Asia-Pacific Economic Cooperation

APEC Low Carbon Model Town (LCMT) Project Dissemination Phase 1

FINAL REPORT

APEC Energy Working Group

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LCMT PROJECT DISSEMINATION PHASE 1

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Executive Summary

1. What is the APEC LCMT Project Dissemination

The APEC Low-Carbon Model Town (LCMT) Project Dissemination Phase 1, which succeeds LCMT Project Phases 1-7, seeks to accelerate the dissemination of low-carbon towns in order to manage rapidly growing energy consumption in the APEC region.

The key activities are: 1) to hold the 2nd LCMT Symposium for the dissemination of the "Concept of the Low-Carbon Town in the APEC Region (Concept)" through utilizing APEC Low-Carbon Town Indicator (LCT-I) System; and 2) to conduct Feasibility Studies for a specific area of three towns participated as the LCT-I volunteer towns in the 1st LCMT Symposium in the LCMT Project Phase 7. The nominations of the LCT-I volunteer towns are on a voluntary basis and three LCT-I volunteer towns are planned to be selected through the EWG.

The key objectives of the project are:

1) To disseminate the basic ideas and effective approaches of the Concept through utilizing the LCT-I System, which helps evaluate the progress and status of low-carbon development of various areas in the APEC region;

2) To provide Feasibility Studies of a specified area of low-carbon development projects selected as the LCT-I volunteer towns in the LCMT Project Phase 7 and identify how to improve the low-carbon development plans through the Feasibility Studies; and

3) To share best practices and real-world experiences of low-carbon town design with planners and policymakers throughout the APEC region.

Source: APEC Homepage

2. Scope of Work

This project will be undertaken according to the following procedure.

Prepare Low-Carbon Development (LCD) Strategy for the three volunteer towns' Low-Carbon Town development projects.

1) Background research and data collection
2) Develop a high-level Low-Carbon vision
3) Define the CO_2 emission baseline as BAU (Business As Usual) Scenario
4) Define comprehensive, specific and feasible Low-Carbon measures

Analyze CO2 emission reduction and costs for selected design measures.

5) Perform scenario analysis of implementation alternatives and Analyze CO2 reduction efficiency

Study the implementation methodology and action plans of proposed CO2 reduction measures

6) Identify regulatory agencies and approval process and Develop the business model required for Low Carbon Methodologies in three volunteer towns
7) Analysis financial efficiency of Low Carbon Business Model in three volunteer towns

3. Overview of three Volunteer town

As shown in the figure below, this project will conduct Feasibility Study for three volunteer town in one city in Indonesia and two cities in Malaysia.

Fig. 1-1. Location of Three Volunteer Town
Source: NSRI

3.1 Banda Aceh City of Indonesia

Aceh Province, Indonesia is located on the island of Sumatra on the northwestern tip of Indonesia. The province rose to international prominence after December 26, 2004 when an earthquake of a magnitude of 9.0 on the Richter scale occurred at approximately 150 km off the northern western tip of the island of Sumatra triggering tsunami that hit Aceh Province. The event caused casualties of hundreds of thousands of people and destroyed over 60% of city's buildings.

Banda Aceh is the capital city of Aceh Province. It is located at the mouth of the Aceh River. Banda Aceh Municipality consists of 9 districts. The 9 districts comprises of 90 villages which are known as 'Gampong' (Indonesian Law No.11 concerning Government of Aceh). With the total area of 61,36km (Banda Aceh Dalam Angka, 2016) located on an average altitude of 0.80 m above sea level.

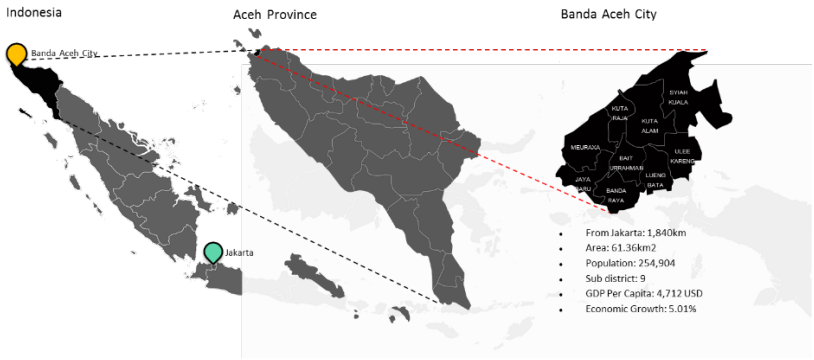


Fig. 1-2. Location of Banda Aceh City
Source: NSRI

Banda Aceh City has four areas Ulee Lehue, Keudah Social Housing (Rusunawa) and BNI Trembesi city forest, Alue Naga and Gampong Jawa as the target area this time.

3.2 Shah Alam City Center Section 14, Selangor of Malaysia

Shah Alam is the state capital of Selangor, Malaysia. It is situated within the Petaling District and a small portion of the neighboring Klang District. Shah Alam was opened in 1963 with the purpose of making it the new administrative center of Selangor.

Shah Alam replaced Kuala Lumpur as the capital city of the state of Selangor in 1978 due to Kuala Lumpur's incorporation into a Federal Territory in 1974.

Generally Shah Alam can be divided into three parts, North, Central and South parts. There are 56 Sections in total. North Shah Alam consists of 18 Sections including Sections U1 and U2 and Kampung Melayu Subang. The Central Shah Alam is where all the state administrative buildings and agencies are situated. It consists of Section 1 until Section 24. While South Shah Alam consists of 12 Sections including Section 25, Section 30, Section 31 and Section 32

Fig. 1-3. Location of Section 14
Source: NSRI

3.3 City of Hang Tuah Jaya, Melaka of Malaysia

Hang Tuah Jaya is a satellite city for Melaka City which is also the new administrative center of Melaka since June 2006. The Hang Tuah Jaya administrative center is located about 15 km from the center of Melaka. This area is located under the Hang Tuah Jaya Municipal Council.

Hang Tuah Jaya covers an area of 144.61 square kilometers, being part of three districts, namely Melaka Tengah , Alor Gajah and Jasin.

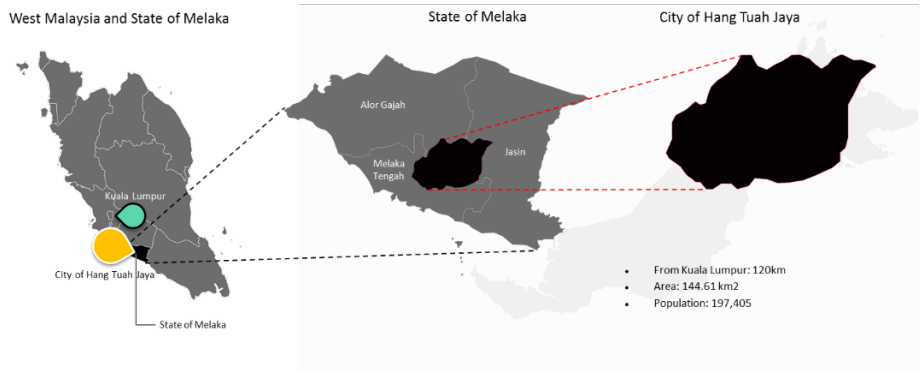


Fig. 1-4. Location of Hang Tuah Jaya
Source: NSRI

4. Principles and Methodologies of Feasibility Study

The study conducted by NSRI suggests that all the 3 volunteer towns have been selected as the pilot projects in their countries and have already implemented low carbon measurements in their development.

This study will develop based on the existing low carbon initiatives, but also take advantage of NSRI's experiences.

The basic concepts for 3 volunteer towns are including:

1) Environmental, social and economic aspects should be comprehensively stressed in the study
2) The plan and business model that consider all the stake holders are vital
3) The vision should both consider the local features and their expansion
4) Design, implementation and operation

The vision for low carbon development in the three volunteer towns will be developed in as the following chart, based on their common issues and features.

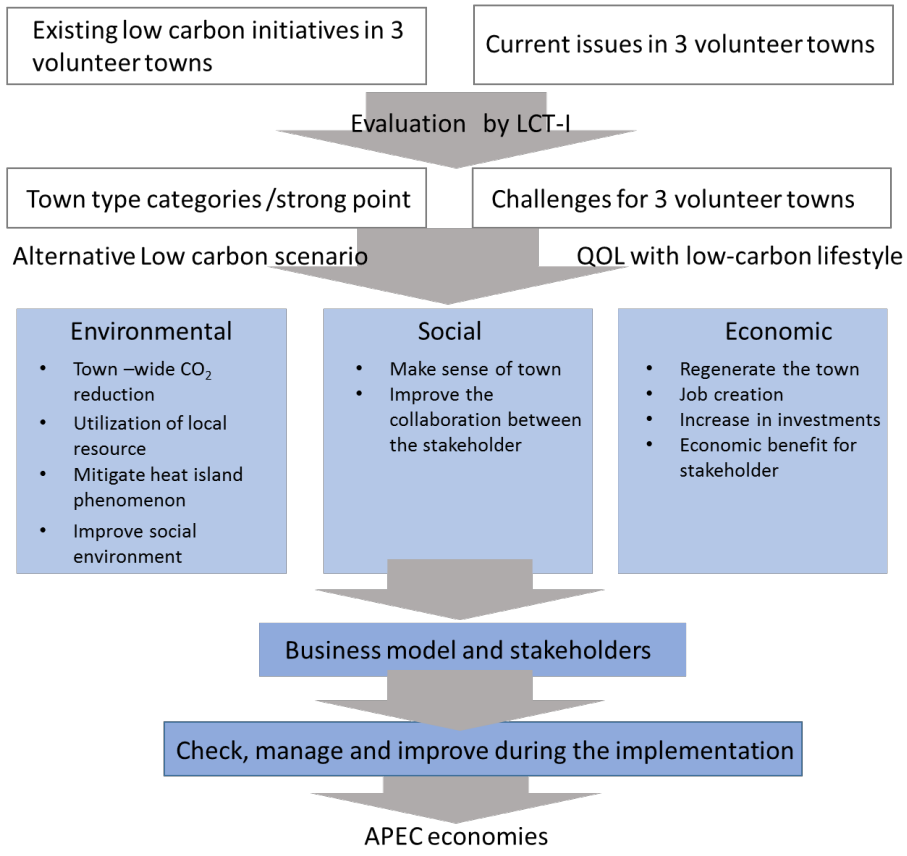


Fig. 1-5. Vision of this study
Source: NSRI

5. Low-Carbon scenario for Three Volunteer Town

1) Banda Aceh City of Indonesia

Concept

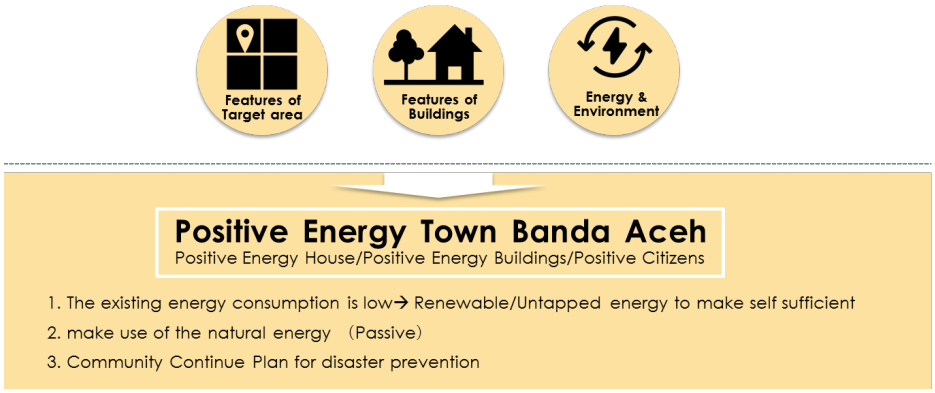


Fig. 1-6. Low-Carbon Concept for Banda Aceh
Source: NSRI

The main concept for Banda Aceh is “Positive Energy town”, which means the energy generation are more than energy consumption. It is implemented by the plan of community based on Community based Micro Grid with Distributed energy resource

Community are the basic unit for the town that the whole town is consisted with different kind of community, the communities in the CBD area, seaside and inland. Every community has their own grid with formed by domestic grid or utility grid. The town is formed by these grid.

The proposals for every micro grid include the energy conservation methods for the types in that communities to lower the energy consumption first. Secondly, the potential renewable energy, untapped energy will be proposed as the onsite distributed energy resource both for carbon reduction in the normal time and also the BCP in the disaster time. Finally, the management for the optimization of the demand and the supply side.

In this research, the four targets areas are located in communities of the coastal area with different features of building. The low carbon measures are proposed according to the concept above.

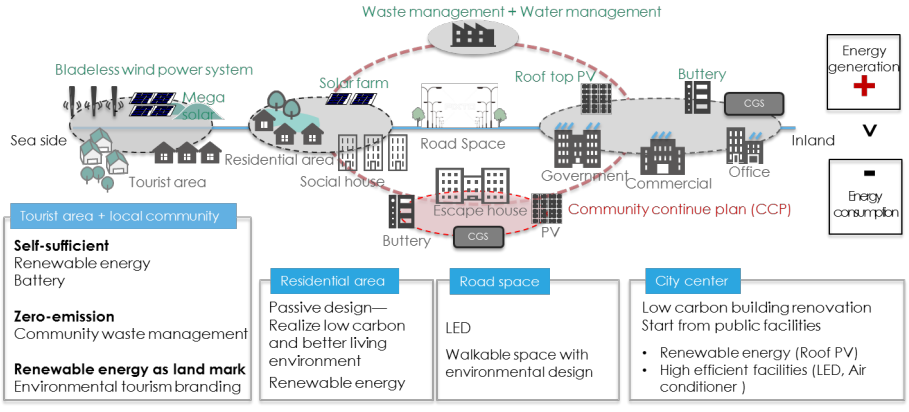


Fig. 1-7. Image of Micro Grid for Target Area
Source: NSRI

The Low-Carbon Effect - Building

As the technical plan scenario set as Table. 1-1, all target areas can reduce around 43% carbon emission in 2030 and 60% in 2040, compared with BAU.

Table. 1-1. Low-Carbon scenario for target areas

Target area	short-term	long-term
Ulee Lheue	**Urban development:** Develop the port part and the station centered community **Low carbon method:** • Short –term Building energy conservation methods • Bladeless wind power system • Roof PV for Commercial Buildings • Energy management system	**Urban development:** Develop the community **Low carbon method:** • Long –term Building energy conservation methods • Roof PV for Community • LPG cogeneration system in escaped house • Area energy management system • Co-generation system
Keudah Social Housing (Rusunawa) and BNI Trembesi City Forest – Peulangghan	• Short –term residential energy conservation methods • Roof PV for social house • Develop community Eco-education activity in City Forest	• Long –term residential energy conservation methods • PV system with the landscape design in the city forest • Demonstration eco facility model in the city forest for eco education • AEMS
Alue Naga, Kecamatan Syiah Kuala	**Urban development:** Develop the costal area **Low carbon method:** • Short –term Building energy conservation methods • Bladeless wind power system • Float PV • Energy management system	**Urban development:** Develop the community **Low carbon method:** • Long –term Building energy conservation methods • Roof PV for Community • LPG cogeneration system in escaped house • Area energy management system • Co-generation system
Gampong Jawa, Juta Raja District	Biomass power plant	
Whole City	50% of the road lamp change to LED	All the road lamp change to LED

Source: NSRI

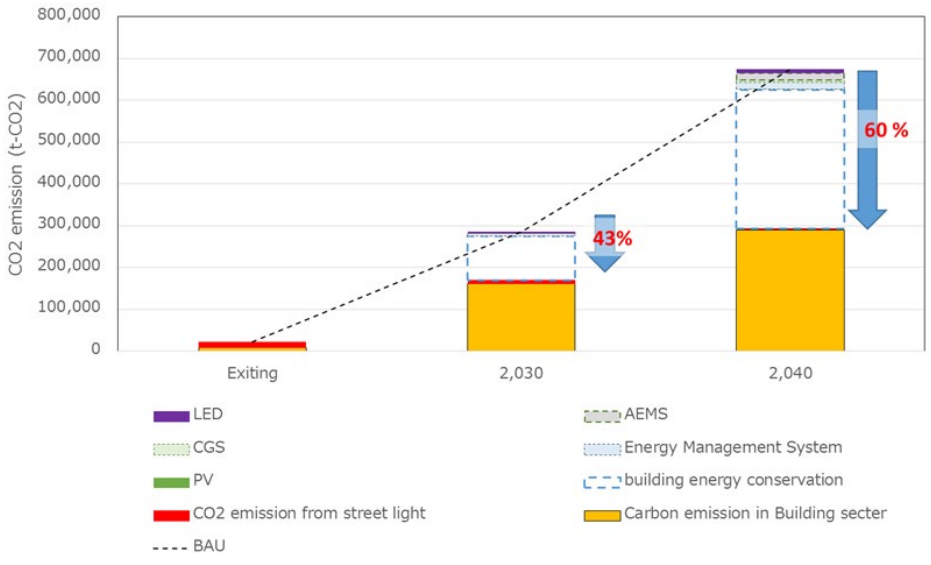


Fig. 1-8. Low-Carbon Effect - Building

Source: NSRI

The Low-Carbon Effect - Transportation

he scenario is set based on the five policies such as the introduction of BRT and Loop buses, environment-friendly cars, maintenance of bicycle lane, construction of IoT platform, estimated CO2 reductions by 2040 respectively.

Among these CO2 reduction measures, it became clear that introducing BRT is most contribute. The total reduction rate of other reduction measures was about 60% of the total in the case of the scenario set this time. Therefore, it is important not only to introduce BRT, but also to tackle CO2 reduction through a comprehensive approach including other measures promoting the use of public transportation and Electric vehicle.

We estimated the CO2 emissions in 2018 (BAU) to be 3,061 t-CO2 per year as follows. Although it will be 172,998 t-CO 2 considering the increase rate of automobile by 2040, it can be expected to be reduced to 83,910 t-CO 2 (48% reduction) by promoting the use of public transportation.

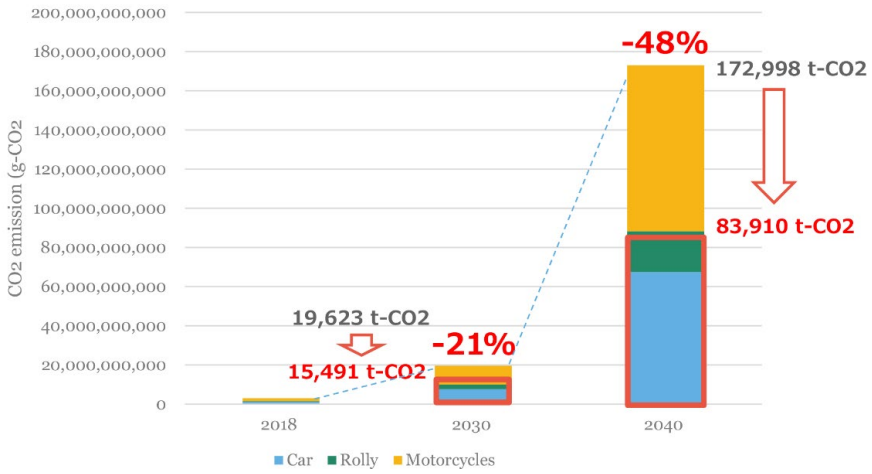


Fig. 1-9. Low-Carbon Effect - Transportation
Source: NSRI

2) Shah Alam City Center Section 14, Selangor of Malaysia

Concept

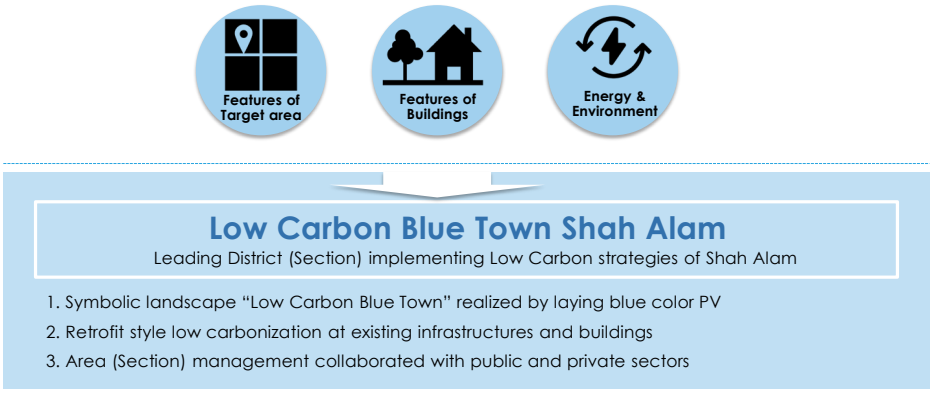


Fig. 1-10. Low-Carbon Concept for Shah Alam City Center Section 14
Source: NSRI

The main concept for Shah Alam City Center section14 there are 3 concept. The first concept is symbolic landscape "Low Carbon Blue Town" realized by laying blue color PV. The second concept is retrofit style low carbonization at existing infrastructures and buildings. The third concept is Area (Section) management collaborated with public and private sectors.

A more specific graphic concept is shown in Figure 1-14. In building sector, we propose roof top PV, low carbonization of buildings, floating PV on pond and CGS. In transportation sector, we proposed TOD, EV circulation bus, and ICT platform for AEMS, MaaS. Detailed methods will be described later.

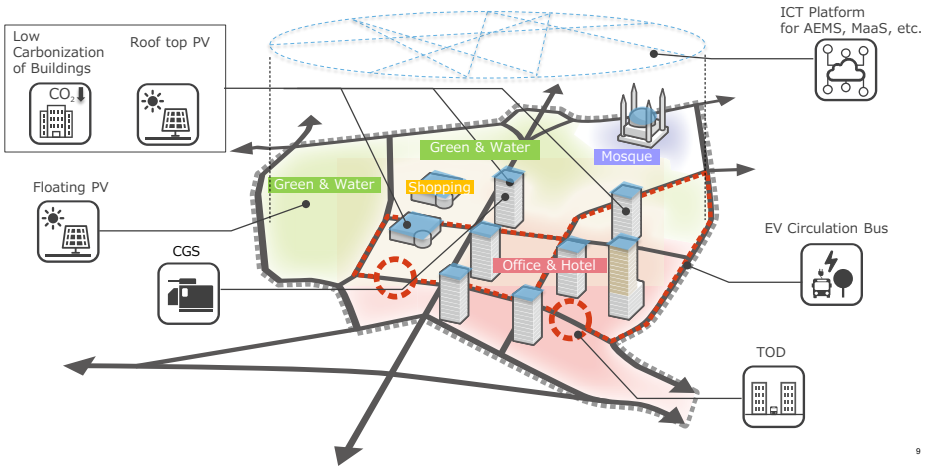


Fig. 1-11. Image of Low-Carbon Concept Shah Alam City Center Section 14
Source: NSRI

The Low-Carbon Effect - Buildings

It is important for low carbonization to reduce energy consumption by saving as much energy as possible as well as creating energy. In order to achieve low carbonization, the following method can be used.

- High efficiency fan and inverter fan.
- PV on roof (PV supply generated electricity into building.)
- LED lighting
- Illuminance correction
- Lighting Human Sensor
- Total heat exchanger
- CO2 control ventilation and High efficiency fan
- EMS (Energy management system),
- CO control of parking fans
- Glass performance improvement.
- COP improvement & Inverter refrigerator
- Inverter pomp

Table. 1-2. Implementation plan of other low carbon technologies

Tier 1	Tier 2	Low carbon measurements	Mid-term (2030)		Long-term	
			Low carbon methods	Conservation ratio (%)	Low carbon methods	Conservation ratio (%)
Supply	Area energy system				●	5%
	Renewable energy	PV (govwerment building)	●			
		PV (all)			●	
	Multi energy system	CGS			●	5%
Demand and Supply	Energy Management System		●	5%		
Government	Policy Framework					
	Education & Managem	Local rule/guideline for low carbonization			●	

Source: NSRI

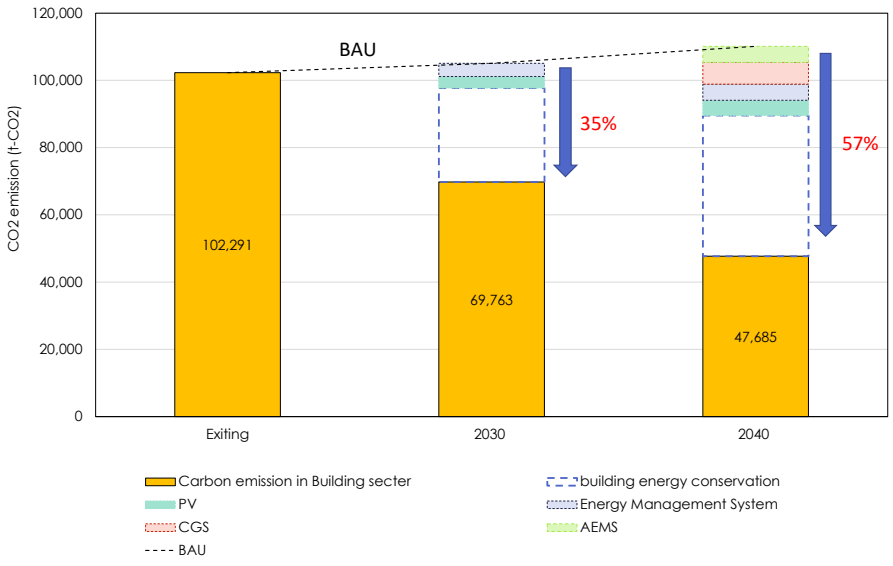


Fig. 1-12. Low-Carbon Effect - Buildings

Source: NSRI

The Low-Carbon Effect - Transportation

The scenario is set based on the five policies such as the introduction of BRT and Loop buses, environment-friendly cars, maintenance of bicycle lane, construction of IoT platform, estimated CO2 reductions by 2040 respectively.

Among these CO2 reduction measures, it became clear that introducing BRT is most contribute. The total reduction rate of other reduction measures was about 60% of the total in the case of the scenario set this time. Therefore, it is important not only to introduce BRT, but also to tackle CO2 reduction through a comprehensive approach including other measures promoting the use of public transportation and Electric vehicle.

We estimated the CO2 emissions in 2018 (BAU) to be 108,701 t-CO2 per year as follows. Although it will be 190,852 t-CO 2 considering the increase rate of automobile by 2040, it can be expected to be reduced to 130,428 t-CO 2 (31% reduction) by promoting the use of public transportation.

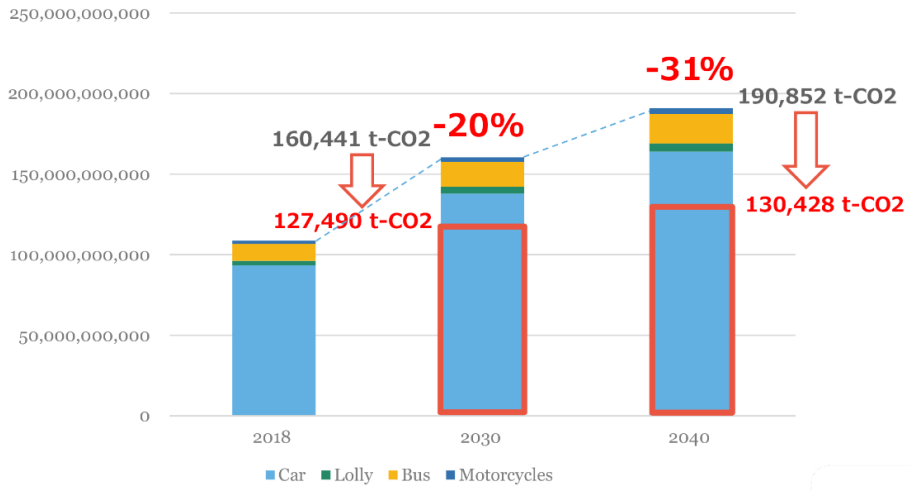


Fig. 1-13. Low-Carbon Effect - Transportation
Source: NSRI

3) Hang Tuah Jaya, Melaka of Malaysia

Concept

The main concept for Hang Tuah Jaya there are 3 concept. The first concept is integrate urban functions around TOD station, strengthening the urban network between surrounding tourism destinations. The second concept is introduce green infrastructure and improve low carbonization. The third concept is Construct an ICT platform and promote data-driven towns.

A more specific graphic concept is shown in Figure 1-17. As Town and transportation measures, we propose Promotion of Transit Oriented Development (TOD), Introduction of low-carbon urban transport, Introduction of Future mobility, and Construction of ICT platform / Area management. As Environment and Energy measures, we propose promotion of low carbonization in facilities, Utilization of renewable energy and Implement Comprehensive Area Energy Management System (AEMS).

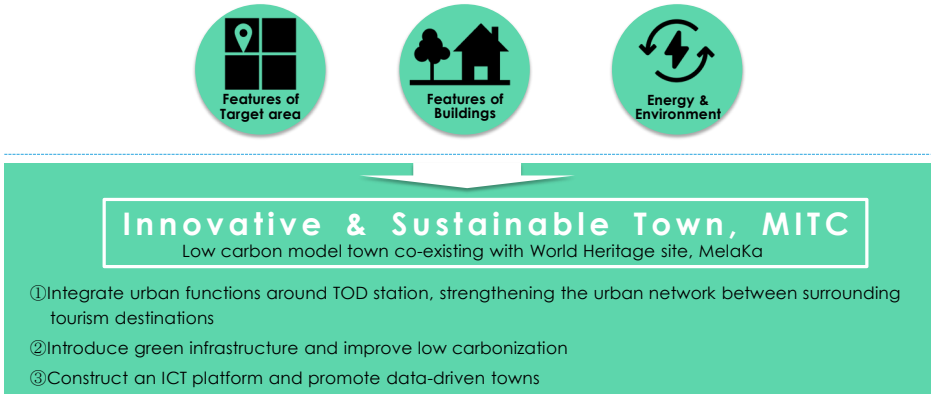


Fig. 1-14. Low-Carbon Concept for Hang Tuah Jaya
Source: NSRI

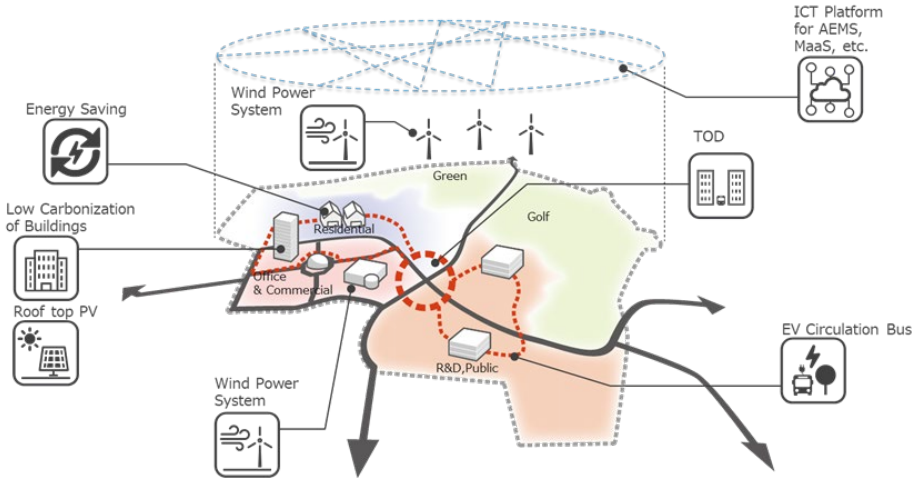


Fig. 1-15. Image of Low-Carbon Concept for Hang Tuah Jaya
Source: NSRI

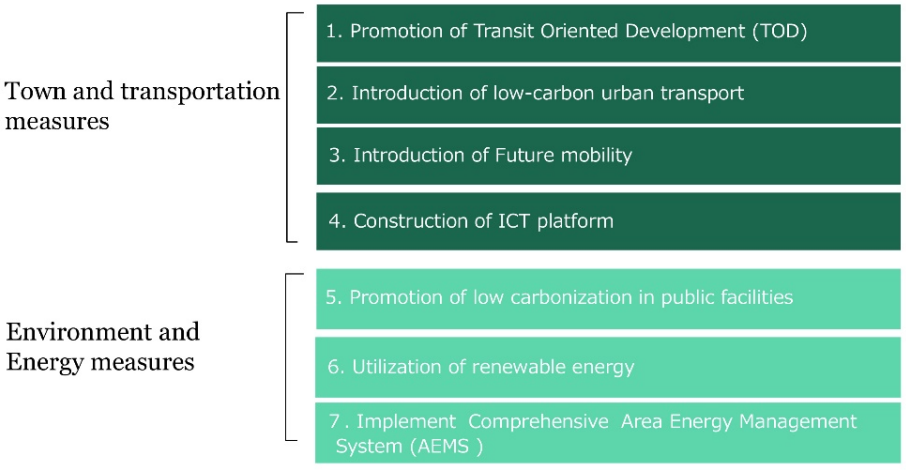


Fig. 1-16. Basic Approach
Source: NSRI

The Low-Carbon Effect – Energy and Environmental

The CO2 reduction in energy and environment is shown in Table.1-3. By using the previously mentioned low carbonization method, it was possible to reduce energy by 33% in 2030 and 43% in 2040.

The low carbonization method used for calculation is summarized in the following table. The method was chosen according to use of the building. The energy saving rate was decided based on our design experience in the past.

The CO2 reduction cost in energy and environment is shown in Table 1-4.

Table. 1-3. Energy and environmental sector Low-Carbon plan in Hang Tuah Jaya

Time	Technologies
2030	Short-term low carbon measures in public buildings （Toward Zero-energy building） Short-term low carbon measures in Residential buildings（Toward Zero-energy houses） Introduction of Building energy management system and town platform Wind power (bladeless)
2040	Long-term low carbon measures in public buildings Long-term low carbon measures in Residential buildings Introduction of AEMS

Source: NSRI

Table. 1-4. The implementation plan of building energy consumption technologies

Items	Menu	energy conservation ratio	office	commercial	hospital	hotel
			implementation time			
Heat source	COP improvement	0.282	●	●	●	●
Heat source	Reduction of internal heat generation	0.05	●	●	●	●
Heat source accessories	Inverter	0.13	●	●	●	●
Water transport	Inverter	0.18	●	●	●	●
Air conveyance	High efficiency fan	0.165	●	●	●	●
Air conveyance	Inverter	0.26	●	●	●	●
Hot water supply	Device performance improvement	0.292	–	–	●	●
lighting	Human Sensor	0.03	●	●	●	●
lighting	Illuminance	0.105	●	●	●	●
lighting	High efficiency of lighting equipment	0.376	●	–	●	●
Outlet	Reduced power	0.02	●	●	●	●
ventilation	Total heat exchanger	0.072	●	●	●	●
ventilation	CO2 control	0.057	●	●	●	●
ventilation	High efficiency fan	0.131	●	●	●	●
ventilation	Introduction of CO concentration control of parking fans	0.2	●	●	●	●
Water supply and drainage	Improve pump performance	0.15	●	●	●	●
Elevator	Smart operation	0.1	●	●	●	●
Other	Introduction of high efficiency	0.085	●	●	●	●
facade	Glass performance improvement	0.1	○	○	○	○

Source: NSRI

● Mid-Term Low-Carbon building conservation method ○ Long-Term Low-Carbon building conservation method

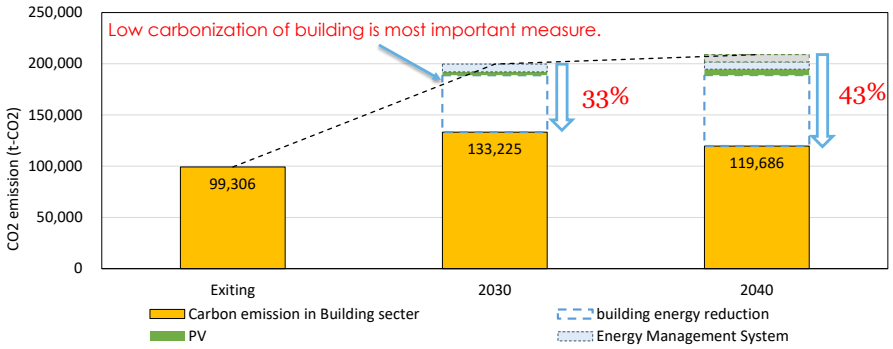


Fig. 1-17. Low-Carbon Effect – Energy and Environment
Source: NSRI

The Low-Carbon Effect – Transportation

CO2 in the traffic field is mainly emitted by private automobiles. One reason for this is because, as compared with public transportation such as railways and buses, automobiles emit a large amount of CO2 per person. In order to reduce CO2, it is effective to control the traffic volume of automobiles, use forms of public transportation with less CO2 emissions, reduce travel distance and reduce the amount of CO2 emitted by each car.

In addition, it is effective to change bus transportation, which is the main form of public transportation, to vehicles with low CO2 emissions, and to reduce the amount of CO2 emitted by each bus.
We estimated the amount of CO2 reduction of vehicles such as automobile, Rolly, bus and motorcycle for areas centered on Melaka International Trade Center (MITC).

The scenario is set based on the five policies such as the introduction of LRT and Loop buses, environment-friendly cars, maintenance of bicycle lane, construction of IoT platform, estimated CO2 reductions by 2040 respectively.

Among these CO2 reduction measures, it became clear that introducing LRT is most contribute. The total reduction rate of other reduction measures was about 60% of the total in the case of the scenario set this time. Therefore, it is important not only to introduce LRT, but also to tackle CO2 reduction through a comprehensive approach including other measures promoting the use of public transportation and Electric vehicle.

Table. 1-5. CO2 Emissions per each vehicle

	2018	2030	2040
Car	45,841 t-CO2	57,035 t-CO2	56,894 t-CO2
Rolly	4,683 t-CO2	8,196 t-CO2	8,524 t-CO2
Bus	2,263 t-CO2	3,960 t-CO2	466 t-CO2
Motorcycles	1,644 t-CO2	2,878 t-CO2	2,864 t-CO2
TOTAL	54,432 t-CO2	72,070 t-CO2	68,749 t-CO2

Source: NSRI

We estimated the CO2 emissions in 2018 (BAU) to be 54,432 t-CO2 per year as follows. Although it will be 99,067 t-CO 2 considering the increase rate of automobile by 2040, it can be expected to be reduced to 68,749 t-CO 2 (31% reduction) by promoting the use of public transportation.

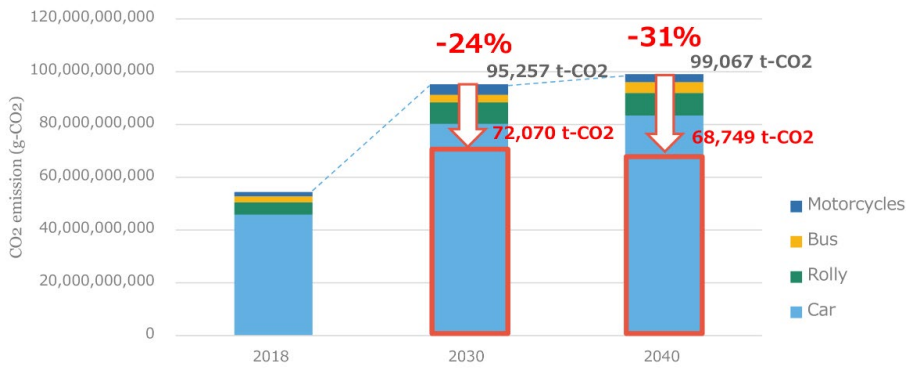


Fig. 1-18. Low-Carbon Effect – Transportation
Source: NSRI

6. Business Scheme for Three Volunteer Town

Overall flow

NSRI has estimated the CO2 reduction from proposed measures and studied business model for implement the low carbon town .

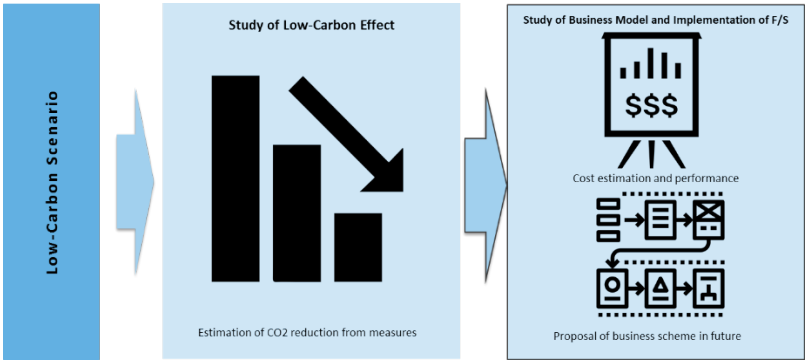


Fig. 1-19. Overall flow of business scheme
Source: NSRI

Basic approach for conducting strategy

As we studied realistic business scheme for each towns, we have considered the current situation and characteristic of each towns

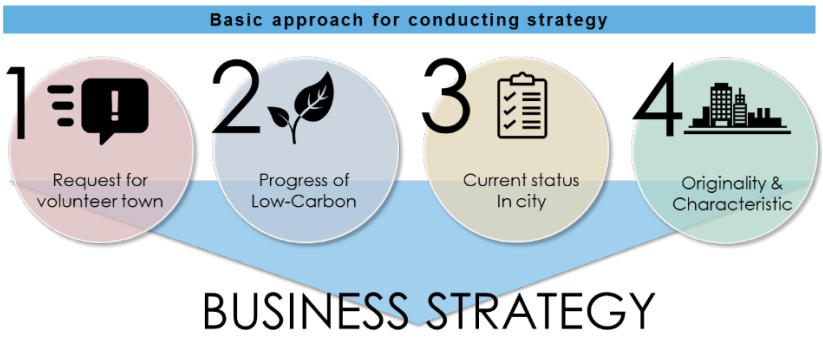
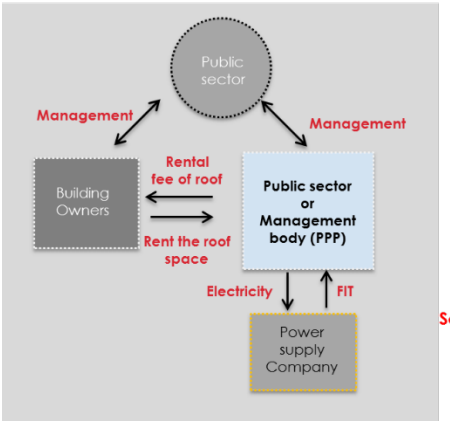


Fig. 1-20. Image of basic approach for conducting strategy
Source: NSRI

Business model - Energy

Important point of our proposal is, Establishing the energy management body.
It borrows roof spaces from building owners and places PV panels on the roofs.
Building owners can get profit of rental fee and management body can get PV panel space and buy electricity to Power company totally.



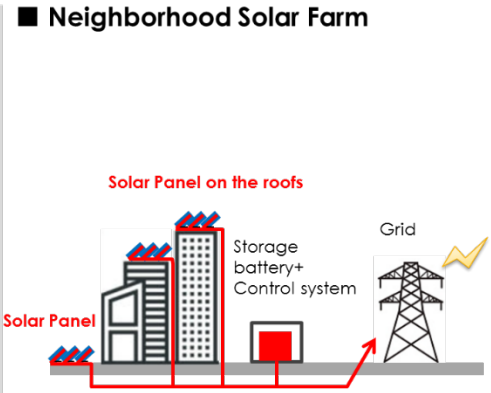
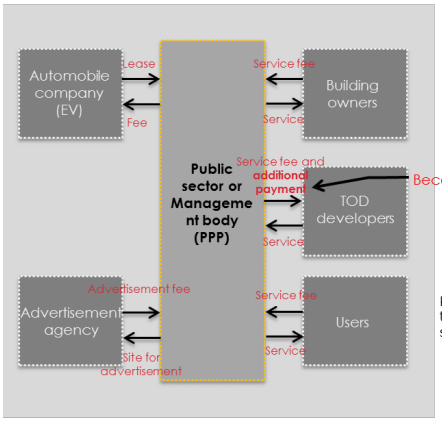


Fig. 1-21. Business model for Energy Section
Source: NSRI

Business model - Transportation

In generally, public transportation business is not so feasible. We have proposed to develop the new business scheme. As shown fig.1-22 , public transportation management body will gain profit from building owner and TOD developer by providing service such as developing the bus stops near the building. And this management body will get advisement fee from the advertisement agency.



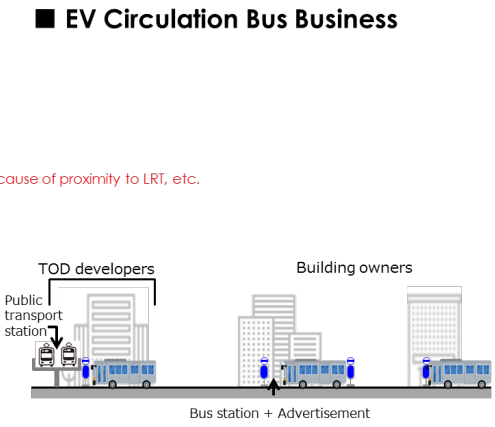


Fig. 1-22. Business model for transportation sector
Source: NSRI

7. Next Steps for Three Volunteer Town

This study is considered as the first step in aiming for Low Carbon Model Town. In the future, in order to implement these plans, it is necessary for local governments to proceed more concrete actions.

In Banda Aceh, since development of coastal target areas has not been undertaken, first of all, development of traffic infrastructure will be necessary. After that, measures to induce low carbonization are prepared in advance as a low carbon guideline for urban development.

In Shah Alam, since they have already made efforts to reduce the carbon emission to some extent, it is a challenge how to set incentives for low carbonization, including private enterprises and citizens in the area. Legal institutionalization will take much time, so it is necessary to improve public-private collaboration-type low carbonization while taking deregulation etc.

In Hang Tuah Jaya, it is necessary to prepare measures to induce low carbonization beforehand, as urban development including the surrounding areas will be promoted in the future.

From the viewpoint of economic support, the possibility of diversified financing through international organizations and social media, etc. based on the concept of SDGs, by appealing low-carbonization with the area through those measures and ecosystem. At the same time, capacity building of municipal officials is also a necessary element.

It is necessary for municipalities to lead the way toward lowering the carbon emission, and incorporate companies / citizens accordingly through various dissemination enlightenment, workshops, etc.

INTRODUCTION

01

CHAPTER 1. Introduction

Chapter1. INTRODUCTION

1.1. What is the APEC LCMT Project Dissemination

The APEC Low-Carbon Model Town (LCMT) Project Dissemination Phase 1, which succeeds LCMT Project Phases 1-7, seeks to accelerate the dissemination of low-carbon towns in order to manage rapidly growing energy consumption in the APEC region.

The key activities are: 1) to hold the 2nd LCMT Symposium for the dissemination of the "Concept of the Low-Carbon Town in the APEC Region (Concept)" through utilizing APEC Low-Carbon Town Indicator (LCT-I) System; and 2) to conduct Feasibility Studies for a specific area of three towns participated as the LCT-I volunteer towns in the 1st LCMT Symposium in the LCMT Project Phase 7. The nominations of the LCT-I volunteer towns are on a voluntary basis and three LCT-I volunteer towns are planned to be selected through the EWG.

Relevance

This project directly responds to the declaration at the 9th APEC Energy Ministers Meeting (EMM9), held in Fukui, Japan on 19 June 2010, where ministers discussed low-carbon paths to energy security which also provide cooperative energy solutions for a sustainable APEC as well as growth strategies.

Among several messages, they noted that the introduction of low-carbon technologies in city planning to boost energy efficiency and reduce fossil energy use is vital to manage rapidly growing energy consumption in urban areas of the Asia-Pacific region. In this context, APEC Energy Ministers have agreed to launch an "APEC Low-Carbon Model Town (LCMT) Project" with a view to presenting successful models for coordinated usage of advanced low-carbon technologies. This project is considered as one of the priority projects for APEC.

While local government and municipal officials are getting interested in making their town low-carbon, their urgent concerns tackling now are to alleviate urban problems such as traffic congestion, air/water pollution, waste management, recycling of used water and so on. However, the main objective of the APEC LCMT Project focuses on CO2 emissions reduction. One element of realizing a low-carbon town is to increase energy efficiency while to reduce unnecessary energy consumption.

The investments required for them pay for themselves in a short/medium perspective. The other element is to introduce renewable energy sources such as solar photovoltaic power generation, advanced technology which include building energy management system (BEMS), electric vehicles, smart grid systems and so on.

These technologies are still expensive and some of them may need demonstration tests before putting into commercial applications. However, all these technologies have a huge potential to substantially reduce CO2 emissions in towns. As such, the APEC LCMT Project provides towns with opportunities to obtain financial benefit and a future economic development.

This project is directly linked to "building sustainable and resilient communities" (Rank 1) and "energy efficiency, energy security and energy resiliency including the development of low-carbon technology and alternative energy sources" (Rank 2), which is because it aims to identify successful models for sustainable communities through coordinated usage of advanced low-carbon technologies.

Objective

The key objectives of the project are:

1) To disseminate the basic ideas and effective approaches of the Concept through utilizing the LCT-I System, which helps evaluate the progress and status of low-carbon development of various areas in the APEC region;

2) To provide Feasibility Studies of a specified area of low-carbon development projects selected as the LCT-I volunteer towns in the LCMT Project Phase 7 and identify how to improve the low-carbon development plans through the Feasibility Studies; and

3) To share best practices and real-world experiences of low-carbon town design with planners and policymakers throughout the APEC region.

Source: APEC Homepage

The Concept of the Low-Carbon Town in the APEC Region

The concept provides a basic idea of what is a low-carbon town and an effective approach to its development. The concept aims to promote the development of low-carbon towns in the APEC region by providing a basic principle that can assist the central and local government officials of the member economies in planning effective low-carbon policies and in formulating an appropriate combination of low-carbon measures while taking socio-economic conditions and city-specific characteristics into consideration.

Source: The Concept of the Low-Carbon Town in the APEC Region, Six Edition, Executive Summary

LCT-I System

The objective of the LCT-I System is to further promote low-carbon efforts at the town level and control CO2 emissions. It was designed to be as simple as possible in consideration of user friendliness. In addition, the LCT-I System is expected to be used as an indicator that reflects the circumstances of each economy and the characteristics of the project.

Source: APEC Low-Carbon Town Indicator System Guideline, First Edition, November 2016

1.2. Scope of Work

This project will be undertaken according to the following procedure.

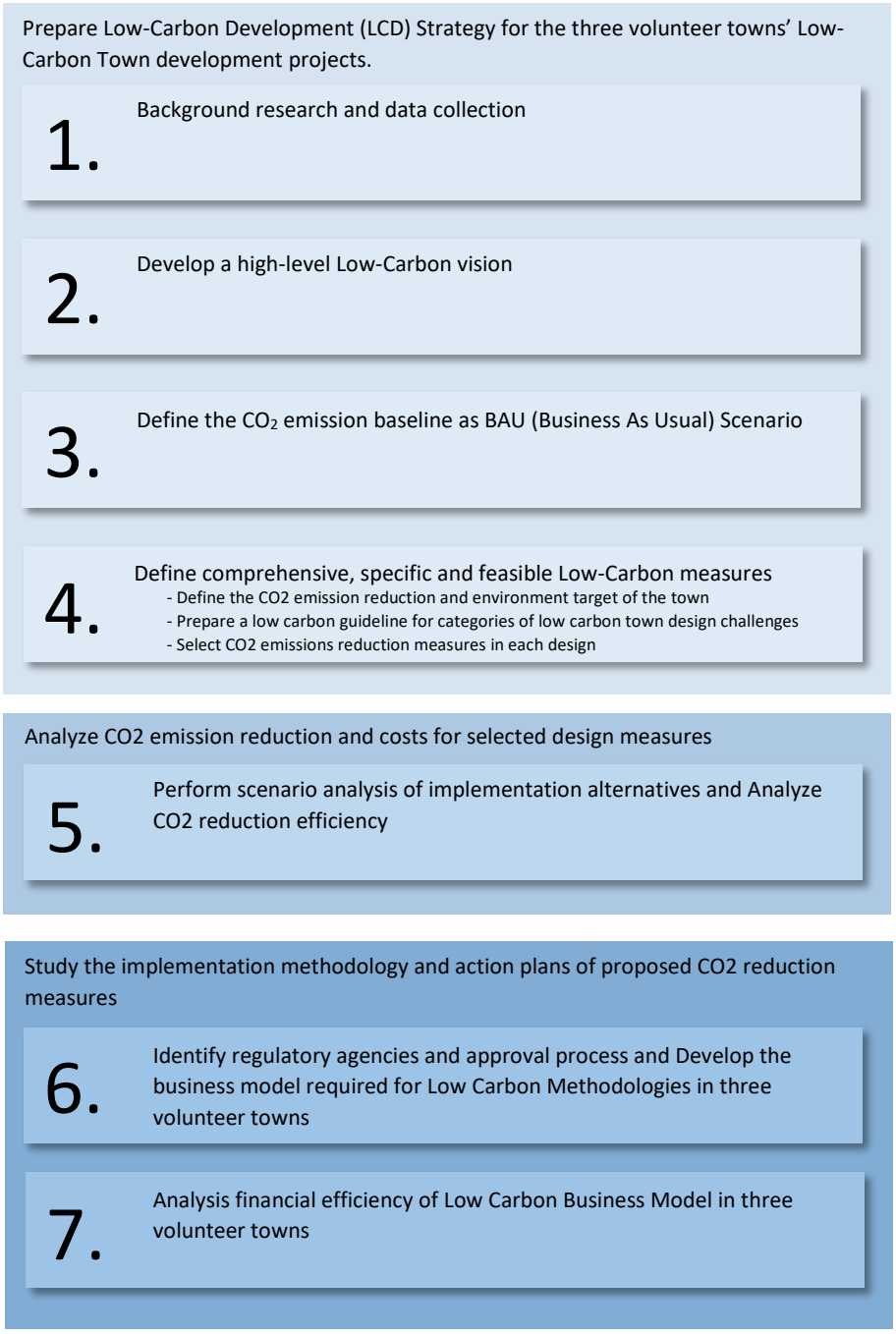


Fig. 1.2-1. Scope of work outline
Source: NSRI

02

CHAPTER 2. Overview of Three Volunteer Town

Chapter2. OVERVIEW OF THREE VOLUNTEER TOWN

2.1. Banda Aceh City of Indonesia

2.1.1. Geographic Data

2.1.1.1. Regional Context: Aceh Province

Aceh Province, Indonesia is located on the island of Sumatra on the northwestern tip of Indonesia. The province rose to international prominence after December 26, 2004 when an earthquake of a magnitude of 9.0 on the Richter scale occurred at approximately 150 km off the northern western tip of the island of Sumatra triggering tsunami that hit Aceh Province and the North West part of North Sumatra Province devastating strips of land along the coast up to 8 km land inwards. The event caused casualties of hundreds of thousands of people and destroyed over 60% of city's buildings.

The damages and losses from the earthquake and the following tsunami affected 17 out of the 21 region/city of Aceh including Banda Aceh and two districts in North Sumatra.

Fig. 2.1-1. Location of Aceh Province in Indonesia
Source: PSUD

2.1.1.2. Regional Context: Aceh Province

Banda Aceh is the capital city of Aceh Province, Indonesia. It is located at the mouth of the Aceh River. Banda Aceh Municipality consists of 9 districts namely: Meuraxa, Jaya Baru, Banda Raya, Baiturrahman, Lueng Bata, Kuta Alam, Kuta Raja, Syiah Kuala, and Ulee Kareng. The 9 districts comprises of 90 villages which are known as 'Gampong' (Indonesian Law No.11 concerning Government of Aceh). With the total area of 61,36km (Banda Aceh Dalam Angka, 2016) located on an average altitude of 0,80 m above sea level, Banda Aceh shares boundaries with Aceh Besar Regency along the South to East, Malacca Strait along the North Shore, and Indonesian Ocean along the Western shore.

