction.
2 - Buildings, fuels on construction site	**Fuel** *(tonnes/KW.h/Toe/litters/)* Diesel oil; Natural gas; Petrol for land engines		
3 - buildings, INIES materials	*(Surface area m2, supplement and Amort period (year))* Masonry wall in concrete blocks; Plaster panels; Homogeneous PVC floor covering		
4 - Buildings, bulk materials	*(Tones used, supplement and Amort period (year))* Cement Construction timber Gravel/cement mix		
5 - Buildings, metals	*(Tones used, % of recycled material used, supplement and Amort period (year))* Aluminium Steel or sheet metal Copper – average		
6 - Building, plastics	*(Tones used, % of recycled material used, supplement and Amort period (year))* Low density polyethylene - PET - PVC - Plastic Ave		
7 - Building, glass	*(Tones used, % of recycled material used, supplement and Amort period (year))* Technical glass - average Flat glass Glass fibre - average		
Construction timber	*(Tones used and Amort period (year))* Construction timber		
Roads, railways, car parks, ports and miscellaneous infrastructures			
2 - roadway, approximation by type and length of road	*length and width(meter*) *Amort period(year)* C2 or "normal" parking area TC7 TC6		
2b - metal crash barriers, approximation by type and length of road	*length(meter*) *Amort period(year)* TC5 TC7 TC6		
3 - infrastructures, road materials	*(Tones used, supplement and Amort period (year))* Hot in-place recycling (HIR) Short life timber Construction timber **(can select 25 options)**		
Vehicles, machines and tools			
1 - vehicles, tools & machines, method by weight	*(Tones used and Amort period (year))* Vehicles Machines Furniture		
IT (It calculates the number of computers (including laptops) and peripherals (printers, scanners, etc.) owned or rented by company and also account manufacture date of the products) (Note: Amort period should be in between 5 years)			
1 - IT, method by	*(Number of device and Amort period (year))*		

Item	Require Data/units/year	Data units/year	Remarks
units	Photocopiers PC with flat screen Printers Fax machines Computer with cath. tube		
2 - IT, method by prices	*(Keuros spent and Amort period (year))* Amount of purchases		