Table. 2.1-1. Area of Banda Aceh by District

No.	District	Area (ha)	Percentage (%)
1	Meuraxa	726	11.83
2	Jaya Baru	378	6.16
3	Banda Raya	479	7.81
4	Baiturrahman	454	7.40
5	Lueng Bata	534	8.70
6	Kuta Alam	1,005	16.38
7	Kuta Raja	521	8.49
9	Syiah Kuala	1,424	23.21
9	Ulee Kareng	615	10.02
Total		6,136	100.00

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

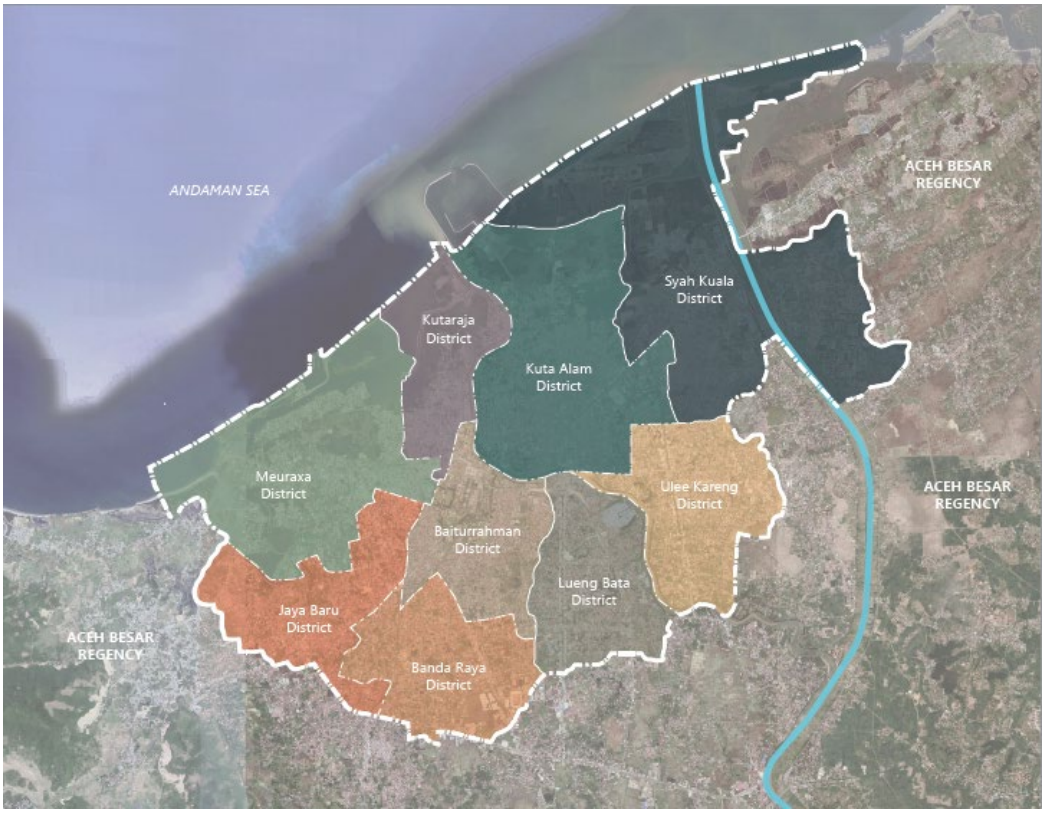


Fig. 2.1-2. Banda Aceh Municipality

Source: PSUD

2.1.1.3. Regional Climate and Local Weather

The temperature in Banda Aceh varies so little throughout the year. Banda Aceh features a tropical rainforest climate under, with near constant average temperatures. The city's annual average temperature is around 27-28°C.

The hot season usually lasts from May to August, with an average daily high temperature above 32°C. The cool season usually lasts from October to January, with an average high temperature below 30°C and the lowest up to 23°C.

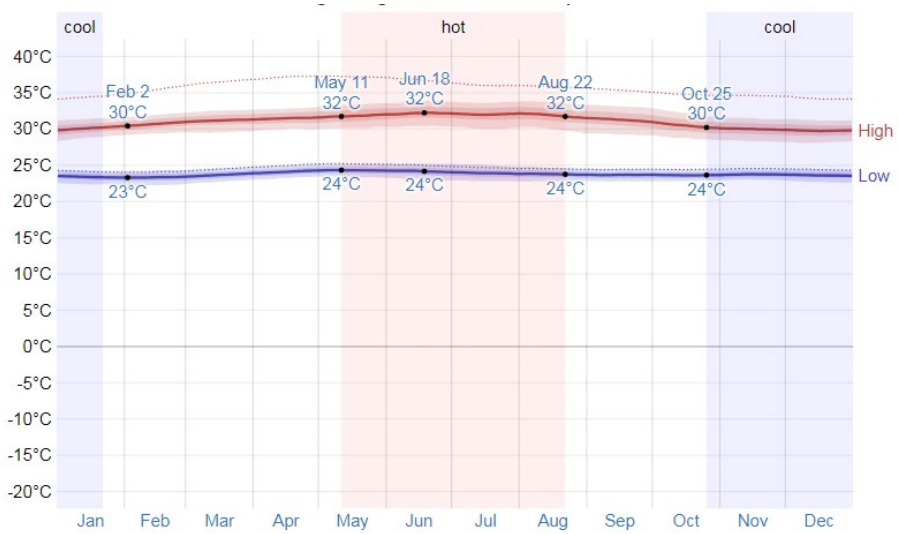


Fig. 2.1-3. Average High and Low Temperatures of Banda Aceh
Source: https://weatherspark.com/y/112346/Average-Weather-in-Banda-Aceh-Indonesia-Year-Round, downloaded 21st June 2018

The average precipitation is approximately 209 mm. The lowest precipitation in Banda Aceh in 2016 happens in April, June, July and September with an average of 64.5 mm which makes June through July being the driest months of the year for consecutive low rainfall and October through December as the wettest. On average, the city experiences a little less than 2509 mm of precipitation annually in 2016.

Table. 2.1-2. Rainfall, Number of Rainy Day, and Average of Sun Irradiating Recorded at Meteorology, Climatology & Geophysical Station, Blang Bintang, 2016

No.	Month	Rainfall (mm)	Number of Rainy days (Days)	Average Sunshine Radiation (%)
1	January	325.5	15	54
2	February	160.0	11	65
3	March	92.8	6	59
4	April	51.0	8	63
5	May	241.0	19	37
6	June	66.0	14	54
7	July	74.8	10	55
8	August	357.7	18	53
9	September	66.1	20	57
10	October	359.5	18	46
11	November	487.4	23	36

Total Numbers, N	12
Sum	2509
Average	209.083

Source: Department of Meteorology, Climatology, and Geophysical Station, Blang Bintang, 2016

2.1.2. Demographic Data

2.1.2.1. Population and Household Size

The main source of population data was derived from a population census conducted every ten years. Population census in Aceh had been conducted six times since the independence day of Indonesia in 1961, 1971, 1980, 1990, 2000, and 2011. The data presented in the report in regards to population are results of population projection based on 2011 census as baseline data supported by data such as migration rate, fertility rate, and mortality rate. Population of Banda Aceh are defined as residents who have stayed in Banda Aceh for at least six months and those who intend to stay more than six months.

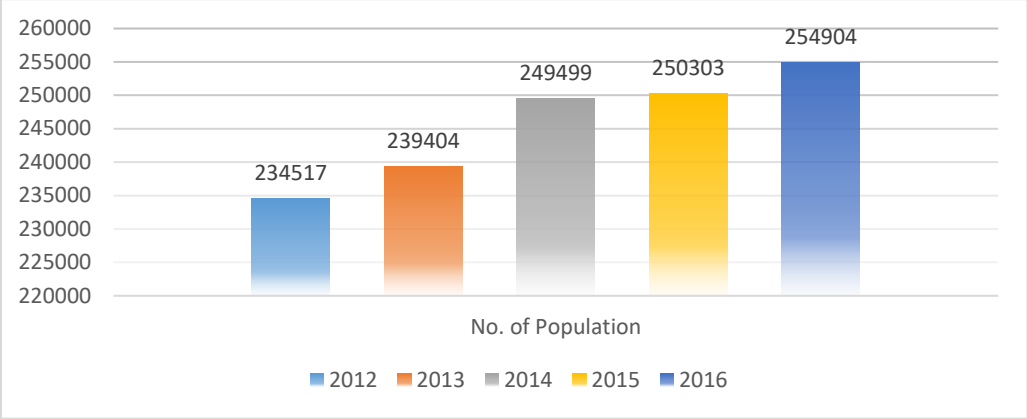


Fig. 2.1-4. Number of Population in Banda Aceh from 2012 to 2015
Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

2.1.2.2. Gender Distribution

No.	District	Male	Female	Total
(1)	(2)	(3)	(4)	(5)
1	Meuraxa	10253	9135	112.24
2	Jaya Baru	12881	12131	106.18
3	Banda Raya	11730	11729	100.01
4	Baiturrahman	18379	17634	104.22
5	Lueng Bata	12844	12270	104.68
6	Kuta Alam	26293	24325	108.09
7	Kuta Raja	7006	6101	114.83
8	Syiah Kuala	18581	17896	103.83
9	Ulee Kareng	13043	12673	102.92
Total Population				
2016		131010	123894	105.74
Percentage(%)		51.40%	48.60%	

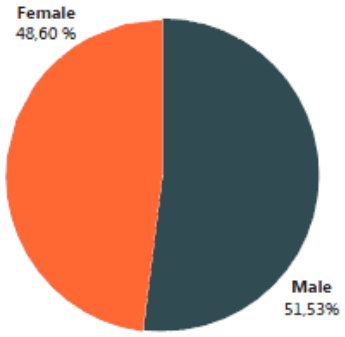


Fig. 2.1-5. Population Gender Distribution of Banda Aceh Municipality in 2015
Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

2.1.2.3. Gender Distribution

The figure indicates that a majority of inhabitants in Banda Aceh are of an employable age of between 18-50 years old (about 63%). Younger inhabitants (under 17 years) are the second largest group (about 26%). The rest about 11% of the inhabitants are older age (>50 years).

This simple breakdown by age provides an insight into how a push/pull community awareness program could be categorized into – for example:- (i) student awareness of the need for sustainable transport and the need to use (yet to be improved) public transport, (ii) the use of public transport to work to reduce congestion, arrive at work quicker and to reduce the inconvenience of searching for curbside parking locations in crowded urban conditions.

No.	Age	Male	Female	Total
(1)	(2)	(3)	(4)	(5)
1	00-04	13621	13477	27098
2	05-10	9580	9447	19027
3	11-14	8280	7876	16162
4	15-19	11886	12325	24211
5	20-24	20239	19666	39905
6	25-29	15702	13773	29475
7	30-34	11924	10330	22254
8	35-39	9582	8978	18560
9	40-44	8238	7797	16035
10	45-49	7038	6232	13270
11	50-54	5361	4547	9908
12	55-59	3996	3695	7691
13	60-64	2622	2307	4929
14	65-69	1486	1441	2927
15	70-74	781	875	1656
16	75+	668	1128	1796
Total Population				

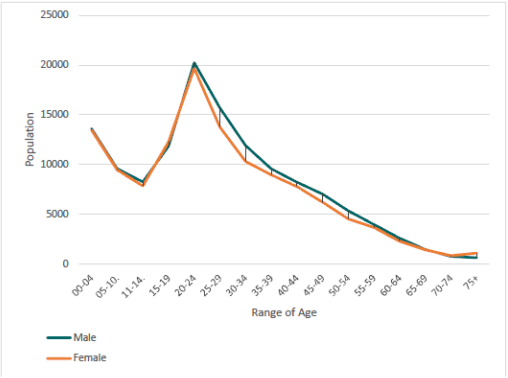


Fig. 2.1-6. Population Age Distribution of Banda Aceh Municipality in 2015
Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

2.1.2.4. Employment Status and Structure

Employment Status

The main source of employment data is the National Labour Force Survey (Survey Angkatan Kerja Nasional or Sakernas). Population considered as labour forces are people aged 15 years and over who in the previous week were working, temporary absent from working but are currently employed, or people who are currently unemployed.

Table. 2.1-3. Employment Status of Banda Aceh Population in 2015

No.	Description	2014	2015
1	**Labour Force (Person)**		
	Employment	100592	101808
	Unemployment	11475	13888
	Subtotal	**112067**	**115696**
2	**Non active Labour Force (Person)**		
	Student	37826	35205
	Homemaker	31077	32796
	Others	7111	5815
	Subtotal	**76014**	**73816**
3	**Non Labour Force (Person)**		**60791**
	Total	149830	250303
Labour Force Rate		59,58	61,05
Unemployment Rate		10,24	12,00

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

Table. 2.1-4. Unemployment Rate of Banda Aceh from 2012-2015

2012 (%)	2013 (%)	2014 (%)	2015 (%)
7,17	-	10,24	12,00

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

The household survey in 2014 by the ministry of E revealed that 38% of household members are employed (full time work, more than on job, part time work). For those not employed, 20% were housewife, 29% were students, and another 14% advised they were unemployed (searching for a job, unemployed or other category).

Employment Structure

There are four types of job. These are primary, secondary, tertiary and quaternary jobs. Primary jobs involve getting raw materials from the natural environment e.g. mining, farming and fishing. Secondary jobs involve making things (manufacturing) e.g. making cars and steel. Tertiary jobs involve providing a service e.g. teaching and nursing.

Employment structure means how the workforce is divided up between the three main employment sectors - primary, secondary and tertiary. Note that the quaternary sector has been included in the tertiary sector. Employment structures change over time. Countries in the early stage of development usually have a high percentage of the population in primary employment. This is because most people are engaged in agricultural activities.

As a country begins to develop an industrial base there is an increase in the secondary sector. An increase in machinery on farms means fewer people are needed. People tend to migrate to urban areas to get jobs in factories. When a country becomes more economically developed there is a greater demand for services such as education, health care and tourism. Therefore the tertiary sector undergoes growth. By this time computers, machinery and robots replace people in the secondary sector hence the decrease in secondary jobs. Employment structures are usually displayed as pie charts.

In the richest country, most people work in the tertiary sector. In the poorest country, most people work in the primary sector. In Brazil, the labor force is more evenly distributed between the three sectors.

2.1.2.5. Educational Level

Table. 2.1-5. Number of students in Banda Aceh's schools, in 2016

No.	Educational Level	Male	Female	Total
1	Elemetary School	11.876	10.951	22.827
2	Junior High school	4.771	4.585	9.356
3	Senior High school	6.254	6.407	12.661
Total Population		22.901	21.943	44.844

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

Table. 2.1-6. Educational level of Civil Servants by Gender

No.	Educational Level	Male	Female	Total
1	Elemetary School	17	3	20
2	Junior High school	43	3	46
3	Senior High school	525	524	1049
4	Diploma1	4	63	67
5	Diploma2	29	267	296
6	Diploma3	95	299	394
7	Diploma4	25	33	58
8	Bachelor	648	1534	2182
9	Master	136	156	292
10	Doctoral	1	-	1
Total Population		1523	2882	4405

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

2.1.2.6. Home Ownership

Approximately 50% of the housing unit in Banda Aceh in the year 2016 are privately owned. The figure shows that there had been an increase of privately owned housing unit from 2014 to 2015 but also a slight decrease of 1.61% from the year 2015 to 2016. Rented house however shows a more stable figure from 2014 to 2016. The data indicates that in 2015 there had been an increase of private housing purchase and an increased availability of rented housing unit. And an increase of social housing provision in 2016.

Table. 2.1-7. Percentage of Household by Home Ownership in Banda Aceh from 2013-2015

No.	Home Ownership Status	2014 (%)	2015 (%)	2015 (%)
1	Privately owned	48.37	51.97	50.36
2	Rented	32.17	33.80	32.03
3	Free Rent (Social Housing)	4.90	10.22	13.33
4	Government Housing Facility for Civil Servants	6.21	4.00	4.28
5	Others	8.36	0.00	0.00
Total (%)		**100**	**100**	**100**

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

2.1.2.7. Vehicle Ownership

The vehicle ownership statistics, indicate that over 70% of all households own at least one vehicle. Approximately 60% of the households own one or more motorcycles and 17% of households own one or more cars for their transportation. This high level of ownership suggests an ongoing challenge for the public transport sector.

Table. 2.1-8. Percentage of Vehicle Ownership in Banda Aceh in 2016

No.	Vehicle Ownership Status	2016 (%)
1	One Motorcycle	25
2	Two Motorcycle	26
3	Three or More Motorcycle	8
4	One Car	16
5	Two or More Cars	1
6	Bicycle	20
7	Others	4
Total (%)		**100**

Source: PFS report prepared by Government of Banda Aceh (GoBA), Banda Aceh Bus Rapid Transit (BRT) Network Improvement Document, 2017

2.1.2.8. Traffic Share Ratio

Fig. 2.1-7 below presents the mode used for the survey respondent's travel. Motorcycle is the most dominant mode, accounting for approximately 77% of all trips. In the context of the future capacity of an improved public transport network to capture some of this motorcycle market, it will be a significant challenge due to (i) the door to door convenience of the motorcycle, (ii) the ability of motorcycles to avoid being stuck in traffic congestion, (iii) the current mindset of "travel independence" this mode offers to the user. For these reasons, the need for effective push/pull policies will be required for public transport to make a discernible impact on the traffic and urban mobility of Banda Aceh. These aspects are discussed in subsequent chapters.

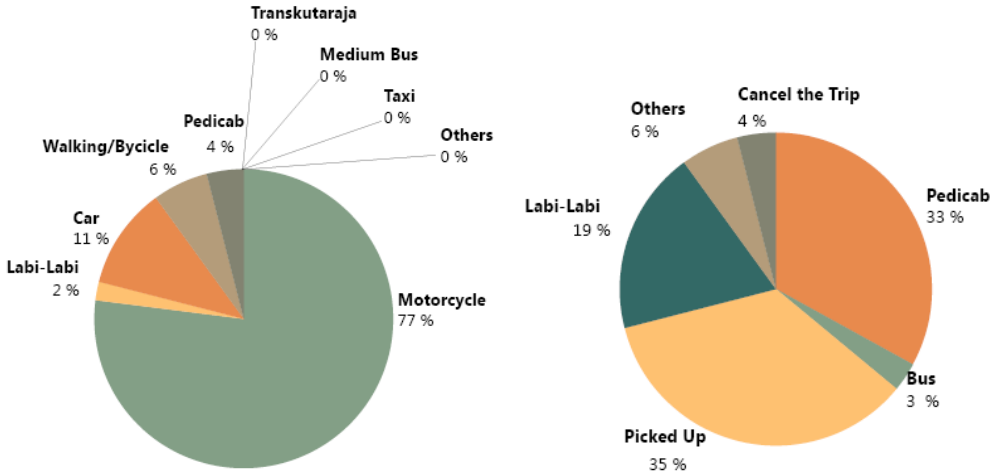


Fig. 2.1-7. Percentage of Traffic Share Ratio in Banda Aceh in 2016 (LEFT) and Alternate Mode of Travel Preferences in Banda Aceh in 2016 (RIGHT)

Source: PFS report prepared by Government of Banda Aceh (GoBA), Banda Aceh Bus Rapid Transit (BRT) Network Improvement Document, 2017

The survey asked respondents on their alternative travel arrangements in the event that they were not able to drive a car or motorcycle. This was to help ascertain (amongst other matters) the likelihood of public transport being the first alternative choice for the trip. The results in Figure 2.1-7-1 below show that of respondents who did not have access (as a driver) to make a one-way trip, 35% will travel as a private vehicle passenger with someone else driving.

Furthermore, the survey revealed that 21% will choose to use public transport, bus or labi-labi, approximately 33% will use pedicab to make this trip, 6% will choose another mode and 4% of respondents said they would not make this trip. From the Figure it shows that in the absence of a private vehicle and if conditions of public transport remain the same, only 21% of the respondents will use public transport.

Fig. 2.1-8-1. Pedicab (LEFT) and Labi-Labi (RIGHT)

Source: GoodNews FROM INDONESIA.ID (LEFT), steemit.com (RIGHT)

2.1.3. Local Economy

Method used to estimate national accounts statistics is based on the standard guidelines of the United Nation known as “System of National Accounts”. The obtained data however had used the method which had been adjusted to according to Indonesian social-economic condition.

The GDRP data presented, obtained from the Statistic Book of Banda Aceh uses two approaches namely “production approach” value added and “expenditure approach”. The GDRP data in this report are presented in two forms; at current market prices and at constant base year market price.

2.1.3.1. Main Economic Sectors

GDRP sectors are classified by main types of economic activities such as Agriculture, Forestry, and Fishery; Mining; Industrial Manufacturing; Electricity and Gas; Clean Water, Waste, and Recycling; Construction; Wholesale, Retail Trade, Car and; Motorcycle Repair; Transportation and Warehouse; Accommodation, Restaurants, Food and Beverage; Information and Communication; Banking, Finance, and Insurance; Real Estate; Commercial Services; Government Administration, National Defense, and Public Welfare; Education Services; Health Services and Social Events; and Others which are not classified within the previous sectors.

2.1.3.2. GRDP Growth Rate

GDRP at current market prices all aggregates are valued at current market prices while base year constant market prices are shown by valuing ll aggregates at fixed base year prices referring to the year 2000 data as the base year.

Table. 2.1-9. Gross Domestic Regional Product (GDRP) by Market Prices in Banda Aceh 2013-2015 (in Million Rupiahs)

No.	Economy Sector	2013	2014	2015	2016
1	Agriculture, Forestry, and Fishery	126,329.3	135,264.5	142,701.5	154,320.8
2	Mining	0	0	0	0
3	Industrial Manufacturing	262,640.8	289,525.6	303,710.0	317,841.1
4	Electricity and Gas	32,502.3	36,716.5	39,747.9	47,729.5
5	Clean Water, Waste, and Recycling	10,440.7	11,959.5	14,253.8	18,900.1
6	Construction	958,082.6	960,238.1	1,103,743.6	1,579,485.3
7	Wholesale, Retail Trade, Car and Motorcycle Repair.	2,827,199.8	3,059,382.8	3,191,290.0	3,375,398.7
8	Transportation and Warehouse	1,948,671.9	1,974,370.4	1,986,734.5	1,783,937.7
9	Accommodation, Restaurants, Food and Beverage	331,148.8	397,551.5	466,308.3	538,249.7
10	Information and Communication	942,579.2	939,810.2	956,943.1	957,348.3
11	Banking, Finance, and Insurance	389,608.8	395,006.6	423,800.0	459,951.1
12	Real Estate	700,447.4	830,077.6	970,979.0	1,081,187.6
13	Commercial Services	288,493.0	321,106.6	337,943.9	373,078.6
14	Government Administration, National Defense, and Public Welfare	2,456,331.4	2,730,681.1	2,981,088.0	3,332,436.1
15	Education Service	659,443.4	715,857.0	797,814.8	922,468.1
16	Health Services and Social Events	432,781.4	488,777.1	524,726.2	580,124.3
17	Others	201,303.2	225,282.7	245,129.5	279,334.0
Total GDRP		**12,568,004.0**	**13,501,602.9**	**14,486,814.4**	**15,801,791.2**

Source: National Electrical Company of Nangroe Aceh Darussalam, Banda Aceh Branch - Banda Aceh Dalam Angka, 2016

Growth rate of GDRP is derived from GDRP at constant market prices obtained by subtracting the value number of GDRP year (n) with the value of GDRP year (n-1) , divided by the value of GDRP year (n-1) multiplied by 100% (one hundred percent). The growth rate of GDP explains the income growth during the given period.

Table. 2.1-10. Gross Domestic Regional Product
(GDRP) by Constant Market Prices in Banda Aceh 2013-2015 (in Million Rupiahs)

No.	Economy Sector	2013	2014	2015	2016
1	Agriculture, Forestry, and Fishery	115,843.2	118,948.4	123,626.9	128,549.5
2	Mining	0	0	0	0
3	Industrial Manufacturing	241,926.1	254,139.0	263,261.8	268,244.0
4	Electricity and Gas	38,164.4	40,952.5	40,802.1	51,470.9
5	Clean Water, Waste, and Recycling	9,843.8	10,615.1	11,492.7	12,827.2
6	Construction	874,894.3	874,192.1	1,000,391.6	1,408,788.9
7	Wholesale, Retail Trade, Car and Motorcycle Repair.	2,559,857.3	2,672,562.1	2,763,488.9	2,814,397.2
8	Transportation and Warehouse	1,782,819.3	1,807,892.5	1,833,657.4	1,717,796.1
9	Accommodation, Restaurants, Food and Beverage	296,942.3	362,888.8	358,122.2	400,246.3
10	Information and Communication	1,030,141.2	1,093,525.3	1,112,387.4	1,105,564.23
11	Banking, Finance, and Insurance	322,832.4	311,750.4	320,492.1	339,224.7
12	Real Estate	638,269.6	692,403.3	752,913.4	838,247.4
13	Commercial Services	254,111.0	270,352.6	279,812.4	310,573.7
14	Government Administration, National Defense, and Public Welfare	2,229,707.5	2,363,106.5	2,504,665.2	2,646,798.4
15	Education Service	624,101.7	660,937.6	693,918.9	761,390,8
16	Health Services and Social Events	384,899.8	415,021.1	448,064.3	485,843.7
17	Others	192,874.6	205,760.1	218,826.8	238,331.0
Total GDRP		**11597228.5**	**12119047.3**	**12725924.1**	**13528294.7**

Source: National Electrical Company of Nangroe Aceh Darussalam, Banda Aceh Branch - Banda Aceh Dalam Angka, 2016

GDRP Per Capita of Banda Aceh Municipality is Ro. 43,4 million per capita, with total GDPR Rp.10.3 trillion.

Table. 2.1-11. Growth Rate of GDRP by Constant Market Price of Banda Aceh from 2012-2015

2012	2013	2014	2015	2016
5.33 %	4.67 %	4.50 %	5.01 %	6.31 %

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

2.1.4. Basic Infrastructure, Energy, and Resources

2.1.4.1. Existing Solid Waste Collection System

Existing Solid Waste Treatment System in Banda Aceh

Banda Aceh Municipality, with total population of 254904 produces around 200 to 250 ton in average of municipality solid waste per day. This estimation is predicted to increase every year due to the increasing number of population and the change of community consumption pattern.

The municipal waste treatment of Banda Aceh is the responsibility of the Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota/DLHK3). The municipal solid waste collection system is supported by an organized troop of waste collecting trucks along with supporting facilities and a landfill / final waste disposal site located in Gampong Jawa, Kuta Raja District - Blang Bintang with an area of 21ha. Since 2013, the site operates as sanitary landfills managing up to 200 tons of municipal waste per day.

According to the local authority, municipal solid waste in Banda Aceh are treated in four ways as described in Fig. 2.1-9. Out of the average municipal solid waste production per day, 11% are recycled. Plastics wastes are recycled, converted into plastic pallets which are used to make new materials. Plastic recycling process in Banda Aceh does not occur in site of the final waste disposal area, rather ex-situ involving third party.

Three percent (3%) of organic waste such as food remnants are processed as compost, the rest are mainly processed as landfills for further potential use such as to produce methane for energy.

Typology of Municipal Solid Waste Treatment in Banda Aceh

Like most cities in Indonesia, the characteristic of solid waste in Banda Aceh Municipality mostly consists of organic material such as food waste (32%) as its main component. Other composition based on type of solid waste in Banda Aceh can be seen on Fig. 2.1-9.

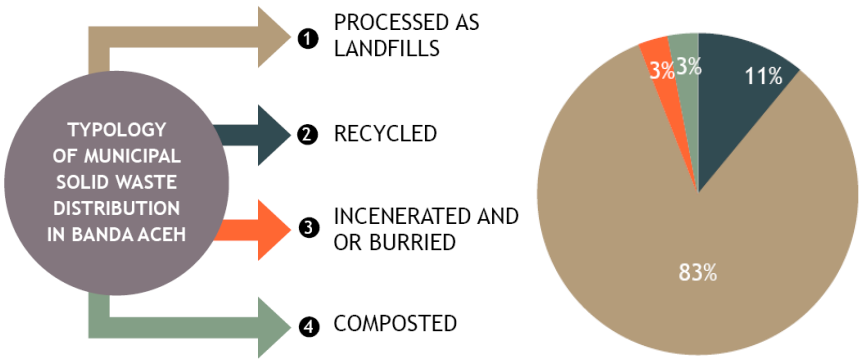


Fig. 2.1-9. The System (LEFT) and its Composition Percentage (RIGHT) of Solid Waste Treatment System Distribution of Banda Aceh City.

Source: http://dlhk3.bandaacehkota.go.id/statistik-pelayanan-sampah/Statistics, 2016

Landfills are potentially known to produce energy. Gampong Jawa Final Solid Waste Disposal Site of Banda Aceh landfill had been able to produce energy from methane used for cooking covering up to 60 housing unit. This strategy is supported by the existing Intermediate Treatment Facility with the capacity to process 24 m3 of....?.

The utilization of methane from black water treatment plant and landfill are introduced as small scale for example of untapped energy which can potentially be harnessed to support the surrounding households.

Table. 2.1-12. Percentage of Solid Waste Treatment Distribution of Banda Aceh.

No.	Type of Solid Waste	Composition (%)
1	Food Waste	32
2	Wood/timber	11
3	Dangerous substance	12
4	Agricultural waste	9
5	Tires	8
6	Textile	7
7	Glass	4
8	Ceramic Waste	2
9	Plastic Waste	4
10	Paper	3
11	Non-Steel Metal	3
12	Post Construction Waste	1
13	Steel	1
14	Plastic bottle	2
15	Rubber	0
16	Leather	0
17	Others	1
Total (%)		**100**

Source: Presentation Prepared By The Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota/DLHK3), 2018.

Solid Waste Treatment System in Banda Aceh in General

The service has served 84% of the total area in Banda Aceh including 90 villages (gampong) covering 81% of the total population. The waste collection system serves up to 50.000 household, offices, commercial buildings, and governmental building.

Waste Collection Service Frequency:

- Main Road: 2-4 times per day
- Gampong (Paid): once every 1-2 days
- Gampong (Unpaid): once every 1-7 days

The collection system of these municipal solid waste in Banda Aceh are divided into two main types: 1) Bring System and 2) Collect System.

The ‘Bring System’ involves community participation in bringing and transferring household waste from home to the nearest waste collecting point or temporary disposal area. These waste are then processed within the waste collecting point at Gampong Alue Deah Teungoh and Deah Glumpong.

The ‘Collect System’ involves The Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota) in collecting municipal solid waste from individual and or communal waste disposal area within Banda Aceh utilizing 42 container (size of 4 m3) and organized troop of Arm Roll truck to collect containers and transferring it to the Final Waste Disposable Area located in Gampong Jawa.

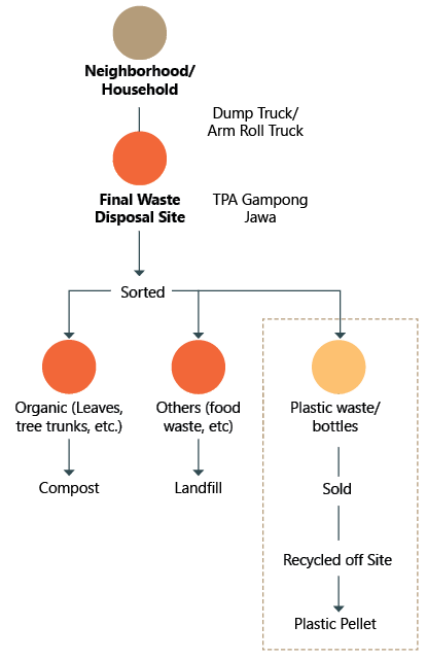


Fig. 2.1-10. Diagram of Solid Waste Treatment System of Banda Aceh.
Source: PSUD

The 'Collect System' exerts zones in collecting municipal solid waste. Banda Aceh Municipality is divided into three (3) zones to define the scope of operation described in Fig. 2.1-11. Zone 1 (one) includes Meuraxa, Jaya Baru, and Banda Raya Districts; Zone 2 (two) includes Syah Kuala, Kuta Alam, and Ulee Kareng Districts; Zone 3 (three) includes Kuta Raja, Baiturrahman, and Lueng Bata Districts.

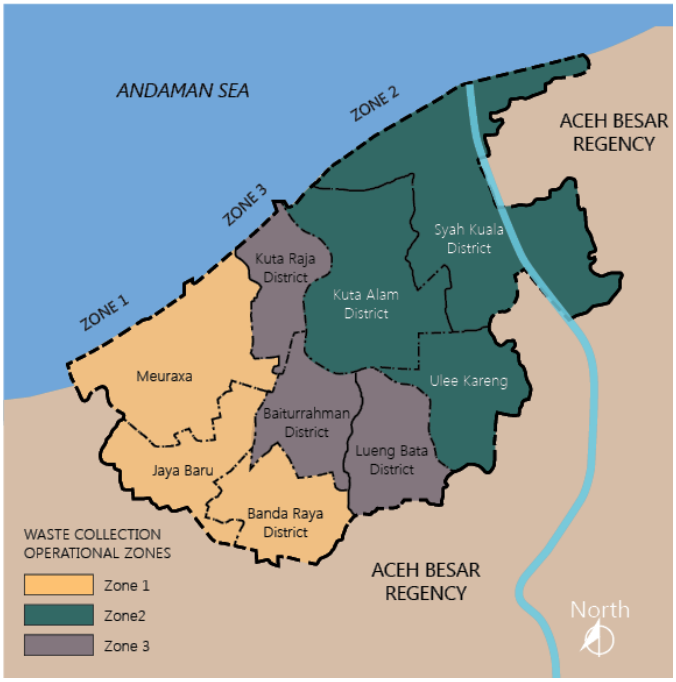


Fig. 2.1-11. Waste Collection Operational Zones in Banda Aceh Municipality.
Source: Presentation Prepared By The Environmental, Sanitation, and Beautification Authority of Banda Aceh,2018

2.1.5. Land Use

Over 65% of the total area of the city is used as cultivated land or built environment such as housings, commercials, offices, etc. The highest land use utilization in Banda Aceh consist of mainly housing and residential areas as shown in table 2.1-13, which is almost 40 % of the land. Whereas 13% remains as protected lands such as river banks, green open space, and natural conservation areas.

Table. 2.1-13. Existing Land Utilization.

No.	Land Use Utilization	Land Area (Ha)	Percentage (%)
1	**Protected Lands**		
	a. River Setback Area	163.7	2.67
	b. Mangrove Forest Area	120.45	1.96
	c. Green Open Space	474.09	7.73
	d. Preservation Area	51.43	0.84
2	**Cultivated lands**		
	Housing and Residential	2373.58	38.68
	Commercial	931.24	15.18
	Offices	143.24	2.33
	Tourism	103.00	1.68
	Open Space (hardscapes)	94.36	1.54
	Fisheries	120.19	1.96
	Public Service Facilities	275.05	4.48
	Harbor Area	14.49	0.24
	Empty	811.27	13.22
	Water/ bodies of water	459.92	7.50
Total		**6136**	**100**

Source: Public Works Department of Banda Aceh Municipality in Banda Aceh Statistics, 2016

Although the land use utilization for housing and commercial is high, Banda Aceh has not established a system or criteria for buildings thermal performance and energy saving equipment performance. Nonetheless, the planning for such policy has been introduced in planning document such as Regional Action Plan for Greenhouse Gasses Reduction (RAD GRK) 2013-2018 and Compilation of Action Plan for Greenhouse Gasses Reduction-Trikarsa Bogor, and Master plan for Smart compact City 2016-2021. Therefore an effort to formulate green development guideline is considered potential to support the Low Carbon Model Town vision.

Fig. 2.1-12. Existing Land Use Plan.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

2.1.6. Buildings

2.1.6.1. Residential Building/Housing

In general, there are three type of housing in Banda Aceh: Detached House, Low Income Apartment, and Informal Housing.

Fig. 2.1-13. Example of residential building typologies: (clockwise from top left) detached house, social house or low-income apartment, and informal house.
Source: NSRI, PSUD

Table. 2.1-14. Percentage of Household by Floor Area in Banda Aceh from 2014-2016.

No.	Floor Area	2014	2015	2016
1	≤19 m²	13.12 %	7.43 %	4.89 %
2	20 – 49 m²	39.37 %	41.11 %	42.50 %
3	50 – 99 m²	28.12 %	28.49 %	26.13 %
4	100 – 149 m²	12.64%	10.53 %	10.55 %
5	150 – m²	13.39 %	12.45 %	15.93 %

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2017

Table. 2.1-15. Percentage of Household by Wall Main Material in Banda Aceh from 2014-2016.

No.	Wall main material	2014	2015	2016
1	Brick / Stone	81.66 %	83.85 %	85.18 %
2	Wood	15.46 %	14.13 %	10.46 %
3	Bamboo	0.30 %	0.00 %	0.00 %
4	Others	2.57 %	2.03 %	4.36 %

Source: Statistics Department of Banda Aceh Municipality in Banda Aceh Statistics, 2017

2.1.6.2. Commercial buildings and Public Facilities

Banda Aceh is not one of metropolitan or the biggest cities in Indonesia, since the number of commercial and facility buildings is not as much as other big cities in Indonesia. For example, there are only 2 (two) typical shopping malls in Banda Aceh, such as Hermes Palace Mall and Suzuya Mall. There are also 11 hotels registered in Banda Aceh, 4 Banks, also few Shop houses area.

Fig. 2.1-14. Example of commercial uses: shopping mall (LEFT) and hotel (RIGHT).
Source: PSUD

Fig. 2.1-15. Example of commercial uses: bank office (LEFT) and shop houses (RIGHT).
Source: PSUD


Fig. 2.1-15. Example of Public uses: Ulee Lheue Police office (RIGHT).
Source: NSRI


Fig. 2.1-16. Example of Public uses: Ulee Lheue Sea port outside (LEFT) and Inside (RIGHT).
Source: NSRI

2.1.7. Environment Planning

2.1.7.1. Green Coverage Ratio

According to the Green City Initiative of Banda Aceh 2034 and also open source data from Banda Aceh local government, existing green coverage area (public green space) of the municipality covers 13.2% of the total land area, by 2016. Meanwhile, if it is including private green area, the total coverage area will be 23.2%.

Green open space in most cities in Indonesia including Banda Aceh, in terms of ownership, are divided into two typologies, Public Green Open Space and Private Green Open Space. Public green open spaces are areas totally owned by the government and private green open spaces are areas owned by the society or private sectors, which not always could be open for public.

The calculation of green open space area is formed from urban forest, city parks, green spine, mangrove forest along beaches, river setback, beach/shore setback, sport fields, and cemeteries. Office parks are only calculated if private green open space is also included in the target and strategies.

The target of green coverage based on Law no. 26, 2007, regarding Spatial Planning, should be minimum 30% of overall land area, consist of 20% public green open space and 10% private green open space.

Therefore, in 20 years the government has made some strategies to increase the remaining 6.8% public green open space. The strategies that mentioned in Green Open Space Master Plan of Banda Aceh 2009-2029 (2012) as follows:

1. Greenering throughout the city, including 60 existing parks.
2. Building a nursery garden (Taman Bustanussalatin).
3. Organising and increasing city parks, including encourage people (especially for shopkeepers and commercial users) to plant trees (at least in pots) in front of their buildings or shops.
4. Greening/Reforestation movement, in cooperation with various parties (for instance Bank Indonesia, Bank Mandiri, BNI, etc.)
5. Allocating rubbish bins and signages in the city parks and tourist areas.
6. Creating a new urban forest in Tibang Village area of 6 Ha (supported/aided by BNI)

As mentioned in Local Government's strategies above, public green open space provision of Banda Aceh can potentially be developed by converting unoccupied land or non-productive agriculture and plantation area.

Other development potential includes green spine arrangements on Right of Ways or water body setbacks. Nonetheless the development process requires large amount of funding especially on strategic locations due to the increase of land prices.

Other planning considerations related to green open space provision plan other than land availability includes the population needs based on density and green open space distribution within the city.

2.1.8. Community Planning and Eco Lifestyle

2.1.8.1. Forming community in residential area

Based on observations by the team of Smart City Development Study, there are several communities that focus on smart energy development (energy savings and renewable energy development).

Some Banda Aceh city communities that focus on energy conservation and environmental awareness include IT communities, such as: KPLI Aceh, Aceh CODE, IBT, Saree Community, Cyber Street, Aceh Renewable Energy Community, Indonesian Conservation Forum (FK3I) Communication Forum, Banda Forum Aceh Green (FBH), Green Community Forum (FKH) Banda Aceh, Forum Hijau Indonesia, and Environment Care Youth Community (KPPL).

However, based on information from the local government (DLHK3), not all of them are still sustain and keep contribute in energy conservation and environmental awareness. The last community that formed by the local government is Sahabat Hijau (SAHI) community in 2014. This 30-active member community was established to encourage society, particularly students, to be active in maintaining the cleanliness of the city and also the greeneries on median road.

Nevertheless, there is still no energy innovation and information center located in the city of Banda Aceh whether it is facilitated by government or non-government. Moreover, there has been no written commitment submitted from energy users, especially electric energy users to the City Government associated with the steps and savings targets.

Therefore, there is no realization of investment in the utilization of renewable energy and energy savings on a large scale. The stage that exists while still offering cooperation from overseas investors in the utilization of renewable energy.

2.1.8.2. Existing education programs for eco lifestyle

Since the development of school curriculum in 2013, the local government of Banda Aceh, in this case the Environmental, Sanitation, and Beautification Authority (DLHK3), has included new subject regarding the management of environment as local content in school. Moreover, DLHK3 also gives awards to the cleanest schools and villages annually, as an appreciation to their effort in preserving the environment.

2.1.8.3. Existing programs or organizations that promote eco lifestyle

To promote eco lifestyle, DLHK3 as local government has initiated an annual event in the last few years. This event is consist of few activities, such as the selection of Banda Aceh Environmental Ambassador and Choir Competition on the song of City Hygiene/Cleanliness. The competition is held at several levels; elementary, junior, and high schools. From this event, the government try to spread or gives more insight to the society including students or youngsters about the environmental awareness.

2.1.9. Legal Framework or Institutions for Environment and Energy

2.1.9.1. Masterplan of Banda Aceh

The master plan of Banda Aceh is based on Local Regulation (Qanun) no. 4, 2009, regarding Spatial Planning of Banda Aceh Municipality 2009-2029, and also Local Regulation no. 2, 2018, regarding Spatial Planning revision. From about 25 maps or plans provided within the regulations, 13 of them are presented in this report, with considerations relating to carbon reduction strategies.

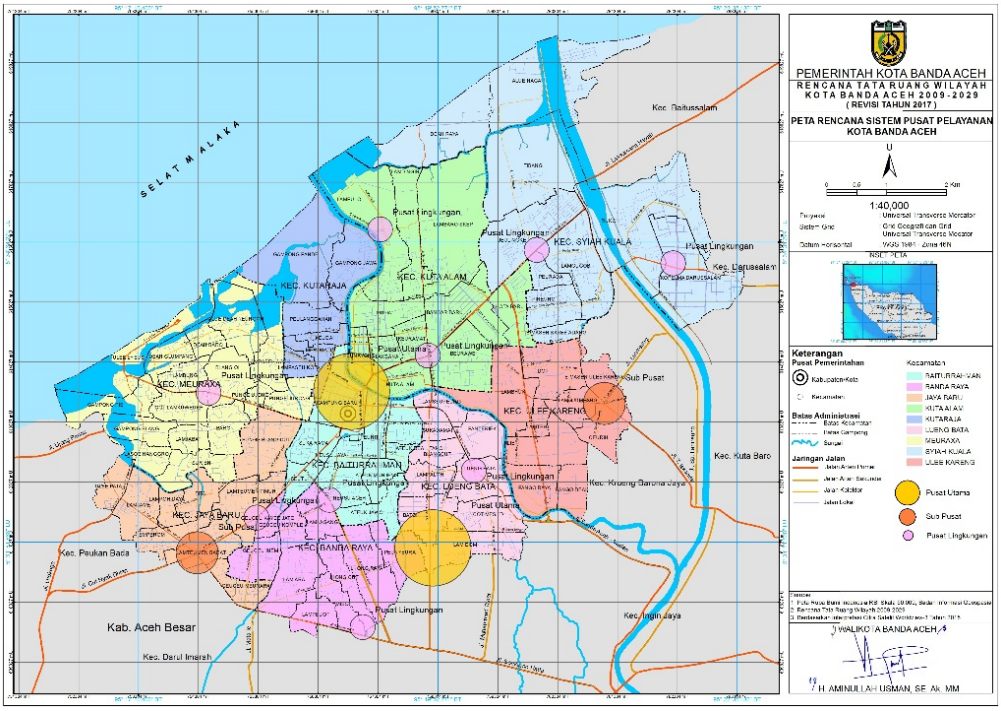


Fig. 2.1-17. Service Area Plan of Banda Aceh Municipality.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

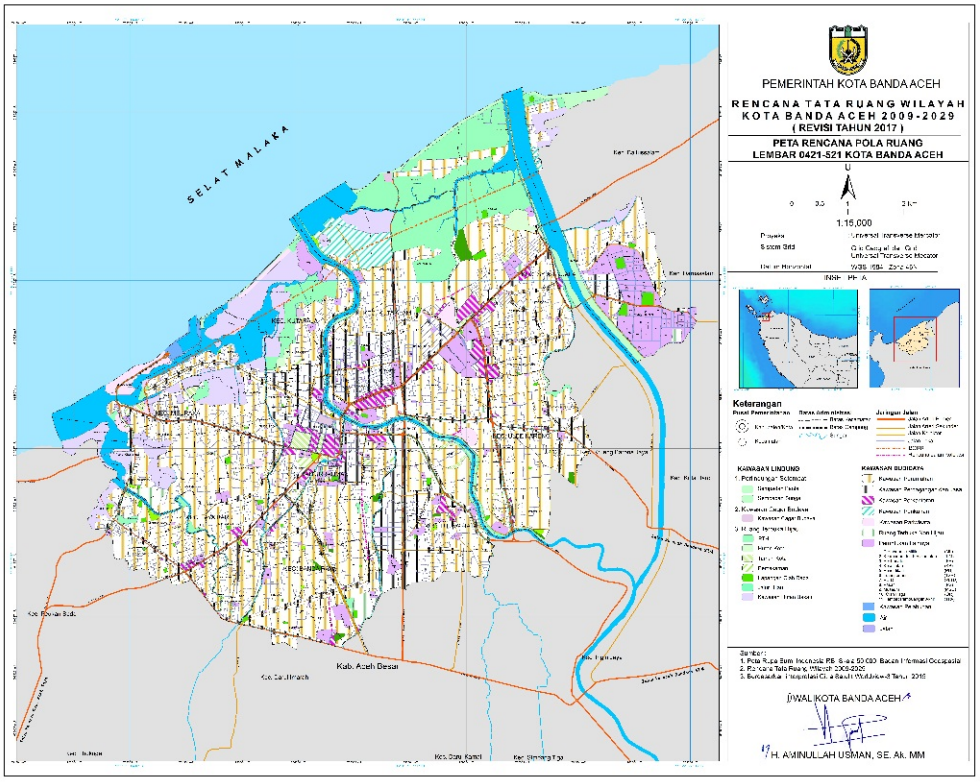


Fig. 2.1-18. Spatial Pattern Plan of Banda Aceh Municipality.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

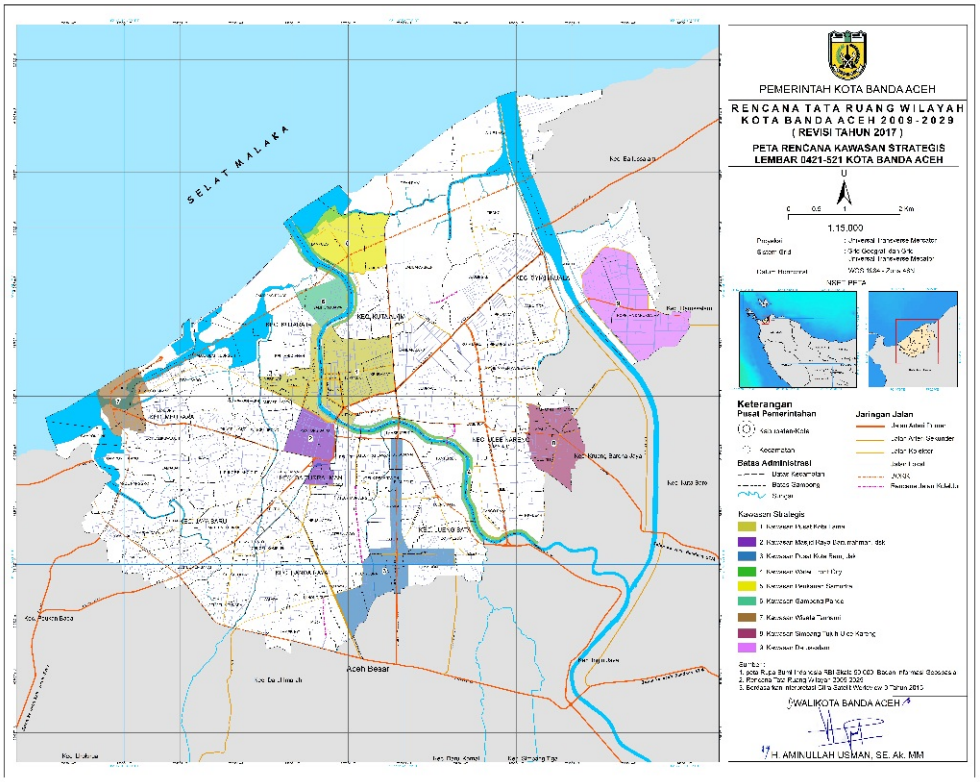


Fig. 2.1-19. Strategic Area Plan of Banda Aceh Municipality.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

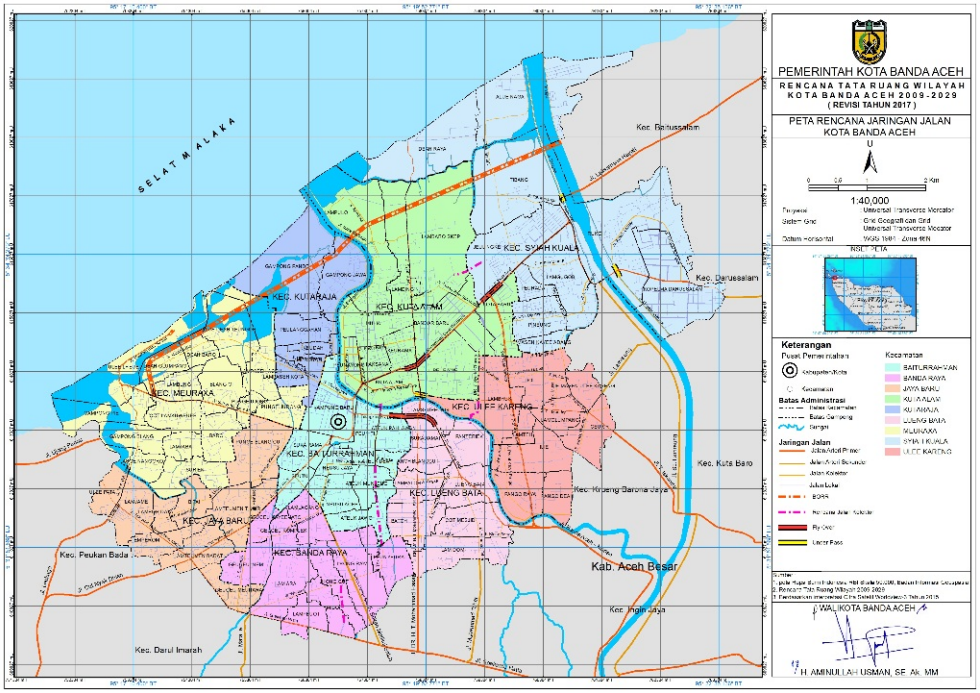


Fig. 2.1-20. Road Network Plan of Banda Aceh Municipality.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

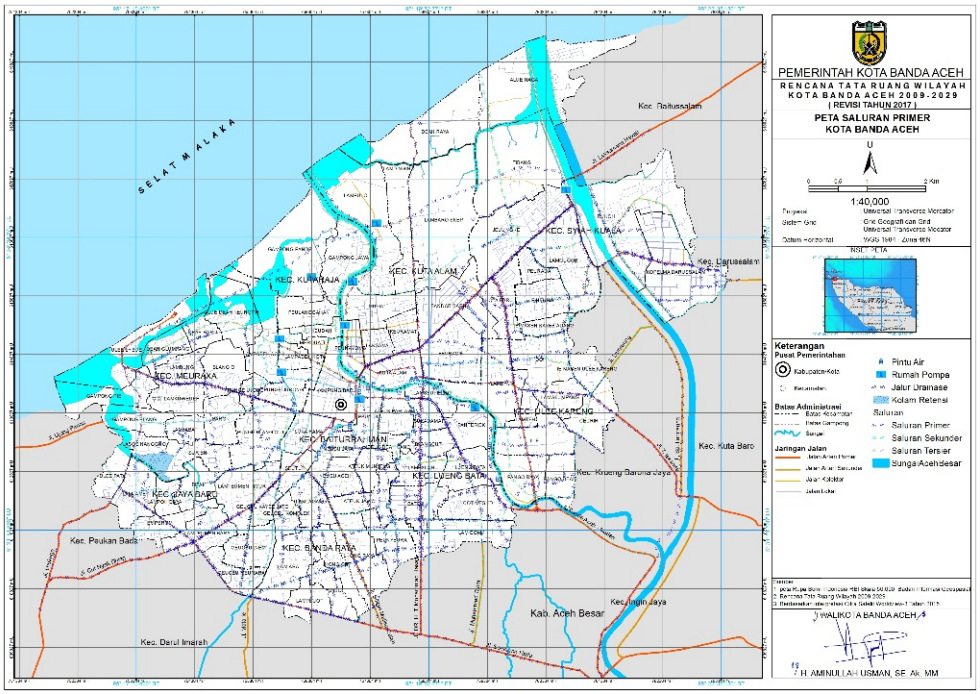


Fig. 2.1-21. Primary Channel Plan of Banda Aceh Municipality.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

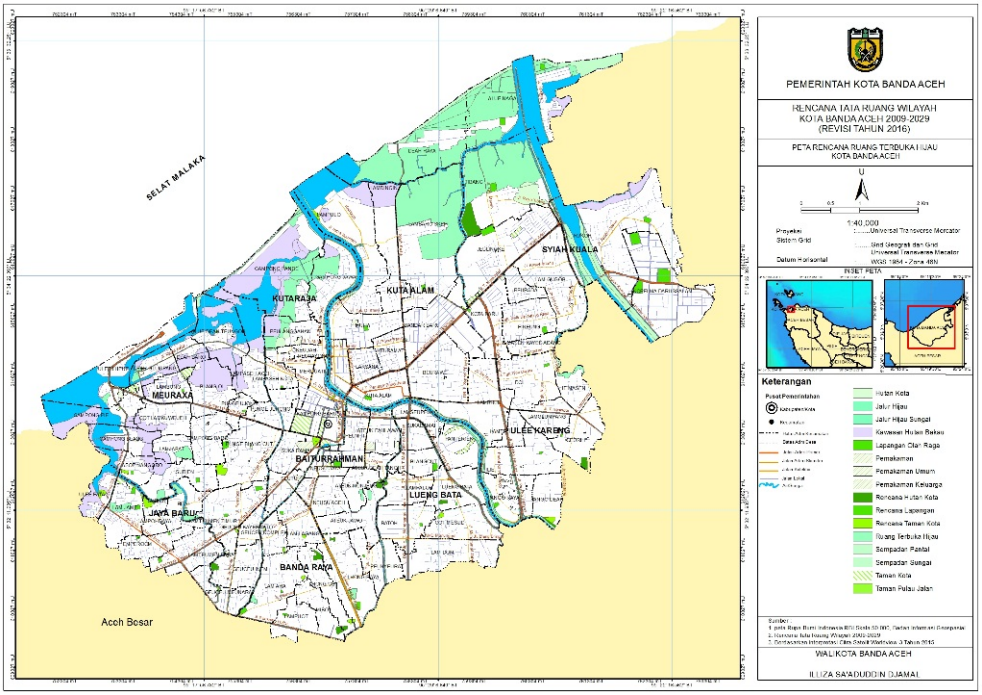


Fig. 2.1-22. Green Open Space Plan of Banda Aceh Municipality.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

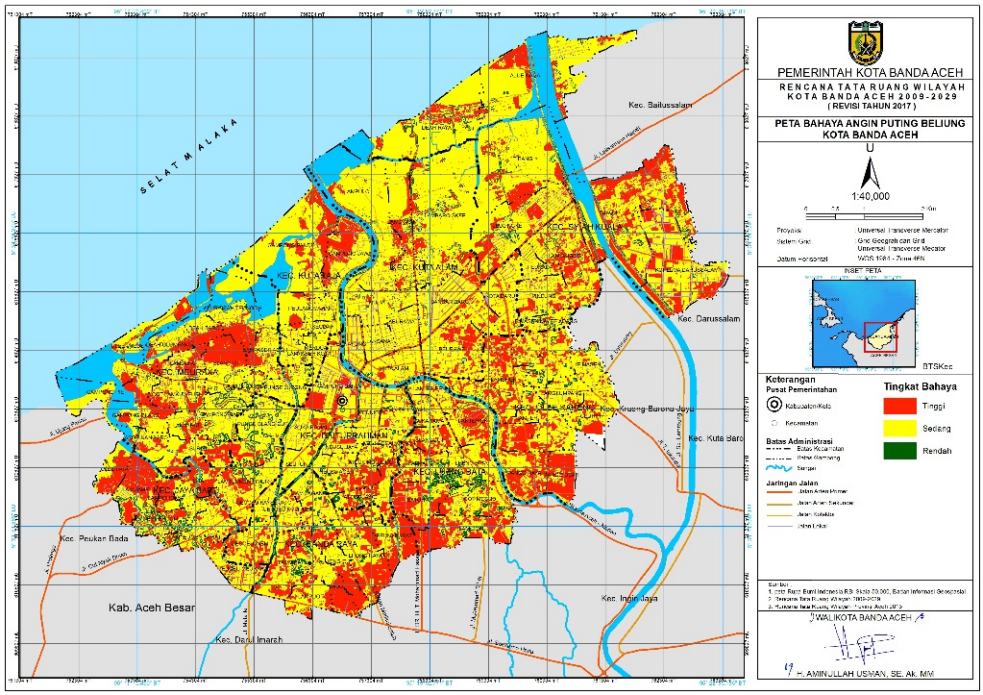


Fig. 2.1-23. Dust Devil/Tornado Hazard Map of Banda Aceh Municipality.
Source: Spatial Planning of Banda Aceh Municipality 2009-2029

2.1.9.2. Policies and Targets related to Low Carbon Strategies

In developing Banda Aceh as Smart and Green City, the current government has published Vision and Mission of the city. However, the term related to smart and green city is not mentioned literally within both vision and mission.

The seriousness of the government to make Banda Aceh city as energy savvy and the greenest city in Indonesia in 2034 has been shown through several policies, such as:

1. Local Regulation (Perda) of Banda Aceh no. 18, 2011, regarding Spatial Planning of Banda Aceh Municipality (RTRW) 2011-2031
2. Local Regulation (Perda) of Banda Aceh no. 9, 2011, regarding Waste Management
3. Local Regulation (Perda) of Banda Aceh no. 5, 2011, regarding Water Resource Management
4. Local Regulation (Perda) of Banda Aceh no. 3, 2014, regarding Regional Medium Term Development Plan (RPJMD) of Banda Aceh 2013-2018
5. Local Regulation (Perda) of Banda Aceh no. 17, 2012, regarding Free Plastic Area
6. Local Regulation (Perda) of Banda Aceh no. 7, 2011, regarding Green Open Space Management
7. Local Regulation (Perda) of Banda Aceh no. 5, 2010, regarding Building
8. Local Regulation (Perda) of Banda Aceh no. 2, 2014, regarding Waste Management and Control of Hazardous and Toxic Materials

However, there is still no particular master plan regarding smart and green city development at the moment, but the government has planned to draw up its master plan as soon as possible. Thus, this Low Carbon Model Town project has been initiated by the government to encourage more strategies and master plan regarding green city development.

2.1.9.3. Public Transportation Policy and Strategies

The Local government has conducted a rapid assessment of Banda Aceh condition on Bus Rapid Transit (BRT) Lite direct service model system proposal in 2017. It focuses on updating, refining, and enhancing the Pre-Feasibility Study (PFS) that has been done by the Transportation Team of Banda Aceh Government previously in 2004. Some strategies on future urban transport are provided in this report, together with other collected data related to transportation strategy.

Regarding policy, the local government so far only refers to Law number 22, 2009 that covers on planning, regulating, and managing the Traffic and Road Transportation (LLAJ).

Based on Development Study on Smart City for Banda Aceh (2016) that published by Ministry of Energy and Resources, there are several strategies for energy savings and clean energy use in the transportation sector. Those strategies are:

1. Transforming transportation pattern or preference from private vehicle to public transportation, particularly bus. The central government (Ministry of Transportation) has operated Transkoetaradja Bus (BRT) to reduce traffic in Banda Aceh, which operates from 7 am to 10 pm.

2. Shifting the use of motor vehicles to using bicycle and/or walking. Since 2013, the government has developed some bicycle paths, started from T. Imeum Leungbata Street. Car Free Day has also been enforced in Teungku Daud Beureueh every Sunday morning.

3. Start using renewable and cleaner energy. Although most public transportation are still using fossil fuel, but few of them start to use biofuel, which consist of diesel fuel and 20% biodiesel.

2.1.9.4. Institutions and Subsidiary System

Nationally, the strategy of developing renewable energy uses and preserving built environment in Banda Aceh is supervised by the central government, particularly the Ministry of Energy and Mineral Resources. Feasibility Study of LCMT Project is one of the programs that supported by the central government, to redevelop Banda Aceh City after hit by tsunami in 2004.

In regional level, the Mayor and vice Mayor of Banda Aceh as the highest structural position are responsible in Banda Aceh development, in terms of environment and energy.

Several authorities below them have particular task to implement the development strategy, such as Regional Development Agency (Bappeda), Transportation Authority, and Environmental, Sanitation, and Beautification Authority (DLHK3). The structure and more detailed task for each position refer to Qanun of Banda Aceh City no. 1 and 11, 2016.

As an additional information, there is also an organization structure below city manager (Sekretaris Daerah), who has responsibility in supporting and implementing the Mayor's programs. It can be seen in diagram below.

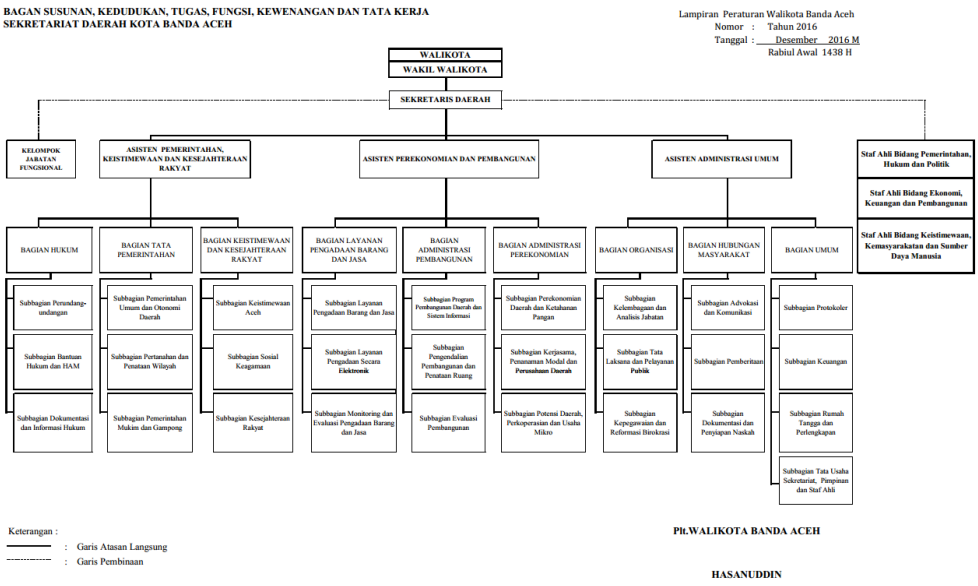


Fig. 2.1-24. Organization Structure of Banda Aceh Municipality Government.
Source: Banda Aceh municipality website (http://bandaacehkota.go.id/p/struktur-organisasi-seketaris-daerah.html)

2.1.9.5. Compliance Monitoring and Management

At the moment, the development of Banda Aceh City to be a Low Carbon Model Town is accompanied and escorted by a team created by the Mayor of Banda Aceh, based on Mayor's Decree number 109, 2018. The team is leaded by the head of Regional Development Agency (Bappeda), supported by several municipality authorities, academics, and experts.

2.1.10. Study Location in Banda Aceh

Banda Aceh City is targeted by the four areas shown below.

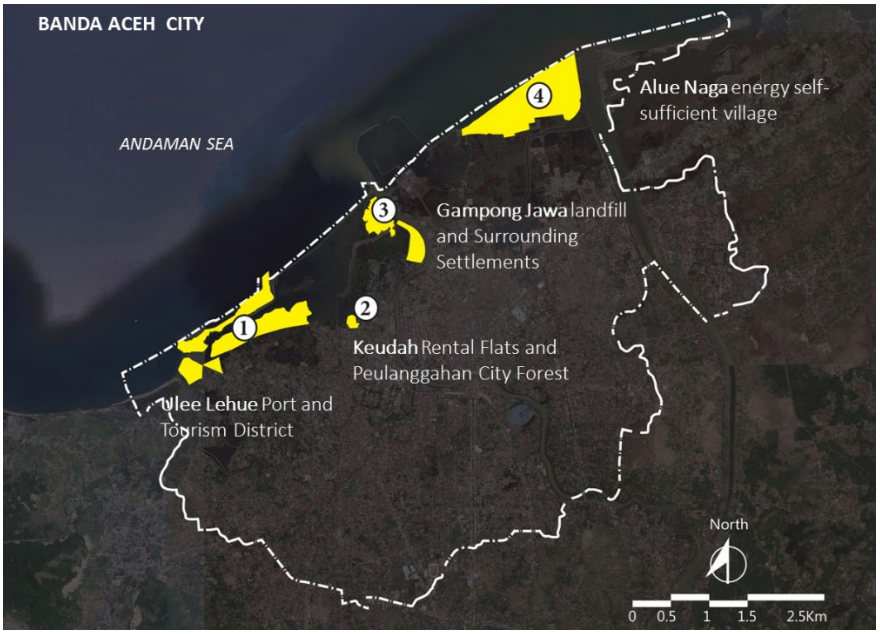


Fig. 2.1-16. Four Study Location in Banda Aceh City
Source: PSUD (Adopted from google maps), 2018

2.1.10.1. Ulee Lehue

Ulee Lehue is a village (gampong) located in Meuraxa district Banda Aceh where the only Sea Port settles. Ulee Lehue is also well known for its seaside. The shoreline ranges from white sandy beach to rocky shore. The beach along the shoreline currently functions as public space and favorite tourism destination for the locals.

Fig. 2.1-2. Area of Gampong Ulee Lheue
Source: PSUD (Adopted from google maps), 2018

*Based on the site delineation above, there are 1974 building unit within the area. 1311891 m² of land and water body

a. Ulee Lehue Sea Port

As the only port that operates and serves the city of Banda Aceh, Ulee Lheue Sea port covers about 8 Ha of land. There are several functions or zones that supports the area for the purpose of transportation of people and goods.

The area is operated by the Municipal government under the Technical Managing Unit Bureau (Unit Pelaksana Teknis Dinas (UPTD)) which coordinates closely with PT. ASDP (Angkutan Sungai Danau dan Penyeberangan) known as a company concerning in water transportation. After the tsunami, Ulee Lheue port had been rebuilt in 2005 with the capacity 1500 GRT (Gross Tonnage).

Fig. 2.1-3. Main Terminal Building (Left and Middle), Integrated Bus Stop (Right)
Source: NSRI

The Sea Port area is a building complex consisting of buildings with height of one up to two storeys high. Buildings within the port area includes main buildings such as terminal, and supporting building such as warehouse, office, and parking building. Ulee Lheue Port can only be only has one access for vehicle which is connected to mainland.

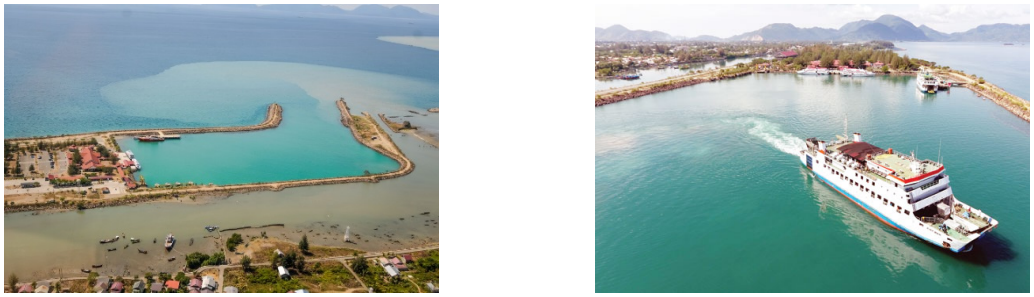


Fig. 2.1-4. Ulee Lheue Port aerial view.
Source: http://menatapaceh.com/images/2014/05/22/23-pelabuhan-ulee-lheue-dariudara/pelabuhan-ulee-lheue-dari-udara/)

b. Ulee Lehue Beach

The northern part of Ulee Lehue beach is famous among tourist due to its peaceful atmosphere with majestic hilly scenery in the horizon and beautiful place to see the sunset. The northern shorelines of Ulee Lehue Beach spans from the east to west up to 3km.

Fig. 2.1-5. Northern Ulee Lheue Beach Line
Source: NSRI, PSUD

Nevertheless, access to the beachfront area is still limited. There are only several access point to enjoy the northern beach line including Ujung Peulanggahan, and Ulee Lehue Beach of Ulee Lehue Sea Port entrance.

Fig. 2.1-6. Limited access towards the beach
Source: PSUD

During an initial survey in Ujung Peulanggahan Beach and Ulee Lehue Beach, apart from its natural beauty, the beach area still possess untapped potential which could be developed further. The tourism area still lack of supporting retail and commercial functions and public facilities due to its suboptimal use. Based from the initial survey, the area was found tainted with trash from the tourism activity. This was assumed to be caused by the lack of environmental awareness of the visitors and the local business perpetrators.

Fig. 2.1-7. Limited Supporting Facility of the Ujung Peulanggahan Beach.
Source: PSUD

Fig. 2.1-8. Tainted beachfront area due to the trash
Source: PSUD

Land around the inner bay area of the Ulee Lehue however is another potential which could be further developed to cater more public activities due to the slow and peaceful current. Nonetheless, hydrodynamic aspects of the water body within the bay should be further considered in order to create an ecological balance of the area.

2.1.10.2. Keudah Social Housing (Rusunawa)

Fig. 2.1-9. Area of Keudah Social housing
Source: PSUD (Adopted from google maps), 2018

*Based on the site delineation above, there are 44 building, including 4 Apartment building and 40 low risebuilding unit with within the area. 27987 m² of land.

Rusunawa Keudah and BNI Tibang City Forest are adjacent developments located in Keudah – Peulanggahan Sub District/Gampong, Kuta Alam District of Banda Aceh. The Keudah low income apartment complex was built above 13.000m2 of Banda Aceh local government land initially to cater the growing demand of housing due to population increase after the event of the Tsunami in 2004. The rented apartment is located in Merduati Street, Keudah, Kutaraja District of Banda Aceh, approximately 1.5 km from Baitturahman Mosque. The road access although located not far from the city center, there are currently no public transportation available within walkable distance from the apartment, therefore generally, motorcycle are used as transportation.

Fig. 2.1-10. Keudah Rusunawa Buildings
Source: PSUD

Operated by the Ministry of Public Works (Kementerian Pekerjaan Umum) in 2010, the rented low income apartment building complex was built in several phases starting in 2008 (phase 1) followed by phase 2 in 2011. The area consisting of four (4) blocks of five (5) storeys high which has 384 housing units of approximately 24 m2 wide.

The apartment building is completed with stairs as vertical circulation, facilities such as mosque, commercial area, meeting room, and motorcycle parking are. Due to the initial development goal to provide affordable rental housing for low income citizens, car parking was not provided within the area. Nevertheless the existing condition showed a contrast view where cars were found parked along the at grade network.

Fig. 2.1-11. Cars Parked on Main Circulation Network
Source: NSRI, PSUD

The rented apartment unit was expected to cater low income families consisting of four to three people per household. Tenants varies from governmental employee, lecturers, national army, and others. The rental price per unit per month of residential unit starts from Rp. 175.000 to Rp. 250.000 depending on the floor, and location; facility; and of the unit. Water management including black water, grey water, and rain water have not been a main concern but are available in standard condition. Black water are managed by on-site sanitation where toilets and the septic tank are in the same location.

Each apartment building has a separate septic tank to manage black water. Grey water and rain water however is flown to the buildings drainage system into the city drainage. However, it is found that there are no separation of grey water and rain water management system. Therefore rain water harvesting system can be developed to improve the overall on site sanitation system.

Fig. 2.1-12. Apartment Building Utility
Source: NSRI, PSUD

Solid waste are managed through the provision of solid waste shaft on the rear side of the building. Solid waste are thrown down through the shaft to be collected by the municipal dump truck to be delivered to Gampong Jawa waste disposal area. One of the drawback of the current system is that there are no on-site solid waste sorting process found within the area.

Fig. 2.1-13. Solid waste drawn shaft
Source: NSRI

Building material in general are concrete used for column, beam, and precast wall. Windows are made from glass and aluminum frame.

Fig. 2.1-14. Apartment Building Material
Source: NSRI

2.1.10.3. BNI Trembesi City Forest – Peulanggahan City Forest

Fig. 2.1-15. Area of Peolanggahan Forest
Source: PSUD (Adopted from google maps), 2018

*Based on the site delineation above the area is 24968 m².

The city forest is located adjacent to the Keudah Apartment complex in Kuta Raja district, Gampong Peulanggahan. Built with the aid of BNI (Bank Negara Indonesia) to support the provision of green open space and facilitate the Keudah social apartment development the area functions as an ecological reserve for the city. The area was built on 6.75 ha of land in 2010 to support the cultivation of Trembesi tree or known as Albizia saman. 204 Albizia saman trees were planted during the initial development.

Fig. 2.1-16. Aerial Photo of BNI Trembesi City Forest – Peulanggahan City Forest
Source: Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota), 2018

The area is managed by the Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota). Supporting facilities includes walkways, waste disposal bin, and natural features such as rocks for sitting group.

Fig. 2.1-17. Open Space Features of BNI Trembesi City Forest – Peulanggahan City Forest
Source: NSRI, PSUD

One of the drawback of the area is the minimum integration with the surrounding development. In terms of accessibility it is still low, to enter the area, one must enter the apartment complex. Improvement of accessibility needs to be developed in order to increase reachability of the city forest.

Another aspect of the area which can be further developed is the amenities that supports children's play. Play area is important for stimulating cognitive development of children and social interaction. Due to the close location of the area to the Keudah Apartment, the area is potential to cater the need of children's play space. Amenities such as playground and courtyard for sports facilitating different age of children can increase children's activity in the area.

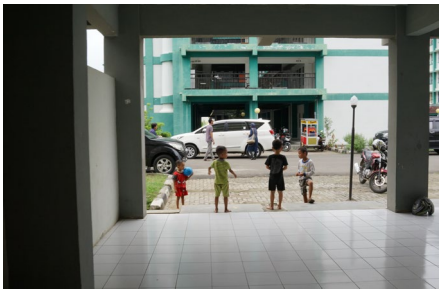


Fig. 2.1-18. Children playing in Keudah Apartment Area
Source: NSRI, PSUD

2.1.10.4. Alue Naga, Kecamatan Siyah Kuala

Fig. 2.1-19. Area of Alue Naga
Source: PSUD (Adopted from google maps), 2018

*Based on the site delineation above, there are 1229 building unit within the area. 1420698 m² of land.

Alue Naga (Sub-district), in the estuary of the main fresh water body of Banda Aceh was one of the most affected area of the 2004 tsunami. Located 1 (one) meter above sea level, the area is classified as a coastal village prone to disaster.

The sub-district is separated by the main river that runs along Banda Aceh city. Small docks along the river are used for small fisher boats. The river is also used as source for basic water in daily life even though it is brackish water.

The area is known to be a fishing village where most of the inhabitant of the area lives mainly on fishing and oyster harvest as well as cultivation.

Fig. 2.1-20. Households of Alue Naga
Source: NSRI

Table. 2.1-16. Data of Inhabitant of Alue Naga per Gampong

No.	Gampong/Village	Households	Male	Female
1	Bunot	53	97	89
2	Kuntaran	175	279	218
3	Musafir	157	234	207
4	Podiamat	32	50	59
Total		417	660	573

Source: http://aluenaga-gp.bandaacehkota.go.id/sejarah/

Alue Naga is renowned for its beautiful beach. According to Banda Aceh Spatial Planning (RTRW 2017) the sub district covers around 291.46 Ha land with 39.18 Ha residential area, 40 Ha mangrove forest, 45 Ha ponds and the rest is water body.

Fig. 2.1-21. Beach area of Alue Naga
Source: NSRI

The buildings in Alue Naga are mostly single building with one up to two storeys level, there are also attached buildings with same height range. Moreover, buildings distribution is 11 unit per Ha, which is considered as a low density area. Physically, the buildings condition are built by using brick and concrete.

Table. 2.1-17. Building Density of Alue Naga per Gampong

No.	Gampong / Village	Building Density		
		Residential Area (Ha)	Buildings (unit)	Density (unit/Ha)
1	Bunot	2.9	49	17.01
2	Kuntaran	22.2	175	7.87
3	Musafir	11.5	170	14.77
4	Podiamat	2.6	32	12.55
Total		39.2	426	11

Source: http://aluenaga-gp.bandaacehkota.go.id/sejarah/

Based on the Spatial Planning document 2009-2029, the area is reserved as a fishing harbor, nature reserve along the coastal area, high density fishermen housing development, and coastal tourism development. The area also encourages traditional fishing practice as its local identity. The poverty rate of the inhabitant of Alue Naga is considerately high, almost 40% of the total inhabitant are impoverished. Almost 35% of the household have low income.

Table. 2.1-18. Social Economic Condition of Inhabitant of Alue Naga

No.	Subject	Total	Unit	Data Resource
1	Adult Inhabitant	1,170	Ppl	Gampong
2	Total of Low Income Households	394	Household	Base Line
3	Impoverished Inhabitant needs Productive Economic Activities	466	Ppl	Census Data
4	Total of Impoverished People Dropout from School	97	Ppl	Census Data
5	Total of Impoverished Elders Need Endowment	30	Ppl	Census Data
6	Total of Impoverished People's Babies	50	Ppl	Census Data
7	Total of Impoverished People's Children	220	Ppl	Census Data

Source: http://aluenaga-gp.bandaacehkota.go.id/sejarah/

2.1.10.5. Gampong Jawa, Kuta Raja District

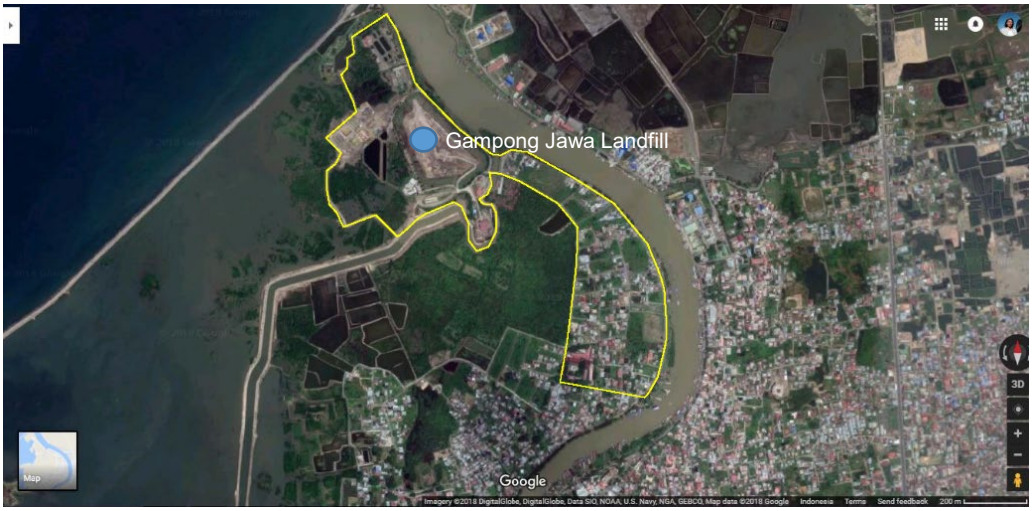


Fig. 2.1-22. Area of Gampong Jawa
Source: PSUD (Adopted from google maps), 2018

*Based on the site delineation above, the landfill area is 245522m², whereas the residential area is 205559 m² with total of 310 building unit

The final waste disposal and processing site for Banda Aceh City is located in Gampong Jawa district of Kutaraja. This landfill is built within 20 hectares area, and managed by the Environmental, Sanitation, and Beautification Authority of Banda Aceh.

Gampong Jawa final disposal site is known to be the first landfill in Indonesia to be converted from open dumping system to sanitary landfill. The sanitary landfill system is built up in the soil. This system ensures the health, safety and sustainability of the ecosystem around the landfill, so that the garbage generated by the Banda Aceh community, which is up to 250 tons per day, is treated very well. In operation at the landfill is always covered with soil, to reduce odor and avoid flies.

Fig. 2.1-23. Landfill area (LEFT) and Compost Facility (RIGHT)
Source: NSRI

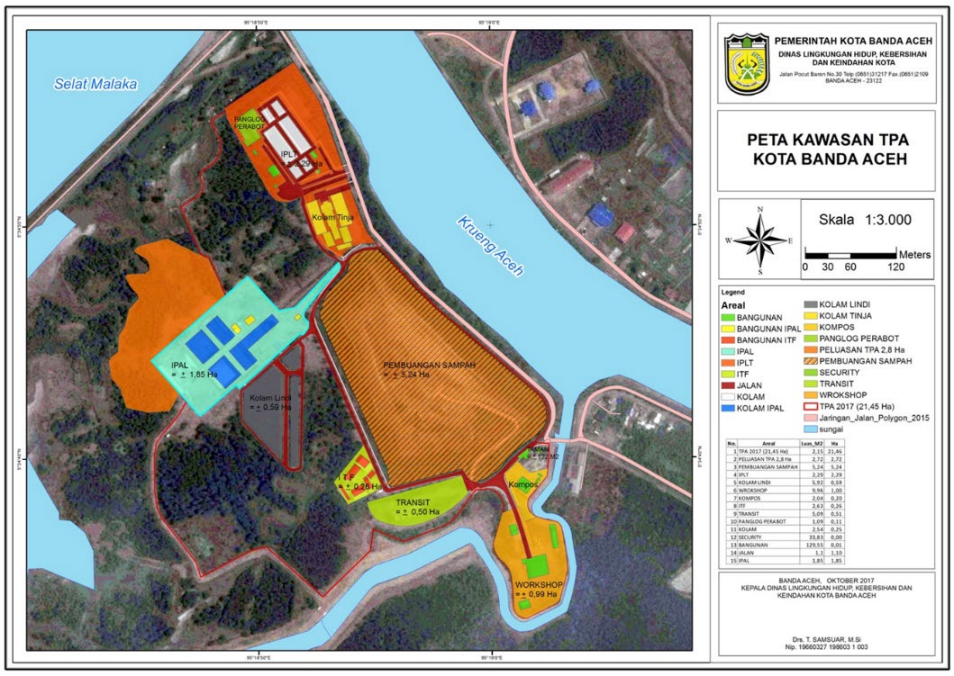


Fig. 2.1-24. Aerial Photo of BNI Trembesi City Forest – Peulanggahan City Forest

Source: Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota), 2018

Landfills are potentially known to produce energy. Gampong jawa final solid waste Disposal Site of Banda Aceh landfill had been able to produce energy from methane used for cooking and to generate small amount of electricity. Methane are distributed through 22 vertical pipes as described in the plan below.

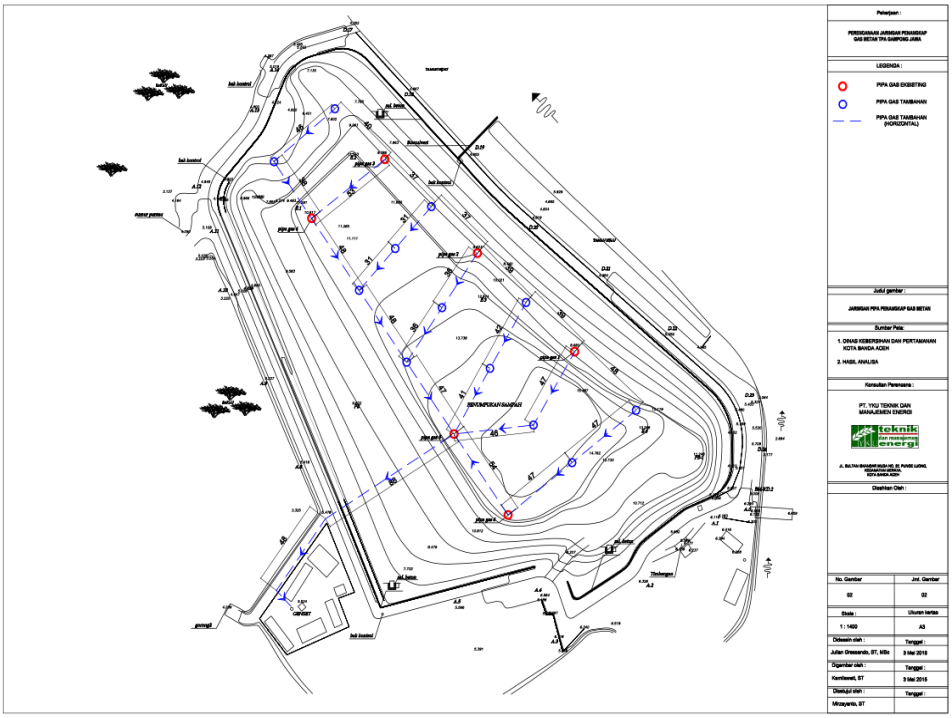


Fig. 2.1-25. Methane Harvesting Network Plan of Gampong Jawa Sanitary Landfill

Source: Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota), 2018

Methane gas collected from the site is able to fuel 5 (five) unit of gas stove and 2 (two) traditional stove for 12 (twelve) hours per day and fuel one unit of generator set to generate electricity with the capacity of 1000 watt for 24 hours with an interval of one hour per usage, and on hour of interval.

Actually, the management office uses a gas range that uses collected methane gas.

Fig. 2.1-26. Methane gas pipe (LEFT) and Gas range using methane gas (RIGHT)
Source: NSRI

The distribution of methane through pipes reaches to up to 110 housing unit.

Fig. 2.1-27. Methane Harvesting Network Plan of Gampong Jawa Sanitary Landfill
Source: Environmental, Sanitation, and Beautification Authority of Banda Aceh (Dinas Lingkungan Hidup, Kebersihan dan Keindahan Kota), 2018

2.2. Shah Alam City Center Section 14, Selangor of Malaysia

2.2.1. Introduction

Shah Alam is the state capital of Selangor, Malaysia. It is situated within the Petaling District and a small portion of the neighbouring Klang District. Shah Alam was opened in 1963 with the purpose of making it the new administrative center of Selangor.

Shah Alam replaced Kuala Lumpur as the capital city of the state of Selangor in 1978 due to Kuala Lumpur's incorporation into a Federal Territory in 1974.

Generally Shah Alam can be divided into three parts, North, Central and South parts. There are 56 Sections in total. North Shah Alam consists of 18 Sections including Sections U1 and U2 and Kampung Melayu Subang. The Central Shah Alam is where all the state administrative buildings and agencies are situated. It consists of Section 1 until Section 24 (as seen in Fig. 2.2-1 as beige coloured areas). While South Shah Alam consists of 12 Sections including Section 25, Section 30, Section 31 and Section 32 (as seen in Fig. 2.2-1 as the light purple coloured areas).

Referring to Fig. 2.2-1, Section 14 is within Central Shah Alam with an area of 366.24 acre.

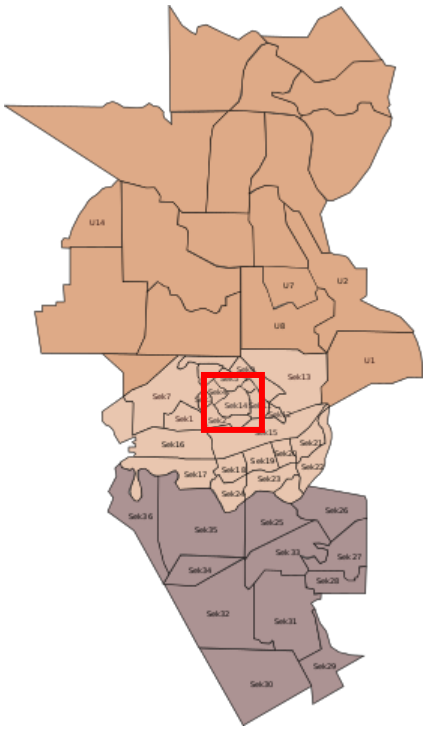


Fig. 2.2-1.Map of Shah Alam
Source: Google Image

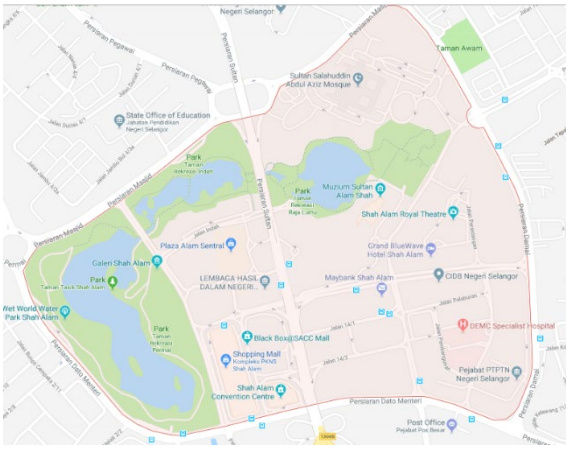


Fig. 2.2-2. Section 14, Shah Alam
Source: Google Maps

2.2.2. Demographic Data

2.2.2.1. Population and Households Size (Current Data and Forecast), Gender Distribution and Age Distribution

Table. 2.2-1 refers to the data of the overall population in Selangor by age and ethnic group. While Table. 2.2-2 and Table. 2.2-3 shows the distribution by age and ethnic group for male and female respectively. The main source of the population data is from the Department of Statistics, Malaysia.

Table. 2.2-1. Overall population by age and ethnic group in SELANGOR, 2017

Age	Total	Bumiputera	Chinese	Indians	Others	Non-Malaysian Citizens
Total	6,380.80	3,383.70	1,553.00	721.2	44.8	678.2
0 - 4	536.9	360.2	90.7	42.3	10.3	33.4
5 - 9	493.6	321.3	97.5	50.9	7.9	16
10 - 14	472.6	307.2	102.2	55.2	4.3	3.6
15 - 19	461.2	276.1	105.9	56.5	3.1	19.5
20 - 24	565.7	261.1	106.7	60.1	3.8	134.1
25 - 29	704.5	344.3	130	69.6	5.8	154.7
30 - 34	712.7	364.8	156.3	73.1	5.1	113.5
35 - 39	569.4	282.8	143.2	62.4	1.9	79
40 - 44	443.4	218.5	124.1	51	0.6	49.1
45 - 49	370.1	177.7	115.2	47.1	0.5	29.5
50 - 54	311	147.3	100.8	43.6	0.6	18.7
55 - 59	250.1	116.6	85.3	37.1	0.3	10.8
60 - 64	184.4	83.3	65.8	27.6	0.2	7.5
65 - 69	137.7	58.7	54.6	20.9	0.2	3.5
70 - 74	81.6	31.9	36.3	11.4	0.1	1.8
75 - 79	44.5	16	21.2	6.1	0	1.1
80 - 84	22.6	7.5	10.6	3.5	0	0.9
85+	18.9	8.1	6.6	2.8	0	1.4

Source: Population Quick Info - Department of Statistics, Malaysia

Table. 2.2-2. Male population by age and ethnic group in SELANGOR, 2017 (Population ('000))

Age	Total	Bumiputera	Chinese	Indians	Others	Non-Malaysian Citizens
Male						
Total	3,318.30	1,715.20	797	360.7	22.4	423.2
0-4	279.8	187.4	47.3	22.6	5.3	17.3
5-9	258.4	168.7	51.3	25.8	4.2	8.4
10-14	241.3	157.9	51.8	27.2	2.3	2.1
15-19	237.5	141.5	53.8	28.5	1.6	12.1
20-24	297.8	128.3	54.5	29.8	1.8	83.3
25-29	373.2	163.5	65.9	34.1	2.9	106.9
30-34	369.5	178.5	76	37.2	2.6	75.1
35-39	298.3	145.1	73	32.1	0.8	47.3
40-44	233.1	113.1	65.4	26.4	0.2	28
45-49	192.1	91.9	60	23.6	0.2	16.5
50-54	163.1	77.1	52.9	22.4	0.3	10.5
55-59	131.2	60.3	46.2	18.2	0.1	6.3
60-64	94.9	42.7	34.7	13	0.1	4.3
65-69	67.9	29.3	27.1	9.4	0.1	2
70-74	38.9	15	18	4.9	0	1
75-79	21.4	7.5	10.5	2.8	0	0.6
80-84	10.8	3.6	5.1	1.6	0	0.6
85+	9.3	3.8	3.4	1.1	0	0.9

Source: Population Quick Info - Department of Statistics, Malaysia

Table. 2.2-3. Female Population by age and ethnic group in SELANGOR, 2017 (Population ('000))

Age	Total	Bumiputera	Chinese	Indians	Others	Non-Malaysian Citizens
Female						
Total	3,062.50	1,668.50	756.1	360.5	22.4	255
0-4	257.1	172.7	43.4	19.7	5.1	16.1
5-9	235.2	152.7	46.2	25	3.7	7.6
10-14	231.3	149.3	50.4	28	2	1.5
15-19	223.7	134.6	52.1	28.1	1.5	7.4
20-24	267.9	132.8	52.1	30.2	2	50.8
25-29	331.3	180.9	64.2	35.5	2.9	47.8
30-34	343.2	186.2	80.3	35.9	2.5	38.3
35-39	271.1	137.8	70.1	30.3	1.1	31.8
40-44	210.3	105.4	58.7	24.6	0.4	21.2
45-49	178	85.8	55.3	23.5	0.4	13.1
50-54	147.9	70.3	47.8	21.2	0.3	8.3
55-59	119	56.4	39.1	18.9	0.2	4.4
60-64	89.5	40.6	31.1	14.5	0.1	3.2
65-69	69.9	29.4	27.4	11.5	0.1	1.5
70-74	42.6	16.9	18.3	6.5	0.1	0.8
75-79	23	8.5	10.7	3.4	0	0.5
80-84	11.8	3.9	5.5	2	0	0.3
85+	9.6	4.3	3.2	1.6	0	0.4

Source: Population Quick Info - Department of Statistics, Malaysia

2.2.2.2. Income Distribution

This section presents statistics on household income and basic amenities for Malaysia, derived from the Household Income and Basic Amenities Survey conducted in 2016 and 2017.

This survey collected data on the income and basic amenities characteristics of Malaysian households. It was carried out using personal interview approach for a period of twelve months starting from May 2016 until April 2017. All administrative districts were covered in this survey. This survey was analyzed scientifically using probability samples that represent all Malaysian households.

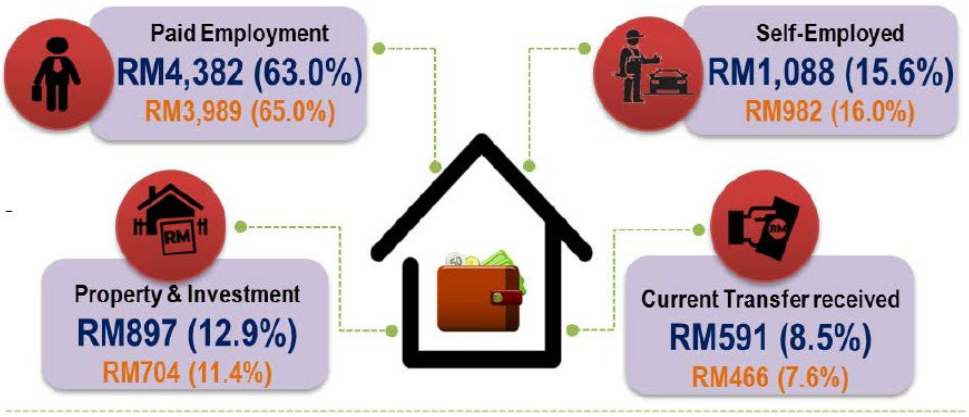


Fig. 2.2-3. Four main sources of income

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

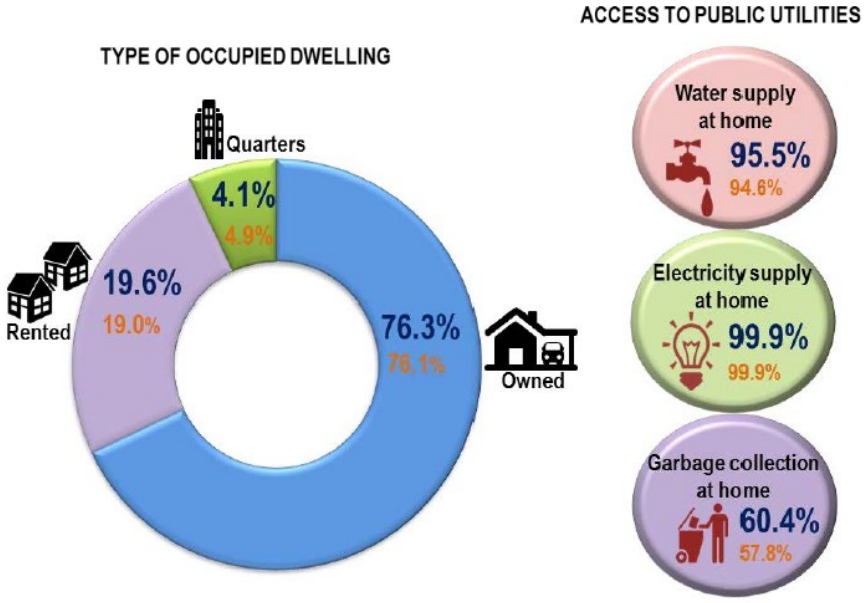


Fig. 2.2-4. Basic amenities

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

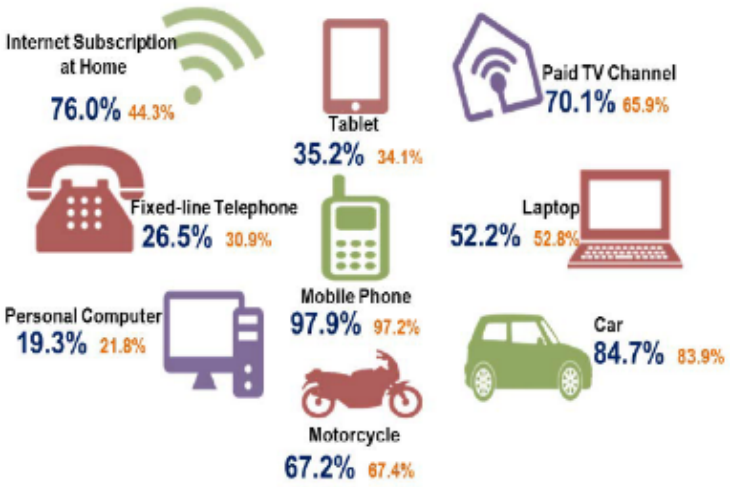


Fig. 2.2-5. Household equipment ownership

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

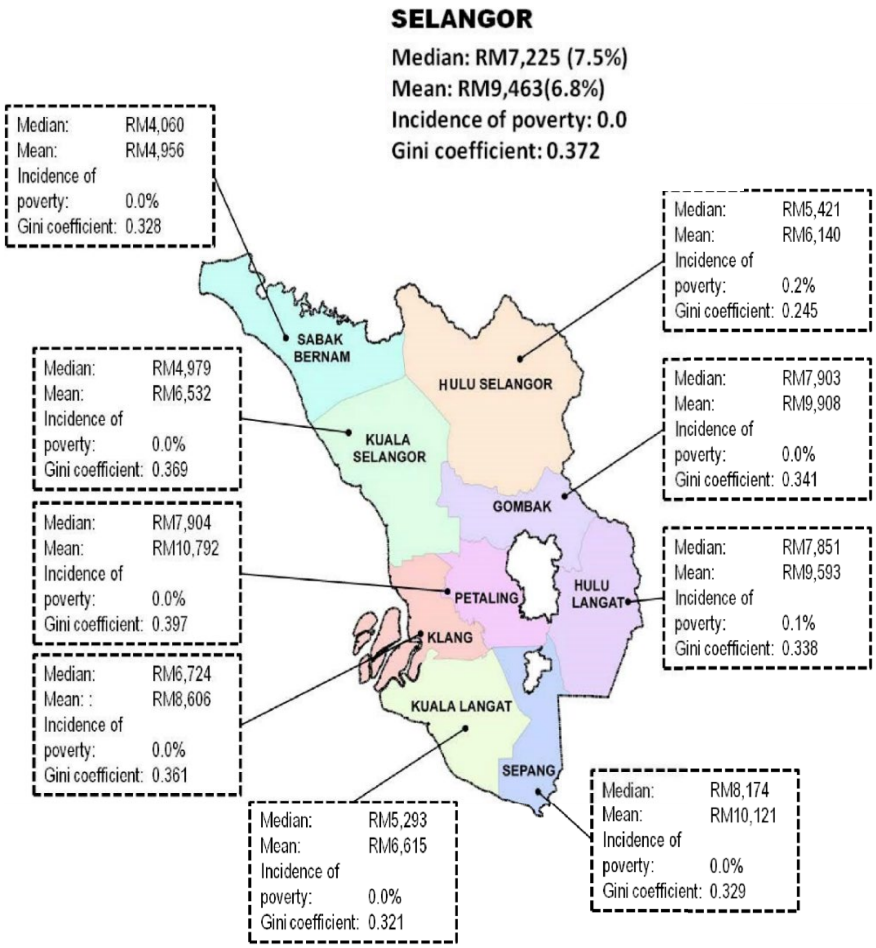


Fig. 2.2-6. Key Statistics on Income in Selangor, 2016

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

2.2.2.2.1. Sources of Income Received By Households

In general, there are four sources of income that can be received (accrued) by household, namely income from Paid Employment, Self-Employed, Property & Investments and Current Transfer received. A household can have more than one income recipient and the income received can be obtained from various sources.

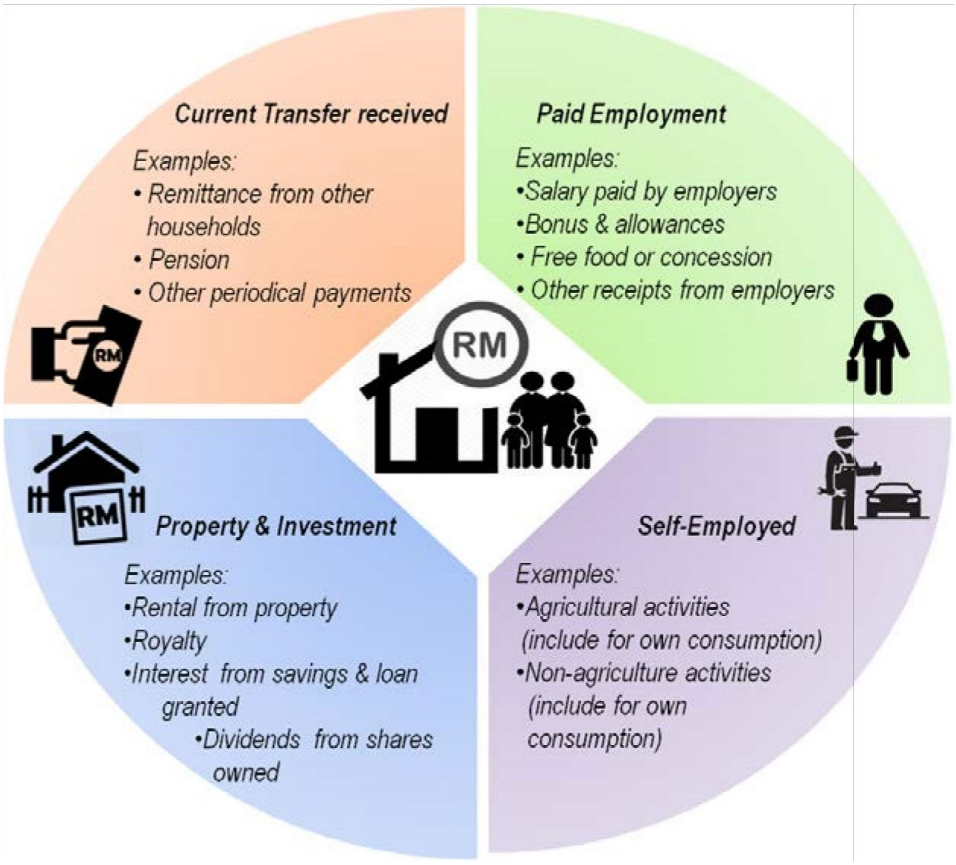


Fig. 2.2-7. Sources of income received by households

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Selangor, 2016 Department of Statistics Malaysia

In 2016, the main source of household income was from Paid Employment (67.9%), followed by Property & Investment (15.1 %), Self-Employed (12.3%) and Current Transfer received (4.7%). Income from Property & Investment and Current Transfer received has increased by 3.1 percent and 0.7 percent respectively.

2.2.2.2.2. Mean Income by Administrative District

Petaling recorded the highest mean monthly household income (RM10,792) in 2016 followed by Sepang (RM10,121), Gombak (RM9,908) and Hulu Langat (RM9,593). Administrative districts that recorded mean monthly household income below the state level (RM9,463) are Klang (RM8,606), Kuala Langat (RM6,615), Kuala Selangor (RM6,532), Hulu Selangor (RM6,140) and Sabak Bernam (RM4,956). The mean monthly household income of all administrative districts has increased where five districts exceeded the state growth rate of (6.8%). Hulu Langat recorded the highest growth rate of (9.5%), followed by Klang (8.4%), Sabak Bernam (8.0%), Kuala Langat (7.8%) and Hulu Selangor (6.9%).

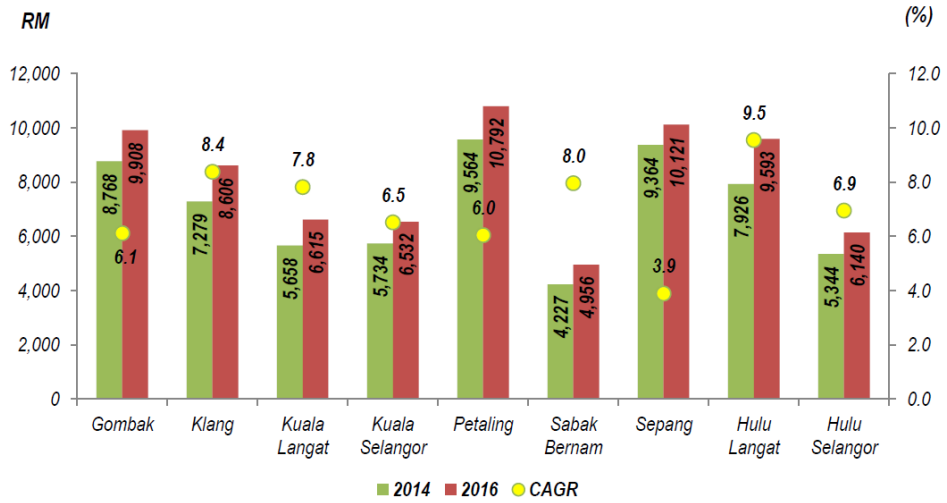


Fig. 2.2-8. Mean monthly household income by administrative district in Selangor, 2014 and 2016

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

Table. 2.2-4. Percentage by strata for main source of income of head of household in Selangor, 2014 and 2016

(%)

Mainsourceofincome	2014			2016		
	Total	Urban	Rural	Total	Urban	Rural
Incomefrompaidemployment	70.9	71.2	64.2	67.9	68.3	59.1
Incomefromself-employed	13.1	12.9	18.1	12.3	12.1	15.7
Incomefrompropertyandinvestment	12.0	12.0	11.5	15.1	15.0	16.6
Currenttransfersreceived	4.0	3.9	6.2	4.7	4.5	8.6

Source: Household Income and Basic Amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

Table. 2.2-5. Median, mean and compounded annual growth rate of monthly household gross income by strata, ethnic group of head of household and administrative district in Selangor, 2014 and 2016

ADMINISTRATIVE DISTRICT	Median (RM)		Compounded annual growth rate	Mean (RM)		Compounded annual growth rate
	2014	2016	2014 – 2016 (%)	2014	2016	2014 – 2016 (%)
SELANGOR	**6,214**	**7,225**	**7.5**	**8,252**	**9,463**	**6.8**
Urban	6,484	7,443	6.9	8,471	9,671	6.6
Rural	4,003	5,119	12.3	5,272	6,357	9.4
ETHNIC GROUP						
Bumiputera	5,776	6,784	8.0	7,747	8,677	5.7
Chinese	8,033	9,290	7.3	10,059	12,022	8.9
Indians	5,215	6,457	10.7	6,939	8,319	9.1
ADMINISTRATIVE DISTRICT						
Gombak	6,640	7,903	8.7	8,768	9,908	6.1
Klang	5,488	6,724	10.2	7,279	8,606	8.4
Kuala Langat	4,556	5,293	7.5	5,658	6,615	7.8
Kuala Selangor	4,303	4,979	7.3	5,734	6,532	6.5
Petaling	7,185	7,904	4.8	9,564	10,792	6.0
Sabak Bernam	3,371	4,060	9.3	4,227	4,956	8.0
Sepang	7,218	8,174	6.2	9,364	10,121	3.9
Hulu Langat	6,507	7,851	9.4	7,926	9,593	9.5
Hulu Selangor	4,440	5,421	10.0	5,344	6,140	6.9

Source: Household Income and Basic Amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

2.2.2.3. Employment Status

Table. 2.2-6 shows the employment status in year 2002 until 2017. It can be divided into four different statuses which are labour force, employed, unemployed and outside labour force.

Table. 2.2-6. Employment status in Malaysia from 2002 to 2017

	Labour force	Employed	Unemployed	Outside labour force	Labour force participation rate (%)	Unemployment rate (%)
2002	1,803.2	1,749.9	53.3	971.8	65.0	3.0
2003	1,895.3	1,834.2	61.0	930.4	67.1	3.2
2004	2,028.1	1,973.3	54.7	1,017.3	66.6	2.7
2005	2,048.8	1,985.9	62.9	1,063.6	65.8	3.1
2006	2,084.4	2,017.7	66.8	1,091.6	65.6	3.2
2007	2,128.0	2,064.2	63.8	1,116.0	65.6	3.0
2008	2,159.8	2,092.0	67.8	1,160.9	65.0	3.1
2009	2,173.3	2,095.3	78.0	1,213.7	64.2	3.6
2010	2,634.4	2,551.1	83.2	1,349.7	66.1	3.2
2011	2,710.8	2,645.2	65.5	1,295.0	67.7	2.4
2012	2,842.6	2,776.1	66.6	1,226.1	69.9	2.3
2013	3,006.2	2,933.3	72.9	1,226.3	71.0	2.4
2014	3,096.0	3,033.6	62.4	1,221.1	71.7	2.0
2015	3,212.9	3,135.0	77.9	1,183.6	73.1	2.4
2016	3,325.0	3,217.6	107.4	1,156.1	74.2	3.2
2017	3,457.6	3,359.5	98.1	1,109.9	75.7	2.8

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

2.2.2.4. Employment Structure

Table. 2.2-7. Number of employed persons by sector and state, Malaysia, 2014 and 2016

State	Sector										Total	
	Agriculture		Mining and quarrying		Manufacturing		Construction		Services			
	2014	2016	2014	2016	2014	2016	2014	2016	2014	2016	2014	2016
Selangor	18.8	17.3	25.9	30.1	557.9	553.0	218.7	248.6	1,700.8	1,664.2	2,522.1	2,513.2

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.2-8. Labour force participation rate by state and age group, Malaysia, 2016

State	Total %	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
Selangor	74.2	11.3	63.6	94.6	90.6	91.2	86.8	87.1	75.9	59.2	32.8

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.2-9. Male labour force participation rate by state and age group, Malaysia, 2016

State	Total %	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
Selangor	82.2	15.2	70.5	95.2	97.2	98.5	98.8	98.5	94.0	76.1	44.0

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.2-10. Female labour force participation rate by state and age group, Malaysia, 2016

State	Total %	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
Selangor	65.4	7.1	56.3	94.0	83.4	82.9	73.4	74.5	55.5	40.6	20.9

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.2-11. Labour force participation rate by state and highest certificate obtained, Malaysia, 2016

State	Total %	UPSR/UPSRA or equivalent	PT3/PMR/SRP/LCE/ SRA or equivalent	SPM or equivalent	STPM or equivalent
Selangor	74.2	66.0	60.0	73.6	55.1

State	Certificate	Diploma	Degree	No certificate	Not applicable
Selangor	88.7	84.7	92.0	67.2	48.0

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.2-12. Male labour force participation rate by state and highest certificate obtained Malaysia, 2016

State	Total %	UPSR/UPSRA or equivalent	PT3/PMR/SRP/LCE/ SRA or equivalent	SPM or equivalent	STPM or equivalent
Selangor	82.2	81.0	69.8	82.6	69.2

State	Certificate	Diploma	Degree	No certificate	Not applicable
Selangor	92.7	87.9	93.5	83.6	62.1

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.2-13. Female labour force participation rate by state and highest certificate obtained, Malaysia, 2016

State	Total %	UPSR/UPSRA or equivalent	PT3/PMR/SRP/LCE/ SRA or equivalent	SPM or equivalent	STPM or equivalent
Selangor	65.4	47.8	46.5	63.3	46.6

State	Certificate	Diploma	Degree	No certificate	Not applicable
Selangor	79.7	81.8	90.6	55.0	36.4

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

2.2.2.5. Educational Level

Table. 2.2-14. Educational level by age group in Selangor, 2010

AGE GROUP	TOTAL	PRE-PRIMARY	PRIMARY SCHOOL	PRIMARY SCHOOL	UPPER SECONDARY
TOTAL	4,640,936	141487	779434	561432	1,336,043
0-4	34,228	34,228	-	-	
5-9	371,649	107,259	264,390	-	
10-14	433,680	-	247,362	186,318	
15-19	442,052	-	4,215	86,513	231,387
20-24	614,881	-	12,270	22,144	168,411
25-29	623,662	-	18,402	30,845	207,976
30-34	477,687	-	20,582	36,873	169,601
35-39	408,032	-	20,140	41,861	147,300
40-44	340,883	-	23,395	40,546	129,771
45-49	284,692	-	28,997	37,301	106,526
50-54	221,159	-	35,930	29,607	74,022
54-59	160,006	-	33,081	22,722	48,411
60-64	99,907	-	29,333	13,412	24,667
65-69	55,347	-	17,940	6,445	13,073
70-74	35,097	-	12,782	3,406	6,929
75+	37,974	-	10,615	3,439	7,969

AGE GROUP	PRE-UNIVERSITY	CERTIFICATE PROGRAMMES INSPECIFIC TRADES AND TECHNICAL SKILL	TERTIARY (CERTIFICATE/ DIPLOMA LEVEL)	TERTIARY (DEGREE/ADVANCED DIPLOMA AND ABOVE)	UNKNOWN
TOTAL	143,184	19,607	362,210	493,116	804,423
0-4			-	-	-
5-9					
10-14					
15-19	56102	1978	43258	15,129	3,470
20-24	21505	4643	84678	118,310	182,920
25-29	12556	4230	72722	104,583	172,348
30-34	10254	2777	52568	83,377	101,655
35-39	11352	2063	37676	63,218	84,422
40-44	10525	1358	25078	36,859	73,351
45-49	8499	1069	18824	27,683	55,793
50-54	5640	668	12054	18,869	44,369
54-59	3207	375	7076	11752	33,382
60-64	1776	163	3564	6182	20,810
65-69	829	117	2031	3076	11,836
70-74	399	60	1016	1524	8,981
75+	540	106	1,665	2,554	11,086

Source: Education and Social Characteristics of the Population, 2010 – Department of Statistics, Malaysia

2.2.2.6. Educational Level

The percentage of owned dwelling remained at 70.2 percent in 2016 as compared to 2014. Meanwhile, the percentage of rented dwellings increased by 0.7 percent in which the percentage of quarters dropped by 0.7 percent.

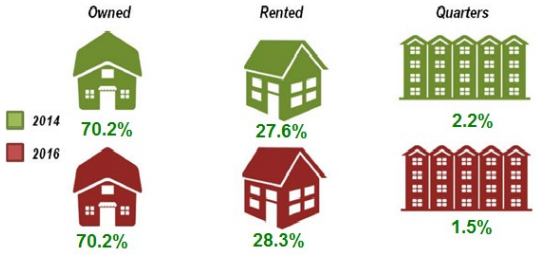


Fig. 2.2-9. Percentage of household by type of dwelling, Selangor 2014 and 2016
Source: Household Income and Basic amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

Table. 2.2-15. Percentage of households by type of occupied dwelling and administrative district, Selangor, 2016

STATE	Owned	Rented	Quarters	Total
	Total	Total	Total	Total
SELANGOR	**70.2**	**28.3**	**1.5**	**100.0**
Gombak	71.7	27.7	0.6	**100.0**
Klang	69.1	27.7	3.2	**100.0**
Kuala Langat	81.1	18.9	0.0	**100.0**
Kuala Selangor	75.3	23.9	0.8	**100.0**
Petaling	66.3	31.9	1.8	**100.0**
Sabak Bernam	85.0	11.2	3.8	**100.0**
Sepang	74.1	24.2	1.7	**100.0**
Hulu Langat	72.8	26.8	0.4	**100.0**
Hulu Selangor	67.4	31.5	1.1	**100.0**

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

2.2.2.7. Vehicle Ownership

The two tables below show the number of vehicles ownership by type in year 2014 and 2015. Motorcycle is the most dominant and popular in Selangor as compared to Motorcar and other Public Transports. There is an increase of user using motorcycle in year 2015 as compared to year 2014.

Table. 2.2-16. Total motor vehicles ownership by type and state, 2014

State	Motorcycle	Motorcar	Bus	Taxi	Hire & Drive Car	Goods Vehicle	Others	Total
Selangor	1,273,286	1,068,420	6460	14,647	1,990	181,434	133,718	2,679,955
Malaysia	11,629,265	11,199,910	65,044	1,990	58,945	1,159,872	882,467	25,101,192

Source: Data Set from Department of Transportation - http://www.data.gov.my/data/ms_MY/dataset?tags=jenis+dan+negeri

Table. 2.2-17. Total motor vehicles ownership by type and state, 2015

State	Motorcycle	Motorcar	Bus	Taxi	Hire & Drive Car	Goods Vehicle	Others	Total
Selangor	1,342,398	1,085,737	6,773	15,322	2,202	188,492	138,808	***2,779,732***
Malaysia	12,094,790	11,871,696	66,999	108,149	63,885	1,197,987	898,446	26,301,952

Source: Data Set from Department of Transportation - http://www.data.gov.my/data/ms_MY/dataset?tags=jenis+dan+negeri

2.2.2.8. Traffic Share Ratio

Table. 2.2-18 to Table. 2.2-20 shows the volume of vehicle in Section 14, Shah Alam from 2015 to 2017.

Table. 2.2-18. Volume of vehicles in Section 14, Shah Alam (2015)

NO	ROAD NAME	TYPE OF VEHICLE (JANUARY-DICEMBER 2015)					TOTAL/ Year
		CAR	LORRY	BUS	MPV/SUV	MOTORCYCLE	
1.	PERSIARAN DAMAI (1.5KM)	3653	108	140	1256	900	6057
2.	PERSIARAN DATO MENTERI (1KM)	3656	239	55	2569	557	7076
3.	PERSIARAN MASJID (2.5KM)	3267	132	85	1560	733	5777
4.	PERSIARAN PERBANDARAN (1.2KM)	1658	126	258	900	652	3594
5.	PERSIARAN BANDARAYA (1.2KM)	140	32	0	50	125	347
6.	PERSIARAN TASIK (800KM)	917	153	136	890	275	2371
7.	PERSIARAN SULTAN (BERSAMBUNG LKSA) (1KM)	2756	205	402	3089	963	7415
JUMLAH		16047	995	1076	10314	4205	
TOTAL							32637

Source: Majlis Bandaraya Shah Alam, MBSA

Table. 2.2-19. Volume of vehicles in Section 14, Shah Alam (2016)

NO	ROAD NAME	TYPE OF VEHICLE (JANUARY-DICEMBER 2016)					TOTAL/ Year
		CAR	LORRY	BUS	MPV/SUV	MOTORCYCLE	
1.	PERSIARAN DAMAI (1.5KM)	2531	97	87	895	768	4378
2.	PERSIARAN DATO MENTERI (1KM)	2756	136	55	2523	108	5578
3.	PERSIARAN MASJID (2.5KM)	2231	96	30	1986	501	4844
4.	PERSIARAN PERBANDARAN (1.2KM)	980	85	20	1425	240	2750
5.	PERSIARAN BANDARAYA (1.2KM)	200	25	0	89	100	414
6.	PERSIARAN TASIK (800KM)	850	356	97	900	123	2326
7.	PERSIARAN SULTAN (BERSAMBUNG LKSA) (1KM)	1650	176	365	1823	765	4779
JUMLAH		11198	971	654	9641	2605	
TOTAL							25069

Source: Majlis Bandaraya Shah Alam, MBSA

Table. 2.2-20. Volume of vehicle in Section 14,Shah Alam (2017)

NO	ROAD NAME	TYPE OF VEHICLE (JANUARY-DICEMBER 2017)					TOTAL/ Year
		CAR	LORRY	BUS	MPV/SUV	MOTORCYCLE	
1.	PERSIARAN DAMAI (1.5KM)	2236	88	88	1165	586	4163
2.	PERSIARAN DATO MENTERI (1KM)	2756	50	34	1356	78	4274
3.	PERSIARAN MASJID (2.5KM)	1853	53	25	1754	222	3907
4.	PERSIARAN PERBANDARAN (1.2KM)	787	65	22	832	261	1967
5.	PERSIARAN BANDARAYA (1.2KM)	185	15	0	75	124	399
6.	PERSIARAN TASIK (800KM)	764	223	76	657	200	1920
7.	PERSIARAN SULTAN (BERSAMBUNG LKSA) (1KM)	979	124	275	1760	536	3674
JUMLAH		9560	618	520	7599	2007	
TOTAL							20304

Source: Majlis Bandaraya Shah Alam, MBSA

2.2.3. Local Economy

2.2.3.1. GDP Growth Rate

Table. 2.2-21. GDP by State, 2014, 2015 And 2016 at constant 2010 Prices - Annual Percentage Change & Percentage Share To GDP

State	Annual Percentage Change			Percentage Share to GDP		
	2014	2015e	2016P	2014	2015e	2016P
Selangor	6.8	5.7	4.8	22.4	22.6	22.7

Source: Household Income and Basic Amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

2.2.3.2. Main Economic Sector

Table. 2.2-22. GDP by state and kind of economic activity, 2014 at constant 2010 prices - RM Million

Kind of economic activity	Agriculture	Mining and quarrying	Manufacturing	Construction	Services	Plus : Import duties	GDP at purchasers' prices
Selangor	3,870	493	66,872	13,849	135,200	6,716	227,000

Source: Household Income and Basic Amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

Table. 2.2-23. GDP by state and kind of economic activity, 2015 at constant 2010 prices - RM Million

Kind of economic activity	Agriculture	Mining and quarrying	Manufacturing	Construction	Services	Plus : Import duties	GDP at purchasers' prices
Selangor	3765	513	70,485	14,830	142,768	7,687	240,048

Source: Household Income and Basic Amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

Table. 2.2-24. GDP by state and kind of economic activity, 2016 at constant 2010 prices - RM Million

Kind of economic activity	Agriculture	Mining and quarrying	Manufacturing	Construction	Services	Plus : Import duties	GDP at purchasers' prices
Selangor	3,526	660	73,504	14,527	151,278	8,105	251,601

Source: Household Income and Basic Amenities Survey Report by State and Administrative District, Selangor, 2016 – Department of Statistics Malaysia

2.2.4. Basic Infrastructure, Energy and Resources

2.2.4.1. Provision rate and volume of basic infrastructure

Basic infrastructure in Section 14, Shah Alam are as follow:

a) Road Network
b) Drainage System
c) Train (Future LRT)

2.2.4.2. Existing Solid Waste Collection System Including Recycle System

In Shah Alam, a few programs are conducted for solid waste management such as:

i. Project 1: Reduce Waste Programme

According to the principle (Integrated solid waste management) the main component of reducing carbon emission is by reducing the generation of solid waste. Initiatives taken by MBSA to reduce solid waste are polystyrene free programme and mini zeebee program

ii. Project 2: Waste Separation Programme

The solid waste separation at home programme is separated into 2 phases involving different locations:

Phase 1: Seksyen 7, Seksyen 32, Seksyen U8, Seksyen U13, Seksyen U16

Phase 2: Seksyen 8, Seksyen 19, Seksyen 24, Seksyen U5, Seksyen U20

iii. Project 3: Recycle Used Clothes

Location for collection:

a) Recycling center Section 16
b) Recycling Center Section 11
c) Jalan Lompat Galah 13/36, Seksyen 13
d) Jalan Lontar Lembing 13/38, Seksyen 13
e) Jalan Teras Jernang 27/8, Seksyen 27
f) Jalan Bukit Ceding 28/4, Seksyen 28
g) Jalan Serambi U8/21, Seksyen U8

iv. Project 4: E-Waste Collection Programme

E-wastes are electronic wastes that are unused, damaged or expired. They can be categorized as waste materials under the code SW110, First schedule, and environmental quality regulations (Scheduled waste 2005). Households and companies are advised to send their used electronic items to any of the collection centers. The item will then be sent to agencies responsible for appropriate safety disposal

2.2.4.3. Accessibility of Recycling Services

Majlis Bandaraya Shah Alam (MBSA) has created seven (7) recycling centers that are accessible to the residents:

a) PKS Seksyen 17, Shah Alam
b) PKS Seksyen 2, Shah Alam
c) PKS Seksyen 6, Shah Alam
d) PKS Seksyen 20, Shah Alam
e) PKS Seksyen 25, Shah Alam
f) PKS Seksyen 11, Shah Alam
g) PKS Seksyen U8, Shah Alam

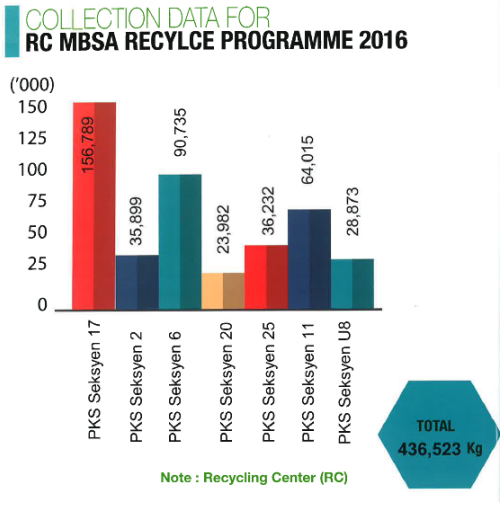


Fig. 2.2-10. Collection data for MBSA Recycle Programme 2016
Source: Report of Shah Alam Towards 2030 Low Carbon City – The Comprehensive Approach And Implementation To Develop A Sustainable City

MBSA also carried out a used cooking oil recycling programme where it is a joint venture project between MBSA, Uni10 Energy and CGV Industries Sdn Bhd. Used cooking oil barrels area place at all MBSA recycling centers. The resident association can run a small-scale used cooking oil collection programme in the community area

Table. 2.2-25. Collection Data for Cooking Oil Recycle Programme

YEAR	TOTAL (kg)
2009	720
2010	900
2011	1,000
2012	1,200
2013	5,648
2014	7,878
2015	74,276
2016	88,342
SUB TOTAL	179,964

Source: Report of Shah Alam Towards 2030 Low Carbon City – The comprehensive approach and implementation to develop a sustainable city

2.2.4.4. Current Energy Supply and Demand by Type (Electricity, Heating, Liquefied or Propane Gas, Solar Power)

In Section 14, Shah Alam there is only one Electricity Energy Supply and Gas District Cooling (GDC) plant at the Wisma MBSA Building.

2.2.5. Land Use and Development

2.2.5.1. Area Development Plans (Including urban forestry and TOD (LRT, Heavy Rail, Metro), Industrial Area Planning if any)

Fig. 2.2-12 shows the transportation planning in Shah Alam. There are two LRT hub stations planned for the future in Section 14, Shah Alam. Whereas only one bus stop will be provided.

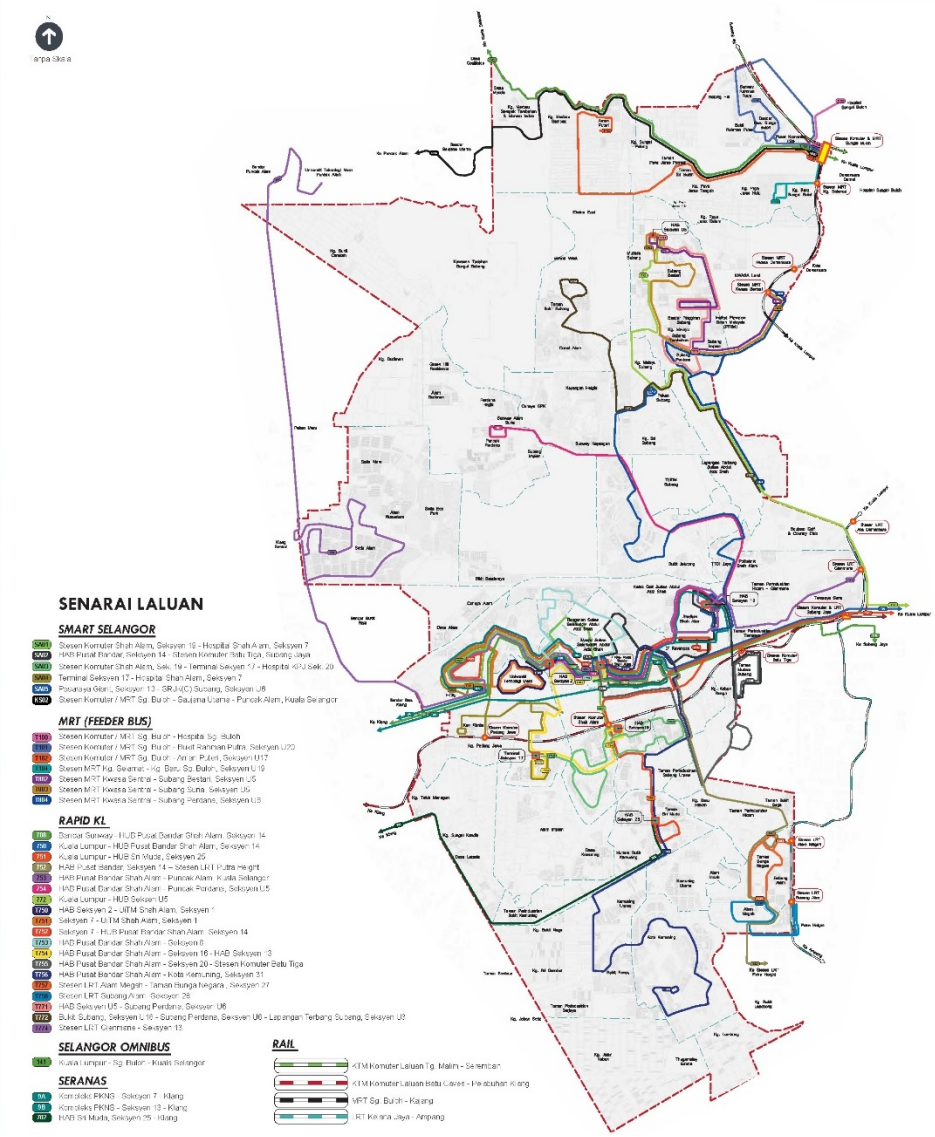


Fig. 2.2-11. Transportation Planning Layout Plan in Shah Alam
Source: Majlis Bandaraya Shah Alam, MBSA

2.2.6. Commercial Building and Public Facilities

2.2.6.1. Types and sizes of existing commercial building (Shopping centers, Office Building, Public Facilities, etc.)

All information for the types and sizes of existing buildings are from the Master Layout Development, Section 14 Shah Alam

Table. 2.2-26. Existing Development in Shah Alam

No.	Precint	Name of Building	Type	Floor Area (m2)
1	1.1 & 1.2	Shah Alam City Center Mall (SACC Mall)	Mall	114,755
2	1.3	Shah Alam Exhibition Convention Centre	Hall	28,488
3	2.3	Maybank	Bank	8,731
4	2.5	Transmission Main Intake (PMU)	TNB	4,419
5	2.6	Angerik Mall (Mara Digital)	Business Complex and Office	64,757
6	2.13	Pejabat Pos Besar Shah Alam	Post Office	NA
8	3.2	Wisma Perbadanan Kemajuan Pertanian Selangor (Wisma PKPS)	Office Building	25,912
9	3.3	Studio 14 / D'Kayu Nasi Kandar	SOHO / Restaurant	12,379
10	3.4	Affin Bank	Office Building	12,379
11	3.5	Plaza Azalea	Office Building/	32,899
12	3.7	Zet Enterprise	Furniture Store	36,291
13	3.9	Darul Ehsan Medical Central	Hospital	34,854
14	3.10		Parking	8,758
15	4.5	Vista Alam Service Apartment	Service Apartment	N.A
16	4.6	Dwiemas International School	Private School	N.A
17	5.4	Jabatan Audit Negeri Selangor		20,480
18	5.5	Bangunan UMNO Selangor/ Hotel Grand Blue Wave	Office Building/ Hotel	25,400
19		Selangor Teater	Teater	14,274
20		State Museum	Museum	
21	7	Wisma Majlis Perbandaran Shah Alam (MBSA)	Office Building	133,000
22		State Library	Library	
23		State Mosque	Mosque	
24	8.1/8.2/8.3/8.5	Plaza Alam Sentral	Business Complex	N.A
25	8.4	Bangunan Darul Ehsan	Office Building	12,612
26	8.6	Bank Negara	Bank	12,612
27	8.7	Plaza Peransang	Office Building & Hotel	13,898
28	8.8	Laman PKNS		44,997
29	9A/9B/9C	Kompleks PKNS	Mall	167,808

Source: Master Development Layout, Section 14, Shah Alam

Table. 2.2-25. Under Construction

No.	Precinct	Owner	Land Area (M^2)
1	2.1	TNB	4,992
2	2.2	Puncak Niaga	10,385
3	2.4	MBSA	1,515
4	2.8	Dato' Hj Shalimin	5,081
5	2.9	Permodalan Nasional Selangor Berhad (P.N.S.B)	14,043
6	2.10	Kumpulan Darul Ehsan Berhad (K.D.E.B)	19,478
8	2.11	Perbadanan Kemajuan Negeri Selangor (PKNS)	13,243
9	2.12	Perbadanan Kemajuan Negeri Selangor (PKNS)	9,299
10	2.14	Perbadanan Kemajuan Negeri Selangor (PKNS)	32,841

Source: Master Development Layout, Section 14, Shah Alam

Table. 2.2-26. Empty Land

No.	Precinct	Name of Building	Type	Floor Area
1	2.7	Hospital	Office	46,625
2	2.12A	JAKEL	Office	N.A
3	4.4	Decathlon	Sport Equiptment Sale Complex	N.A

Source: Master Development Layout, Section 14, Shah Alam

Fig. 2.2-12. Master Layout Development Shah Alam, MBSA.

2.2.6.2. Annual unit energy consumption by source (Electricity, Liquefied Petroleum or Propane Gas)

Table. 2.2-27. The total electrical energy consumption of all buildings in Section 14, Shah Alam.

No.	Building Category	Name of Building	TAHUN		
			2015	2016	2017
1	Financial Institution	Maybank	949,355	1,115,504	984,607
2		Menara Affin	4,106,610	4,114,050	4,119,430
3	Center of Attraction /Entertainment Center	Shah Alam Convention Centre	2,701,503	2,590,657	2,237,979
4		Muzium	945,329	841,441	1,045,002
5		Laman Budaya	1,967	3,117	10,373
6		Galeri Shah Alam	42,141	43,786	29,173
7	Health	DEMC Speacialsit Hospital	5,592,955	5,520,120	5,239,541
8	Mix Development	Plaza Peransang	3,908,111	4,520,677	4,022,356
9	Hotel	Grand Bluewave Shah Alam	6,621,996	6,329,802	6,771,363
10	Office	Wisma MBSA	7,771,523	8,119,468	7,650,818
11		Bangunan Darul Ehsan	4,031,838	4,172,541	4,164,937
12		Bangunan UMNO Selangor (Bangunan Muara)	1,019,093	1,075,120	1,062,344
13		Jabatan Audit Negara Selangor	258,195	249,865	231,104
14		Wisma PKPS	2,153,700	2,258,640	2,060,980
15	Serviced	Pejabat Pos	640,486	741,775	660,771
16		Hentian Pusat Bandar	9,024	12,002	10,856
17	Business	Plaza Alam Sentral	13,075,765	13,213,436	11,929,846
18		SACC Mall	4,726,170	4,647,990	4,135,418
19		Plaza Anggerik	944,239	906,473	835,015
20		Kompleks PKNS	8,085,574	8,288,009	8,128,623
JUMLAH			**67,585,574**	**68,764,473**	**65,330,536**

Source: Majlis Bandaraya Shah Alam, MBSA

2.2.6.3. Typical Heating and Cooling System

Typical heating systems are used only to heat up water with electricity while cooling systems used are Air Conditioner and Refrigerators.

2.2.7. Energy and Resources

2.2.7.1. Electricity and Gas (Liquefied Petroleum or Propane) tariff structure

Feed-in Tariff (FiT) is a mechanism that allows electricity that is produced from indigenous Renewable Energy resources to be sold to power utilities at a fixed premium price and for specific duration.

FiT provides a conducive and secured investment environment which will make financial institutions to be comfortable in providing loan with longer period (>15 years).Provides fixed revenue stream for installed system. Only pays for electricity produced: promotes system owner to install good quality and maintain the system. With suitable degression rate, manufacturers and installers are promoted to reduce prices while enhancing quality.

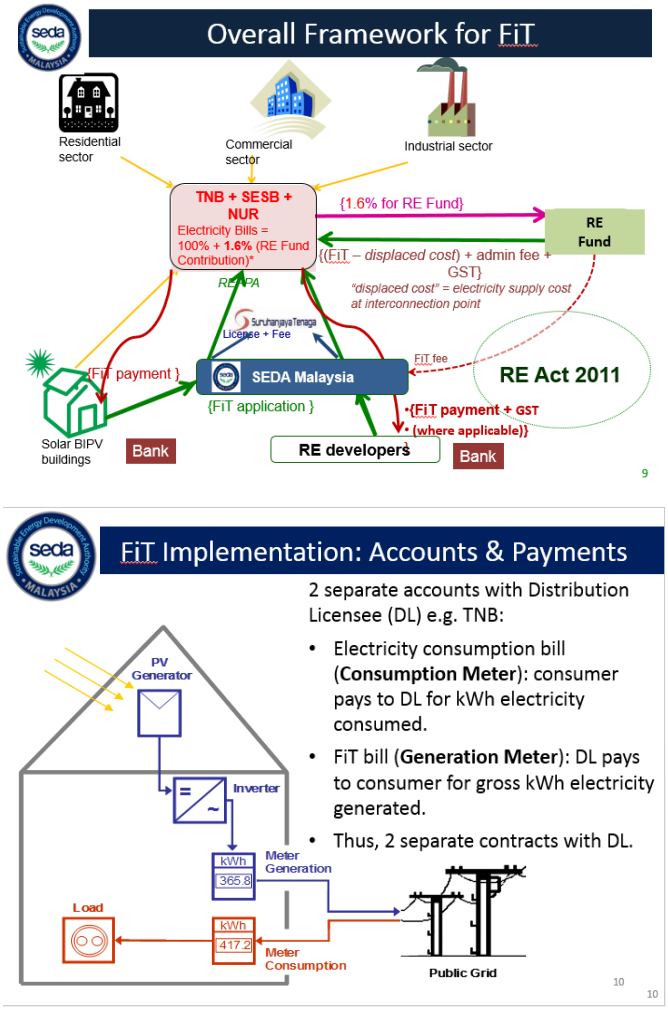


Fig. 2.2-13. Details for FiT
Source: Sustainable Energy Development Authority Malaysia

2.2.7.2. Renewable resources available in volunteer towns (including waste-to-energy and untapped (Biomass, etc)

For renewable resources in Section 14, Shah Alam, only Wisma MBSA Building uses Solar Panels which are located at the open parking of the building. MBSA is also upgrading to LED Road Lamps in total of 64,498 units.

2.2.8. Environment Planning

2.2.8.1. Greenery Coverage Ratio

The following tables show the types of trees and location of trees not within green space and also trees within green space for Section 14, Shah Alam. The data source is from MBSA.

Table. 2.2-28. Trees not within Green Space, Section 14 Shah Alam

Type of Landscape not within Green Space	BASELINE			
	Surface Area (Ha)	Area Covered By Trees (Ha)	Number Of Tree (Nos)	Type Of Tree
Persiaran Dato' Menteri				
1,860 x 10m	1.86	2.0450	3,865	Samanea saman
1,900 x 2m	0.0004		2,631	Peltophorum pterocarpum
2,000 x 2m	0.40		4,561	Pterocarpum indicus
			1,563	Dalbergia
Persiaran Sultan				
1,285 x 25m	4.05	3.2125	9,687	Tabebuia
				Cinnamomum iners
				Filicium decipens
				Cassia biflora
				Bucida
				Mimusops elengi
Persiaran Tasik				
776 m x 10m	0.776	0.7176	9,236	Xanthostemon
				chrysanthus
				Fragrea fagraus
				Eudenia oleana
Persiaran Perbandaran				
2,050 m x 10m	2.05	0.9030	2,236	Ficus benjamina
			1,996	Bucida Mollineti
			196	Fillicium Decipiens
			264	Podocarpus Macrophyllus
Persiaran Bandaraya				
965 m x 10m	0.96	4.7650	859	Eugenia grandis
4,590 m x 10m	4.59		155	Plumeria
			95	Roystonea regia
			590	Livistonia
			265	Archontophoenix
			137	Mentega
			190	Bucida
			50	Manggis Cina
			235	Batai
			64	Tower Tree
			396	Ficus
			80	Akasia
			55	Cinnamoun Inners
Persiaran Damai				
285 x 25m	4.05	3.5630	25,956	Tabebuia
				Cinnamomum iners
				Filicium decipens
				Cassia biflora
				Mimusops elengi
Persiaran Masjid				
	29.00	25.0360	29,863	Hevea brasiliensis
				Leucaena leucocephala
				Agathis
				Acacia
				Tecoma
				Pteracarpus indicus
				Salix babylonica
				Poaceae
				Dillenia suffruticosa

Source: Majlis Bandaraya Shah Alam, MBSA

Table. 2.2-29. Tree within Green Space, Section 14 Shah Alam

Types of Landscape within Green Space	BASELINE			
	Surface Area (Ha)	Area Covered By Trees (Ha)	Number Of Tree (Nos)	Type Of Tree
Taman Tasik Raja Lumu	10	8.68900	9367	Lansium domesticum
Taman Tasik Indah	7	6.23600	15326	Mangifera foetida
Taman Tasik Permai	23	21.4265	15326	Garcinia xanthochymus
				Castanopis
				Gnetum gnemon
				Garnicia mangostana
				Eriglossum Rubiginosum
				Flacourtia
				Anarcardium occidentale
				Phillanthus emblica
				Agathis
Dataran Kemerdekaan Shah Alam	6.4	6.4	17,365	Eugenia grandis
				Plumeria
				Roystonea regia
				Livistonia
				Archontophoenix
				Mentega
				Bucida
				Manggis Cina
				Batai
				Tower Tree
				Ficus
				Akasia
				Cinnamoun Inners
Bangunan Ibu Pejabat PKNS	1.113	1.113	1986	Default
DEMC Hospital	0.536	0.536	566	Default
Padang MBSA	2.517	2.517		Default
Padang Dataran Shah Alam	6.4	6.4		Default
Kota Kemuning Highway (LKSA)	100,000	76,896	23,659	Xanthostemun
				Oil Palm
				Bucida molineti
				Khaya grandiflora
				Messua ferrea
				Plumeria rubra
				Shorea sumatrana
				Agathis borneensis
				Dyera costulata
Taman Tasik Shah Alam	40	76,896	35,622	Lansium domesticum
				Mangifera foetida
				Garcinia xanthochymus
				Castanopis
				Gnetum gnemon
				Garnicia mangostana
				Eriglossum Rubiginosum
				Flacourtia
				Akasia Kuning
				Phillanthus emblica
				Agathis

Source: Majlis Bandaraya Shah Alam, MBSA

2.2.8.2. Waste Recycling Rates

The data tabulated below show the difference between public waste and domestic waste from year 2012 to 2017. SD means Domestic Waste and SPA means Public Wastes. The source is by MBSA.

Table. 2.2-30. Total waste of year 2012 and 2013

NO	MONTH	TOTAL WASTE (TAN METRIK)			
		YEAR 2012		YEAR 2013	
		SD	SPA	SD	SPA
1	JAN	14,001.70	3,149.66	15,385.92	4,086.60
2	FEB	15,176.81	1,986.10	13,783.43	3,496.96
3	MAC	14,971.57	2,629.94	14,606.82	3,928.12
4	APR	14,656.84	2,604.10	14,794.32	4,074.21
5	MEI	15,397.85	2,796.57	14,606.89	3,868.35
6	JUN	15,383.50	2,901.59	14,324.60	3,666.71
7	JUL	16,245.20	3,086.75	15,597.76	4,139.13
8	OGS	15,049.00	2,835.92	14,481.31	3,489.72
9	SEPT	16,982.20	3,303.41	14,720.48	3,729.17
10	OKT	17,933.50	3,662.38	15,139.35	3,788.23
11	NOV	18,563.38	4,021.38	16,201.87	3,911.79
12	DIS	17,104.34	4,173.22	16,677.05	3,873.26
JUMLAH		**191,465.89**	**37,151.02**	**180,319.80**	**46,052.25**

Table. 2.2-31. Total waste of year 2014 and 2015

NO	MONTH	TOTAL WASTE (TAN METRIK)			
		YEAR 2014		YEAR 2015	
		SD	SPA	SD	SPA
1	JAN	15,974.33	3,227.24	15,456.25	6,677.13
2	FEB	13,251.51	4,421.14	13,790.21	6,221.29
3	MAC	14,013.65	5,160.37	15,864.18	7,323.71
4	APR	14,214.50	5,282.99	15,298.60	7,830.61
5	MEI	14,507.32	4,964.00	15,219.97	7,371.47
6	JUN	13,641.80	5,068.10	15,819.40	7,730.02
7	JUL	16,187.91	5,271.45	15,394.32	7,059.75
8	OGS	15,825.76	5,958.56	15,911.14	8,025.09
9	SEPT	15,700.75	5,866.64	15,158.52	8,068.37
10	OKT	16,141.95	6,719.45	16,603.99	8,812.22
11	NOV	18,775.74	6,950.06	16,030.23	8,644.98
12	DIS	15,598.29	6,981.14	17,085.79	8,692.46
JUMLAH		**167,859.18**	**65,871.14**	**172,176.35**	**92,457.10**

Table. 2.2-32. Total waste of year 2016 and 2017

NO	MONTH	TOTAL WASTE (TAN METRIK)			
		YEARS 2016		YEARS 2017	
		SD	SPA	SD	SPA
1	JAN	26,085.45	8,302.22	12,099.18	6,695.44
2	FEB	11,588.12	7,790.35	10,090.37	6,952.87
3	MAC	16,335.19	7,504.38	11,368.82	7,202.86
4	APR	14,505.36	7,480.11	12,205.81	6,074.41
5	MEI	15,235.69	7,733.80	11,126.31	6,463.60
6	JUN	14,958.87	7,645.71	10,661.15	7,643.74
7	JUL	13,847.58	5,209.88	10,076.63	6,234.37
8	OGS	11,057.74	7,279.71	11,276.07	7,485.99
9	SEPT	14,204.73	7,156.28	10,322.17	6,336.69
10	OKT	14,330.94	7,285.81	12,158.40	6,129.72
11	NOV	14,351.74	8,855.32	10,108.42	7,436.44
12	DIS	12,755.77	7,687.28	11,842.66	6,083.57
JUMLAH		**153,171.73**	**89,930.85**	**121,236.81**	**80,739.70**

Source: Majlis Bandaraya Shah Alam, MBSA

Table. 2.2-33. Recyclable Material Collected from Year 2015 until 2017

NO	ITEM	2015												TOTAL (KG)
		JAN	FEB	MAC	APR	MEI	JUN	JUL	OGO	SEP	OKT	NOV	DIS	
RECYCLABLE MATERIAL (VARIETY OF MATERIAL) –KG														
1	PKS Seksyen 2	3,585	5,638	4,331	2,024	2,650	2,225	9,290	2,420	9,560	5,999	3,250	2,500	53,471
2	PKS Seksyen 6	8,206	8,303	5,250	4,650	8,220	5,350	5,560	2,229	4,300	3,411	2,900	2,980	61,359
3	PKS Seksyen 11	5,520	5,526	5,176	5,298	7,825	5,551	5,223	5,358	4,440	1,821	1,580	5,550	58,868
4	PKS Seksyen 17	2,350	10,758	3,421	3,301	8,337	8,023	3,520	6,426	6,439	5,036	5,881	2,558	66,049
5	PKS Seksyen 20	1,550	6,150	2,250	1,228	9,526								20,704
6	PKS Seksyen 25	1,630	5,294	5,505	3,440	2,735	2,121	3,866	1,059	2,286	1,293	2,559	2,490	34,278
7	PKS Seksyen U8	1,240	5,649	5,063	3,858	4,364	1,117	4,568	2,110	2,053	1,726	2,549	2,110	36,407
8	Persatuan Amal Sinar(PASS)	24,130	20,241	20,992	11,688	11,586	11,489	13,047	13,230	11,153	11,035	15,780	19,150	183,521
													TOTAL -KG	514,655
DATA COLLECTION USE CLOTHES (KG)														
10	Brackwell (M) Sdn Bhd	6,138.80	3,250.90	3,250	2,558.50	9,023	5,403.20	2950.5	3,350.80	2,459.00	5,008	4,540	5,580	53,512.70
													TOTAL	642,444
DATA COLLECTION USE COOKING OIL (KG)														
9	Uni10 Energy	946	2,541	3,342	3,615.9	4,548.00	5,284	6,264	6,674	8,337	9,864	10,810	12,050	74,276
													TOTAL	74,276

NO	ITEM	2016												TOTAL (KG)
		JAN	FEB	MAC	APR	MEI	JUN	JUL	OGO	SEP	OKT	NOV	DIS	
RECYCLABLE MATERIAL (VARIETY OF MATERIAL) –KG														
1	PKS Seksyen 2	3,585	2,320	5,250	3,088	3,350	8,221	6,008	2,800	5,440	6,090	2,899	3,655	52,706
2	PKS Seksyen 6	8,206	3,530	1,580	3,905	2,229	3,980	1,200	1,980	2,880	2,552	2,350	2,253	36,645
3	PKS Seksyen 11	5,520	2,200	1,100	1,270	2,480	3,875	585						17,030
4	PKS Seksyen 17	2,305	5,580	2,685	4,229	1,940	4,009	2,640	1,885	1,500	2,820	2,253	2,114	33,960
5	PKS Seksyen 20	1,550												1,550
6	PKS Seksyen 25	1,630	1,890	1,679	2,245	2,817	2,330	1,270	1,994	1,890	1,850	2,660	1,998	24,253
7	PKS Seksyen U8	1,240	2,500	1,550	2,121	2,800	2,500	1,525	1,987	2,228	1,936	2,475	2,673	25,535
8	Persatuan Amal Sinar(PASS)	15,130	11,950	11,032	13,250	13,540	23,100	10,066	23,200.0	19,000.0	10,260.0	13,180.0	19,865.0	183,573
													TOTAL -KG	375251
DATA COLLECTION USE CLOTHES (KG)														
10	Brackwell (M) Sdn Bhd	2,500	5,350	5,007	4,228.9	4,110.5	5,890	3,375	5,350	4,329.00	7,851	5,050	5,869	58,910.30
													TOTAL	58,910.30
DATA COLLECTION USE COOKING OIL (KG)														
9	Uni10 Energy	890	2,517	3,616	5,083	5,879	6,542	7,880	9,017	10,370	10,269	10,298	10,980	83,342
													TOTAL	83,342

NO	ITEM	2017												TOTAL (KG)
		JAN	FEB	MAC	APR	MEI	JUN	JUL	OGO	SEP	OKT	NOV	DIS	
RECYCLABLE MATERIAL (VARIETY OF MATERIAL) –KG														
1	PKS Seksyen 2	4,054	19,081	946										24,081
2	PKS Seksyen 6		1,490	7,451	5,502	4,850	6,230	5,320	4,800	4,472	3,567	3,872.00	2,997.00	50,551
3	PKS Seksyen 11	3,279	3,537	1,657	2,705	3,900	3,018	4,715	5,132	5,356	5,602	3,175.00	13,268.00	55,344
4	PKS Seksyen 17		3,611.5	691	694	720	946	2,100						8,763
5	PKS Seksyen 20													0
6	PKS Seksyen 25	3,287	2,290	820	2,250	2,975	2,117	2,845	1,017	1,867	1,682	1,802.00	2,139.00	25,091
7	PKS Seksyen U8	9,487	7,260	6,090	5,628	6,120	8,063	7,101	8,125	3,695	3,857	22,957.00	2,456.00	90,839
8	Persatuan Amal Sinar(PASS)	14,217	3,216	3,051	2,903	2,811	9,743	8,322	8,129	24,745	4,186	3,856.00	4,127.00	89,306
													TOTAL -KG	343,875
DATA COLLECTION USE CLOTHES (KG)														
10	Brackwell (M) Sdn Bhd	4,306	6,308	4,650	4,790	5,489	4,820	12,298.3	16,213.00	3,840.00	13,261.40	10,265.70	21,917.60	108,159.00
													TOTAL	108,159.00
DATA COLLECTION USE COOKING OIL (KG)														
9	Uni10 Energy	1,672	2,827	3,982	5,137	6,610	7,711	8,322	10,101	8,124	11,513.60	1,672.60	8,747.50	76,420
													TOTAL	76,420

Source: Majlis Bandaraya Shah Alam, MBSA

Table. 2.2-34. Composting Data from Year 2015 until 2017

BIL.	PLACE OF WASTE COMPOST	JAN	FEB	MAC	APR	MEI	JUN	JUL	OGO	SEP	OKT	NOV	DIS	TOTAL (tan)
2015														
1	PUSAT KOMPOS, SEKSYEN 17, SHAH ARAM	16	11	59	9	10	25	28	9	18	13	29	15	240
2016														
1	PUSAT KOMPOS, SEKSYEN 17, SHAH ARAM	18	10	25	22	19	16	8	8	25	12	12	5	180
2017														
1	PUSAT KOMPOS, SEKSYEN 17, SHAH ARAM	35	22	23	18	29	35	24	22	9	10	25	18	270

Source: Majlis Bandaraya Shah Alam, MBSA

2.2.9. Community Planning and Eco Life

2.2.9.1. Public awareness initiative for energy efficiency and environmental conservation

Shah Alam Low-Carbon City 2030 Action plan is prepared to realize MBSA'S direction into, 'Making Shah Alam a beautiful, green and competitive city with environment that will shape the community of sustainable values.

Recycling program with schools and MPP

- Recycling program at school level has begun since 2007.
- Collaboration with F&N Beverages marketing Sdn. Bhd is still continue and at one time managed to get 53 entries from schools throughout Shah Alam.
- Through this program as much as 150 tons of recyclable materials were collected.

3 Step separations of solid waste (Zero Waste)

- -Sorting garbage by type: Can be recycled or cannot be recycled.
- Store in separate bins.
- Saturday is a recycling collection day. While the collection of non-recyclable garbage has been schedule 3 times a week

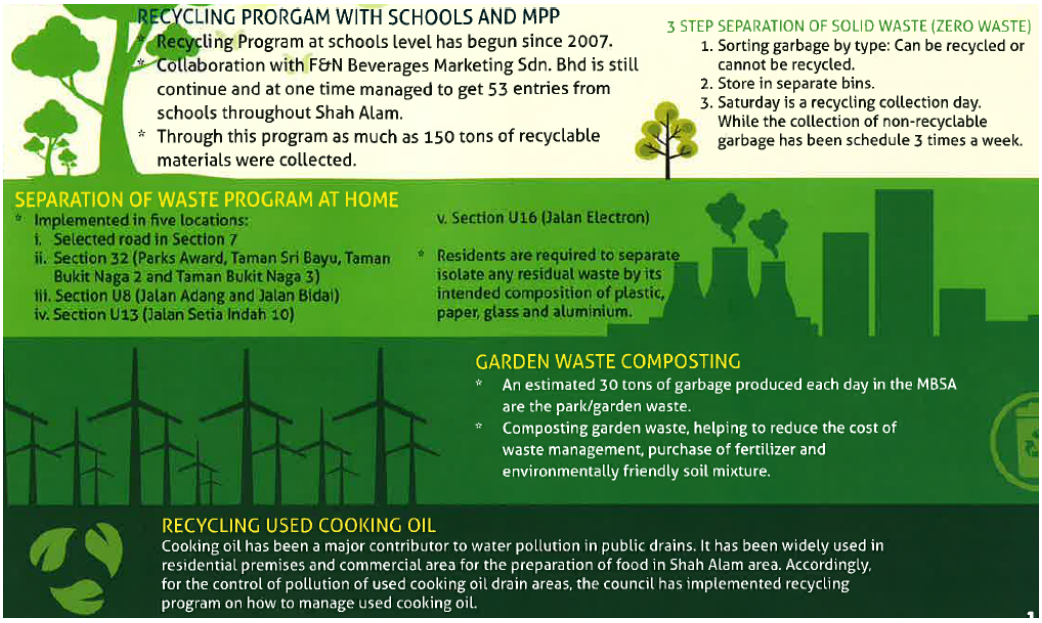


Fig. 2.2-15. Green Solid Waste Management System
Source: Shah Alam Low Carbon City 2030, Action Plan, Majlis Bandaraya Shah Alam

2.2.10. Legal framework or institutions for environment an energy

2.2.10.1. Masterplan and Related Projects

Shah Alam Low Carbon City 2030 is a target for the city of Shah Alam to reduce the carbon in the city. The main objective is to sustain the environment to make Shah Alam a brilliant city by carrying out Green Technology practices toward developing Shah Alam into a Low Carbon City.

This action plan focuses on five aspects:

1. Transportation and Mobility
2. Integration of Nature into Building Environment
3. Solid Waste Management
4. Energy and Waste Resources Management
5. City Administration and Management

Fig. 2.2-16. Component of Development for Sustainbility (Top) and Framework for Green Cities (Bottom)
Source: Shah Alam Low Carbon City 2030, Action Plan, Majlis Bandaraya Shah Alam

2.2.10.2. Policies and Target

The sustainable development direction on implementation of document and policy as follow:

a) International Level

New Agenda is an agenda that is for "Political statement not legally binding" meant for United Nation (UN) States members to achieve the sustainable development goals and human settlements by the year 2036.

In the New Agenda, there is 17 Sustainable Development Goals. It includes several element such as no poverty, no hunger, health and welfare, quality education, gender equality, water sanitation, clean water, clean energy resources and other issues.

b) National Level

Commitment declaration and action taken by Malaysia in making sure the Development is achievable by 2036.

- National Physical Plan (NPP)
- National Green Technology Policy
- Framework for Low Carbon Cities (LCCF)
- MURNInets
- Guidelines for Green Neighbourhood

c) State Level

Shah Alam Low Carbon City 2030 Action Plan has developed core strategy in order to achieve the goal to make Shah Alam as Low Carbon City 2030

- State Plan – Structure
- Smart Selangor
- Green City Action Plan

Fig. 2.2-17. Implementation of documents and policies
Source: Shah Alam Low Carbon City 2030, Action Plan, Majlis Bandaraya Shah Alam

Fig. 2.2-18. MBSA 2030 Goals and Carbon Reduction Target
Source: Shah Alam Low Carbon City 2030, Action Plan, Majlis Bandaraya Shah Alam

2.2.10.3. Current Energy Policy and Strategies

The following shows the action plans to reduce the current energy usage:

1. LED street lighting
2. Shah Alam Carbon Management Plan (Draft)
3. Waste Management Plan
4. Green Requirement for Development

The use of water resources and energy efficiently and effectively

This Rainwater Harvesting System (SPAH) is purposely used for collecting and reusing of rainwater. Rain water is collected, and then channeled to the rainwater storage tank prior to usage.

The benefits of SPAH installation

i. Reduce water demand of the public
ii. Water supply in the event of a public water supply crisis
iii. Reducing the flow of water on the surface (surface run off) from entering the public drainage system
iv. Economical operation of water treatment plant, thus helping to save energy and improve energy efficiency nationwide

Public Toilet Green Roof

i. Design is based on the concept of nature
ii. Features of construction materials and hardware are durable.
iii. Maintenance of tools and meet the needs of user
iv. Lighting and ventilation were also used to enhance the cheerful atmosphere in the interior of public toilets

Retention Pond at Taman Lembah Bukit SUK

i. Retention pond at Taman Lembah Bukit SUK, Section 5, Shah Alam is an area
ii. There is 2 pools in the area that serves as retention pond. The development concept is based on the preservation and recreation.
iii. Maintain existing plants
iv. Enriched with new trees as protected areas
v. Placement of birds, poultry and other.

Taman Tasik Shah Alam

i. Covering an area of 127.8 acres and 40 acres from it is water.
ii. The three major area: West Lake (62.6 acres), Central Lake (29.2 acres) and East Lake (3 acres).
iii. Landscape consultant: Takano Landscape Planning, Japan and completed in 1985.
iv. The water depth between 1 to 6 meters.
v. Basic Shah Alam Lake is soil

2.2.10.4. Current environmental policy (Resource circulation planning, etc) and strategies.

The action plans to integrate nature with the built environment are as follow:

i. Low Carbon Development Project
ii. Wisma MBSA as a Low Carbon Building
iii. Site Green Technology
iv. Low Carbon Community Hall
v. Community Garden And Community Orchard Project
vi. Shah Alam Trees For Life (target planting 90,000 trees a years)
vii. Public Toilet With Green Roof
viii. Lembah Bukit SUK Retention Pond
ix. Dataran Kemerdekaan
x. Laman Seni Shah Alam
xi. Back Alley Beautification
xii. Rainwater Harvesting System (SPAH)
    a) Wisma MBSA
    b) MBSA Brach Offices
    c) Community Halls
    d) Mosque

Initiatives to greening the alley behind a residential area

i. The program is a collaboration between MBSA and the local community in the neighborhood.
ii. To transform the back alley into a clean, green, safe and fun for social interaction
iii. Partners consist of corporate bodies, religious institutions, educational institutions, local resident and volunteers

Laman Seni Shah Alam

i. Was establish to provide a platform for public to express their talent and creativity through performances exhibitions and mural art
ii. It is a smart partnership between MBSA and Bank Muamalat Berhad whereby mural painted by the student of the faculty of the art and design, University Technology Mara (Uitm).

Water Permeable Parking Lot

In Section 2, Shah Alam. The purpose is to manage the water flow naturally, the frequency of damage in the parking area can be reduces because the material is durable

Shah Alam Trees for Life

Has been implemented since 2010. Involve various agencies and large number of volunteers including the residents of Shah Alam, universities, private institutions, NGOs and private companies

Community Orchard

Is an exposure to the city generation and people of Shah Alam. Give Space to the local community to interact and collaborate. To optimize the idle and uneconomic spaces.

Herb Garden

This program held in conjunction with Worlds Environment Day. Located next to the Town Forest Part, Section 5, Shah Alam. Serves as a Green Pilot Program and around 700herbs have been grown in the garden

Neighborhood Garden

This is an agricultural activities carried out in the neighborhood. Cultivated by individual or communities.

Green Pilot Program

The program is held in MBSA's nursery at Section 17, Taman Tasik Shah Alam and Taman Tasik Lembah Bukit SUK. Getting exposure about planting trees such as how to plant and take care of as well as learn about the art of the landscape.

2.2.10.5. Public Transportation Policy and Strategies

The transportation action plan aims to provide efficient services of transportation and mobility. The following shows the current plans in Shah Alam:

1. Electric Cars
2. Electric Buses
3. Free Buses (Smart Selangor)
4. Community Bus
5. Preparation of Bicycle Track
6. EvCharger around Shah Alam

7. Free Vehicles Day for every Second Sunday each Month
8. Parking Area Outside City Center for Promoting Walking in the City Center
9. Upgrading of the Covered Walkway for more comfortable and disabilities friendly
10. E-Parking

Vision: Shah Alam Public Transport Friendly 2030

Mission : To Increase The Accessibility of Public Transportation to Consumer.

:To Provide A Systematic And Efficient Public Transportation System.
: To Have Conducive Infrastructure Facilities.
: To Serve Efficient Public Transportation Facilities

The challenges to provide efficient transport and mobility services

1. Providing comprehensive public transport.
2. Preparation of public transport infrastructures with connectivity.
3. Educate and encourage the use of bicycles as one of the modes of public transport.
4. Introducing public transport services.
5. Plan and coordinate public transport needs in the early stages of development as one of the modes of public transport.

2.2.10.6. Compliance Monitoring and Management

An area that has been identified as having unsatisfactory level of cleanliness has to be upgraded into a clean area to promote awareness of cleanliness through community participation in order to make Selangor the cleanest state in Malaysia.

The theme, Green Neighbourhood Concept was chosen as the choice of implementation for the MBSA Clean Zone program. Which seen in a timely manner and carried out in accordance with the global agenda, will be able to enhance and foster public awareness of green technology in order to achieve sustainable development that provides environmentally healthy life especially in cities with high density.

Administration and management of the city of green technology based:

1. Carbon Level Assessment for Shah Alam City Center, Section 14
2. Carbon Level Assessment for Satellite City Development in Shah Alam for Existing Development
3. Carbon Level Assessment for Satellite City Development in Shah Alam for Planning Approval Stage
4. Organize awards and recognition:
    i. Mini Zee Bee Competition
    ii. Low Carbon Award Competition
    iii. Competition for Low Carbon Building in Shah Alam
    iv. Low Carbon Innovation
    v. Low Carbon Idols

2.3. City of Hang Tuah Jaya, Melaka of Malaysia

2.3.1. Introduction

Hang Tuah Jaya is a satellite city for Melaka City which is also the new administrative center of Melaka since June 2006. The Hang Tuah Jaya administrative center is located about 15 km from the center of Melaka. This area is located under the Hang Tuah Jaya Municipal Council.

Hang Tuah Jaya covers an area of 144.61 square kilometers, being part of three districts, namely Melaka Tengah , Alor Gajah and Jasin.

Fig. 2.3-1. Map of Hang Tuah Jaya.
Source: Majlis Perbandaran Hang Tuah Jaya, MPHTJ

2.3.2. Demographics Data

2.3.2.1. Population and Households Size

Table. 2.3-1 shows the overall population in Melaka distributed by age and ethnic group while Table. 2.3-2 and Table. 2.3-3 show the male and female population distributed respectively by age and ethnic group. The main source of the population data is from the Department of Statistics, Malaysia.

Table. 2.3-1. Overall population by age and ethnic group in Melaka, 2017

Age	Total	Bumiputera	Chinese	Indians	Others	Non-Malaysian Citizens
Total	914.7	593.3	217	50.9	4.7	48.8
0 - 4	72.2	56.4	11.1	3.2	0.6	0.9
5 - 9	68.1	50.2	12.7	3.9	0.8	0.6
10 - 14	71.6	51.8	14.5	4	0.8	0.4
15 - 19	77.7	52.7	16.3	4.2	0.7	3.8
20 - 24	101.4	65.3	19.5	4.7	0.3	11.7
25 - 29	95.3	60.3	17.9	5.1	0.3	11.8
30 - 34	73.8	47.8	15.2	4.1	0.2	6.5
35 - 39	58.1	36.8	13.2	3.6	0.1	4.4
40 - 44	48.1	29.7	12.6	3	0.1	2.7
45 - 49	49.3	30.8	13.7	3.1	0.1	1.6
50 - 54	49.3	29.3	15.5	2.9	0.1	1.3
55 - 59	43.7	24.9	14.7	3	0.1	1
60 - 64	34.7	19.4	12.2	2.3	0.1	0.7
65 - 69	28.1	15.4	10.6	1.6	0.1	0.4
70 - 74	18.9	10	7.5	1.1	0.1	0.2
75 - 79	12.2	6.3	5.1	0.6	0	0.2
80 - 84	6.5	3	2.9	0.3	0	0.2
85+	5.6	3.2	1.8	0.4	0	0.2

Source: Population Quick Info - Department of Statistics, Malaysia

Table. 2.3-2. Overall population by age and ethnic group in Melaka, 2017

Age	Total	Bumiputera	Chinese	Indians	Others	Non-Malaysian Citizens
			Male			
Total	460.3	289.8	110	26	2.4	32.1
0 - 4	37.3	29	5.8	1.7	0.3	0.5
5 - 9	34.1	24.8	6.6	1.9	0.4	0.3
10 - 14	36.4	26	7.6	2.1	0.4	0.2
15 - 19	40.9	27	8.5	2.5	0.4	2.6
20 - 24	52.2	31.4	10.2	2.7	0.2	7.7
25 - 29	49.7	29.1	9.4	2.7	0.2	8.3
30 - 34	37.3	22.9	7.8	2	0.1	4.6
35 - 39	29.5	18	6.7	1.9	0.1	2.8
40 - 44	24.2	14.9	6.2	1.6	0	1.6
45 - 49	23.1	14.4	6.3	1.4	0.1	0.9
50 - 54	23.9	13.9	7.8	1.2	0.1	0.9
55 - 59	21.6	12.1	7.3	1.5	0.1	0.6
60 - 64	16.8	9.2	6.1	1.1	0.1	0.4
65 - 69	13.1	7	5.1	0.8	0	0.2
70 - 74	8.8	4.5	3.6	0.5	0	0.1
75 - 79	5.8	2.8	2.7	0.2	0	0.1
80 - 84	3	1.4	1.4	0.1	0	0.1
85+	2.6	1.4	0.9	0.2	0	0.1

Source: Population Quick Info - Department of Statistics, Malaysia

Table. 2.3-3. Female population by age and ethnic group in Melaka, 2017 (Population ('000))

Age	Total	Bumiputera	Chinese	Indians	Others	Non-Malaysian Citizens
Female						
Total	454.4	303.6	107	24.9	2.3	16.6
0 - 4	34.9	27.4	5.3	1.5	0.3	0.4
5 - 9	34	25.4	6	1.9	0.4	0.3
10 - 14	35.2	25.8	6.9	1.8	0.4	0.2
15 - 19	36.8	25.8	7.8	1.7	0.3	1.2
20 - 24	49.2	33.9	9.3	1.9	0.1	4
25 - 29	45.7	31.2	8.4	2.4	0.1	3.6
30 - 34	36.5	25	7.5	2	0.1	1.9
35 - 39	28.7	18.8	6.4	1.8	0.1	1.6
40 - 44	23.9	14.9	6.4	1.4	0.1	1.1
45 - 49	26.3	16.4	7.4	1.7	0.1	0.7
50 - 54	25.4	15.5	7.7	1.7	0.1	0.5
55 - 59	22.1	12.8	7.4	1.5	0.1	0.4
60 - 64	17.9	10.2	6.1	1.3	0.1	0.3
65 - 69	15	8.4	5.5	0.8	0	0.2
70 - 74	10.1	5.5	3.9	0.6	0	0.1
75 - 79	6.4	3.5	2.4	0.4	0	0.1
80 - 84	3.4	1.6	1.5	0.2	0	0.1
85+	3	1.8	0.9	0.2	0	0.1

Source: Population Quick Info - Department of Statistics, Malaysia

2.3.2.2. Income Distribution

This section presents statistics on household income and basic amenities for Selangor, derived from the Household Income and Basic Amenities Survey conducted in 2016 and 2017. This survey collected data on the income and basic amenities characteristics of Malaysian households. It was carried out using personal interview approach for a period of twelve months starting from May 2016 until

April 2017. All administrative districts were covered in this survey. This survey was analyzed scientifically using probability samples that represent all Malaysian households.

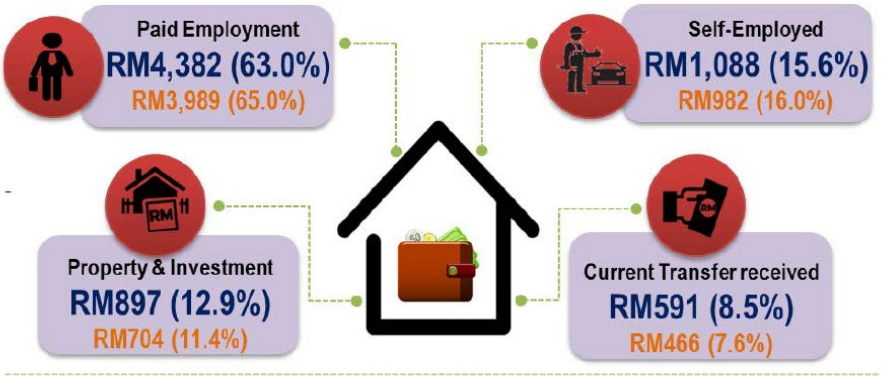


Fig. 2.3-2. Four main sources of income
Source: ousehold Income and Basic amenities Survey Report, 2016 – Department of Statistics Malaysia

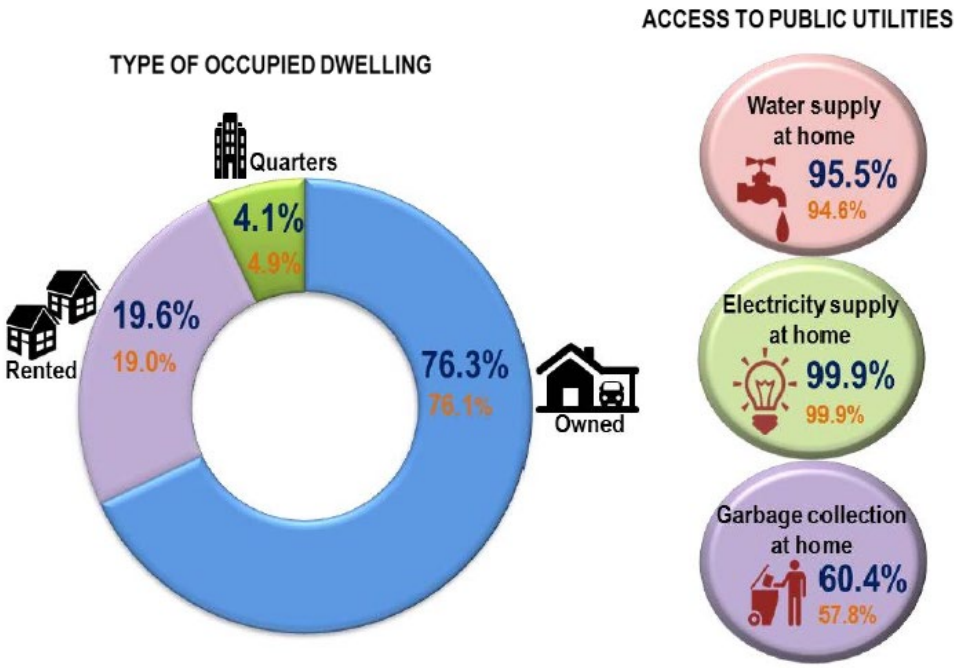


Fig. 2.3-3. Basic amenities
Source: Household Income and Basic amenities Survey Report, 2016 – Department of Statistics Malaysia

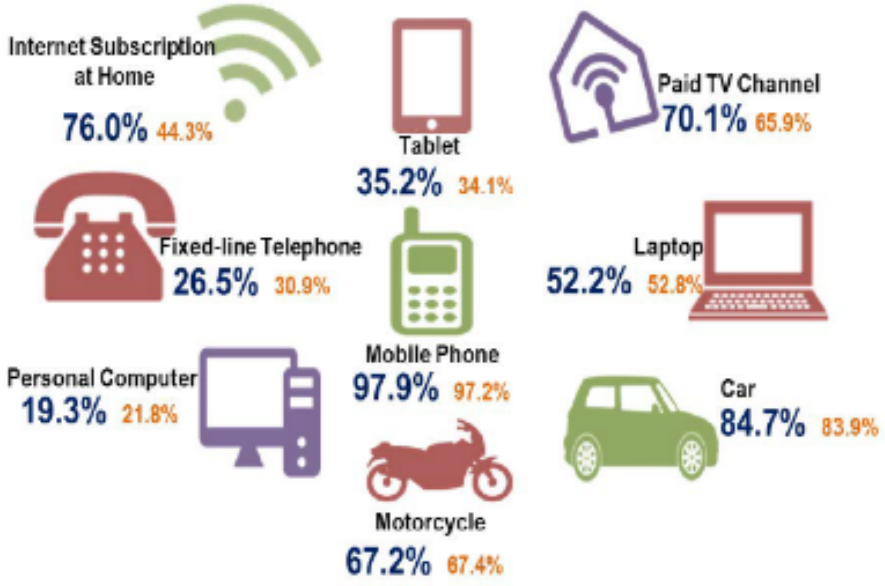


Fig. 2.3-4. Household Equipment Ownership
Source: Household Income and Basic amenities Survey Report, 2016 – Department of Statistics Malaysia)

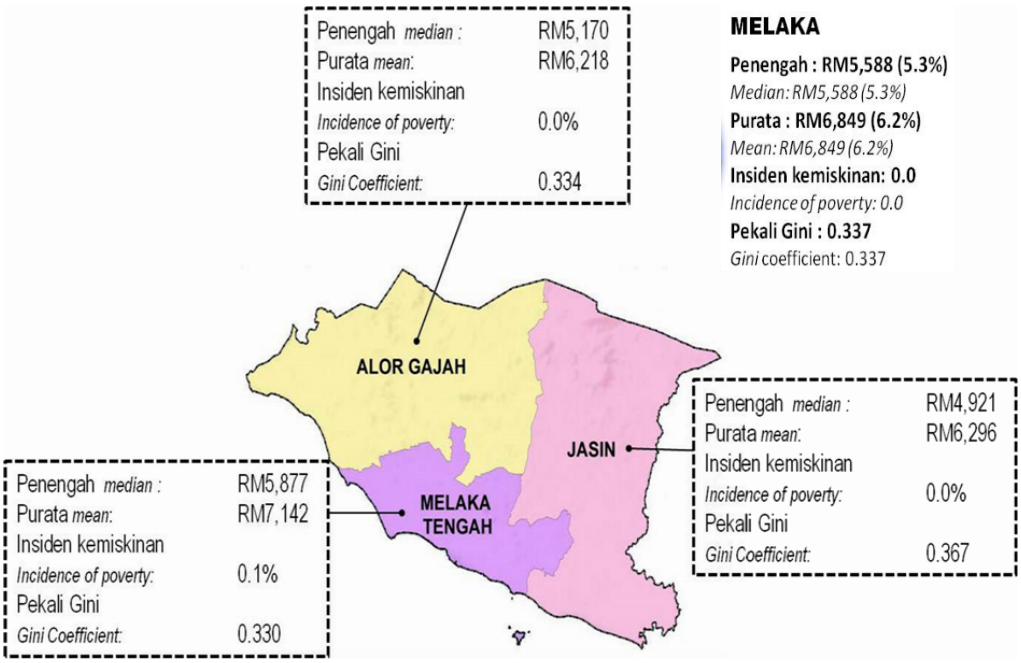


Fig. 2.3-5. Key Statistics on Income in Melaka, 2016

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka, 2016 – Department of Statistics Malaysia

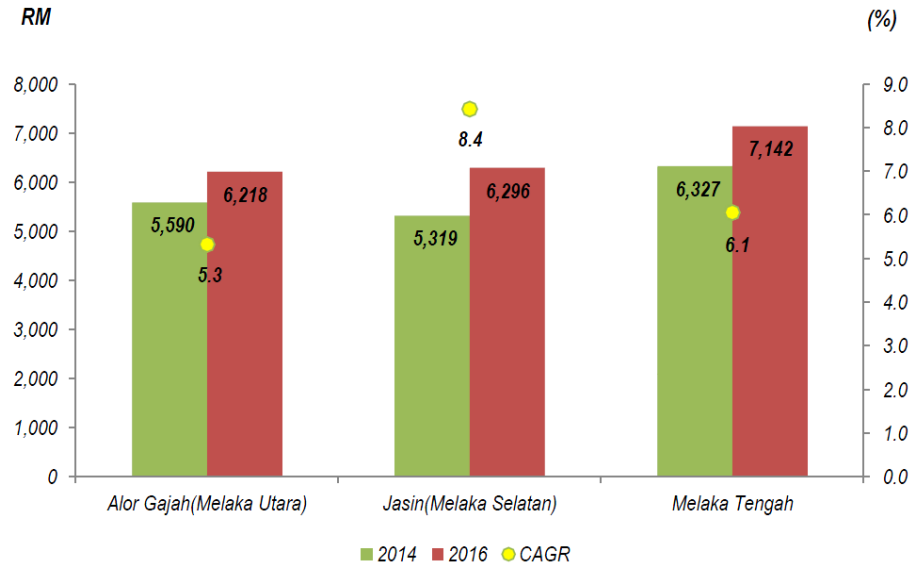


Fig. 2.3-6. Mean Income in 2014 and 2016 in Melaka

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka, 2016 – Department of Statistics Malaysia

Melaka Tengah recorded the highest mean monthly household income (RM7,142) in 2016. However, both Jasin (RM6,296) and Alor Gajah (RM6,218) recorded mean monthly household income below the state level (RM6,849). Despite that, the mean monthly household income of all administrative districts has increased where Jasin recorded the highest growth rate of 8.4 percent.

Table. 2.3-4. Percentage of by strata for main source of income of head of household in Melaka, 2014 and 2016

Main source of income	2014			2016		
	Total	Urban	Rural	Total	Urban	Rural
Income from paid employment	63.8	64.0	61.5	63.0	63.3	57.9
Income from self-employed	16.2	16.1	16.8	15.9	15.7	19.1
Income from property and investment	10.8	10.8	10.3	11.7	11.7	11.5
Current transfers received	9.2	9.1	11.4	9.4	9.3	11.4

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka, 2016 – Department of Statistics Malaysia

Table. 2.3-5. Median, mean and compounded annual growth rate of monthly household gross income by strata, ethnic group of head of household and administrative district in Melaka, 2014 and 2016

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka,, 2016 – Department of Statistics Malaysia

ADMINISTRATIVE DISTRICT	Median			Mean		
	(RM)		Compounded annual growth rate	(RM)		Compounded annual growth rate
	2014	2016	2014 – 2016 (%)	2014	2016	2014 – 2016 (%)
MELAKA	**5,029**	**5,588**	**5.3**	**6,046**	**6,849**	**6.2**
Urban	5,126	5,659	4.9	6,157	6,904	5.7
Rural	4,014	4,484	5.5	4,810	6,069	11.6
ETHNIC GROUP						
Bumiputera	4,887	5,563	6.5	5,799	6,735	7.5
Chinese	5,373	5,961	5.2	6,458	7,319	6.3
Indians	4,802	5,297	4.9	6,257	6,304	0.4
ADMINISTRATIVE DISTRICT						
Alor Gajah	4,719	5,170	4.6	5,590	6,218	5.3
Jasin	4,460	4,921	4.9	5,319	6,296	8.4
Melaka Tengah	5,245	5,877	5.7	6,327	7,142	6.1

2.3.2.3. Employment Status

Table. 2.3-6 shows the employment status in year 2002 until 2017. It can be divided into four different statuses which are labour force, employed, unemployed and outside labour force.

Table. 2.3-6. Employment status in Malaysia from 2002 to 2017

Year	Labour force	Employed	Unemployed	Outside labour force	Labour force participation rate	Unemployment rate
					(%)	
2002	236.2	229.3	6.9	152.3	60.8	2.9
2003	280.6	272.7	7.8	166.5	62.8	2.8
2004	269.5	265.1	4.4	162.2	62.4	1.6
2005	274.5	271.1	3.4	168.2	62.0	1.2
2006	276.7	273.1	3.5	173.7	61.4	1.3
2007	290.4	284.3	6.1	169.7	63.1	2.1
2008	290.0	286.8	3.2	179.3	61.8	1.1
2009	290.9	284.0	6.9	186.3	61.0	2.4
2010	338.6	335.1	3.5	216.1	61.0	1.0
2011	343.3	340.8	2.5	222.8	60.6	0.7
2012	358.8	357.0	1.8	218.6	62.1	0.5
2013	378.3	375.5	2.7	208.3	64.5	0.7
2014	398.3	394.9	3.4	197.2	66.9	0.9
2015	402.4	398.3	4.1	201.6	66.6	1.0
2016	400.8	397.3	3.5	211.9	65.4	0.9
2017	409.4	405.4	4.0	215.0	65.6	1.0

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

2.3.2.4. Employment Structure

Table. 2.3-7. Number of employed persons by sector in Melaka, 2014 and 2016

State	Sector										Total	
	Agriculture		Mining and quarrying		Manufacturing		Construction		Services			
	2014	2016	2014	2016	2014	2016	2014	2016	2014	2016	2014	2016
Melaka	7.7	9.2	0.6	2.8	86.4	85.5	19.5	18.2	176.8	188.0	290.9	303.7

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.3-8. Labour force participation rate by age group in Melaka, 2016

State	Total %	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
Melaka	65.4	19.0	59.7	81.7	87.1	86.1	82.0	78.2	74.5	56.0	31.4

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.3-9. Male labour force participation rate by age group in Melaka, 2016

State	Total %	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
Melaka	76.6	23.9	65.7	92.1	98.8	98.4	96.9	97.2	91.0	74.4	44.9

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.3-10. Female labour force participation rate by age group in Melaka, 2016

State	Total %	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
Melaka	54.0	13.5	53.4	70.4	75.2	73.5	67.2	61.8	57.9	38.8	18.7

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.3-11. Labour force participation rate by highest certificate obtained in Melaka, 2016

State	Total %	UPSR/UPSRA or equivalent	PT3/PMR/SRP/LCE/ SRA or equivalent	SPM or equivalent	STPM or equivalent
Melaka	5.4	54.4	51.4	69.4	38.0

State	Certificate	Diploma	Degree	No certificate	Not applicable
Melaka	87.7	76.0	87.5	58.9	46.6

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.3-12. Male labour force participation rate by highest certificate obtained in Melaka, 2016

State	Total %	UPSR/UPSRA or equivalent	PT3/PMR/SRP/LCE/ SRA or equivalent	SPM or equivalent	STPM or equivalent
Melaka	76.6	72.7	64.2	80.7	39.1

State	Certificate	Diploma	Degree	No certificate	Not applicable
Melaka	94.1	82.9	91.8	88.6	69.2

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

Table. 2.3-13. Female labour force participation rate by highest certificate obtained in Melaka, 2016

State	Total %	UPSR/UPSRA or equivalent	PT3/PMR/SRP/LCE/ SRA or equivalent	SPM or equivalent	STPM or equivalent
Melaka	54.0	35.8	35.4	57.5	37.1

State	Certificate	Diploma	Degree	No certificate	Not applicable
Melaka	75.7	70.5	84.1	33.8	35.6

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

2.3.2.5. Educational Level

Table. 2.3-14. Educational level by age group in Melaka, 2010

Age group	TOTAL	Pre-primary	Primary school	Primary school	Upper secondary
TOTAL	685,923	21,632	144,637	96,842	192,775
0-4	4,800	4,800	-	-	-
5-9	60,566	16,832	43,734	-	-
10-14	74,889	-	42,677	32,212	-
15-19	88,883	-	700	14,124	44,201
20-24	77,266	-	1,517	3,508	24,557
25-29	66,507	-	1,947	4,357	24,772
30-34	50,421	-	2,637	5,322	20,480
35-39	47,179	-	2,633	6,650	19,342
40-44	48,579	-	3,749	6,777	17,506
45-49	46,141	-	5,808	6,980	15,875
50-54	38,956	-	8,728	6,154	10,832
54-59	30,997	-	8,440	4,924	6,949
60-64	20,164	-	8,430	2,961	3,712
65-69	12,889	-	5,666	1,488	2,207
70-74	8,755	-	4,312	674	1,008
75+	8,931		3,659	711	1,334

Age group	Pre-university	Certificate programmes in specific trades and technical skill	Tertiary (certificate/ diploma level)	Tertiary (degree/advanced diploma and above)	Unknown
TOTAL	38,959	3,681	50,403	32,543	104,451
0-4	-	-			
5-9	-	-			
10-14	-	-			
15-19	12,538	795	14,228	2,297	
20-24	7,026	1037	14,218	10,117	15,286
25-29	6,116	659	7,018	5,640	15,998
30-34	4,511	426	4,421	4,108	8,516
35-39	4,721	262	3,085	3,021	7,465
40-44	1,683	187	2,270	2,492	13,915
45-49	838	131	1,677	1,931	12,901
50-54	664	59	1,386	1,255	9,878
54-59	346	55	817	716	8,750
60-64	212	25	419	395	4,010
65-69	141	22	352	243	2,770
70-74	74	4	142	148	2,393
75+	89	19	370	180	2,569

Source: Source: Education and Social Characteristics of the Population, 2010 – Department of Statistics, Malaysia

2.3.2.6. Home Ownership

The percentage of owned dwelling decreased by 2.5 percent from 84.4 per cent in 2014 to 81.9 per cent in 2016. Occupied quarters also dropped 0.7 percent, however the percentage of rented dwellings increased by 3.2 percent.

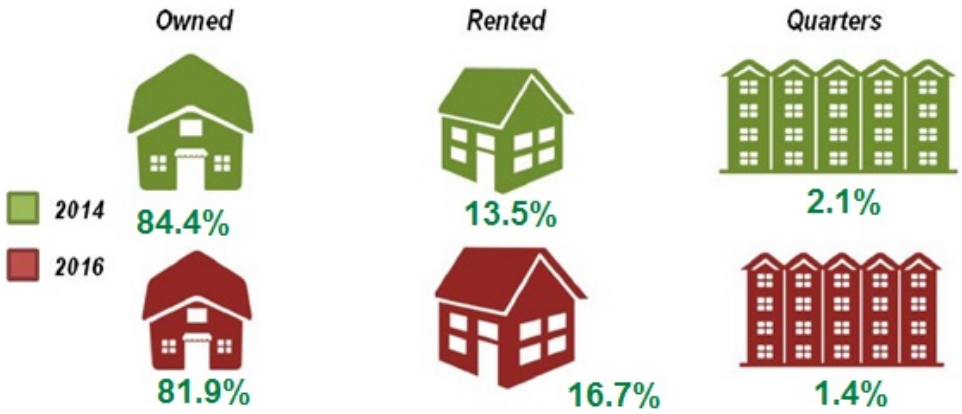


Fig. 2.3-7. Percentage of household by type of dwelling, Melaka 2014 and 2016

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka, 2016 – Department of Statistics Malaysia

Table. 2.3-15. Percentage of households by type of occupied dwelling and administrative district in Melaka, 2016

State	Owned	Rented	Quarters	Total
	Total	Total	Total	Total
MELAKA	**81.9**	**16.7**	**1.4**	**100.0**
Alor Gajah	83.3	15.1	1.6	**100.0**
Jasin	87.5	11.6	0.9	**100.0**
Melaka Tengah	80.5	18.2	1.4	**100.0**

Source: Labour Force Survey (LPS) Time Series Statistics – Department of Statistics Malaysia

2.3.2.7. Vehicle Ownership

2.3.2.8. Traffic Share Ratio

The two tables below show the number of vehicles ownership by type and also the traffic share ratio in year 2014 and 2015. Motorcycle is the most dominant and popular in Melaka as compared to Motorcar and other Public Transports. There is an increase of user using motorcycle in year 2015 as compared to year 2014.

Table. 2.3-16. Total motor vehicles ownership by type in Melaka and Malaysia, 2014

State	Motorcycle	Motorcar	Bus	Taxi	Hire & Drive Car	Goods Vehicle	Others	Total
MELAKA	433,604	322,338	1,673	1,554	431	27,443	13,709	800,752
MALAYSIA	11,629,265	11,199,910	65,044	105,689	58,945	1,159,872	882,467	25,101,192

Source: Data Set from Department of Transportation

Table. 2.3-17. Total motor vehicles ownership by type in Melaka and Malaysia, 2015

State	Motorcycle	Motorcar	Bus	Taxi	Hire & Drive Car	Goods Vehicle	Others	Total
MELAKA	449,980	328,242	1,692	1,558	434	28,352	14,092	824,350
MALAYSIA	12,094,790	11,871,696	66,999	108,149	63,885	1,197,987	898,446	26,301,952

Source: Data Set from Department of Transportation

2.3.3. Local Economy

2.3.3.1. GDP Growth Rate

Table. 2.3-18. GDP in Melaka, 2014, 2015 And 2016 at constant 2010 Prices - Annual Percentage Change & Percentage Share to GDP

State	Annual Percentage Change			Percentage Share to GDP		
	2014	2015[e]	2016[P]	2014	2015[e]	2016[P]
Melaka	7.7	5.5	4.5	3.0	3.0	3.0

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka

2.3.3.2. Main Economic Sector

Table. 2.3-19. GDP in Melaka by type of economic activity, 2014, at constant 2010 Prices – RM Million

Kind of economic activity	Agriculture	Mining and quarrying	Manufacturing	Construction	Services	Plus : Import duties	GDP at purchaser s' prices
Melaka	3,219	41	12,164	743	13,885	21	30,073

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka,, 2016 – Department of Statistics Malaysia

Table. 2.3-20. GDP in Melaka by type of economic activity, 2015, at constant 2010 Prices – RM Million

Kind of economic activity	Agriculture	Mining and quarrying	Manufacturing	Construction	Services	Plus : Import duties	GDP at purchaser s' prices
Melaka	3,403	44	12,966	770	14,469	61	31,712

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka,2016 – Department of Statistics Malaysia

Table. 2.3-21. GDP in Melaka by type of economic activity, 2016, at constant 2010 Prices – RM Million

Kind of economic activity	Agriculture	Mining and quarrying	Manufacturing	Construction	Services	Plus : Import duties	GDP at purchaser s' prices
Melaka	3,529	53	13,491	813	15,206	63	33,155

Source: Household Income and Basic amenities Survey Report by State and Administrative District, Melaka,, 2016 – Department of Statistics Malaysia

2.3.4. Basic Infrastructure, Energy and Resources

2.3.4.1. Provision rate and volume of basic infrastructure

Basic infrastructure in Hang Tuah Jaya is as follow:

a) Road Network
b) Drainage System
c) Train (Future High Speed Rail)

2.3.4.2. Existing solid waste collection system including recycle system

There is one sewerage treatment plant (STP) located in Hang Tuah Jaya (refer to Fig. 2.3-10) located at Batu Berendam and divided into three sub-catchment zones which are Batu Berendam, Sungai Putat and Bandar Melaka East.

Table. 2.3-22. STP area based on population projection

	Year				
	2010	2015	2020	2025	Ultimate
Population	144,986	165,114	188,037	214,205	650,000
STP area (ha)	5.59	6.06	6.43	7.10	15.96

Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

Table. 2.3-23. Population equivalent projection in three sub-catchment zones

Sub Catchment Zero	Population Equivalent						
	2010	2015	2020	2025	2030	2035	Ultimate
Batu Berendam	132,373	148,257	166,048	185,974	194,901	199,578	202,983
Sungat Putat	80,926	90,638	101,514	113,696	127,339	142,620	163,450
Bandar Melaka East	171,873	192,497	215,597	241,469	270,445	302,898	304,997
Total	385,172	431,392	483,159	541,139	592,685	645,097	671,430

Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

A special sewerage system called LAKASA biomatic grease interceptor is proposed for food stall or businesses and workshops producing grease/oil. While new developments including housings and businesses are suggested to use a food separator sink. These proposed systems are as shown in figures below.

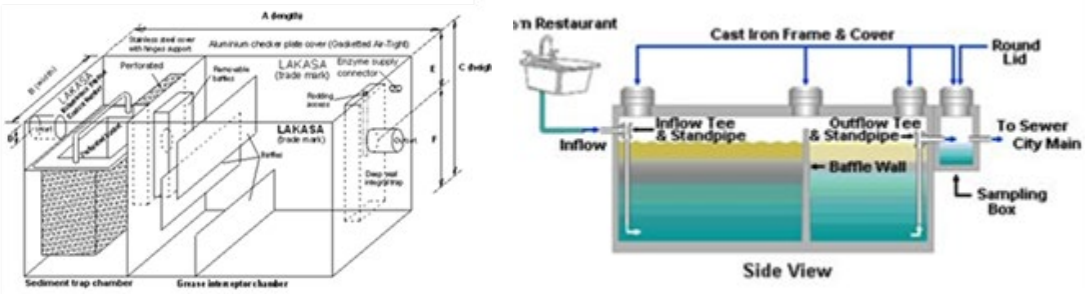


Fig. 2.3-8. LAKASA Biomatic grease interceptor.
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

Fig. 2.3-9. Motorized food separator.
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

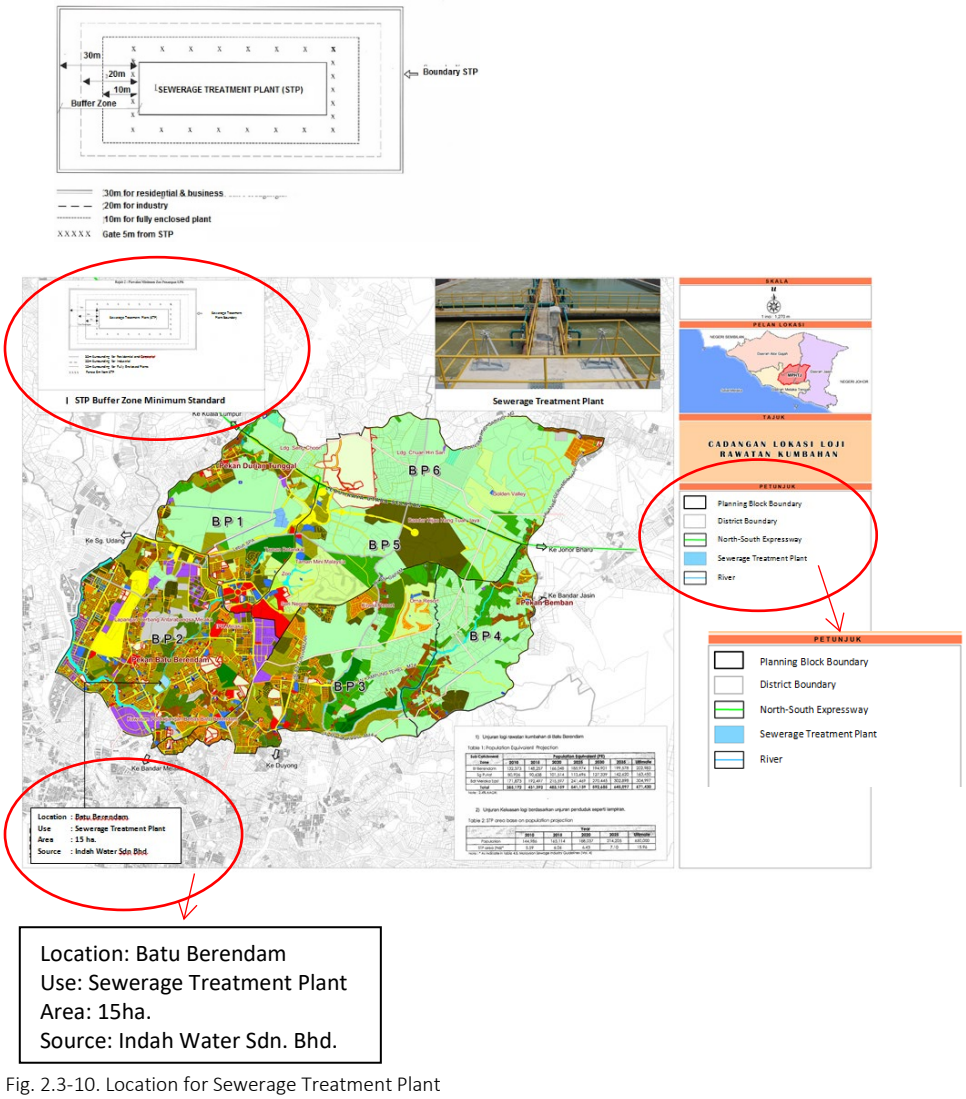


Fig. 2.3-10. Location for Sewerage Treatment Plant
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

2.3.4.3. Current Energy Supply and demand by type (electricity, Heating, Liquefied Petroleum or propane gas, Solar Power, etc)

Current energy supply in Hang Tuah Jaya is electrical energy supply. There is also renewable energy ie. Solar energy. The Solar Farm Project was initiated in Melaka. There is a total of three projects for Solar Farms in Melaka, with two in Hang Tuah Jaya.

2.3.4.3.1. KMB(Kumpulan Melaka Berhad) Solar Farm (5MW)

Kumpulan Melaka Berhad (KMB) is wholly owned by State Government of Malacca. The owner of solar farm had commissioned and started to export the power to Malaysia Utility (TNB) via Feed in tariff since 11 April 2013 for Phase 1 (1.30MWp), 16 May 2013 for Phase 2 (1.22MWp) and 02 August 2013 for Phase 3 (2.48MWp).

The Feed in tariff rate : RM0.9016/kwh for period of 21 Years FIAH capable to produce average estimates energy of 6,162Mwh per year, 514Mwh per month ,or 17Mwh per day.

Fig. 2.3-11. 5MW KMB Solar Farm
Source: Melaka Green Technology city state, The green mechanics.com

2.3.4.3.2. Kompleks Hijiau Solar (8MW)

Hang Tuah Jaya is a gazette green zone located in the state of Malacca, Malaysia and its territory is also reserved for institutional development. Solar photovoltaic currently contributes to 67% of the 270MW of renewable energy generated in the member economy and the latest 8MW Kompleks Hijau Solar farm has started feeding solar power into the national grid in mid December 2014.

The project is developed and operated by Gading Kencana Sdn Bhd, a leading energy service company in Malaysia using Yingli PANDA Monocrystalline 60 Cell Series Panels which generates enough energy to power 1,800 house daily.

Company Managing Director Dato Guntor Tobeng shares that the 8MWp of panels installed produce about 10,120 MWh per year, avoiding the carbon emission of 136,700 tonnes over 21 years (the duration of the FiT scheme). “This is equivalent to what is emitted by 30 jets flying everyday from Kuala Lumpur to London and back for five and a half years.“

Fig. 2.3-12. 8MW kompleks Hijau Solar Farm
Source: Yingli Solar, Gading Kencana

2.3.5. Land Use and Development

There is mixed development in Hang Tuah Jaya. We need more clarification for the area of study either in state of Melaka Administrative Centre (1,956.57 acre) or overall of Hang Tuah Jaya (16, 1117.18 acres).

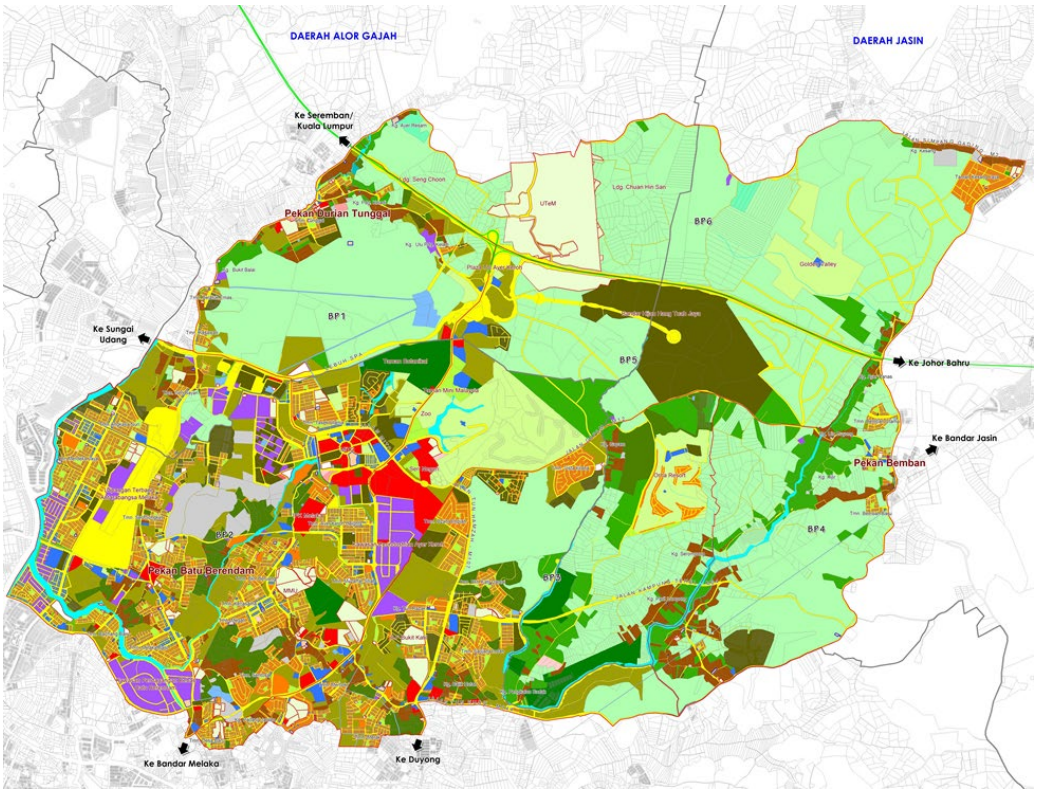


Fig. 2.3-13. Master Plan Development of Hang Tuah Jaya, 2012.
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

LAND USE	AREA (ha)	PERCENTAGE (%)
RESIDENTIAL	**1,331.73**	**9.17**
Perumahan Terancang	857.65	5.91
Perumahan Tidak Terancang	474.08	3.26
INDUSTRY	**353.13**	**2.43**
Industri Terancang	329.05	2.27
Industri Tidak Terancang	21.17	0.15
Lombong/ Kuari	2.90	0.02
BUSINESS	**202.96**	**1.40**
Perniagaan Terancang	165.89	1.14
Perniagaan Tidak Terancang	37.08	0.26
INSTITUTION AND COMMUNITY FACILITY	**1,026.08**	**7.07**
Institusi	163.62	1.13
Kemudahan Masyarakat	862.46	5.94
STRANDED LAND AND RECREATION	**860.70**	**5.93**
Tanah Lapang	117.71	0.81
Kemudahan Sukan dan Rekreasi	710.36	4.89
Kawasan Hijau	32.64	0.22
VACANT LAND	**1,977.57**	**13.62**
Semulajadi (Belukar/ Tanah Berumput/ Lalang)	1071.67	7.38
Buatan (Tapak Projek Terbengkalai/ Tapak Projek Dalam Pembinaan/ Tapak Infill/ Tanah Bekas Lombong)	905.90	6.24
AGRICULTURE	**6,351.84**	**43.75**
Getah	1,630.21	11.23
Kelapa Sawit	3,617.83	24.92
Lain-lain Jenis Pertanian	690.69	4.76
Tanah Terbiar	413.11	2.85
Penternakan dan Akuakultur	**34.43**	**0.24**
Penternakan	32.79	0.23
Akuakultur	1.64	0.01
FOREST	**252.89**	**1.74**
Hutan Darat	130.55	0.90
Hutan Tanah Lembap	122.34	0.84
NATURAL WATER	**193.55**	**1.33**
Semulajadi	186.85	1.29
Buatan	6.70	0.05
INFRASTRUCTURE AND UTILITI	**115.45**	**0.80**
Bekalan Elektrik	13.13	0.09
Pembentungan	28.35	0.20
Telekomunikasi	0.29	0.00
Pengairan dan Perparitan	19.14	0.13
Bekalan Air	54.54	0.38
TRANSPORTATION	**1,819.68**	**12.53**
Kemudahan Pengangkutan	202.72	1.40
Jalan dan Rezab Jalan	1,616.96	11.14
	14,520.00	**100.00**

Fig. 2.3-14. Legend for Master Plan Development of Hang Tuah Jaya, 2012.
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

2.3.5.1. Typical Housing Type

Typical housing types in Hang Tuah Jaya are as follow:

a. Apartment
b. Link House
c. Low-income apartment
d. Village House

2.3.5.2. Area Development Plans

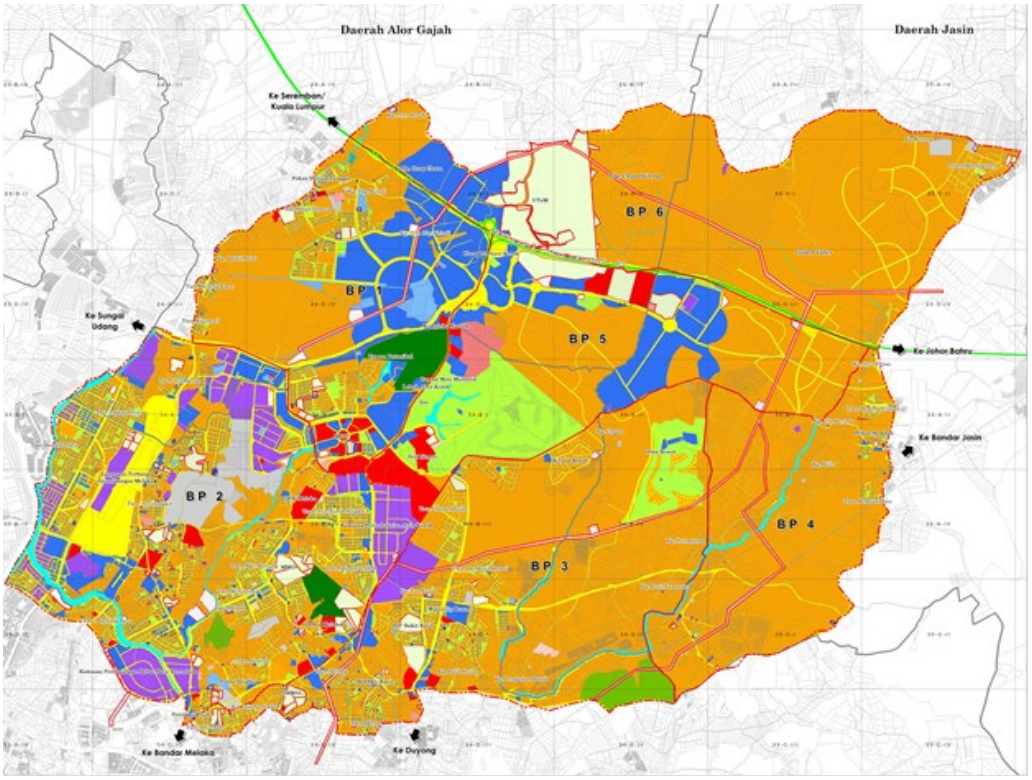


Fig. 2.3-15. Master Plan Development of Hang Tuah Jaya until year 2025.
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

Fig. 2.3-16. Legend for Master Plan Development of Hang Tuah Jaya until year 2025.
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

2.3.6. Energy and Resources

Table. 2.3-24. Fuel usage in Melaka from year 2010 to 2017

Fuel: Diesel (Utre)	2010	2011	2012	2013	2014	2015	2016	2017
Pahlawan Power Sdn Bhd	62,412	4,961,569	4,326	1,825,365	2,361	15,373	-	-
Panglima Power Sdh Bhd	7,091,390	59,814,676	20,148,513	30,635,561	10,998,145	-	7,100	862,168
Powertek Berhad (mmbtu)	1,118,190	4,493,572	14,044,651	14,663,587	17,511,735	820,510	1,963,497	2,343,545

Fuel: Diesel (Utre)	2010	2011	2012	2013	2014	2015	2016	2017
Pahlawan Power Sdn Bhd (GJ)	15.801,021	20,663,653	15,709,139	21,386,441	18,676,727	16,060,100	12,493,827	9,041,349
Panglima Power Sdh Bhd (mmbtu)	33,001,901	25,029,316	29,586,730	32,663,346	31,372,547	32,796,845	33,798,669	31,487,225
Powertek Berhad (mmbtu)	278,479	105,460	228,783	5,326,312	5,955,312	4,430,380	5,249,240	3,943,422

Source: Energy Comission Malaysia

2.3.6.1. Energy consumption by sector (residential, commercial, public, industrial, transportation, etc)

Table. 2.3-25. Energy consumption by sector in Melaka from year 2010 to 2017

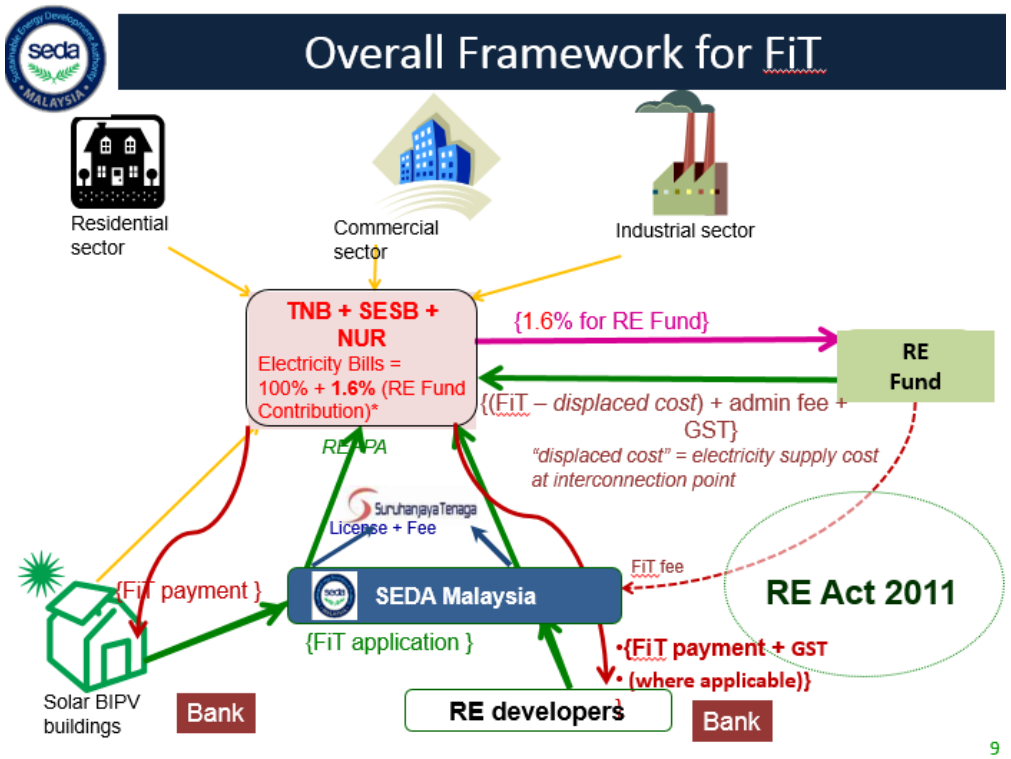
	Melaka					
	Domestic (GWh)	Commercial (GWh)	Industrial (GWh)	Mining (GWh)	Public Lighting (GWh)	Agriculture (GWh)
2000	328	490	1,814	-	26	-
2001	355	523	1,937	-	29	-
2002	396	616	1,995	-	33	-
2003	425	651	2,008	-	36	-
2004	457	688	2,116	-	38	-
2005	495	735	2,142	-	43	-
2006	529	782	2,224	-	49	9
2007	557	832	1,904	-	51	28
2008	586	887	1,600	-	53	29
2009	633	925	1,374	-	59	28
2010	684	1,016	1,624	-	60	30
2011	689	1,044	1,932	-	65	35
2012	733	1,081	2,015	-	68	38
2013	780	1,128	2,027	-	76	43
2014	815	1,161	2,063	-	77	48
2015	856	1,197	2,122	-	78	57
2016	942	1,266	2,144	-	70	64
2017	915	1,250	2,299	-	90	71

Source: Energy Comission Malaysia

2.3.6.2. Electricity and Gas (Liquefied Petroleum or Propane) tariff structure

Feed-in Tariff (FiT) is a mechanism that allows electricity that is produced from indigenous Renewable Energy resources to be sold to power utilities at a fixed premium price and for specific duration.

FiT provides a conducive and secured investment environment which will make financial institutions to be comfortable in providing loan with longer period (>15 years).Provides fixed revenue stream for installed system. Only pays for electricity produced: promotes system owner to install good quality and maintain the system. With suitable degression rate, manufacturers and installers are promoted to reduce prices while enhancing quality.



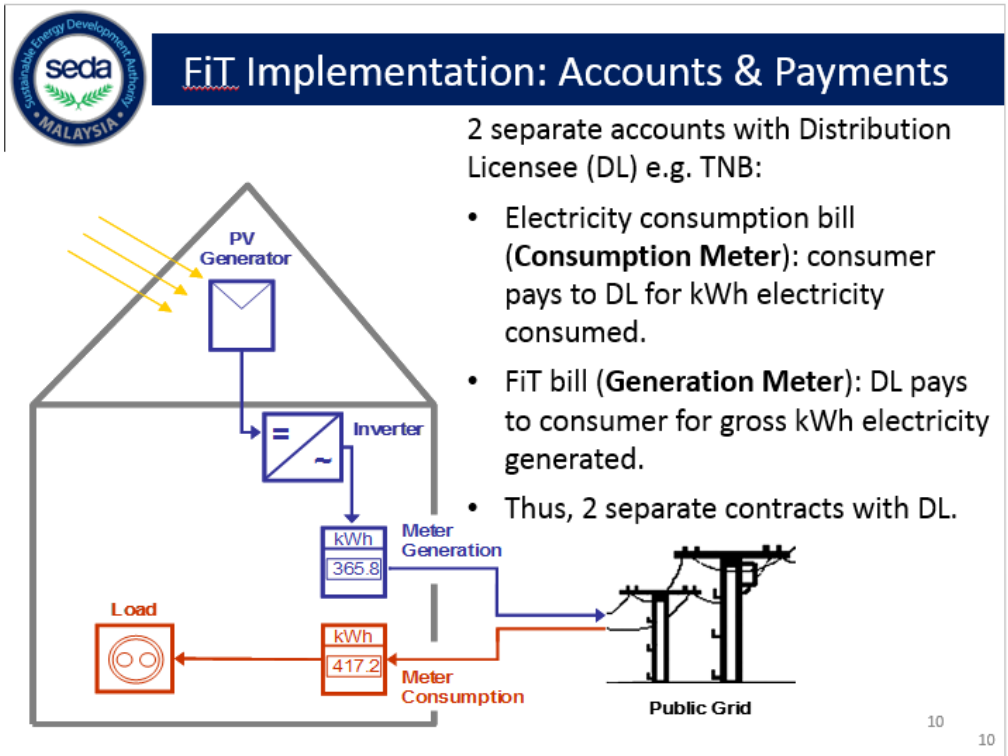


Fig. 2.3-17. Details for FiT
Source: Sustainable Energy Development Authority Malaysia

2.3.6.3. Renewable resources available in volunteer towns

The renewable resources available are Solar Energy as mentioned in Section 2.2.4.4 and implementation Rain Water Harvesting Tank at Hang Tuah Jaya.

Below are the locations of Solar Farm in Melaka:

1. Gading Kencana Solar Farm (capacity – 8 MW)
2. KMB Solar Farm (capacity – 5 MW)
3. Green Plus Solar Farm (capacity – 50 MW)

2.3.7. Environment Planning

2.3.7.1. Greenery coverage ratio

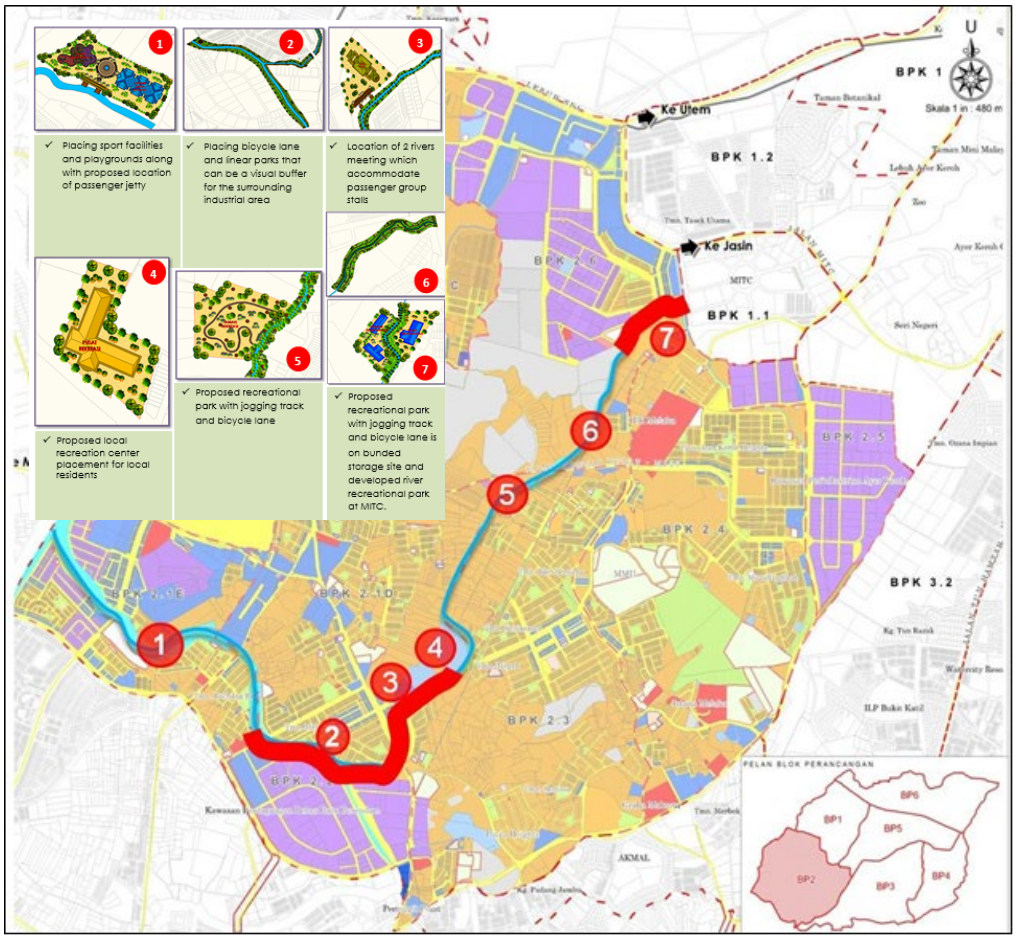
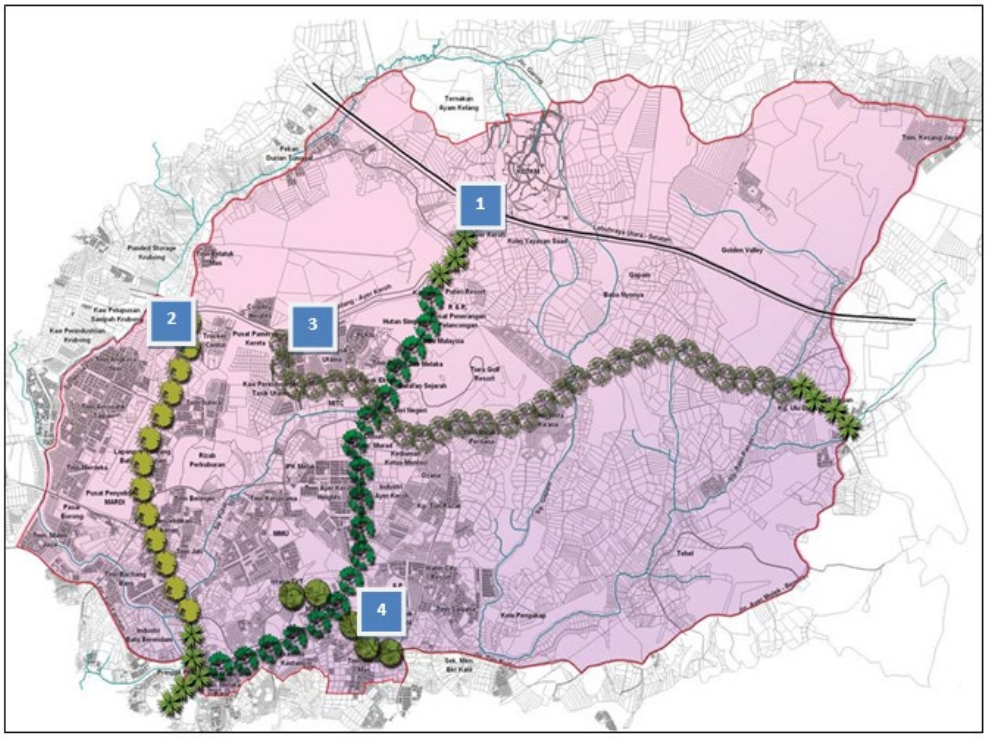


Fig. 2.3-18. Hang Tuah Jaya Linear Park.

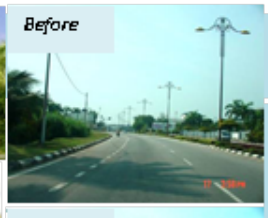
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya



ROAD PROTOCOL 1: LEBUH AYER KEROH

1

- Starting from Ayer Keroh Toll to Peringgit Point Junction.
- Proposed road decoration improvement by providing road furniture for road user's comfort.
- Proposed decorative plants and shade such as Samanea aaman.
- User friendly design for walkway and bicycle lanes.



ROAD PROTOCOL 2: JALAN BATU BERENDAM

2

- Starting from Lebuhraya Sungai Udang to Peringgit Point Junction.
- Proposed road improvement by providing road furniture for road user's comfort.
- Proposed decorative plants and shade such as *Tabebuia rosea*

Fig. 2.3-19. Hang Tuah Jaya Landscape Development Inline Plan
Source: Racangan Tempatan Majlis Perbandaran Hang Tuah Jaya

2.3.8. Legal framework or institutions for environment / energy

2.3.8.1. Master plan and related project

2.3.8.1.1. Short Term Action Plan

1. To conduct energy and water conservation programs by 10% savings (no cost)
2. To adjust the surrounding temperature of the air conditioner in each building involved to 24°C.
3. Implement Rainwater harvesting systems (SPAH) for use of landscaping, toilets and general cleaning
4. Use of natural daylight in the building (less use of electric lighting)

2.3.8.2. Master plan and related project

2.3.8.2.1. Short Term Action Plan

1. To conduct energy and water conservation programs by 10% savings (no cost)
2. To adjust the surrounding temperature of the air conditioner in each building involved to 24°C.
3. Implement Rainwater harvesting systems (SPAH) for use of landscaping, toilets and general cleaning
4. Use of natural daylight in the building (less use of electric lighting)

2.3.8.2.2. Long Term Action Plan

1. Planting trees with high carbon absorption rates.
2. Use renewable energy such as Solar Fotovoltaik
3. Use of energy efficient equipment in each building (LED/T5, laptop, inverter air-conditional)
4. To has a minimum green open space of 10% or more of development.

2.3.8.3. Policies and Target (Low Carbon Strategies, Etc)

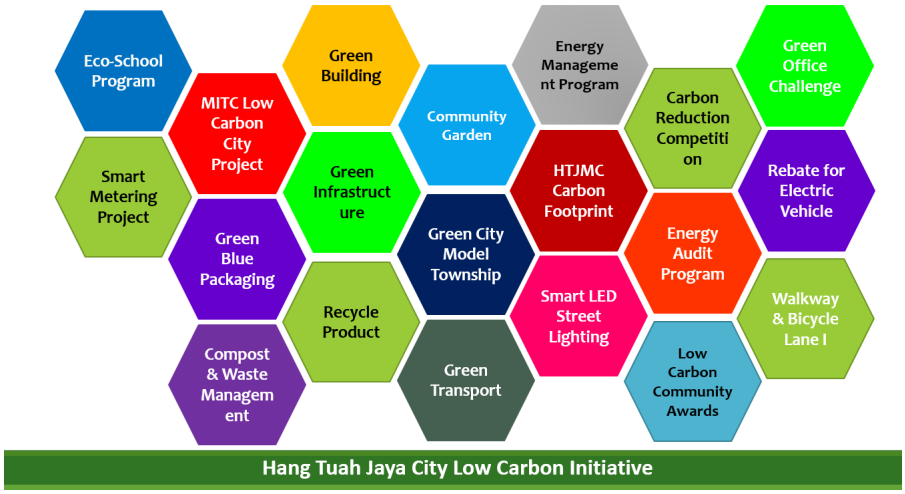


Fig. 2.3-20. Hang Tuah Jaya City low carbon initiatives
Source: Melaka Green Technology city state

Hang Tuah Jaya Low Carbon City

The program started in 2012 whereby Hang Tuah Jaya Municipal Council focuses on the Low Carbon Cities Framework through Low Carbon Cities that have been developed by Ministry of Energy, Green Technology and Water (KeTTHA)

Hang Tuah Jaya Low Carbon Cities Framework is divided into 2 phases

1. 2013-2016 – involving an area of 1956.57 acres, focusing on road and park sector, green open space, number of tree, operational energy emissions and operational water emissions
2. 2017-2035 – involves an increase in the area with a total 16,1117.18 acres

Hang Tuah Jaya Green City Model Town

This model town covers an area of 800 acres of land for construction of the Hang Tuah Jaya Green City. It is part of the supporting activities contained in Melaka Green City Action Plan.

Among the green features or applications that are present in this area are green building ratings, the use of renewable energy sources (rainwater harvesting system), green transportation, urban parks, waste management and recycling and green community police.

Green buildings that are constructed in Hang Tuah Jaya Green City:

a) Perkeso Rehablitation Center (55.42 acre)
b) Solar Farm SMV (17.66 acre)
c) Dewan Citra Kasih (3.43 acre)
d) Rumah Citra Kasih (1.22 acre)

Green Transportation

Green Transportation is the highest priority for implementation at the Hang Tuah Jaya City. The target is to increase the use of public transport that uses EV and hybrid technology which in turn will reduce the use of fossil fuels. Besides, Hang Tuah Jaya City also aims to increase the usage of clean energy. Incentives are given to the green transportation. MPHTJ will provide 50% discount parking stickers for vehicles that are using EV or hybrid technology. In addition, electric buses that pass through the area of MPHTJ will be provided.

Community Program

Local Agenda (LA21) is a program that emphasizes the involvement of third parties, local authority, public and private sector work together to plan and manage their environment toward sustainable development and a higher quality of life.

MPHTJ also focus on activities / community programs as part of strategies to accelerate the Hang Tuah Jaya Low Carbon City.

Activities / Community Program as follow:

a) Community Awards
b) Community Garden Program & Compost
c) Compost Fertilizer Program
d) Recycling Product Program
e) 3R Recycling Program
f) Tree Planting Program

Energy Efficiency

Hang Tuah Jaya Manucipal Council focuses on the management aspect of energy efficiency as one of the sectors under green initiatives was also implemented.

2.3.8.4. Current Energy Policy and Strategies

Tenaga Nasional Berhad (TNB) has initiated a pilot project by installing Smart Meters in 400 households in Melaka. Residents are able to monitor energy usage online via apps. TNB plans to expand the usage of Smart Meter to the whole Melaka in the next 2 years

Fig. 2.3-21. News on smart meters
Source: Melaka Green Technology city state

2.3.8.5. Current environmental policy (Resource circulation planning, etc) and strategies

Electric and Hybrid Vehicle

This first launch was on 11 October 2013. Two (2) charging station was made available in Melaka City & Hang Tuah Jaya City. To establish Melaka as the center of the electric car connectivity between Kuala Lumpur and Singapore, this was a necessary step to carry out.

2.3.8.6. Public Transportation Policy and Strategies

Bike share services started in Melaka City and Hang Tuah Jaya city as one part of Melaka's initiative to become a Green City.

Fig. 2.3-22. Melaka Bike Rental
Source: Melaka Green Technology city state

Electric Bus

The first fully operated electric bus in Malaysia successfully completed a 3 month trial in March 2014. It travelled in Melaka World Heritage City and Low Carbon City (Hang Tuah Jaya) and can travel up to 280 km fully charged. There are plans for 40 electric buses to operate in Melaka.

Fig. 2.3-23. Electric bus in Melaka
Source: Melaka Green Technology city state

2.3.8.7. Performance Indicator and Metric

For output to a Low Carbon City project, the baseline 2013 has been developed and a total of 10,088.87 tCO2 were recorded. For 2014, total of 434.26 tCO2 was reduced as compared to 2013 through a number of initiatives such as reducing carbon competitions, tree planting program and also energy-saving program. Assessment year 2016 showed a further decrease of 902.36 tCO2 equivalent to 8.94%

METHODOLOGIES AND APPROACHES

03

CHAPTER 3. Principles and Methodologies of Feasibility Study

Chapter3.Principles and Methodologies of Feasibility study

3.1. Background research and Define baseline in BAU scenario

3.1.1. Background research and Data collection

3.1.1.1. The background research and data collection method in energy and environmental aspect

The background and data collection for low carbon decision in environment aspect includes the factors that affect town energy consumption and carbon emission both in demand-side and supply-side.

1) Factors in supply-side

The factors in supply side refers to the current situation of energy supply, energy resource structure and related town infrastructure. Generally, the existing condition analysis is based on the town data.

2) Factors in demand-side

The factors in demand-side include economic condition, lifestyle and existing building conditions and energy system. The survey covers the following items:

Table 3.1.-1 The survey items for energy and environment

Related factors	Survey items
Economics	GDP. Income
Life style	Non-residential: ・ Working time, energy system operation schedule Residential: ・ Daily Life style
Building condition	Non-residential ・ Existing Energy Conservation efforts ・ Energy consumption condition Residential ・ Building condition and usual layout ・ End-use energy consumption ・ Indoor thermal comfort
Building energy system	Non-residential ・ Heat resource ・ Main building energy system and facilities Residential ・ The appliance in residential for high-income, middle income and Low income ・ The general schedule for electronic appliance

Source: NSRI

3.1.1.2. Survey approach

The shortage of energy related data is the common issue for most of the researches in South Asia countries. The following approaches are applied for data collection according to the existing situation.

1) Estimate based on limited energy consumption data

As the development and implementation of building management system (BEMS) in some of the cities of South Asia countries, some data of the non-residential and residential buildings are available.

For these buildings, the existing energy consumption are estimated based on the existing data analysis.

2) Estimate based on field survey

Most of the buildings, especially residential buildings are lack of data. For these buildings, we conduct lifestyle hearing survey and onsite measurement survey.

The energy consumption of these buildings are estimated based on field survey.

3) Estimated by site other existing research

For the buildings that still under plan, the energy consumption for BAU is estimated with review for other existing researches.

3.1.2. Develop a high-level low-carbon vision

The study conducted by NSRI suggests that all the 3 volunteer towns have been selected as the pilot projects in their countries and have already implemented low carbon measurements in their development.

This study will develop based on the existing low carbon initiatives, but also take advantage of NSRI's experiences.

The basic concepts for 3 volunteer towns are including:

1) Environmental, social and economic aspects should be comprehensively stressed in the study

   The existing low carbon innovation in the 3 volunteer towns and their evaluation are mostly put stress on the environmental aspect. However, two make a successful and sustainable development, not only the t environmental but also their social benefits and economic benefits should be comprehensively discussed.

2) The plan and business model that consider all the stake holders are vital

The existing projects in 3 volunteer towns mostly focused on technical issues. However, for implementation, a business model, development plan, considering the benefit for all the stakeholders.

3) The vision should both consider the local features and their expansion

The existing projects in 3 volunteer towns only developed the concept for the district. As low carbon model town, this study will make the 3 volunteer towns as a typical model, including the technical model, business model, implementation model and management model, that can be used for other areas in the economies.

4) Design, implementation and operation

The existing projects focused on the concepts and design phase, but for a success project the implementation, operation and maintenance phase are also important.

The vision for low carbon development in the three volunteer towns will be developed in as the following chart, based on their common issues and features.

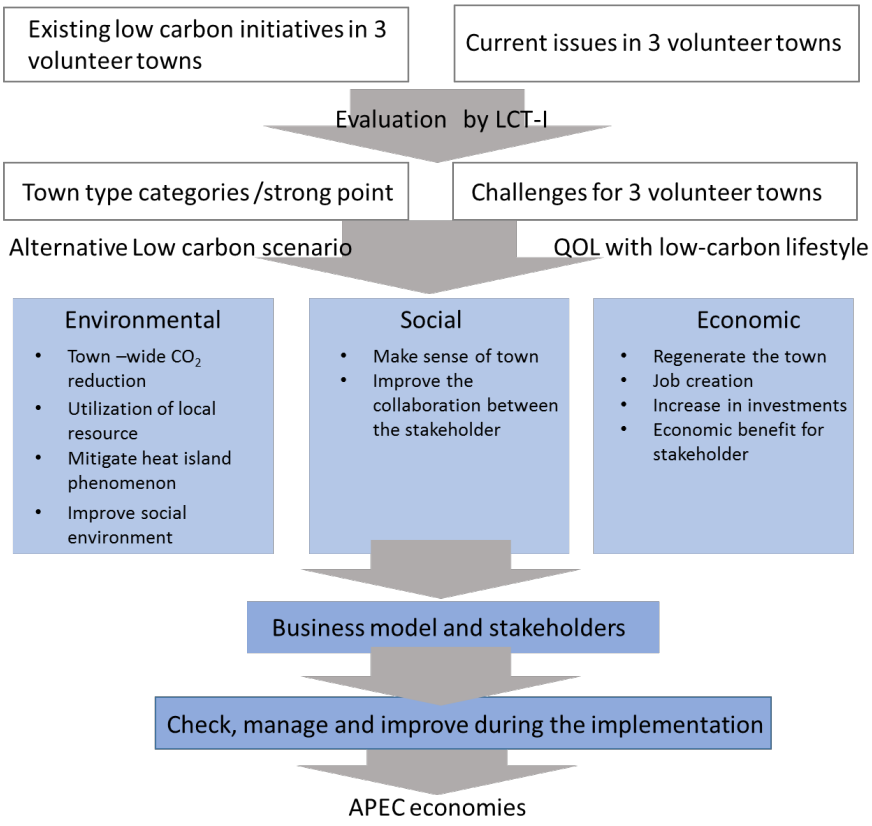


Fig. 3.1-1. Vision of this study
Source: NSRI

3.1.3. Define CO2 emission baseline in BAU scenario

1) The approach to define the baseline in BAU

The approach to define the baseline in BAU scenario is conducted by the following steps:

- Data collection and define the baseline in BAU;

  The base year and target year in BAU will be decided according to the low carbon action plan in the economies or states of the three volunteer towns and existing low carbon that have already been planned by government or stakeholders.

- Data collection and define the baseline in BAU;

  Though the detail information is different according to the different features, target and scale of the three volunteer towns, the following parameters will be collected for defining the baseline:

  - Existing population, economic factors;
  - Infrastructure information, facility information,
  - Energy consumption in building sectors and traffic sectors;

- Make projections of carbon emission in the target year

  The study will predict the future carbon emission in the target year according to the changing economic factors and populations. The target year includes mid-term and long-term.

- Review and estimate the existing low carbon technologies (EXT)

  All the three volunteer towns have their own low carbon action plan which has already been planned or partially implemented by the government. Therefore, the EXT is the special BAU condition that should be evaluated and predicted. The study will estimate and predict their effect in the target year.

- Set target domain as alternative planning scenario (APS)

  The analysis for BAU and EXT will be used for set target for alternative planning scenario, which means additional measures which are possible to be implemented in the target year.

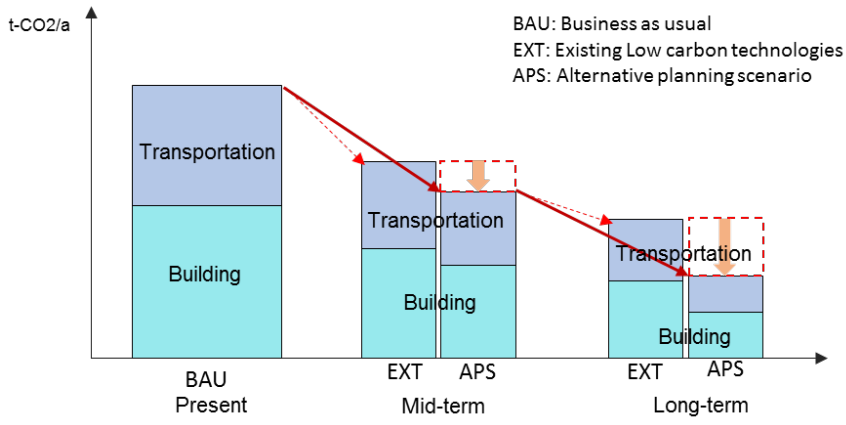


Fig. 3.1-2.Output example for CO2 reduction targets
Source: NSRI

2) The method for BAU setting in building sectors

The Existing carbon emission from energy sector refers to the carbon emission from building energy consumption

(1)The existing building energy consumption

Building energy consumption is estimated as

Σ Building energy consumption = Σ (Building energy consumption unit[1)] for different type $\times$ building area)

※uilding energy consumption unit is refer to the energy consumption density, the energy consumption for per area. In this research, the energy consumption unit is set as below, according to based on the research of JYUKANKYO RESEARCH INSTITUTE INC.

		section14	Hang Tuah Jay	Banda Aceh
office	MJ/m2	1,546	1,546	1,546
commercial	MJ/m2	2,418	2,418	2986
hospital	MJ/m2	2,718	2,718	2898
hotel	MJ/m2	2,432	2,432	3703
residencial_normal	GJ/Gen	20	20	18
residential_social	GJ/Gen	–	–	8.8

(2)The Method for estimate the BAU in short-term and long-term

There are two methods to decide the BAU

- The relationship with GDP growth rate
  The energy consumption has a firmly relationship with GDP. For example, in the residential buildings, the household appliance increases with the GDP growth and causes increase of energy consumption. For the office and the commercial buildings, the increasing GDP growth rate also cause the longer of Business hours and increase of energy consumption.
  The factors that can represent the relationship between GDP growth rate and the energy consumption growth rate is Energy-GDP elasticity. It can be calculated as below'

  Energy Growth rate = GDP Growth rate $\times$ Energy-GDP elasticity

  While uses this method, the BAU is predicated with the existing energy consumption that set in (1) and the energy growth rate with predicted by GDP growth rate and the Energy-GDP elasticity value for each economic.
  This method is especially fit for the area that with less development.

- The relationship with urban development
  The other method, which used in the area where are still not yet be developed decides BAU by the increasing of building floor area.

3) The principles for setting low carbon targets

The principles for setting low carbon targets is generally as follows.

- Low carbon targets must be realistic (they must be both appealing and realistic)
- Low carbon targets and indexes will comprise "Low Carbon Targets," "other Indexes"
- Targets and indexes will be composed of quantifiable and visible categories.
- Stakeholders in the 3 volunteer towns will jointly aim at reaching the low carbon targets and indexes and will also share data regarding them together
- Targets and indexes will require ongoing efforts throughout the life cycle of the project

Table.3.1-2. is an example for BAU setting in the three volunteer towns. The detail should be discussed in the future study.

Table. 3.1-1. Base year and target year setting for three volunteer towns

Volunteer towns	Baseline	Mid-term	Long-term	Reference
Band Aceh City	2011	2020	-	The National Action Plan for Green House Gas Reduction (RAN-GRK)
Shah Alam City Center Section 14	2017	2020	2030	Green target action plan Selangor state
Hang Tuah Jaya	2017	2020	2030	Low carbon action plan of Malaysia

Source: NSRI

3.2. CO2 reduction scenario

3.2.1. Define comprehensive, specific and feasible low carbon measure

The study for step4 including the three main parts

A) Define the CO2 emission reduction and environment target of the town

Based on the step3, our study will define CO2 emission reduction and environment target of three volunteer towns according to the existing condition (BAU) and the low carbon measures that have already been implemented by government or stakeholders (EXT).

B) Prepare a Low carbon guideline for categories of low carbon town design challenges.

Based on the analysis of LCT-I, and prediction for BAU, a comprehensive and interactive low carbon design guideline will be provided for three volunteer towns with the technologies in demand, supply, demand and supply, governance aspects.

C) Select CO2 emission reduction measures in each design

With our experience in LCMT development, NSRI has low carbon technologies packages which is developed based on LCT-I. Therefore, in this section, we will propose a package of low carbon solutions suitable for 3 volunteer towns while considering the actual situation of each town and propose a system that is balanced from both technology level and cost.

The following show 5 design categories that can help 3 volunteer towns realize their low-carbon development vision, provided that the development of each is in full alignment with the on-the-ground realities and institutional context of each town.

The guidelines and feasibility assessment for each of the 5 design categories and the specific CO_2 avoidance/reduction measures it identifies as promising for 3 volunteer towns will include the following information:

- Assessment of potential CO_2 avoidance and reductions of specific measures
- Identification of an appropriate and effective implementation methodology
- Estimates of implementation timeline and costs for each measure
- Ideas for implementers funding sources and funding mechanisms
- How quality of life, quality of the environment and the quality of natural resource usage will be improved

Fig. 3.2-1.CO2 Reduction Categories
Source: NSRI

A. Demand Side

A-1. Low-carbon buildings

Since buildings contribute over 30% of total primary energy all over the world (Data source: International Energy Agency. Key World Energy Statics. 2010), low-carbonization in building sector is considered to be the most important approach to realize low-carbon society. Basically, two are two effective ways in lowering the CO_2 emissions of a building: passive way and active way.

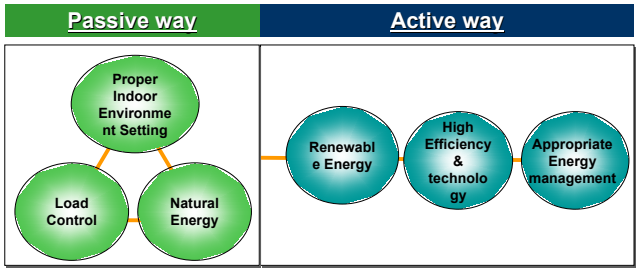


Fig. 3.2-2.Passive way and Active way
Source: NSRI

The guidelines for building will not be limited to the Low-Carbon aspect; both measures from energy and sustainable aspects of buildings, especially office and commercial buildings with high energy us intensity, will be considered. In addition, policy and market instruments will be studied in order to provide recommendations for the promotion of sustainable building practices in 3 volunteer towns for the long run. The overall process of establishing guidelines and policies for the 3 volunteer towns is shown in Fig.3.2-3

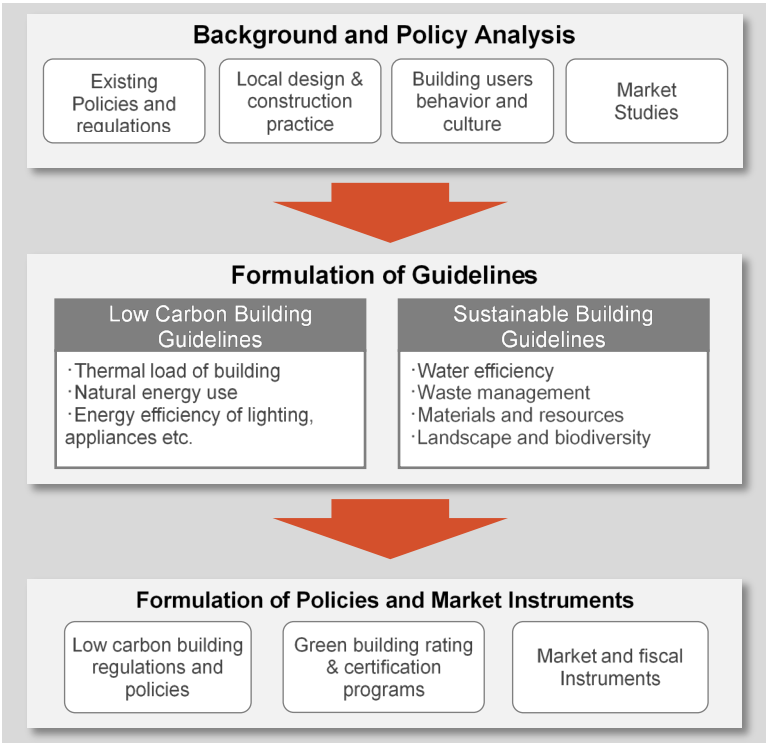


Fig. 3.2-3.Flow of Establishing Low-Carbon and Sustainable Building Guidelines
Source: NSRI

The Low carbon technologies in building sectors are mainly refer to the building energy conservation technology, as Table3.2-1. It includes the passive technologies like façade engineering technologies and other active technologies. The energy conservation ratio of every technologies are set based on the experience.

Table. 3.2-1.Building energy conservation technologies and energy conservation effect

Items	Menu	energy conservation ratio
Heat source	COP improvement	0.282
	Reduction of internal heat generation	0.05
Heat source accessories	Inverter	0.13
Water transport	Inverter	0.18
Air conveyance	High efficiency fan	0.165
	Inverter	0.26
Hot water supply	Device performance improvement	0.292
lighting	Human Sensor	0.03
	Illuminance correction	0.105
	High efficiency of lighting equipment	0.376
Outlet	Reduced power consumption	0.02
ventilation	Total heat exchanger	0.072
	CO2 control	0.057
	High efficiency fan	0.131
	Introduction of CO concentration control of parking fans	0.2
Water supply and drainage	Improve pump performance	0.15
Elevator	Smart operation	0.1
Other	Introduction of high efficiency transformer	0.085
facade	Glass performance improvement	0.1

Source: NSRI

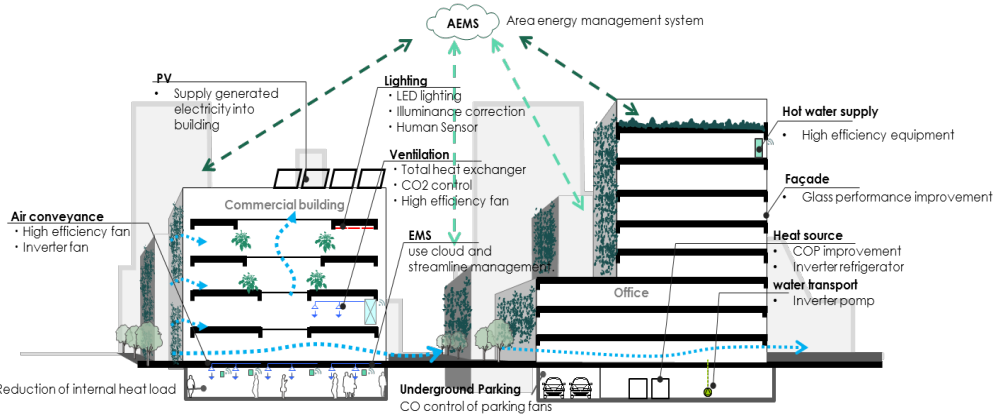


Fig. 3.2-2.Image of low carbon building technologies

Source: NSRI

A-2. Low-carbon Transportation

In this section, we will prepare the public transport network plan for 3 volunteer towns. Since car traffic as well as motorbike traffic will increase with the economic growth, it is important to establish the overall transport network in which special emphasis is placed upon public transport, such as bus and Tram services.

Meanwhile, a “low-carbon transport plan” that varying according to the real land use will also be proposed. That plan will comprise a public transport plan, a bicycle network plan and a pedestrian network plan each of which reflects traffic features varying with land use of residential area or commercial area.

Use of low-carbon vehicles is considered effect to improve energy efficiency. It is necessary to promote electrification of motorbikes and conversion of cars and buses to PHV, EV and other low-carbon vehicles, as well as the construction of peripheral infrastructure needed for EV such as charging stations.

Moreover, we will propose that the central area is developed with more walkable areas that are friendly for pedestrians and bicycles. Such walkable areas, allowing “carbon-less transport modes”, will greatly improve the quality of the environment in the city.

CO2 emissions emitted by cars accounts for a large portion of CO2 emissions produced in transportation. This is partly because the amount of CO2 emissions generated by a car carrying one person is large compared to public transportation such as subways and buses. Basically, CO2 emissions emitted by cars can be calculated by the multiplication of three parameters: traffic volume, distance traveled and emission intensity.

Accordingly, controlling traffic volume, modal shift to public transportation emitting less greenhouse gas, shortening of travel distance and the use of fuel efficient vehicles are effective in reducing CO2 emissions in transportation.

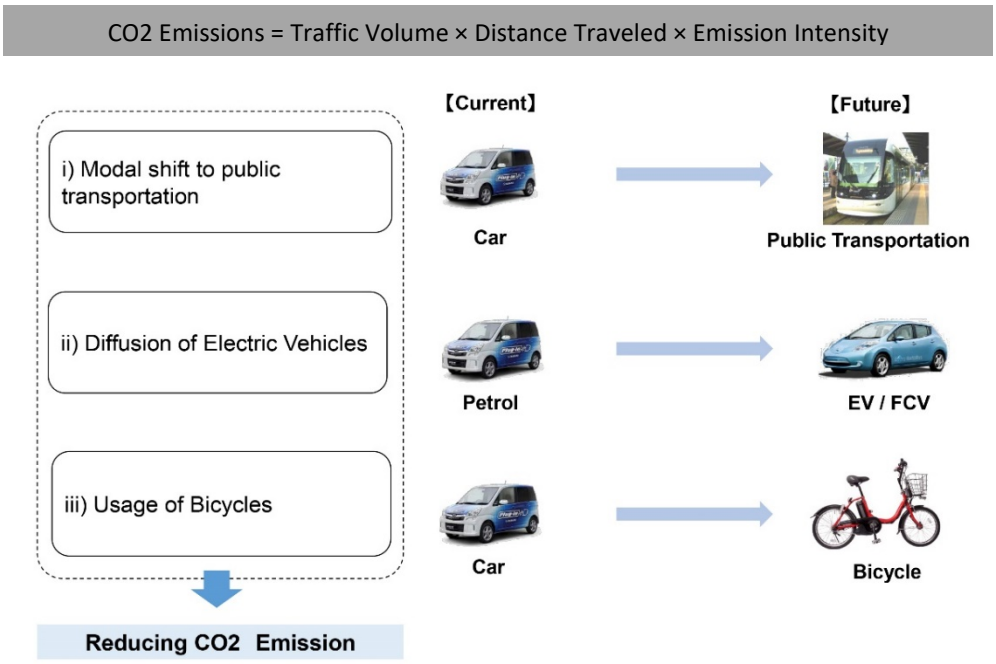


Fig. 3.2-1. Basic policy for Reducing CO2 Emission in Transportation

Source: NSRI

i) Reducing CO2 emissions by Mode Shifting to Public Transportation

Within urban public transportation, there are different modes such as heavy rail, subways, light rail transit (LRT) and buses. The different modes could be further classified in terms of capacity. High capacity transit systems include heavy rail and subways while medium and low capacity transit systems include LRT and buses. CO2 emissions per passenger-km of these public transportation modes are about one-sixth when compared to the emissions from cars. CO2 emissions could be reduced by aiming to build a city centered public transportation with more use of public transportation available.

ii) Diffusion of Electric Vehicles

Electric vehicles are assumed not to directly emit CO2 emissions because they do not use fossil fuels, globally, the adoption rate for commercial usage is growing steadily. The experience already shows that when you compare the CO2 emissions from gasoline powered vehicles with electric vehicles, electric vehicles emit about 1/2 less CO2 emissions per passenger-km than that of gasoline-powered vehicles.

iii) Encouraging the Usage of Bicycles

Bicycles have many advantages such as short distance travel, flexibility, low cost and no CO2 emissions. Improving convenience to move around a city by making use of bicycles could cut down CO2 emissions. To achieve this, the following is necessary: providing adequate physical space for safe bicycle travel, establishing the infrastructure necessary to enable the usage of bicycles anywhere in a city and reserving space for bicycle parking at public transportation.

Reference for CO2 Reduction Initiatives

Efforts to contribute to CO2 reduction will be summarized focusing on cases in transportation.

1) Effect of car sharing to reduce environmental impact

As a result of the questionnaire survey of subscribers to the five major car sharing companies, the CO2 reduction effect is seen due to the reduction in the number of cars owned by car share subscribers and the distance traveled by car share subscribers.

- The average number of vehicles owned per household declined by approximately 60%
- Annual total vehicle mileage per household decreased by approximately 40%
- Reduce the average annual CO2 emissions from automobiles per household by 0.34 tons (about 50% of the rate) due to the effects of reduced mileage, smaller owners, rejuvenated age of vehicles used, and improved fuel efficiency.

2) Measures to promote the use and dissemination of EVs and PHVs

Since EVs and PHVs have superior performance to GVs in terms of energy efficiency and CO2 emissions, measures to promote their use and dissemination have been developed in other countries.

3) Utility of Micro Mobility

The ultra-small mobility is a vehicle that is more compact and small-sized, has excellent environmental performance, and rides one or two passengers, which is a foot of easy movement in the region.

Since vehicles are light, energy consumption is low, and CO2 emissions are low, efforts are being made to disseminate them in Japan.

Examples of initiatives utilizing ultra-small mobility include Kawauchi-shima and Miyakojima-shi, Japan.

Koshikijima, Satsumasendai City, Kagoshima Prefecture

- Lending as a means of daily transportation
- As the population ages, it is used as a new means of transportation for elderly people, especially in the island traffic environment where one community bus is not operated in 2 to 3 hours, and the movement of islanders is revitalized.
- Out of users, 49% use from automobiles and mini-cars, and 15% use from foot

Miyakojima city in Okinawa-prefecture

- Use as an emergency power source in the event of a disaster
- A PV charging station with solar panels installed to make use of natural energy in the event of a disaster and to move to necessary locations on the island to supply electric power.

Effects of LRT development (example: Toyama City, Toyama Prefecture)
The share of automobiles in Toyama City is about 72%, and the share of public transportation is about 4% (PT Survey of Toyama Takaoka Wide Area of Cities in 1999). The dependence on automobiles is high, and the city is one of the top automobile users in Japan.

LRT maintenance effect (case: Strasbourg, France)
In Strasbourg, the following effects have been achieved through the integrated implementation of LRT and urban transportation and town development measures.

- Reduction of automobile traffic in the vicinity of the center of Tokyo and improvement of the urban environment
- Improvement of Public Transportation Share on LRT Lines
- Maintaining a high motorcycle share (rebuilding road space and developing a bicycle route network)
- To add new life to the downtown district

Effect of improvement of loop bus (case: Matsuyama City, Ehime Prefecture)

In Matsuyama City, an organic public transportation network for trains and buses was constructed by constructing a transportation base station (train station and bus terminal) which strengthened the nodal point function in the suburbs, and by constructing a loop bus line with the base station as a fulcrum.

As a result, the number of railway station users has increased by 10-40% compared to before the maintenance.

Effects of BRT improvement (Case: Gifu City, Gifu Prefecture)

Gifu City has positioned BRT as the center of public transportation for realizing an intensive urban structure.

Among the BRT routes, the Gifu University Hospital route has an increasing number of users, and the effect of switching to public transportation has been obtained.

CO2 reduction efforts

Malaysia is promoting a modal shift to public transportation and the introduction of high-energy-efficient vehicles, including EVs.

Malaysia/EV Targets

- The Government of Malaysia is promoting a modal shift to public transportation with the aim of rebuilding weak public transportation and alleviating traffic congestion and environmental problems in line with the expansion of the passenger car market. To this end, the government established a state-owned Prasalana Company under the Ministry of Finance, which has the mission of nationalizing LRT, monorails, and route bus facilities that constitute urban public transportation, and promoting the improvement of convenience by strengthening management and unifying services.
- The company announced that it would start intermediate steps such as hybrid and CNG for environmental measures in public transportation, and that it would put it into an EV bus at once.
- Malaysia has established 12 priority economic sectors (National Key Economic Areas: abbreviated as "NKEAs") as part of its economic policies toward the entry of 2020 industrialized countries. Malaysia is working to promote business expansion and investments in these sectors.
- Entry Point Project No. 18 (EPP18) on the electric and electronic fields of NKEAs shows that, as a specific introduction target, 2000 EV buses and 100,000 EV passenger cars will be introduced by 2020.
- National Automobile Policies (National Automotive Policy: NAP 2014) also set the goal of raising the share of domestic production vehicles (Energy Efficient Vehicle: EEV *), including EVs, to 85% by 2020.
- *Six alternative fuel vehicles: electric vehicles (EVs) and CNG, LPG, biodiesel, ethanol, hydrogen, and fuel cells
- In Malaysia, in addition to securing a budget for public bus transportation, the EV industry is being fostered and promoted as a green technology and as an EEV in the automobile industry. The EV manufacturers and EV users will be given incentives such as tax incentives, subsidies for development and research, and low-interest loans for purchasing green technology.

Study on the possibility of introducing EV buses in Malaysia-Thailand-Pin City

In Malaysia, regular operation of EV buses has been started in Kuala Lumpur and Malacca since 2015.

*In Typin City, although there is an inter-city bus line connecting cities and other cities, there is no bus line in the city.

[Reference]

Government Targets of Foreign Countries for EV and PHV Dissemination

The automobile penetration rate in Malaysia is high, and the goal is to popularize the EV10 million vehicles by 2030. In Indonesia, the company aims to ban the sale of fossil fuel vehicles in 2040.

New Mobility Services Initiatives

In other countries, initiatives aimed at solving the traffic service problems faced by cities and provinces are spreading through the use of new mobility services.

One example is MaaS. What is MaaS?

- ICT is used to cloud traffic, and regardless of whether it is public transportation or not, and whether or not it is operated, it is a new concept of "movement" in which mobility (movement) by all means of transportation other than private cars is regarded as one service and seamlessly connected.

- Since the definition of MaaS is a new service that is being developed, there are currently no definitions in the preceding cities, and there are differences in the definition content and scope among countries and researchers.
- The MaaS Alliance (established at the 2015 ITS-World Conference) said that "MaaS is to integrate various types of transport services into one mobile service that can be used to meet demand."
- Researchers at the University of Chalmers in Sweden divide levels into four levels, depending on the degree of integration.

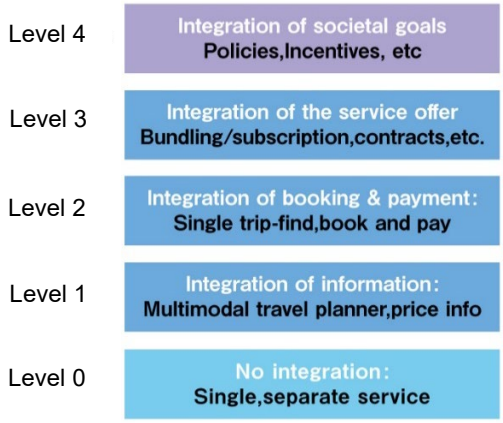


Fig. Defining MaaS Levels
Source: Nikkei BP HP

- In order to realize and provide MaaS, in addition to the development and dissemination of smartphones and digital infrastructures, large-scale data on transportation and transportation, such as information on the operation of railways and buses, information on the location of taxis, and information on traffic on roads, must be opened, and maintenance and cooperation are required.
- It can be said that a variety of technologies that are rapidly developing today, such as the use of personal data such as travel history and payment information such as route searching and ticket gate passage of users, automatic driving and compact mobility to compensate for driver shortages, innovation of vehicles such as electric vehicles (EVs), and the use of AI to analyze, propose and improve efficient means of travel, intersect.
MaaS case/Finnish Helsinki "Whim"

Whim is a multimodal integrated mobility service that has been offered by MaaS Global since 2016.

The Whim is characterized by the adoption of a subscription model with a flat-rate system and a free-ride system.

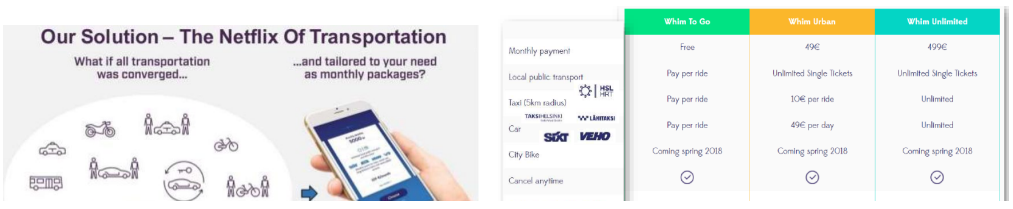


Fig. SUMMARY OF THE Whim
Source: Whim Official Sites (as of 12 April 2018)

MaaS case/German Qixxit

Qixxit is a multimode route/fare search application provided by German Railway, and has been in operation since 2013. Not only route retrieval but also reservation and settlement are possible. Originally, it was limited to use in Germany, but now it sells the convenience of travel planners for long-distance travel across borders, including airplanes and long-distance buses.

Fig. Maas case
Source: Qixxit

At the same time, German railroads are developing rental cars, buses, car sharing, bicycle sharing, and oncoming taxis, as well as investing in a variety of mobility ventures both inside and outside the economy.

In 2017, the company began working on ioki, a new mobility service that meets the needs of the auto-driving and AI-age. Ioki is a project centered on analytics (big data analysis using AIs), autonomous (automated operation), and on-demand, and is planned to be commercialized in 2018.

DRT (Demand Response Transportation)

The German Railway has given DRTs the role of complementing existing public transportation. On demand &door to door, the company plans to switch from driving to automation. In addition to introducing DRT as a means of moving the last mile from the station to the final destination to improve the convenience of the railway, DRT will be placed in hours and places where the railway is thin, such as at night and in rural areas, to encourage shift from private cars. As a result, it aims to improve the urban environment while improving mobility by increasing the number of users of railways and attracting private car users.

Source: Japan Research Institute's website

MaaS case/e-Palette Toyota Motor Corporation

In January 2018, Toyota announced the next-generation MaaS electric vehicle e-PaletteConcept, which uses motorization, connected, and auto-driving technologies that can be used for a variety of purposes, such as ride-share, logistics, and sales, as a concept of mobility solutions.

In order to build a mobility service platform (MSPF) that meets the needs of businesses providing various services in anticipation of automated driving in the future, the company entered into alliances with Amazon, Didi Chuxing Technology, a Chinese ride-sharing company, and Pizza Hat, a U.S. home-delivery pizza company. The number of participating companies is expected to further increase in the future.

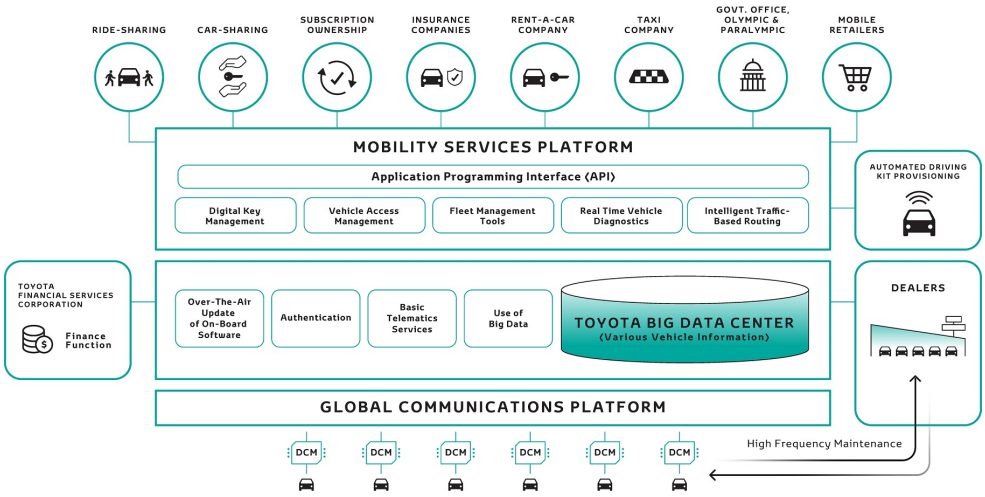


Fig. MSF in MaaS business using e-Palette Concept
Source: Toyota HP

Daimler×BMW

Daimler and BMW have developed their own free-floating car-share businesses through the car2go and DriveNow brands, respectively, and announced in March 2018 that they would integrate their businesses.

Diverse MaaS, such as the car-share business, are tailored into a single package, and the entire package is expected to be profitable.

In addition to the car share business, the four key businesses are "Ride Share," "Parking Solutions, Charging Solutions," and "Multimodal Traffic to Optimize Movements by Cooperating All Traffic Modes."

The company provides applications for centrally managing search, reservation, purchasing, and settlement, including related services such as parking solutions and recharging solutions. The company aims to increase profitability across the business by integrating diverse MaaS businesses into a single package. The package does not limit mobility to cars, but instead captures diverse transportation systems across cities, including public transportation systems such as buses, subways, and trains, as well as bicycles.

Profitability in the MaaS Business (from the Mizuho Industrial Survey Report)

- It is difficult to dramatically change the cost structure unless innovation such as automatic driving is made, since the labor cost of the driver (expected return of the driver) is required by focusing only on the movement of people and goods.
- The key to the MaaS business is the introduction of drivers-less cars and the improvement of profitability in ancillary businesses
- It is important to organically integrate data on the flow of people, goods, and money, such as "vehicle and driving data", "travel data", "purchase data", and "vital data", and to utilize them for new services, marketing, advertising, and promotions.

Increase profitability in incidental businesses

1. Developing the Car Peripheral Services Business
   EV-compliant charging and power storage, parking lot, vehicle cleaning and vehicle maintenance (for commercial vehicles by sharing automobiles)

2. Construction of transport ecosystems
   Multimodal Traffic (Multi-modal Traffic) by linking automobile-based services (Ride Share, Car Share) with other traffic modes such as trains, subways, buses, taxis, and bicycles
   Efficient movement of people and goods by providing route setting (shortest, fastest, and lowest), smooth transit between traffic modes, and a system that provides searching, reservation, purchase, and settlement in a one-step manner

3. Creation and capture of human logistics in cooperation with moving sources and moving destinations
   Establishment of a model to collect moving money from a source or destination that receives benefits by physically moving people and goods

4. Settlement and finance
   Grab has built a huge client base with ride shares, and has created high-value-added services through the use of data.

Source: Mizuho Industrial Survey 2018.8

EFFECTS OF THE MaaS

According to the Whim survey, prior to Whim use, public transportation (48%), private cars (40%), and bicycles (9%), but after use, public transportation (74%), and private cars (20%), have grown significantly.

MaaS and Ride Shares

The following table shows the major Ride Share companies in the world. The area of development is the largest in Uber, and projects are carried out in 633 cities in 78 countries. On the other hand, for the number of registered drivers and the number of trips per day, droplet ejection greatly exceeds the Uber.

Uber's ride-share services are characterized by the fact that a general driver who owns a private car that leaves off seats and hours and a passenger who wants to move in a vehicle easily and inexpensively are matched via a smartphone and provided by a ride. The services are supported by Uber technologies such as matching, optimal route calculation, duration estimation, variable tariff setting, algorithms and data analysis, location information, mutual evaluation systems, and cashless settlement.

Uber is also working to promote more environmentally friendly transportation and expand services, as shown below.

Promotion of environmentally friendly transportation

- Promotion of synergy
  →Add new functions such as allotment and multiple destination sets.
- Establishment of Last One Mile
  →Integration of transportation (cooperation with public transportation, bicycle sharing, car sharing)
  →To plan to share traffic patterns and other data with local government officials
- Driver support
  →Support for drivers upgrading to more efficient vehicles such as alternative fuels, hybrid cars, and electric vehicles

Expansion of services

- Cargo and collaboration of in-house sales services for Ride Shares
  →Cargo sales boxes can be installed in cars free of charge, and when passengers buy confectionery in the boxes, drivers can earn a portion of their sales.
  →With $1 per order and 25% of revenue
  →Average driver revenue of $100 per month
  →Lead to passenger driver evaluation

MaaS/Frameworks, Business Models

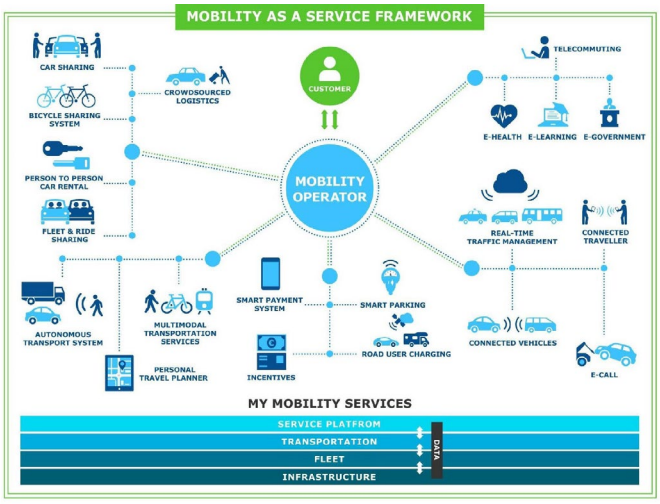


Fig. MaaS Framework
Source: Telematics Wire.net

Business model

The structure of MaaS Business Ecosystem, adopted from Aapaoja, A., Sochor, J., Ko nig, D. and Eckhardt, J. (2016).

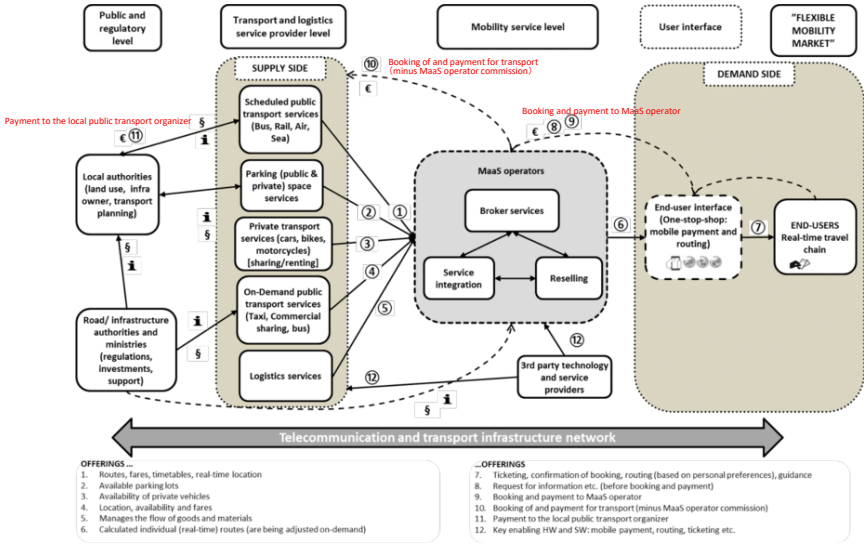


Fig. MaaS Business Ecosystem
Source: Business and operator models for MaaS

[Reference] Business Model

Automatic operation service based on highway stations in hilly and mountainous areas

- While utilizing the surplus power of local energy companies, automatic operation ensures the legs and logistics of living in the local area.
- Platforms such as tablet terminals for life support have already been developed in the region.

B. Supply Side

B-1 Area energy system

Area energy system is the one that different from the traditional centralized energy system. It refers to the system that have their own grid or heat network and can share the energy in the district among different types of building. It usually have their own power generation system, heat resource, and widely connected with the onsite renewable energy system.

District energy helps communities reduce their operating costs and keep more energy dollars local by reducing their need to import fuel for heating and cooling. Environmental impacts from heating and cooling are significantly reduced because of the greatly improved efficiency of these systems and developing district energy/CHP systems can help ease the transition of the power sector as older, polluting coal plants are shut down and removed from the grid. District cooling can cut peak electrical demand that typically occurs in the late afternoon – reducing strain on the grid and avoiding expensive peak power costs.

Usually the district energy system are more efficiently in the city center, with have higher energy consumption density. In the three target towns, Shah Alam and Han Tang Jaya is high density urban district, which District Cooling (DC) is the most effective method to be adopted under area energy planning. Providing cooling from a central plant requires less fuel and displaces the need to install separate space cooling in each building.

Further than the low carbon effect, it also can work as backup in the disaster, providing energy to the people in surrounding area.

B-2 Untapped energy

Untapped energy is, despite the possibility of effective use such as waste heat from factory, exhaust heat from subway or underground shopping center, potential heat energy from river, sewage, snow, etc., which have large temperature difference between outside temperature, however, have not been effectively utilized yet. Generally, untapped energy utilization technology can be combined with various other environmental and energy technologies to help create a low carbon society.

Presently in all 3 volunteer towns, large amount of solid waste is being generated daily but there is no systematic waste sorting or recycling system. We, therefore, propose the following strategy to promote energy utilization from waste.

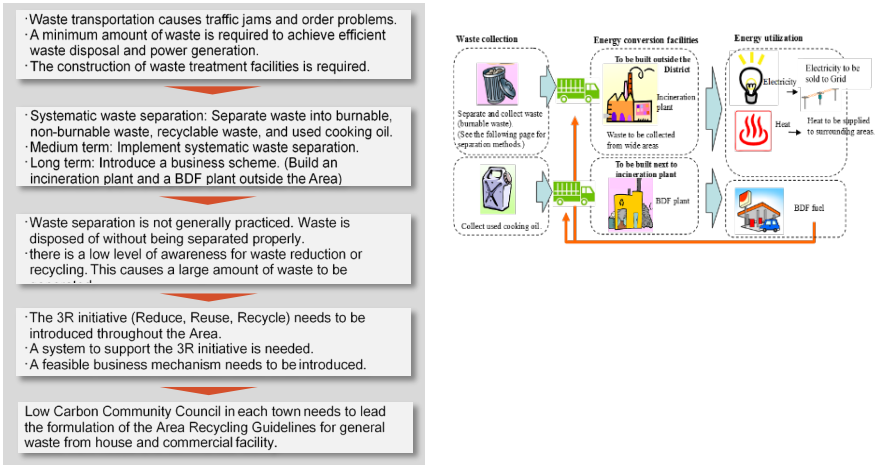


Fig.3.2-3. Concept Diagram of Energy Utilization from solid waste
Source: NSRI

Therefore, the geographical features make it possible to fully utilize waste heat from sewage water and use of potential energy from river water.

NSRI's experiences of high efficient DHC with untapped energy use from river will be supportive to propose same kind of district heating system in 3 volunteer towns.

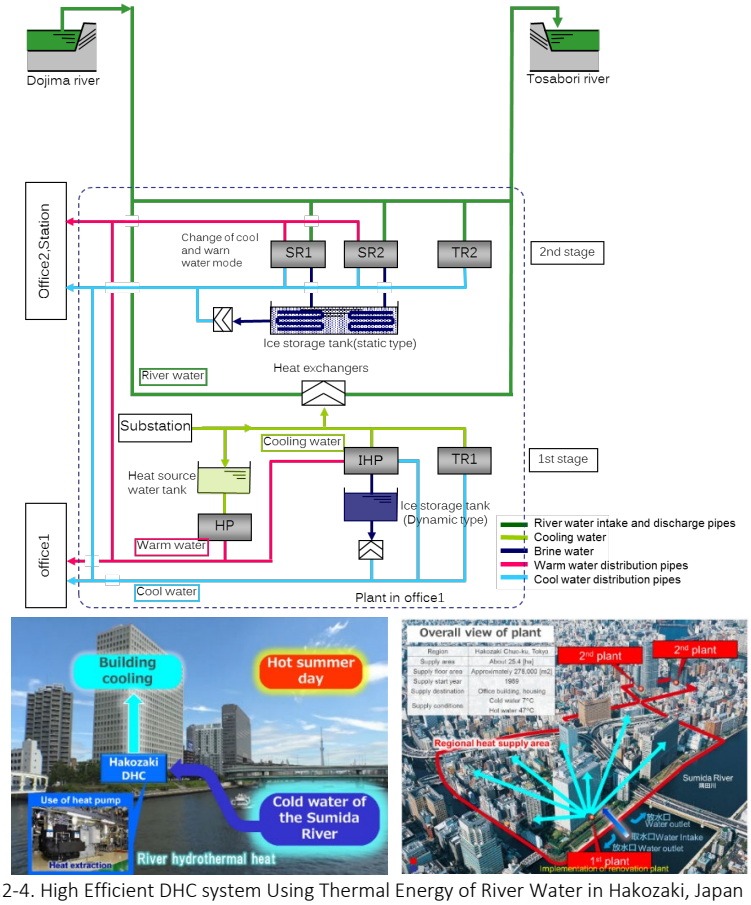


Fig.3.2-4. High Efficient DHC system Using Thermal Energy of River Water in Hakozaki, Japan
Source: NSRI

B-3 Renewable energy

Generally in 3 volunteers, solar radiation of approximately 1,700 to 1,900 kWh/m2 per year can be obtained, introduction of photovoltaic power generation is considered effective. When planning an introduction, consideration of both economic and environmental aspects is necessary.

Figure 2.3 44 summarized the roadmap of promoting PV power generation in 3 volunteer towns at different time and scale.

Step-1. Short-term development target: rooftop PV panels installation.

As model project in short-term, the installation of PV panels on the roof of houses and the canopies in parking lots and gas stations is proposed at small scale.

Step-2. Mid-term development target: PV panels installation

In 2020s, with a continuous price reduction of PV modules and development of PV technology, PV power generation is expected to be widely adopted, besides building roof, PV panels could be placed along the road and the sidewalk.

Step-3. Long-term development target: large-scale PV farm construction

In the large-scale PV Farm, PV layout can be designed as landscape

In south Asia, the solar energy is almost the most popular renewable energy. Its power generation potential are estimated according to the weather condition and capacity. The method is as below.

(1) Figure out the potential area where has the potential to set the solar penal

(2) Estimate the area of solar penal with the potential penal ratio

(3) Estimated the capacity of the PV (P) by capacity per area (0.0667 kW/m2 by the value from Japanese product)

(4) Estimate the Yearly power generation(Ep) as below:

$$Ep = H \times K \times P \times 365 \div 1$$

Ep: yearly power generation (kWh/year)

H: Daily solar radiation (kWh/m2/day)

K: Efficiency(0.73 use in the research by the experience in Japan)

P: Capacity of the PV

C. Demand & Supply Side

C-1 Area energy management system

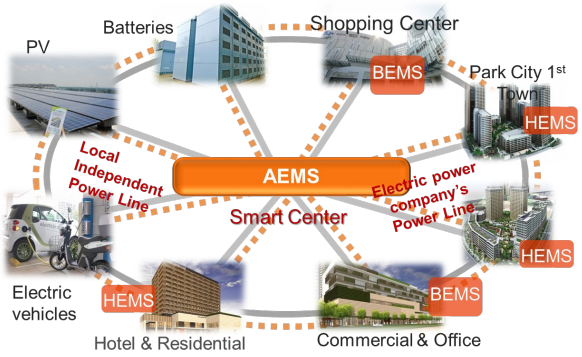


Fig.3.2-6. Smart Grid of Kashiwa-no-ha Campus City
Source: NSRI

We will make differentiation in Low Carbon development scenario for three volunteer, by taking into account each local characteristics and needs.

Band Aceh City of Indonesia

Based on Request for Proposal (RFP), a set of actions in energy sector will be developed. The countermeasures are grouped into following actions.

Table. 3.2-2. Specific area for Banda Aceh

The City in Specific Area for LCT			
No	Area	Tier1	Tier2
1	Tourism District and Ulee Lheue Port	Demand	Town Structure(Green Tourism Area)
			Building (incl.LED for lighting)
		Supply	Renewable Energy
2	Rusunawa(Rental Flats) Keudah and Hutan wisata(Tourism Forest) Peulanggahan	Demand	Building (incl.LED for lighting)
		Supply	Untapped Energy(Communal waste water treatment plant,waste water recycling)
			Renewable Energy(Methane utilization)
3	Desa Mandiri Energi(energy self-sufficient village) Alue Naga	Supply	Renewable Energy(Solar panel, wind, solar street lighting)
		Demand	Passive residential building design
		Environment	Waste/water management
		Demand and Supply	Smart grid (for optimal utilization of renewable energy)
		Governance	Education and community management
4	TPA(landfills) and IPLT(Installation of sewage treatment) Gampong Jawa also The Surounding Settlement	Supply	Renewable Energy(Solar farm area, windmill, methane gas, Biogas generation)
		Environment	Waste/water management
		Demand and Supply	Smart grid (for optimal utilization of renewable energy)
5	LED used for City Street Lighting	Demand and Supply	Energy Management System (LED for street lighting)
Whole city		Demand	Town Structure (Improve infrastructure, telecommunication, new urban design, traffic management) Building (LED, Sun-shading and natural ventilation)
		Supply	Renewable Energy (Solar Roof-Top)
		Demand & Supply	Energy Management System (smart grid, AEMS)

※ The content in gray color is the additional suggestion from NSRI

Source: NSRI

Shah Alam City Center Section 14, Selangor of Malaysia, and the City of Hang Tuah Jaya, Melaka of Malaysia

Table. 3.2-3. Specific area for Shah Alam

Area	Tier 1	Tier 2	Possible Low-carbon solutions
Whole city	Demand	Building	Sun-shading, natural ventilation, VAV control, desiccant AC, water treatment, etc.
		Transportation	Electric vehicle,
	Supply	Area Energy System	High efficiency district cooling system, large temperature difference
		Untapped Energy	Waste heat from incineration plant, sewage water heat use, etc.
		Renewable Energy	Solar panel, solar heat, water source heat pump, biomass
		Multi Energy System	High reliable power transmission and distribution technology
	Governance	Policy Framework	Eco-point Low carbon city guideline
		Education & Management	Energy conservation commissioning between stakeholders;
	Demand&supply	Energy Management	Smart grid, smart meter, energy monitoring & control system

Source: NSRI

3.2.2. Perform scenario analysis of implementation alternatives and analyze CO2 reduction efficiency

For 3 volunteer town, energy conservation effect, energy creation effect and low carbon effect of all the low carbon measures that proposed in step4, as the example of analysis in Fig. 3.2-7 will be evaluated in step5.

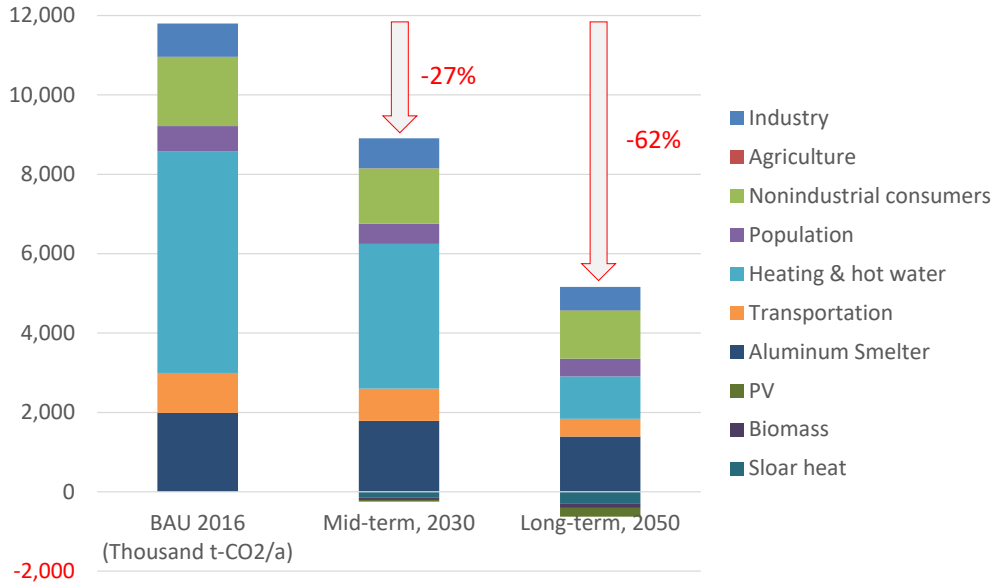


Fig. 3.2-7.Evaluation for various low carbon measures

Source: NSRI

Further, from the view of implementation, We will propose a roadmap towards achieving CO2 targets in the mid and long term. The low carbon measures will be selected according to the target and reduction amount of CO2 reduction.

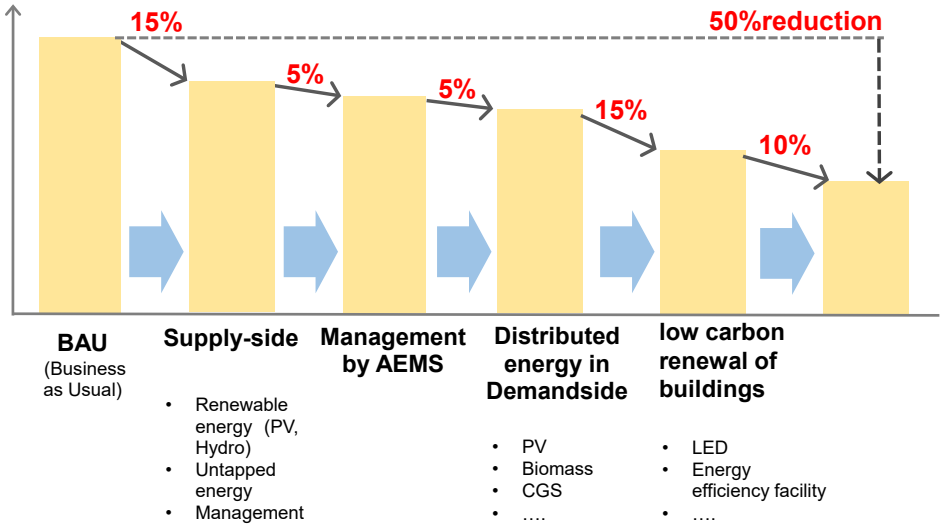


Fig. 3.2-8.Roadmap for achieving CO2 target example
Source: NSRI

As the 3 volunteer town have different features and scale, NSRI will adopt different simulation and visualization method evaluation.

Combined Low Carbon Management with Energy Density and Volume

Low carbon management for the buildings in the city level are vary with buildings according to their features. NSRI have the experience and tool to categories the low carbon method for all the buildings according to energy density and volume in the city scale and estimate its energy conservation effect, as Fig. 0-3.

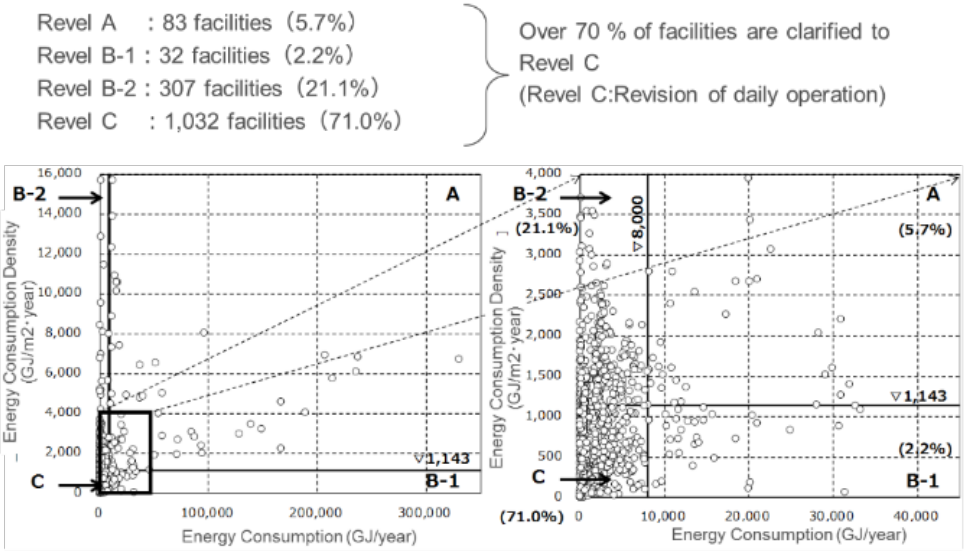


Fig. 3.2-9.Priority setting of low carbon action plan for all of buildings in a area, Yokohama, Japan
Source: NSRI

Simulation and evaluation in city scale

The simulation tool in city level can estimate the hourly energy consumption and distribution in the entire city (demand side), as well as renewable energy potential and distribution (supply side).

This design-aid tool offers a platform for data visualization which can help to realize a comprehensive evaluation and optimal plan.

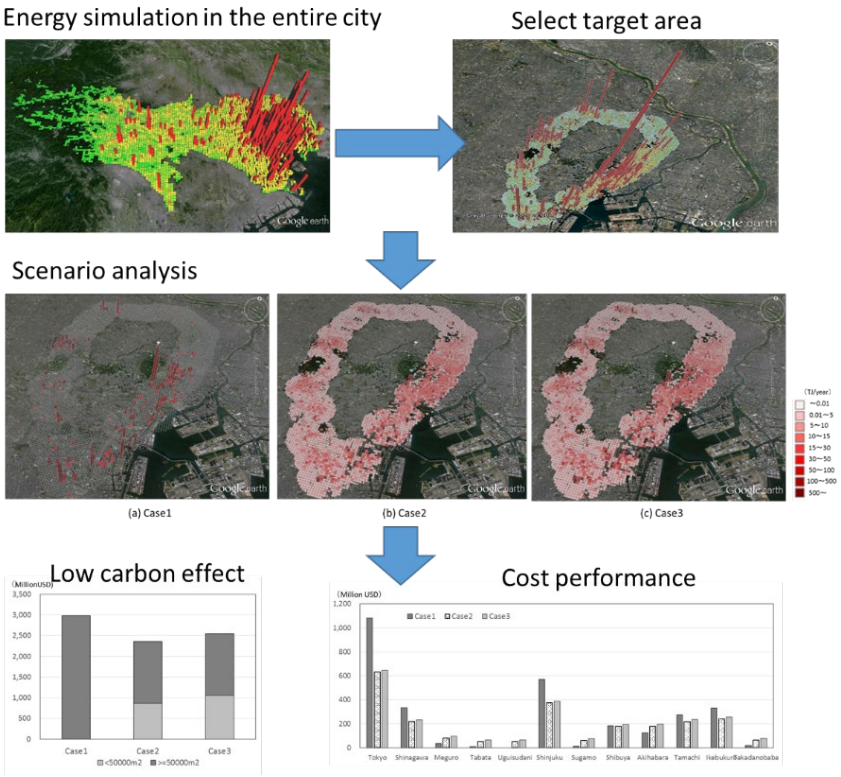


Fig. 3.2-10.Evaluation in the city level

Source: NSRI

Simulation and evaluation in the community scale

The simulation tool in city level is a comprehensive plat form that can:

- Simulate and visualize the energy consumption for each buildings in the community, including hourly, monthly, yearly energy consumption;
- Simulate, predict and visualize the onsite renewable energy potential
- Display the infrastructure information in the community
- Predict the effect of all the low carbon measures in the community level
- Not only in the design stage, but also cooperate with the AEMS and smart grid to realize an optimal control and operation.

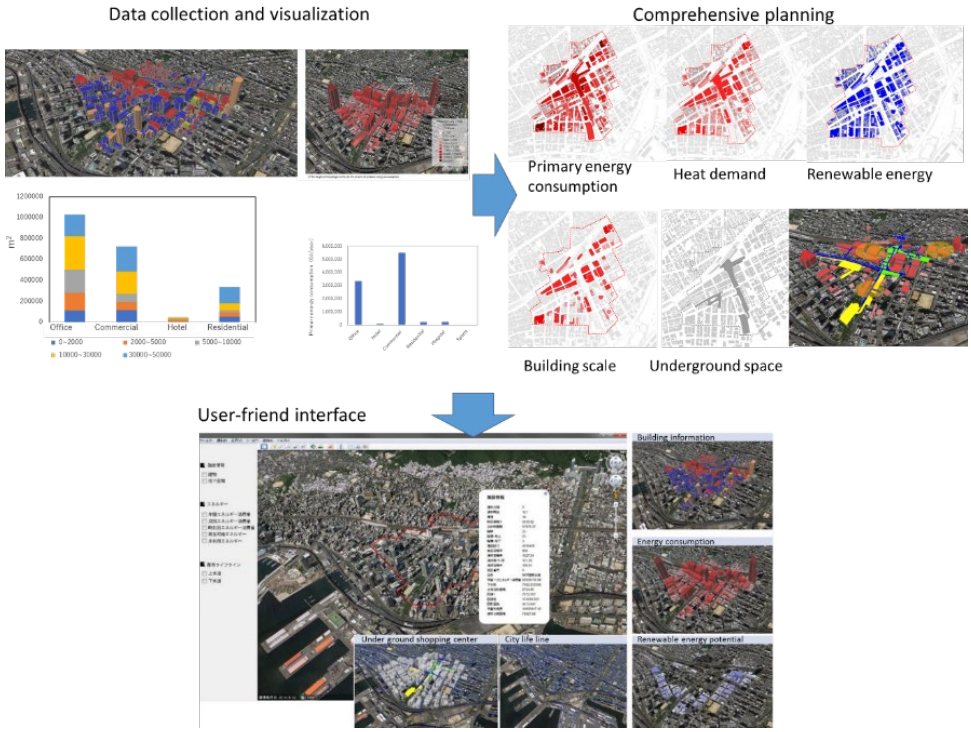


Fig. 3.2-11.Evaluation in the community level
Source: NSRI

Simulation and evaluation in the building level

For the community with existing buildings, the energy simulation tool that can be used for both energy system design and also after design commissioning.

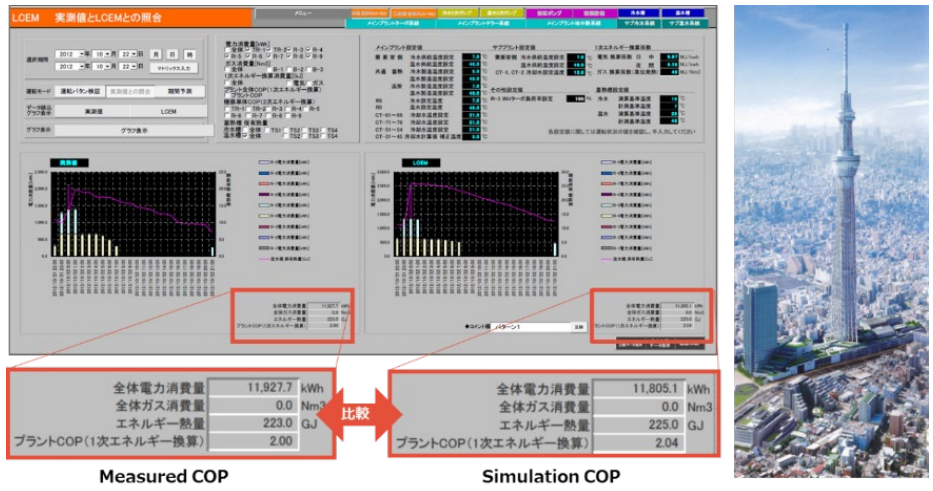
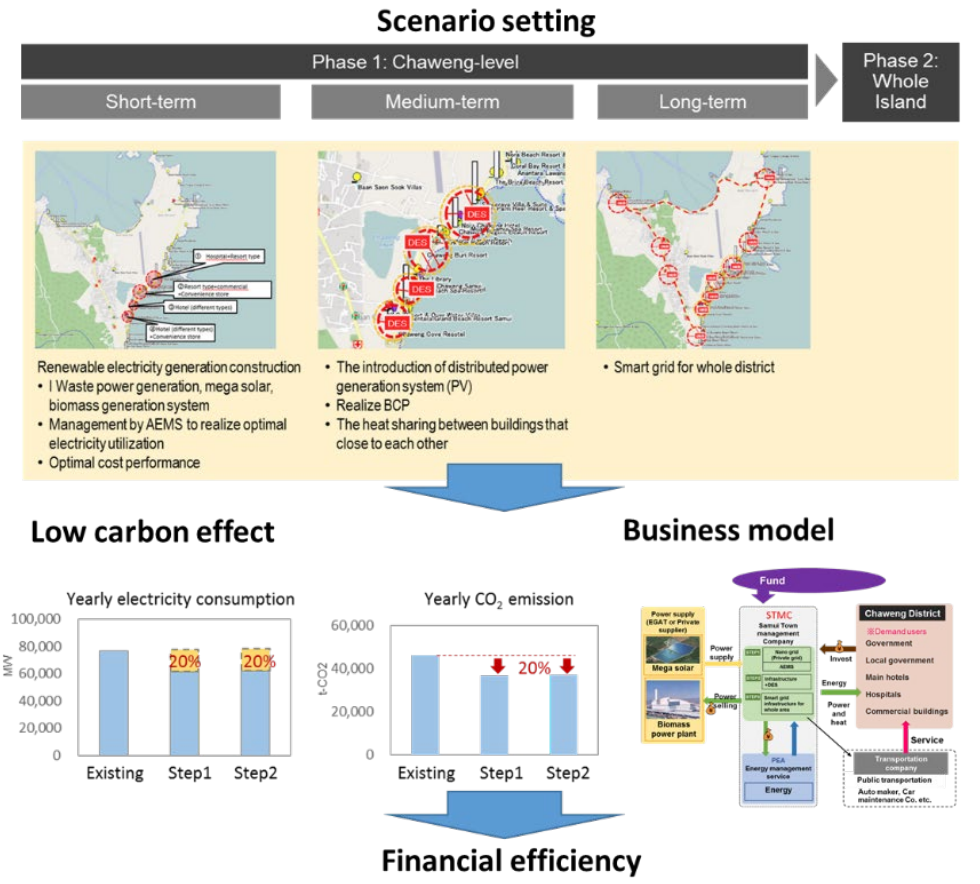


Fig. 3.2-12.Building energy simulation tool used for sky tree town, Japan
Source: NSRI

The scenario for implementation set in this step will both consider the technical possibility and economical realistic. Therefore, both low carbon effect and basic economic factors will be discussed, which is the base for the business model and financial efficiency analysis.



		CaseA-1	CaseB-1
Content of cases	Business body	Demand side	Demand side＋PEA
	Power generation	Energy supply ＋power generation	
	Remarks	The fee for using commercial line is assumed	The fee for using commercial line is not assumed
①	Without fund	revenue and expenditure is minus	More than 16 years
②	With1/2 fund	minus	13.2years
③	With2/3 fund	minus	8.8 years

Fig. 3.2-13.Example for scenario analysis
Source: NSRI

3.3. Priorities for implementation and roadmap for realization

The above-mentioned low-carbon scenario is based on the characteristics and needs of the each districts, but in order to increase its feasibility, it is necessary to clarify what should be preferentially advanced among them, and to draw a road map for their implementation.

1. Evaluation of Priority

The following two points are raised to clarify their priorities.

1) Analysis of importance and feasibility in each district

It is necessary to determine the importance and urgency of how low carbon scenario is useful for solving each district's problems. At the same time, it is also an issue that those scenario's feasibility is higher or not. For example, clarification of the players (administrative office, private real estate developers, etc.), and the objective and scope of project to be analyzed to evaluate their priorities.

2) Cost performance analysis

If there are several low carbon scenarios which have similar priority as described above, it is necessary to pick up the priority measures by analyzing the cost performance of each low carbon scenario.

2. Organization of roadmap consistent with development scenario

Based on the above analysis, consistency with development scenario will be considered to organize roadmap for low carbon scenarios implementation.

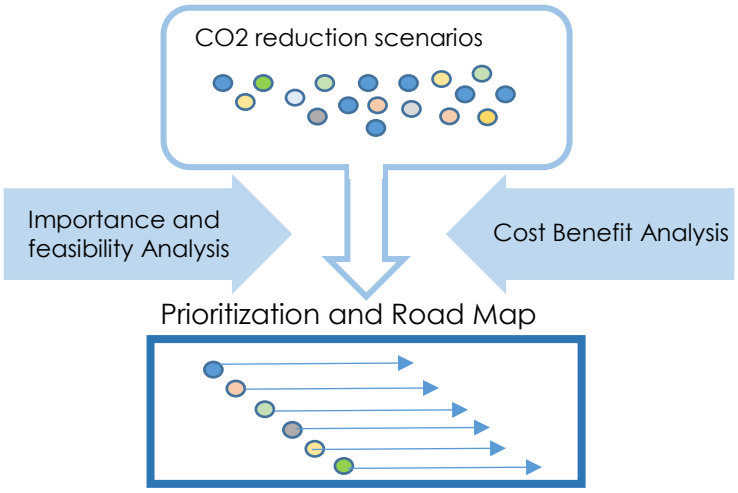


Fig. 3-3-1. Priorities for implementation and roadmap for realization
Source: NSRI

3.4. Business Scheme

The CO2 reduction methods in each region are described previously. In this chapter, we would like to study to implement these methods. Specifically, it is necessary to clarify the leadership and to be able to self-sustain as a sustainable mechanism in the region with the methods established as a business to some extent.

1. Basic concepts

In promoting the mechanism for low carbon of each area, the following are examples of current issues.

- Lack of implementation body

- Lack of legal institutional framework

- Lack of cooperation among multiple entities

For tackling with these issues, the basic concepts for building a business model in this study is as follows.

1) Setting an administrator or management body (PPP) as a Low Carbon methods promoter

Maximizing regional Quality Of Life is a major objective by promoting low carbonization in the region as an official position. It is necessary to construct an ecosystem to continue sustainably in the future, such as entity involved establishing as business to some extent rather than raising profit.

2) Combination of multiple businesses

In considering the business feasibility as described above, even if it is not always possible to establish in individual methods, it may be possible to establish business by combining multiple methods. With public entities managing at the top, it is easier to collaborate with multiple companies.

3) Collaboration with existing businesses

In considering the above, some of the contents proposed here have already been entered by other companies and established as a business. It is not favorable that public sector manage similar business and interfere with them. In other words, it is necessary to work cooperatively with companies that are likely to collaborate flexibly.

2. Examples of business model

After considering the potential players and feasibility of each method in each district, we would like to propose a possible business model. Following examples are our initial ideas and should be examined in detail later. In any case, while considering possibility as a player and the possibility of business feasibility, several business models will be proposed by taking advantage of the characteristics of the area further.

Example A: Local grid network + Sharing EV & E-bicycle + Advertisement

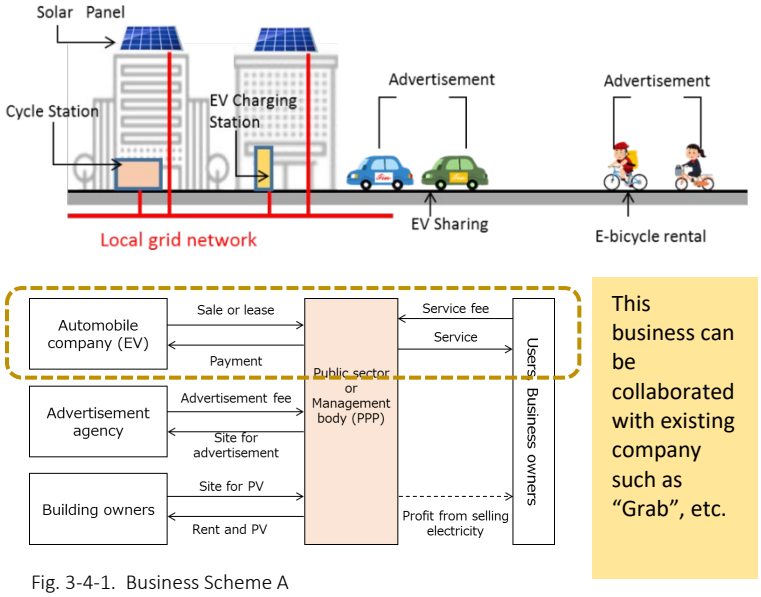


Fig. 3-4-1. Business Scheme A
Source: NSRI

Example B: Area circulation EV + Advertisement

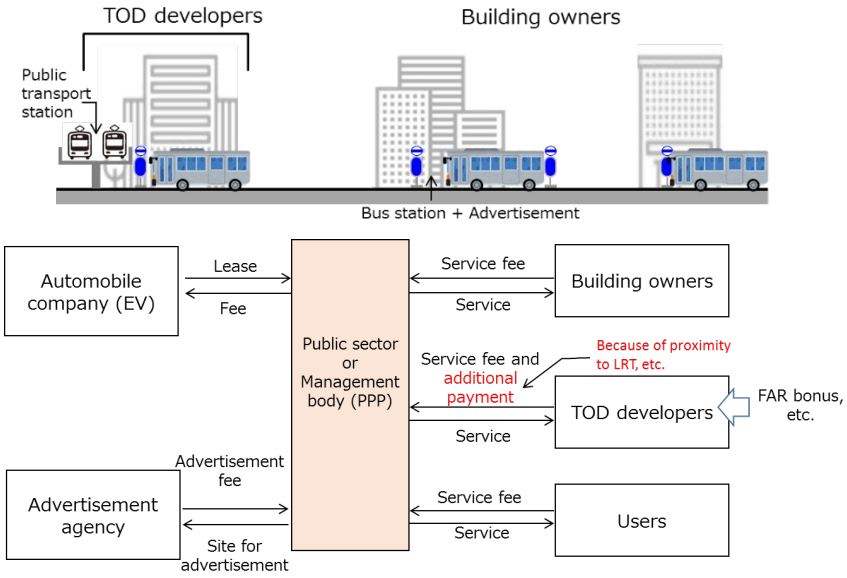


Fig. 3-4-2. Business Scheme B
Source: NSRI

3.4.1. Identify regulatory agencies and approval process and develop the business model in 3 volunteer towns

1) Identify regulatory agencies

- Proposal of the agencies based on the scale and their features:

For example, as a town in the community scale, section14 is suggested to have the building owners as the main player for the project. However, for the new town Hang Tang Jaya are tended to develop the project cooperatively by government, Energy Company and developers.

- Proposal of the agencies based on low carbon measures

As the CO2 reduction potential analysis as Figure 2.3 37, the low carbon measures with high initial cost but low reduction potential as renewable and untapped energy should be initiated by government. On the other hand, the low carbon measures with low investment but high CO2 reduction potential as building energy conservation, multi-energy system and AEMS have the potential that invested by building owner.

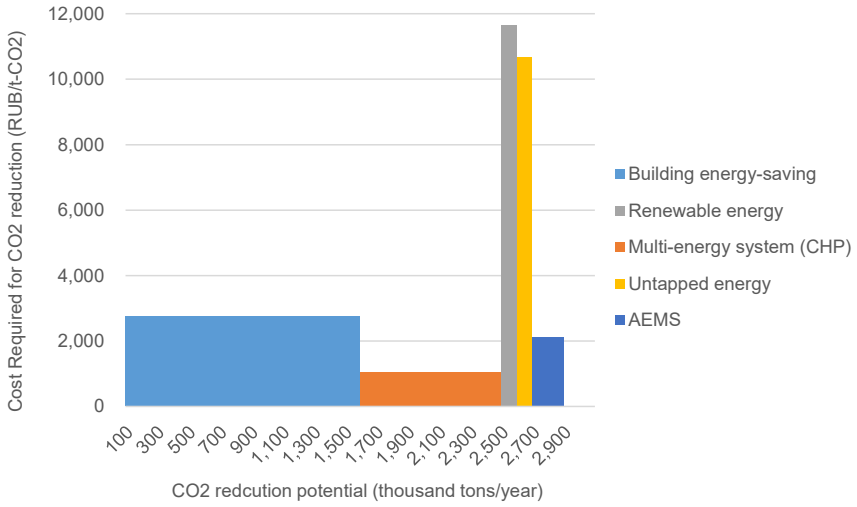
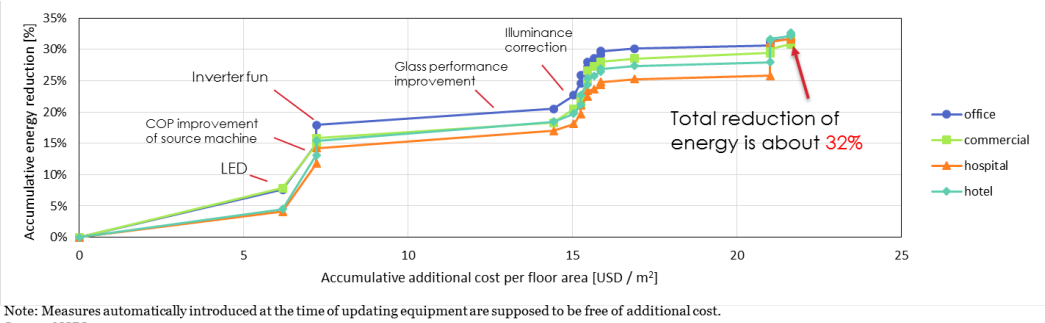


Fig. 3.4-3.CO2 reduction potential and agencies
Source: NSRI

The method for decide the priority in building conservation technologies are decides by the relationship between Relationship between reduction rate and cumulative cost.



Note: Measures automatically introduced at the time of updating equipment are supposed to be free of additional cost.
Source: NSRI

2) Business model

The potential agency needs to coordinate with the related stake owners and set up the business model. NSRI has the experience as consultants for providing various business model in Japan and oversea projects.

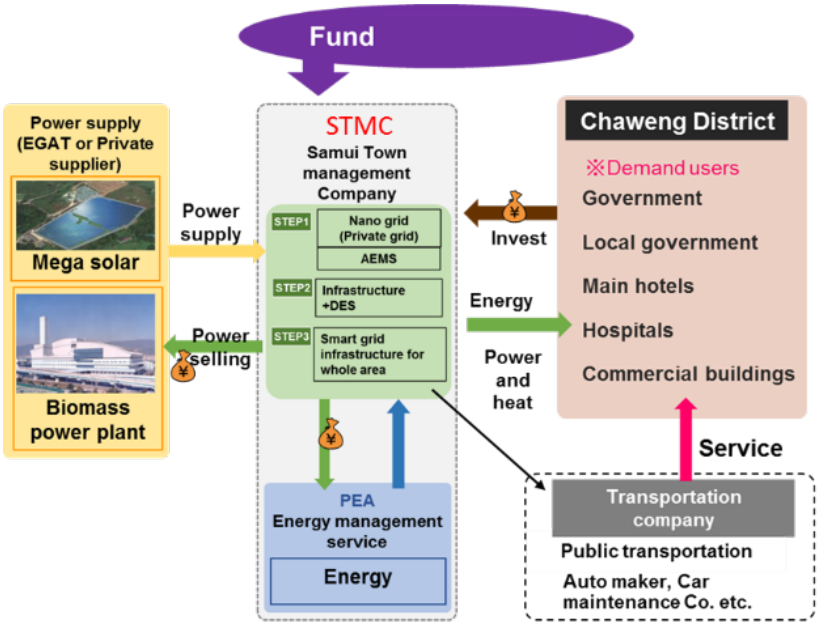


Fig. 3.4-4.Business model for investment and management in Samui, Thailand
Source: NSRI

3.4.2. Analysis financial efficiency of low carbon business model in 3 volunteer towns

Based on the business model that developed in step5 and step6, step7 will analysis financial efficiency of 3 volunteer towns from business model standpoint. The general flow for analysis are as below:

1) Policy review

Collect data and survey on the policy like tax benefits or subsidy

2) Review of business scheme
   - Public works: Public infrastructure and public service projects
   - Public Private Partnership: Projects with operating costs subsidized by public sector
   - Fully privatized projects: Profitable projects

3) Assessments of role-sharing and profitability towards successful implementation
4) Interviews with governmental agencies and public investor
5) Interviews with business operators

6) Cost- Benefit analysis
   - Establish analysis assumptions
   - Estimate payback periods, principal amortization CF (Cash Flow), Accumulated principal amortization CF, P-IRR (Project - Internal Rate of Return), E-IRR (Equity - Internal Rate of Return) and DSCR (Debt Service Coverage Ratio)

7) Creation of business operator appointment policy
8) Develops a roadmap and process flow for implementation

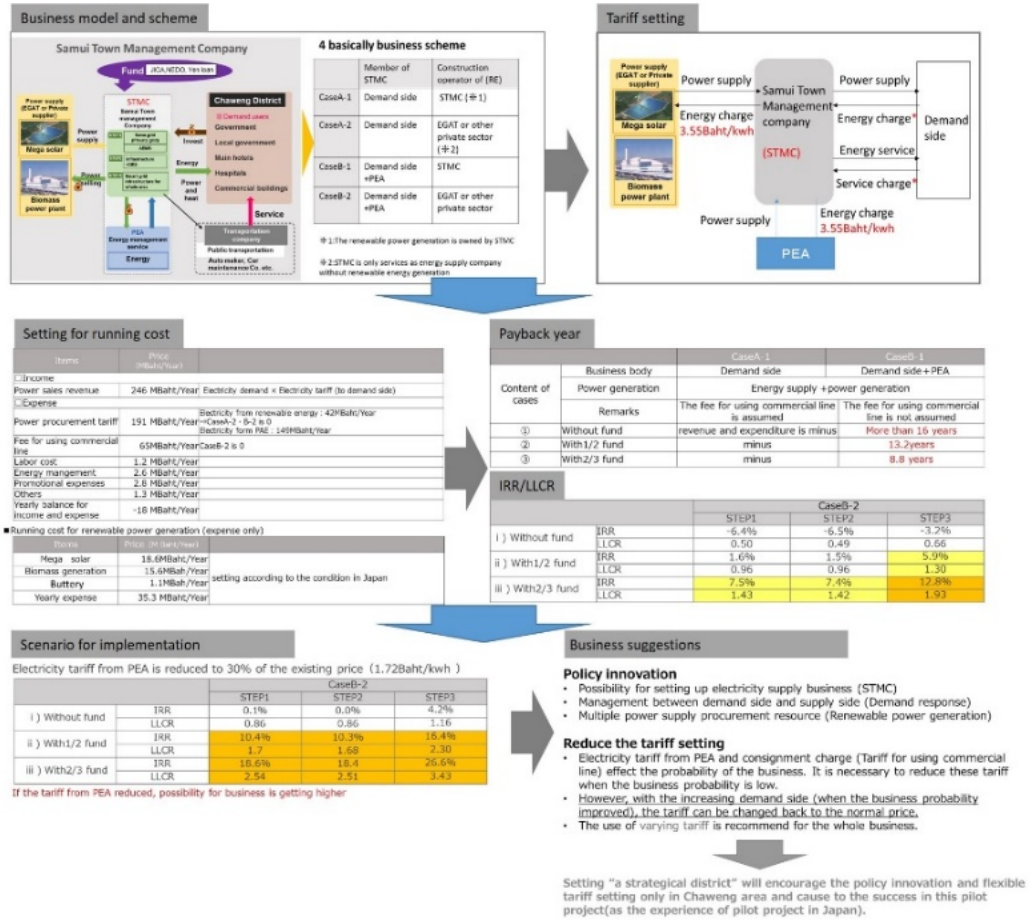


Fig. 3.4-5. financial analysis for Samui smart grid and EV, Thailand

Source: NSRI

3.5. Capacity Building

3.5.1. Introduction

> "Capacity development [is] the process through which individuals, organisations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time."
>
> – UNDP, Capacity Development: A UNDP Primer

Capacity building occurs through the mediums of skills, knowledge, tools, equipment or other resources required to complete the task at hand to a high standard and further impact. Although training is an essential part of achieving this, capacity building extends far beyond just this activity:

- **Human resource development**, the process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform effectively;
- **Organizational development**, the elaboration of management structures, processes and procedures, not only within organizations but also the management of relationships between the different organizations and sectors (public, private and community);
- **Institutional and legal framework development**, making legal and regulatory changes to enable organizations, institutions and agencies at all levels and in all sectors to enhance their capacities.

Capacity building is a key driver of long-term improvement and change, and creates a solid foundation upon which further successful measures, projects or programmes can build. By its very nature, capacity building promotes and delivers a more efficient use of resources, enabling the same funding to be deployed more effectively across activities and stretched to achieve greater impact.

The Carbon Trust has developed a matrix to score the capacity of a given organisation, it uses seven general categories that are widely applicable across organisation types and sectors: policy, internal responsibility, data management, communication & training, finance & investment, procurement and monitoring & evaluation.

	Policy	Responsibility	Data Management	Communication & Training	Finance & Investment	Procurement	Monitoring & Evaluation
5 **BEST**	Specific, Measurable, Achievable, Relevant and Time-bound targets with senior buy-in. Clear delivery plan with aims and progress reviews. Associated strategy document.	Clearly defined roles and communication channels. Dedicated management, with senior stakeholder commitment and engagement.	Defined and reliable data collection, collation, storage and availability. Complete coverage of required estates and data areas.	Topic-specific induction and training. Dedicated team commitment and monthly engagement, and reporting. Holistic stakeholder engagement strategy.	Project appraisal with defined investment criteria. Finance engagement across teams, including financial reporting. Ring-fenced project fund and active assessment of funding.	Competitive tendering for high-quality and reliable equipment, with well-defined works contracts supported with legal review. Understanding of legislation. Use of frameworks, or registers for large-scale works.	Ongoing monitoring and evaluation of project performance, and topic-specific strategy at senior level. Project performance assessed with measurement & verification (IPMVP)
4	Targeted policy, with clear delivery plan and progress reviews, developed. Further refinement and importance required to leverage impact.	Specific management identified, but limited support. Some stakeholder engagement and senior support, but limited due to being under-resourced.	Data management covering most aspects of topic/estate - but not all encompassing, up to date, or digitalised for storage.	Regular communication internally with stakeholders, including circulation of reporting. Engagement and training intermittent.	Some opportunity appraisal, quarterly financial reporting, and cross-team engagement. No dedicated pot available for topic-specific projects. Some understanding of other funding options.	Competitive tendering for project works, but of limited scale (not large scale multi-site projects). Understanding of legislation, but limited capability and legal input to work contracts.	Regular project review and management performance review with some senior engagement. Limited strategy performance review.
3	Policy in place but out of date / not relevant / not topic specific. Shows senior commitment but no direction for ongoing engagement.	Topic area is part-time responsibility of a few staff. Some stakeholder engagement, but no senior input.	Some data management of topic/estate data, but not all encompassing, and significant gaps in data. Collection of data is unreliable.	Regular dedicated team communication and reporting, but no circulation or engagement to wider stakeholders. No specific training to staff.	Ad hoc financing for topic-specific projects. Limited opportunity appraisal and annual financial reporting.	Competitive tendering but no formal procurement process followed. No formal works contracts used or legal input.	Regular team evaluation of performance and projects, but no senior input. No review of management approach.
2	No specific policy, and no topic coverage or direction in other policies or strategies. Mission aspiration at senior level, but not defined or communicated.	Topic is part-time responsibility of an individual, but no resource or importance given to. Not a role of responsibility that can make an impact. No stakeholder support.	Minimal collection of topic/estate data, but not consolidated or stored in an efficient manner. Minimal granular data available.	No regular dedicated team meeting - only ad hoc team engagements. Reporting is not regular.	Ad hoc financing for topic-related projects. No opportunity appraisal or reporting.	Limited projects delivered, and those that are use informal direct procurement. No understanding of procurement legislation.	Ad hoc reviews of performance, but no project reviews. No regular meetings.
1 **Worst**	No specific policy. No senior engagement or aspiration to formalise topic areas with policy.	No topic specific responsibility designation.	Specific or relevant data not compiled.	Poor communication within team, no dedicated reports, and no stakeholder engagement or training.	No internal financing or funding for topic specific projects.	No topic-specific projects procured.	No specific monitoring or evaluation.

Fig.3.5-1. matrix for the seven areas of organisational capacity building

Source: Carbon Trust

3.5.2. Policy

Effective internal policy is a statement of intent, a bedrock for future action, and a standardised approach for achieving aims. A 'policy' is a course of action, adopted or proposed by an organisation or individual, and is an essential tool for organisations to drive forward low carbon development, as it demonstrates senior level commitment that can be passed down through an organisation. It needs to include a clear goal that defines the overall direction and intent, as well as conditions for progress reviews to occur (quarterly), bringing together senior-level management and stakeholders. Policy needs to be set at the senior-level, as this helps communicate both its importance, as well as the existence of multi-level buy-in across the organisation, ensuring thorough implementation. Policies should be launched both internally and externally, developing maximum buy-in as well as greater traction.

In order to develop and ingrain the best practice outlined above, a series of activities can be undertaken. Each is most appropriate depending on the specific situation, and can have its impact amplified through pairing with other components. However, even as a standalone activity, the elements below will build the capacity of the participants to understand what should be in a low carbon policy, how to make it impactful, and how to keep it relevant and evolve over time as a 'living document' – as opposed to being forgotten on a shelf as can occur.

Activities	Description
Strategy/Policy Creation Workshop	• Delivering a workshop with employees across different teams and grades (within a local authority for example) brings together a diversity of opinion and experience, and opens communication. This diversity of discussion creates a more robust policy. • It can also be used as a session to collaboratively develop and test ideas for a policy, as well as creating wide consensus and buy-in. • Of particular value, is doing situational testing or role-playing scenarios, which helps to organically identify gaps, develop solutions and create new collaborative links between individuals/ teams.
Monitoring & Review Training	• It is also valuable to train individual/ teams on how to track their progress against policy targets effectively, e.g. how to run efficient and regular progress reviews

Source: Carbon Trust

3.5.3. Responsibility

'Internal responsibility' is the process within which decisions, actions, and accountability move through the organisational hierarchy. It is where an employee can easily raise a query with the right person, and quickly get a response, decision or action. A clear 'internal responsibility' structure within an organisation is crucial. This helps define the overall senior sponsor for a low carbon project or group of projects, the dedicated manager of this work area, any supplementary support roles, and beyond that, the wider group of key stakeholders with influence across the organisation or city.

Structured internal responsibility with senior accountability and clearly defined roles are required for effective project management. High profile/ senior buy-in through endorsing policy or measures demonstrates clear internal responsibility and can also raise the profile of low carbon action externally. The roles of CEO/leader, CFO and Energy Manager are the fundamental centres of low carbon-related responsibility.

However, 'buy-in' should be part of all job descriptions and employee personal development plans. Clearly defined roles are crucial, a specific focal point should be identified (such as a Low Carbon Manager) with dedicated support roles outlined. For wider stakeholders, having clearly defined roles and responsibilities are essential to creating clear channels of communication. It is also best practice to include finance, procurement, technical and management staff in an energy / low carbon team. Such a group should meet for monthly or quarterly reviews in dedicated slots; this will help keep it high on the agenda and maintain momentum.

Activities	Description
Role-setting Workshop	• Clear communications of 'who is doing what', providing the opportunity for those involved to state what they think others should be doing, and what they would like their own role to be. • Through developing the network of responsibility collaboratively, it has much greater clarity in the minds of those involved.
Contract Key Performance Indicators	• Work with Human Resources, project managers and employees to embed low carbon-based KPIs into their contracts, driving shared responsibility and ownership of outcomes.
Senior-level Annual Reviews	• Undertaking senior level annual reviews helps motivate improved performance, reaffirms channels of responsibility, and, through a critical review of strategy, maintains wider focus and direction.

Source: Carbon Trust

3.5.4. Data Management

Data Management is the activity of development, collection, storage, retrieval and dissemination, archiving, and disposal of data. For the effective delivery of low carbon projects, the collection, storage and reporting of energy and transport data (amongst others) is a key activity. Ensuring that energy data is accurate, available, and shared in a timely manner makes sure that activities are based on real data, they are relevant at time of use, and comparable for performance monitoring purposes. Data could include metrics such as energy consumption (kWh), floor space, no. of occupants, and other fuel consumption. This is then used and presented in energy reports, project registers / forecasts, policy/strategy documentation, energy team minutes/actions, project monitoring and evaluation reports.

The two core areas of capacity building regarding data management are (i) collection and storage, and (ii) quality and use. Collecting granular data, and ensuring it is readily available, provides the evidence base to propose measures and enact change. Furthermore, quality assurance checks are essential to make sure accurate data and information is provided to support investment decisions (and others). This might include checking energy meters are correctly calibrated, or that financial invoices tie up with energy meter data.

With particular relation to energy, it is important that several specific data streams are targeted:

Data Stream	Data Sources	Data Format and Best Practice Management
Electricity / Natural Gas	• Automatic meter reading • Manual reads • Supplier bills • Supplier online portals	• Manual reads for supplier billing may be monthly or quarterly • Own manual reads can be taken weekly or even daily for own records • Automatic meter reading by supplier may be half-hourly format, and available for download – can be downloaded monthly or weekly depending on reporting strategy
LPG, Fuel Oil & other fuels	• Delivery invoices • Own metering	• Collect invoices from finance, or own manual meter readings and store within a excel document, invoicing may be weekly, monthly or quarterly – the most granular data available should be used for reporting.
Biomass	• Delivery invoices • Heat metering	• Collect biomass invoices from finance, and undertake manual (or AMR) heat meter reads for the same period. Use within a dedicated excel document to track biomass boiler efficiency.
Onsite Generation (e.g. Solar PV) or private wire import	• Manual reads • Supplier reports / invoices • Supplier online portals	• Usually available online from supplier – download the data on a weekly/monthly format. Ensure actual data ties up with any supplier billing (e.g. power purchase agreements) • Review import / export profile regularly against building use. Report alongside mains consumption to understand total energy use.
Sub-metering	• Manual reads of installed sub-meters • Connection to a monitoring & targeting system	• Available via an online internet-based software service or BMS system. If no AMR on sub-meters, develop a excel log of manual reads • Ensure available data is used in reporting, and capability of online systems are fully utilised – for instance, consumption alarms are used for proactive notification of high energy.
Building Management Systems (BMS)	• BMS meter and sensor hardware	• BMS control pages to provide system control capability and data management (set-points control, time schedules etc.). Regularly review against O&M design set-points.

Source: Carbon Trust

Further to the energy data itself, there are core documents which are further required for effective project management of low carbon/ energy projects:

Data Stream	Data Sources	Data Format and Best Practice
Energy Policy / Strategy	• Formulated by the energy team with finance and procurement, and senior management	• Word / pdf document containing the substance of the policy, and a headline 'mission statement' • Collaboration between energy, finance, procurement and senior management should be reflected in the document
Energy Performance Reports	• Internal, or supplier monitoring system	• Excel / word / pdf document showing energy consumption data, trend and performance against a benchmark • For Energy Management, best practice is weekly reporting, with regular review of report format and effectiveness as a communication tool
Energy Audits / Surveys	• Generated by the energy team or external consultants to identify energy waste and opportunity	• Regular surveys and audits support the identification of projects and helps support continuous ongoing change. Depending on complexity of estate, often bi-annually or annually is appropriate. • Additionally, external audit of energy management process as a whole can prove invaluable in identifying improvements in overall process (e.g. ISO 50001 audits)
Energy Team Minutes / Actions	• Generated by the energy team to track and document each meeting and subsequent development	• Word document tracking actions on an ongoing monthly basis. Ideally, actions are emailed to energy team and stakeholder to ensure that all review. • It is important for minutes to be 'action' based to ensure that activity is motivated and recorded • Demonstrating dates of setting actions, and delays, can help to push staff to progress actions.
Project Plans	• Output of strategy being combined with wider EPRs / Energy Audits showing 'what is needed'	• Document detailing the project scope, its need / impact, timeline, milestones, financial requirements and delivery • Maintaining a project focus helps to ensure that improvements actually happen - a overall project working document, which also shows saving/cost/payback – helps to focus and prioritise projects and actions
Business Cases	• Document developed by the energy and financial teams together	• Document / pdf that contains analysis to define a specific energy project opportunity and the cost saving benefit • Business cases are core to senior level sign-off and should be constructed in a concise and benefits driven manner
Project Delivery and M&V (Measurement & Verfication)	• Project delivery plans, quotes, supplier documentation, M&V reports	• Encompasses project specific documents which are reviewed and sign-off by stakeholder prior to project deliver. • M&V reports developed by contractors and energy team are important to track ongoing performance of measures.

Source: Carbon Trust

In order to build capacities in data management and embed the best practice elements outlined above, several activities can be undertaken:

Activities	Description
Standardisation	• Create standardised processes and capture documents for data collection and storage, and train employees across the organisation how to utilise correctly, including 'champions' who will ensure continued high standards.
Review Meetings	• Assess the level of success of current policies and procedures, looking at where the gaps are and what lessons can be learned. Subsequently, translate these lessons into actions to be taken to drive improvements, with clear owners for each.
Integrate Data Management into Contracts	• For particularly data-heavy projects, it is crucial that the managing body/ team has sufficient capacity to delivery effectively. • One solution can be to write data management into contracts with partners/ sub-contractors to ensure it receives sufficient attention. This should be complimented by a clear data management policy/ strategy and a roadmap for the processes of the project, to ensure all parties involved understand.

Source: Carbon Trust

3.5.5. Communication and Training

Communication and training are essential tools for leveraging organisational buy-in and they should come together at regular updates. Communication is vital to ensure that efficient processes and awareness are driven across organisations. This helps to ensure that all key stakeholders are fully engaged and that a project has ongoing and lasting engagement. Training introduces staff to why the different capacity areas are important, and how each individual can make their own contribution to the wider mission of the organisation/ team. Training across the elements highlighted in the matrix should be strategically tailored to employees, giving greater relevance and impact, and increasing the likelihood they buy-in.

Creating and following a holistic stakeholder engagement strategy is crucial and ensures persons of influence are properly engaged across central/ municipal government, other public bodies, private businesses and community groups. Stakeholder engagement involves a five step iterative process: identification, mapping, prioritisation, planning and engagement. Providing stakeholders with a platform for feedback and input is important - this allows stakeholders to have ownership/ feel some impact regarding developments and helps to maintain engagement.

The below activities are examples of ways to build understanding and capacity as well as appreciation of these two areas:

Activities	Description
Stakeholder Identification Workshop	• In this workshop a full landscape of stakeholders is mapped out, with preliminary classifications and prioritisation accompanying. • Participants will bring their own knowledge, and therefore a diverse range of stakeholders, covering all angles, which can also be used as the basis for establishing ownership over certain areas of engagement – for example, where an existing relationship is already in place.
Employee Familiarisation Session	• This training session seeks to understand how familiar employees are with the organisations policies and strategies. • If there are gaps, they are then addressed to ensure there is a base level of understanding across the organisation. This base level is key to ensuring all elements of an organisation are working in tune with one another efficiently to a common objective.

Source: Carbon Trust

3.5.6. Finance and Investment

Finance expertise and organisational finance policies provide staff with the knowledge and resources to make financial decisions that are financially robust, in line with financing / borrowing constraints, and such that the procured outcome benefits are fully understood. Finance impacts directly on establishing the financial business case for low carbon projects, and proving capital or other funding for investment. Reporting of energy/carbon data and project performance in financial terms, supports the understanding of value of projects across the organisation, and can help to raise the importance of undertaking mitigation projects.

Finance representation on an energy or low carbon development team is crucial. Representation at meetings and discussions, and including in key decisions helps ensure projects are developed within organisational constraints, are financially robust and more likely to be signed off. Development opportunities should be matched and tailored to available financing as this greatly increases its chances of progressing to delivery. Finance Directors will be able to provide direction on attitude for risk, for instance – payback period requirements, and also be able to determine key factors to support life cycle cost analysis (e.g. discount ratio for discounted cash flow.) This helps to understand the value of an energy efficient piece of equipment across it life (e.g. OPEX requirement and budget impact). All these factors build a picture to help prioritise CAPEX spend (or other investment) between projects.

Under best practice, a mechanism should be put in place to identify granular and effective financing devices and funding sources. One method of achieving this is to undertake an options appraisal of financing pathways, for example: private capital finance, state-sponsored finance schemes, grant funding and internal capital. This will include an assessment of internal reserves and future committed CAPEX, engagement with government agents to understanding grant options, and a review of private finance companies and rates to be built into an appraisal.

Activities	Description
Financing Pathways Options Appraisal	• Undertake analysis to create a database of funding mechanisms, this will greatly increase the likelihood of a proposed project or concept being taken through to delivery.
Regular Financial Updates	• Regular bi-weekly or monthly updates from finance to the wider organisation to discuss current financial position, upcoming events, new financing sources or regulatory changes (or anything else that could have a material impact on a project). • This helps keep the wider organisation updated with crucial relevant information, stimulates news/ knowledge sharing and could result in material improvements to projects through access to the widest range of financial sources possible.

Source: Carbon Trust

3.5.7. Procurement

Procurement is the process of finding, negotiating terms and acquiring goods, services or works from an external source, via a tendering (competitive bidding) process. Effective procurement ensures maximum value for money and quality of goods is obtained through an open, transparent and standardised process. Regardless of their value or complexity, all procurement flows should follow a standard sequence of actions: requirement to purchase, plan the process, prepare the documentation, identify possible suppliers, issue/receive back the tender/quotation documentation, evaluate the submissions, negotiate, award and place the contract, delivery, pay the supplier, manage and monitor the contract, and review the process.

Purchasers should consult and adhere to ICLEI's sustainable procurement values[1]. This means making sure the products and services bought achieve value for money and generate benefits for the environment, society and economy, as well as the organisation. This also includes sustainability being comprehensively integrated into the tendering criteria. Procura+ manual and principles should be incorporated. This can be found in their guide for public authorities on how to implement sustainable procurement. The use of credible procurement frameworks instils trust and reliability into the process, and offers efficiencies through integration with a wider international network (e.g. Official Journal of the European Union procured frameworks such as Re:fit).

Energy Services Company (ESCO) registers (or pre-procured frameworks) support a streamlined and standardised procurement process for Energy Performance Contracts (EnPCs). They remove the complexity of individual assessment by local government – a register is pre-checked and pre-procured. This pre-procurement means that tendering of work is significantly easier, and in many cases, the procurement of a project is undertaken by a mini-competition call-off, rather than a full procurement process.

A public body of any size needs a procurement expert, and larger bodies requiring complex, multi-party procurement need a team. In particular, expertise is required for specific considerations when engaging local contractors, as potential limitations to the supply chain must be comprehensively analysed.

Activities	Description
Create Template Documents	• Create a collection of standardised documents (E.g. contracts, Invitations to Tender (ITT), financial agreements, monitoring documents) to ensure quality and robust text across projects. This approach also cuts time and reduces the need for specific procurement expertise at project management level. • Best practice procurement processes are particularly important during programmes where a large number of different service contracts are running concurrently to support the service. Standardisation ensuring regularity across them all, without sacrificing speed of mobilisation.

[1] http://www.iclei-europe.org/topics/procurement-economy/

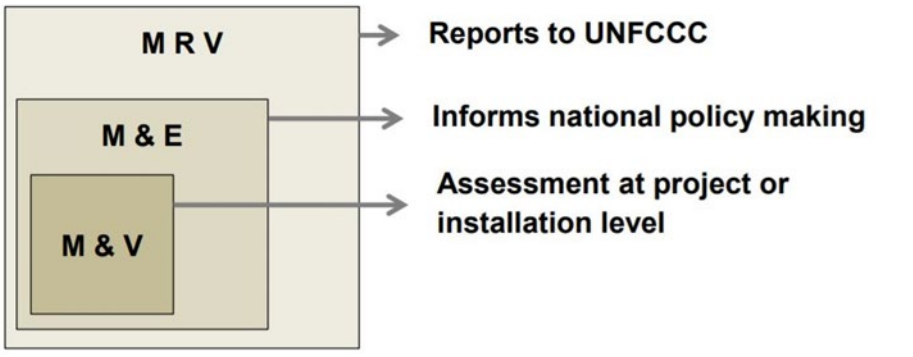
	• Standard documents are useful across all seven capacity building areas, e.g. implementation blueprints, GANTT charts, stakeholder engagement documents, and data capture sheets.
Familiarisation Session for ICLEI Guidelines	• If the organisation faces the future task of tendering, it is key that across the organisation (but particularly with those managing the tendering process itself) the ICLEI Sustainability Guidelines are understood and deployed.

Source: Carbon Trust

3.5.8. Monitoring and Evaluation

Monitoring and Evaluation (M&E) must be understood in its wider context, and should be implemented using the accepted steps. M&E sits between the levels of measuring, reviewing and reporting, that are mainly distinguished by scale. It is important to identify the differences between them:

- **Measurement, Reporting & Verification (MRV)** focuses on reviewing the landscape of various programs across a economy in terms of UN COP21's Nationally Determined Contributions. Thus, it includes more varied factors, such as land use.
- **Monitoring and Evaluation (M&E)** is the tracking of a landscape of different programs across a economy to inform national policy, effectively grouping together all the individual Measurement and Verification (M&V) programs.
- **Measurement and Verification (M&V)** refers to verifying a specific project, for example, the energy savings made by an ESCO installing energy efficiency measures for an EnPC, which then justifies the contractual payments. Fundamentally, M&V provides the crucial trust needed for organisations to engage with EnPCs and install energy saving measures.



Source: Carbon Trust

M&V is the process of explicitly assessing and defining energy savings achieved from projects. The international standard for M&V is the International Performance Measurement & Verification Protocol (IPMVP). IPMVP is the standard commonly used to assess energy savings within EnPC. It provides a universal approach and assurance that savings are being achieved and accurately measured. A key requirement is that IPMVP requires some form of actual measurement (often metering data) to assess IPMVP compliant savings. The IPMVP standard sets out defined terminology to be used in the context of M&V. It also defines methodology for the assessment and calculations of savings.

Key elements of an M&V to IPMVP standards are:

- **M&V Plan** – A document developed in line with IPMVP, which sets out the specific approach to be taken for the energy project. The M&V Plan sets out the baseline, energy saving calculation methodology, defined parameters, and reporting requirements.
- **M&V Operational Verification Report** – Once energy projects have been implemented, a M&V report is developed to provide initial sign-off of project completion, and initial performance in line with requirement.
- **M&V Reconciliation Reports** – These are the yearly reports to assess and quantify performance. Reports refer to and are in line with the M&V Plan, and clearly define routine / non-routine adjustments required in calculation.

M&E and M&V must be accomplished to international standards, incorporating rigorous measurements and review to cement reliability:

- **Multi-level review** is essential. Senior management should review the process, building on more regular reviews by the core team. Ultimately, a visible board level review, alongside all other reviews and reports, should be published externally online. Regular reporting periods: quarterly, or designed to track a specific program as it is rolled out. As part of this, it is important that M&V be built into every stage of a project; it should be discussed from the earliest planning stages, not as afterthought.
- **Following international standards.** For project specific M&V of energy savings, the IPMVP is the most widely used standard. As part of this, the M&V itself must be conducted by certified Energy Analysts – a Certified Measurement and Verification Professional (CMVP) is the qualification of IPMVP.
- **Granular measuring.** Accurate data collection is essential to creating a useful baseline, against which progress can be tracked. Sub-metering and half-hourly meters automatically send data, increasing accuracy and reliability. Sub-meters are usually installed within multi-tenant buildings to measure water, gas or electricity usage of individual flats. Half-hourly meters automatically send updated meter readings to the energy supplier every 30 minutes. In the UK these are now mandatory for all businesses with a supply greater than 65kW.
- **Bottom-up monitoring.** This involves calculating and adding up the energy savings from individual measures, by comparing energy consumption pre-installation to post-installation. By contrast ‘top-down’ uses broad assumptions via national statistics and divides it by residential area for example. Bottom-up calculations have

been shown to be far more effective in offering a nuanced and tailored view of the impacts of Energy Management measures in a particular area, and minimise risk by ensuring any cost-effectiveness calculations are rigorous. Combined with the installation of sub-meters, this accuracy can be achieved at minor additional effort.

Activities	Description
Familiarising Project Managers	• Given M&V is so crucial to many projects, and needs to be included at the planning stages, it is essential project managers are familiar with its concepts and understand its importance, embedding it in their process. • This is also important in the current climate, where government face simultaneous demands to be more transparent and deliver a guaranteed service. M&V allows close tracking of progress o n a project, with granular data available so that issues can be identified and addressed early on.
Hiring M&V Experts/ Upskilling Employees	• M&V is crucial for the success of many projects, however it is often one of the areas in organisations that needs most strengthening. • Building capacity here is the foundation for making improvements elsewhere, providing the skills and data to inform subsequent decisions.

Source: Carbon Trust

3.5.9. International Standards

1) ISO 500001

ISO 50001 is the most widely used energy management standard, created by the International Organisation for Standardisation. It specifies requirements for establishing, implementing, maintaining and improving an energy management system, whose purpose is to enable an organisation to follow a systemic approach in achieving continual improvement of energy performance, including energy efficiency, energy use and consumption. Alongside this, it specifies measurement, documentation, reporting, design and procurement requirements for equipment, systems, processes and personnel that contribute to energy performance.

As a well-developed protocol for developing and improving management, it is essential that ISO 50001 is closely referred to – it is international best practice. With this, and other, international standards, governments can acquire immediate access to a significant portfolio of documents covering energy management in a variety of areas (buildings, domestic, industrial, etc.) In addition, through ISO 50001, governments create three key components, that give crucial direction: an Energy Action Plan, Performance Audits and a Management Review.

A revised version of the standard will be published in 2018, with the draft released indicating a desire to promote adoption among SMEs and help in the integration of several management system standards together.

2) Other

Other particularly key standards include **IPMVP, OJEU, ICLEI and Procura+**. Each has a particular focus, but all are benchmark sources of best practice across energy management:

IPMVP is the most widely used standard for M&V of energy savings, and was designed with ESCO contracts in mind. It analyses measured energy use to determine savings: Savings reported for any period = baseline period energy - reporting period energy ± adjustments. The 'adjustments' are crucial in giving a fair evaluation, and include factors such as changes in building occupancy or the weather.

OJEU provides regulation in the European Union for the procurement of services / goods above a certain threshold. This provides the regulatory requirement to ensure that procurement is fair, competitive and therefore legal. This is particularly important on large-scale projects, such as EnPCs in Europe.

ICLEI collects and applies practical strategies, tools and methodologies to create sustainable cities, as such, it hold a focus on sustainable procurement. ICLEI's Sustainable Procurement Resource Centre is an access point for procurers, policy makers, researchers and others, containing key knowledge, guides, calculators and other tools on how to undertake sustainable procurement.

The **Procura+** manual contains a simple implementation model for sustainable procurement, and a step-by-step guide to the procurement process: from preliminary market consultation to technical specifications, selection and award criteria, and contract clauses.

04

CHAPTER 4. Low-Carbon scenario for Banda Aceh City of Indonesia

Chapter4.Low-carbon scenario for Banda Aceh City of Indonesia

4.1. Background research and Define baseline in BAU scenario

4.1.1. Background research for Banda Aceh City

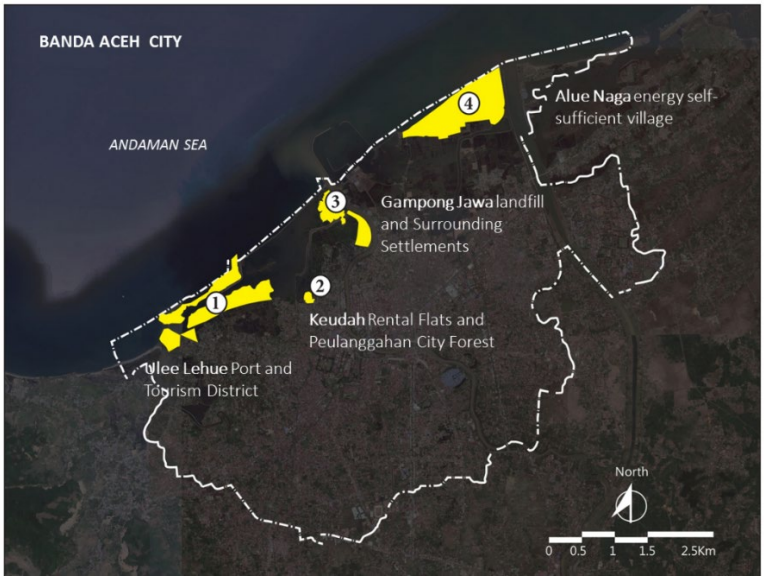


Fig. 4.1-1. Study location of Banda Aceh
Source: PSUD

1. Features of Target area

- The 4 target area of 4 is located along the coast
- Has disaster experience and risk of recurrence
- Attractiveness as a tourist destination
- Increasing vehicles and buildings as city development
- Take advantage of the location along the coast
- Plan considering earthquake disaster
- Promotion of public transportation and low-carbon vehicles

2. Features of Buildings

- Most of the town is covered with residential buildings, less of large scale buildings.
  →The large scale public buildings should lead green building innovation
- The building energy consumption is low.
  →The passive design should be preferentially stressed.

3. Energy & Environment

- Few renewable/untapped energy
- The energy infrastructure is weak.
  →Blackout in the city

4.1.2. Data collection and existing analysis for target areas

1. ULEE LHEUE Sea Port and Tourism District

Fig. 4.1-2.Area map of Ulee Lheue Source: PSUD

Focus Area : Sea Port, Tourism District
District : Meuraxa
Gampong : Ulee Lheue, Lambung Pie,Deah Glumpang, Deah Baro,Deah Teungoh
Study Area : ± 1.018.506 m²
No. of Building : 1974 unit

1-1. Ulee Lheue Port

- one has access point for vehicle which connected to the mainland
- Functions to serve passengers, as main connection terminal of sea transportation from Banda Aceh to Balohan-Sabang Island
- 4 trips per day
- Number of Passengers (2016) 361.166 people
- Capacity: 1500 GRT (Gross Tonnage)

- Complex consist of buildings with height of one up to two story high.
- one has access point for vehicle which connected to the mainland
- Functions to serve passengers, as main connection terminal of sea transportation from Banda Aceh to Balohan-Sabang Island
- 4 trips per day
- Number of Passengers (2016) 361.166 people
- Capacity: 1500 GRT (Gross Tonnage).

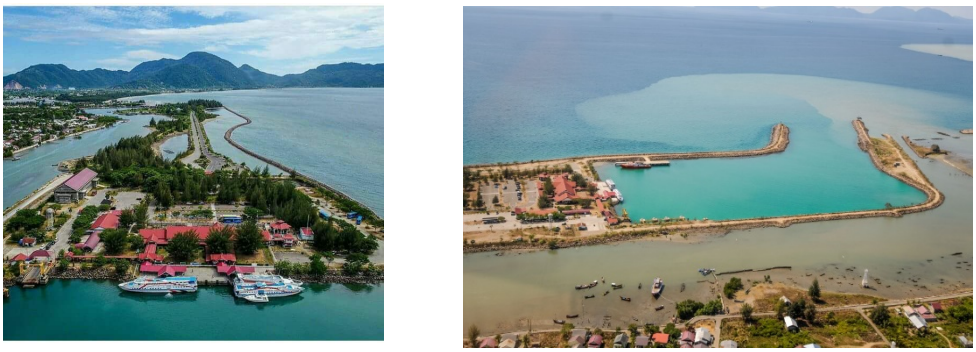


Fig. 4.1-3. Ulee Lheue port aerial view
Source: steemit.com (LEFT), publoe.blogspot.com (RIGHT)

1-2. Ulee Lheue Tourism District

- Well known due to its peaceful atmosphere with majestic hilly scenery in the horizon and beautiful place to see the sunset
- Limited access to the beachfront area
- Lack of supporting retail and commercial functions and public facilities

Fig. 4.1-4. Ulee Lheue Tourism district
Source: NSRI, PSUD

2. KEUDAH AND PEULANGGAHAN - Rental flats and City Forest

Fig. 4.1-5.Area map of Rental flats and city forest Source: PSUD

Focus Area : Rental Flats and City Forest
District : Kutaraja
Gampong : Keudah and Peulanggahan
Study Area : ± 38.386 m²
No. of Flat Unit : 392 flat unit (98 unit/builiding)

2-1. Keudah Rental Flats

- Area per unit 24 m²
- Price Rp 175.000 – Rp 300.000, depending on the floor, and location; facility; and of the unit.
- Solid waste are thrown down through the waste shaft to be collected by the municipal dump truck to be delivered to Gampong Jawa waste disposal area
- Black water are managed by on-site sanitation
- Grey water and rain water is flown to the local drainage system into the city drainage.

Fig. 4.1-6.Rental flats and City forest
Source: PSUD

2-2. City Forest

Taman Kota Trembesi BNI (City Forest) is a valuable urban park built around 7 ha in 2010. The park has an abundant natural environment, and environmental considerations are also taken into account, such as the provision of garbage bins for garbage sorting. For this reason, we propose that the park should be a place of recreation for citizens in the vicinity of the park, as well as a place of environmental education for children.

By connecting with the surrounding natural forests in the future, damage will be minimized through the formation of eco parks and natural disasters such as tsunamis and storms caused by natural forests.

Fig. 4.1-7.Area map of Taman Kota Trembesi BNI (City Forest)
Source: Google earth

Fig. 4.1-8.Inside Taman Kota Trembesi BNI park.
Source: NSRI

2-2-1. Place for environmental education.

To provide education for sustainable development, including the environment, energy, and climate change, not only in schools, but also in nature through hands-on learning, thereby providing education necessary for human resources development that will create a sustainable society in the future. In education, ESD's action program will be utilized.

The Global Action Programme on ESD

Education for Sustainable Development (ESD) is recognized as a key element of quality education and a crucial enabler for sustainable development. The Sustainable Development Goals (SDGs) adopted by the global community recognize the important of education in achieving their targets by 2030. Target 4.7 of SDG 4 on education specifically addresses ESD and related approaches.

The Global Action Programme (GAP) on ESD, the follow- up programme to the Decade of ESD (2005-2014), seeks to generate and scale-up ESD and to accelerate progress towards sustainable development. The GAP aims to contribute substantially to the 2030 agenda, through two objectives:

Reorienting education and learning so that everyone has the opportunity to acquire the knowledge, skills, values and attitudes that empower them to contribute to a sustainable future. Strengthening education and learning in all agendas, programmes and activities that promote sustainable development.

Source: UNESCO
For more information on ESDs website (https://en.unesco.org/node/296036)

Fig. 4.1-9. ESD Concept Map
Source: Ministry of Education, Culture, Sports, Science and Technology-Japan

Fig. 4.1-9. Environment study experience
Source: Mori Building

2-2-2. Build a green network

The government will develop green spaces connecting natural forests around Taman Kota Trembesi BNI Park, which are scattered around. The government will utilize these spaces as places for environmental education. In addition, the green spaces formed will become natural breakwaters and control damage from natural disasters such as tsunamis.

Fig. 4.1-10. Current Taman Kota Trembesi BNI park.
Source: Google earth

Fig. 4.1-11. Future Green Network
Source: Google earth

At the time of the tsunami (Left Illust): Forests become walls. People can earn time to evacuate by reducing the power of the tsunami.
At the time of the tide (Right Illust): They can prevent drifting people and property from flowing into the sea.

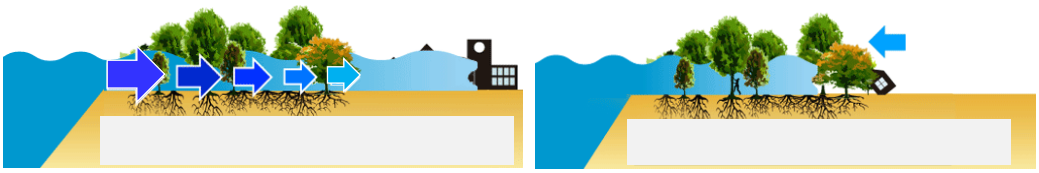


Fig. 4.1-12. Illustration of the breakwater in the forest
Source: morinobouchoutei.com

3. GAMPONG JAWA - Landfill and Surrounding Settlements

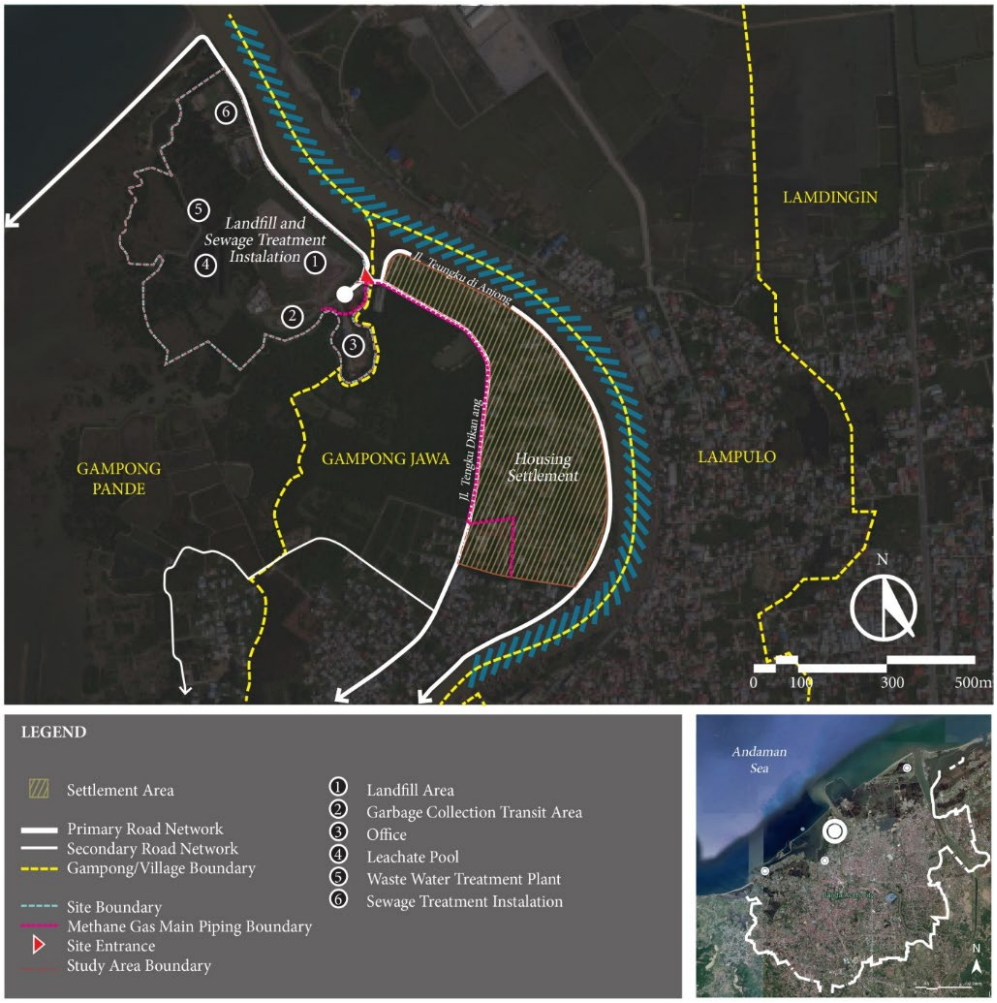


Fig. 4.1-13. Area map of Gampong Jawa
Source: PSUD

Focus Area : Landfill, Sewage Treatment Instalation, and Surrounding Settlements
District : Kutaraja
Gampong : Gampong Pande, Gampong Jawa
Study Area : ± 451.081 m²
No. of Builiding : 310 unit (Gampong Jawa area)

3-1. Landfill area

- the first landfill in Indonesia to be converted from open dumping system to sanitary landfill
- Receives up to 250 tons of municipal garbage per day.
- Has a potential to produce 4000 m² of Methane Gas per day
- Currently provides energy from methane gas for 110 households

Fig. 4.1-14.Landfill area
Source: PSUD

4. ALUE NAGA - Energy Self Sufficient Village

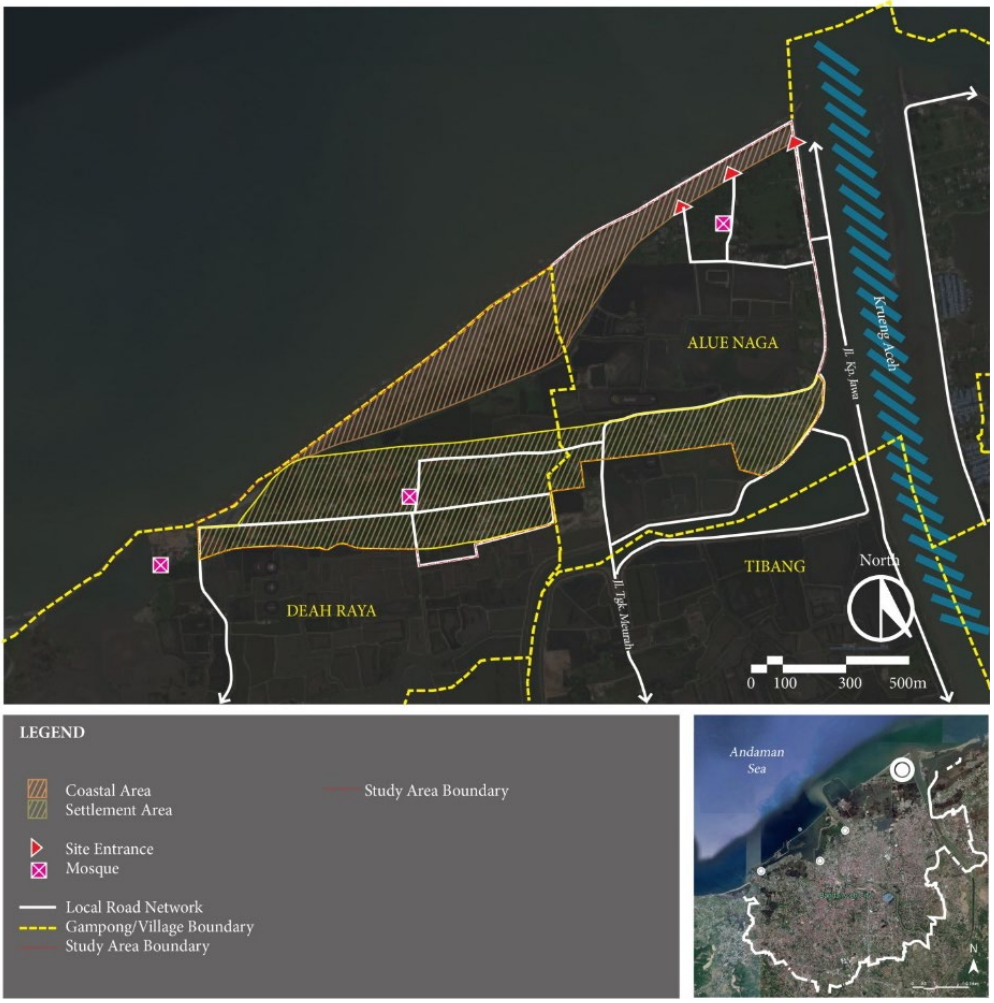


Fig. 4.1-15.Area map of Alue Naga

Source: PSUD

Focus Area : Energy Sufficient Village
District : Syiah Alam
Gampong : Alue Naga, Deah Raya
Study Area : ± 1.420.698m²
No. of Builiding : 1229 unit

Renowned for its beautiful beach area

- Located 1 m above sea level, classified as a coastal village prone to disaster
- The area is reserved as a fishing harbor, nature reserve along the coastal area, high density fishermen housing development, and coastal tourism development. The area also encourages traditional fishing practice. (Spatial Planning document 2009-2029)
- known as fishing village, most of the inhabitant of the area lives mainly on fishing and oyster harvest
- buildings distribution is 11 unit per Ha (low density)
- The poverty rate of the inhabitant of Alue Naga is considerately high, almost 40% of the total inhabitant are impoverished

Fig. 4.1-16. Alue Naga area
Source: PSUD

4.1.3. Indoor environment survey of the residential houses in target cite

Traditional houses around the world have adapted to the requirements of the land's environment in its long history. Such a passive method is highly important for low carbonization methods in housing. We conducted the survey to clarify the actual condition of the indoor environment in the houses in Banda Aceh.

The target building is a detached house and an affordable house in Banda Aceh. The measurement items are air temperature, humidity, illuminance, power consumption. The measurement period is from July to September 2018.

Representative results of measurement for one week are shown. In a detached house with a double-height void space, the peak of room air temperature had reached around 15 o'clock.

In the 1F hole, 1F kitchen, 2F corridor without air conditioning equipment, there were many days when the temperature exceeded 30° C. throughout the day. On the 1F bed room, on the other hand, it was air conditioned throughout the day.

In the Affordable house the temperature of the night room bed room is lower than that of the living room. This is considered to be air conditioned at night in the bed room.

Comparing the temperatures of the 1F and the 2F of the detached house with a double-height void space, we can see that the air temperature of 2F corridor is higher than that of 1F hole. It is thought that warm air is moving from the 1F to the 2F, ensuring ventilation by the void space contributes to improvement of the comfort of the space spent by the family on the 1F.

As mentioned above, there is a possibility that electric power used for air conditioning can be reduced even by devising buildings.

Table. 4.1-1. Measurement items

	Detached house	Affordable house
Air temperature	✓	✓
Humidity	✓	✓
Illuminance	✓	✓
Electric power consumption	✓	NA

Source: NSRI

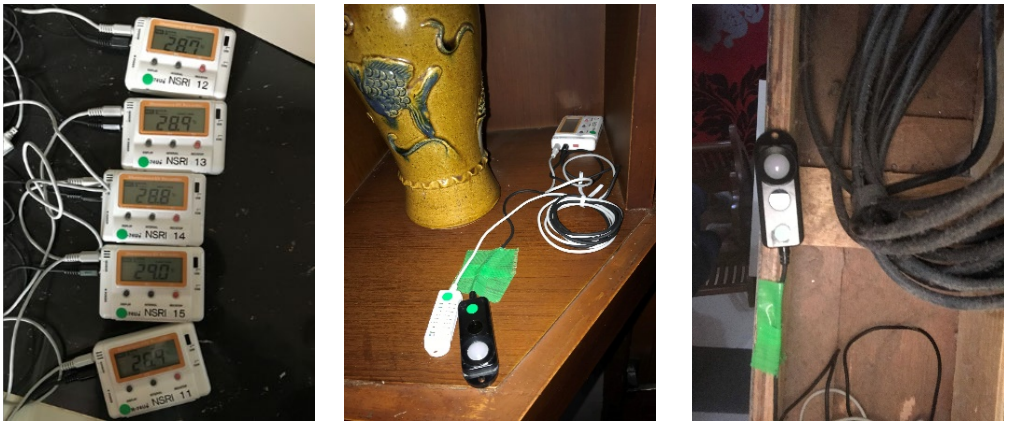


Fig. 4.1-7.The tool used for indoor environment survey
Source: NSRI

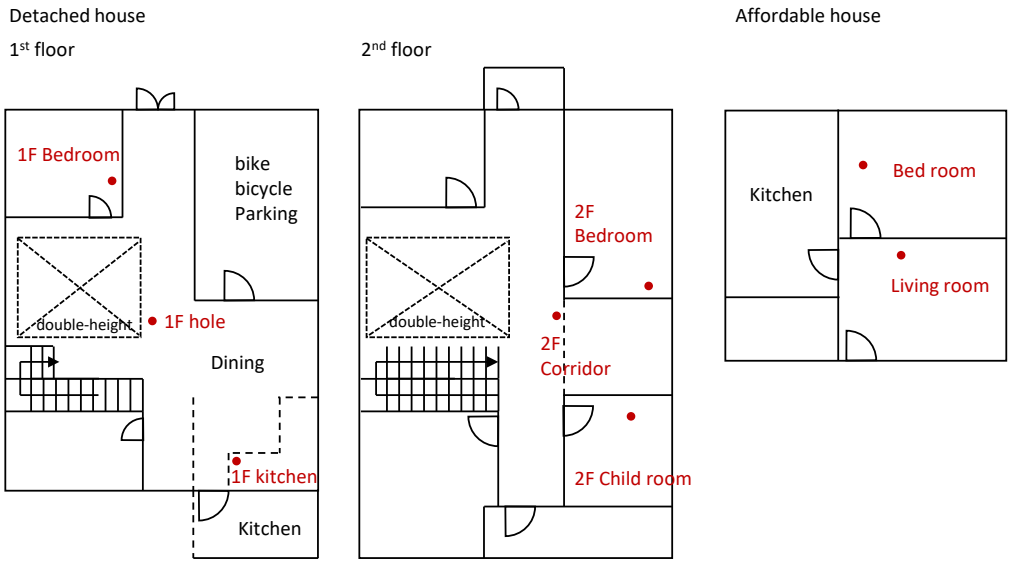


Fig. 4.1-8.The Plans of the detached house and the affordable house for this survey
Source: NSRI

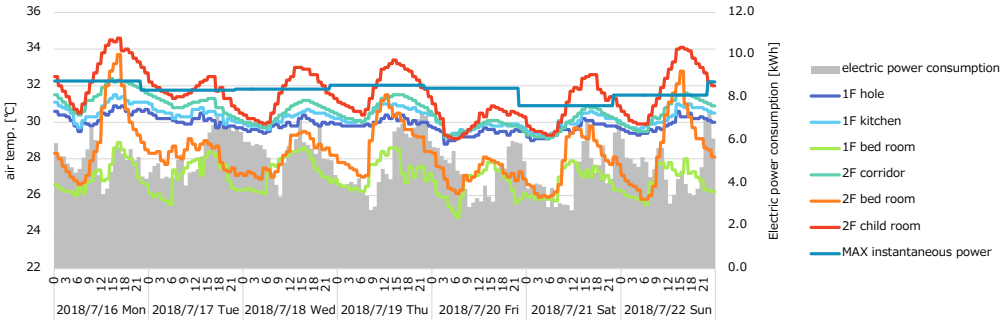


Fig. 4.1-9.The measurement value of the detached house
Source: NSRI

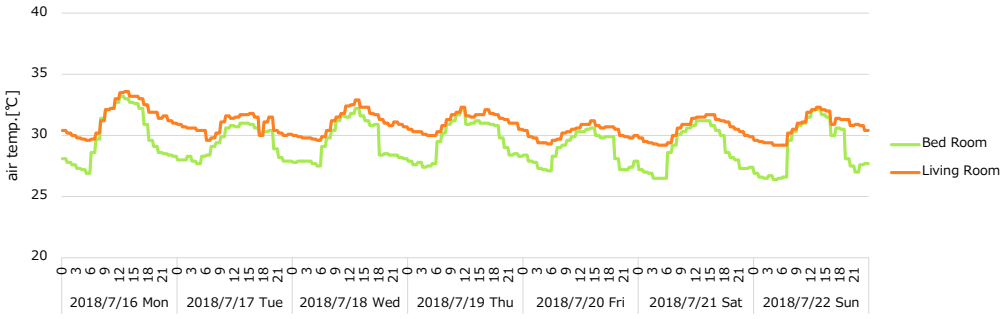


Fig. 4.1-10.The measurement value of the affordable house.
Source: NSRI

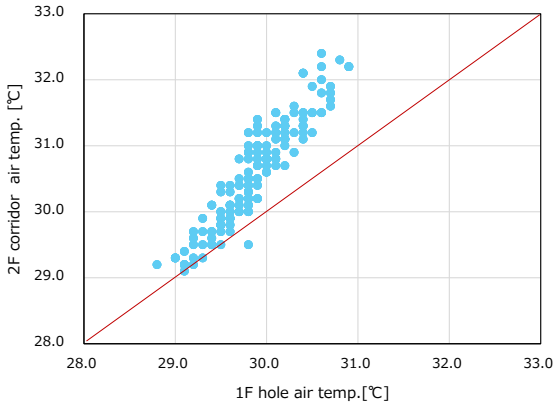


Fig. 4.1-11.The relation of 1st floor and 2nd floor air temperature in the detached house.
Source: NSRI

4.1.4. Summary

The existing conditions of target areas can be summarized as

Table. 4.1-4. Summary of target areas

Area Name	District	Study area (m2)	No. (unit)	Remark
Ulee Lheue	Meuraxa	1.018	1974	Sea Port, Tourism District
Keudah Rental Flats and Peulanggahan City Forest	Kutaraja	38	392	• Rental Flats and City Forest • 98 unit/building • Area per unit 24 m²
Gampong Jawa landfill and Surrounding Settlements	Kutaraja	451081	310	• Landfill, Sewage Treatment Installation, and Surrounding Settlements • Receives up to 250 tons of municipal garbage per day. • Has a potential to produce 4000 m^3 of Methane Gas per day • Currently provides energy from methane gas for 110 households
Alue Naga energy self-sufficient village	Syiah Alam	1.420.698	1229	• buildings distribution is 11 unit per Ha (low density) • The poverty rate of the inhabitant of Alue Naga is considerately high, almost 40% of the total inhabitant are impoverished
LED	Whole city			• Around 10,000 street lamp

Source: NSRI

4.2. Define CO2 emission baseline in BAU scenario for target areas

4.2.1. Define BAU of CO2 emission baseline in building sectors

1) The existing condition

The Existing carbon emission from energy sector refers to the carbon emission from building energy consumption

Building energy consumption is estimated as

Σ Building energy consumption = Σ (Building energy consumption unit1) for different type $\times$ building area)

Table. 4.2-1. The energy consumption and exiting building area is calculate as below

Building type	Energy consumption unit	Building area(m^2)				Energy consumption (GJ)
		Ulee Lheue	Alue Naga	Keudah Rental Flats	Gampong Jawa landfill	
Office	1,546 MJ/m2	21422	4744	-		40,465
Commercial	2986 MJ/m2	4896	770	-		16,919
Hospital	2898MJ/m2	0	0	-		0
Hotel	3703MJ/m2	0	0	-		0
Residencial_detached house（Gen）	18 GJ/Gen	1624	785	-	310	48,942
Residential_social house（Gen）	8.8GJ/Gen	-	-	392		3,450

Source: NSRI

2) The mid-term and long-term urban development

a. The future city zoning plan

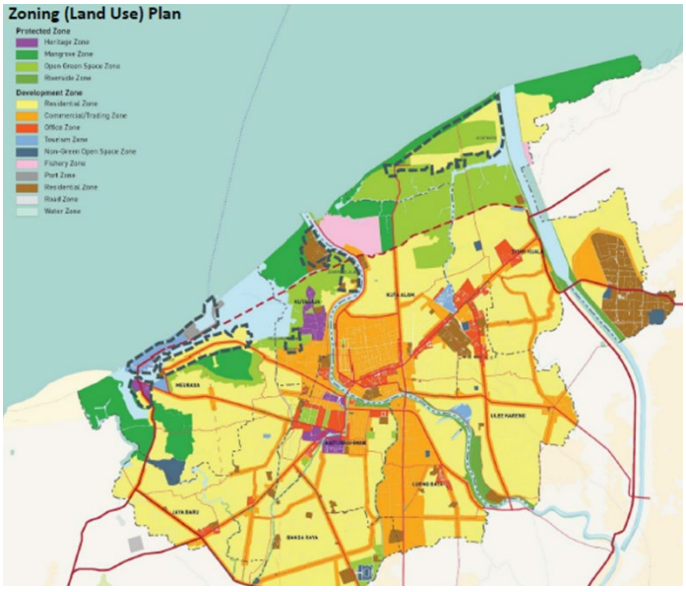


Fig. 4.2-1. Future city zoning plan
Source: Statistik Banda Aceh 2017, Bappeda kota Banda Aceh

In the future zoning plan the four target areas have the characteristic below:

Ulee Lheue Port:

-From 3 area separated, the area is projected to be various uses: port and tourism zone in the North, heritage and residential in the West, and mostly residential areas in the east part

Gampong Jawa:

-The area will be divided into 2 main zone: public facility zone in the North (Waste Collection Area), and Open Green Space in the South.

Keudah-Peulanggahan:

-The area is plotted to be mostly green open space with commercial zone in the South part.

Alue Naga:

-The area will be mostly open green space and residential zone, with mangrove area extended to the sea.

b. Transportation plan

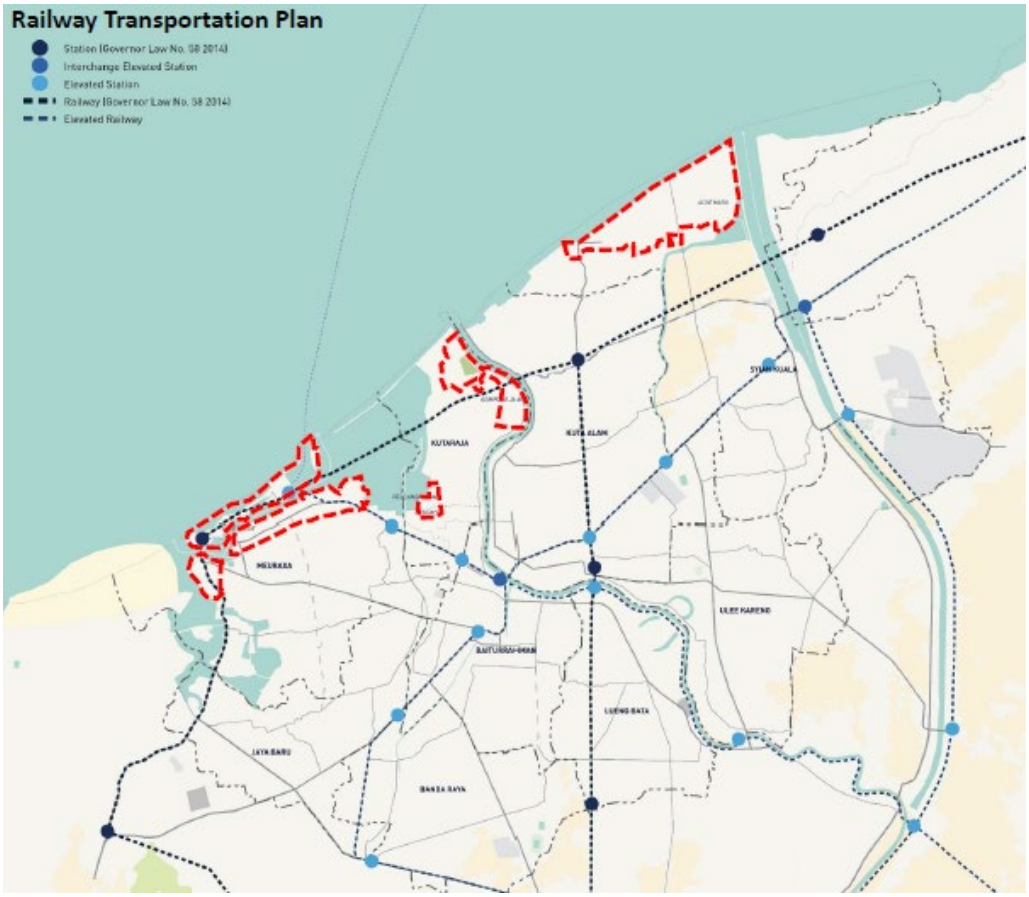


Fig. 4.2-2. Railway Transportation Plan
Source: Pemerintah Kota banda Aceh

Ulee Lheue Port: In the future, there will be 2 stations built within the site: Train station and monorail station. The railway will passing through the way to the port, and continued above the water/sea.

Gampong Jawa: There will be a train/monorail railway passing through the area.

Keudah-Peulanggahan: There will be no train station nor railway on/ passing through the sites

Alue Naga: Alue Naga area has a potential to be connected with Train Station (in the south) by BRT Route, if the area could be developed as the plan/ proposal.

c. The vision and master plan for target areas

According to the zoning plan and transportation plan, the concept master plan for Ulee Lheue Port and Alue Naga are developed as below:

Ulee Lheue Port

- Develop low and middle density housing for fisherman within the areas as well as public facilities to support housing functions
- Develop commercial function to support tourism activities within the area
- Develop high quality open space as main attraction of the area that also function as public facility
- Develop efficient connections to transportation infrastructure to great integration within activates;
- Develop variation of high quality tourism destination within the area:

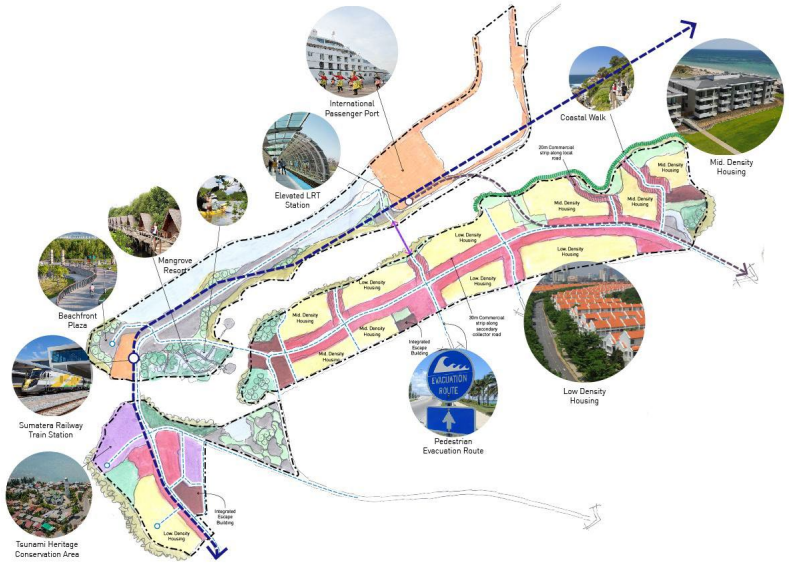


Fig. 4.2-3. Visioning Master Plan for Ulee Lheue Port
Source: PSUD

Following the concept, the master plan of Ulee Lheue Port are as below and it is develop by two phases

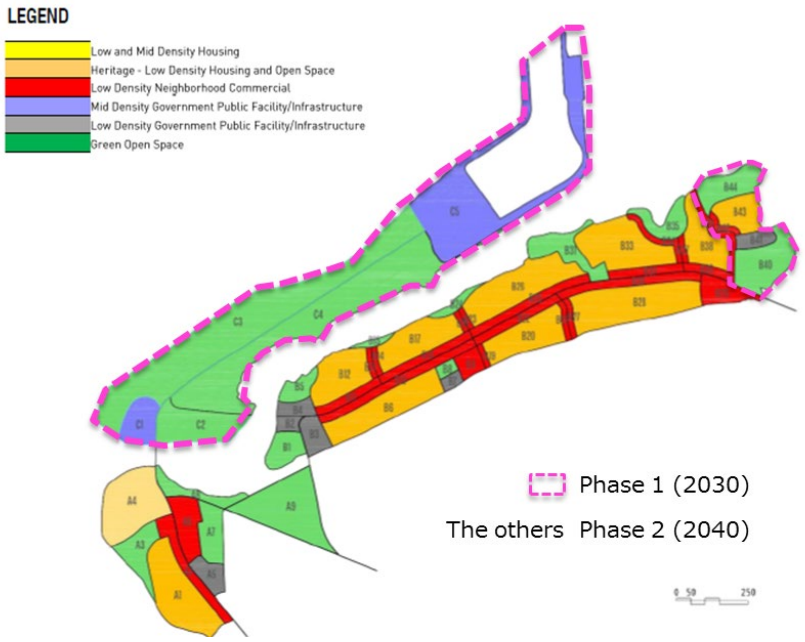


Fig. 4.2-4. Master plan for Ulee Lheue Port
Source: NSRI, PSUD

The building areas are assumed as below

Table. 4.2-2. The building areas

No.	Land Use	Site Area (m²)	Building Coverage Ratio (%)	Floor Area Ratio	Building Height	Appoximate Floor Area (m²)
1	Low and Mid Density Housing	360,527	60%	2	5	721,054
2	Heritage - Low Density Housing and Open Space	61,049	20% - 50%	1	1	61,049
3	Low and Mid Density Neighborhood Commercial	176,860	50% - 70%	3.5	2	619,010
4	Mid Density Government Public Facility/Infrastructure	122,620	70%	4	5	490,480
5	Low Density Government Public Facility/Infrastructure	43,022	70%	3.5	3 - 5	150,577
6	Green Open Space	494,399	20% - 30%	0.2	1	98,880
Total Area		1,258,477				2,141,050

Source: NSRI, PSUD

AlueNaga

- Develop a self-sufficient low density housing with Banda Ache traditional fisherman village character;
- Develop cluster fisherman village as distinctive tourism attraction
- Propose a new feeder transportation route to integrate Alue Naga to future train station
- Develop new road infrastructure network to create integration within activities
- Develop an pedestrian and circulation access to open space and cultivation area to facilitate local fisherman activity
- Optimize the green open space for renewable energy
- Capacity building of Alue Naga communities regarding ecotourism and renewable energy

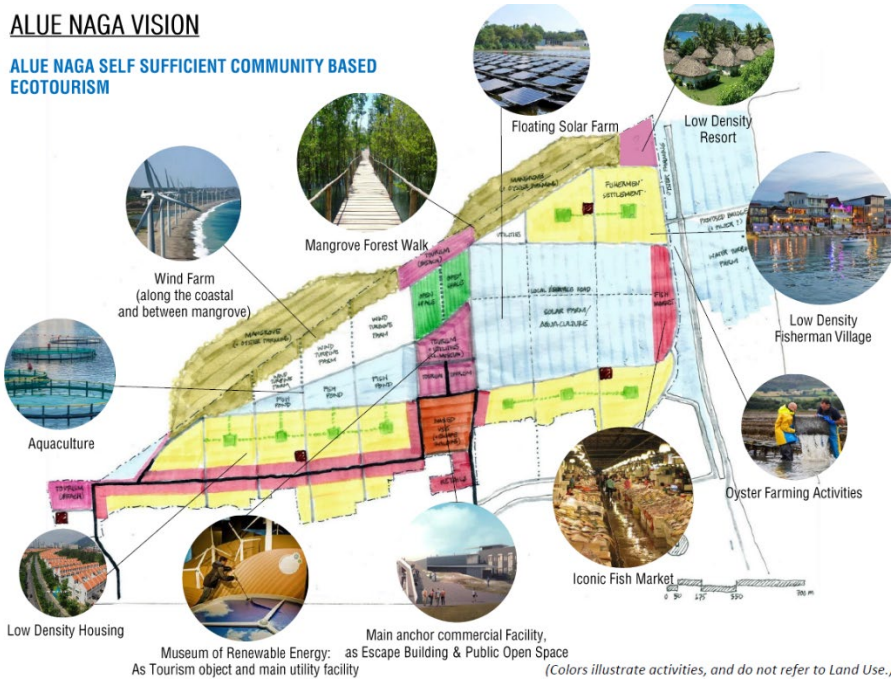


Fig. 4.2-5.Visioning Master Plan for Alue Naga Source: NSRI, PSUD

Table. 4.2-3. The building areas

No.	Land Use	Site Area (m²)	Building Coverage Ratio (%)	Floor Area Ratio	Building Height	Appoximate Floor Area (m²)
1	Low and Mid Density Housing	565,478	50%	0.6	2	339,287
3	Low Density Neighborhood Commercial	167,888	50%	1.2	2	201,466
6	Green Open Space	691,959	20%	0.2	1	138,392
Total Area		**1,425,325**				**679,144**

Source: NSRI, PSUD

3) BAU of target areas

As Fig. 4.2-6 suggests with the urban development, the CO2 emission of target areas will increase to 617888 tonCO2 per year, which is almost 70 times of the existing one.

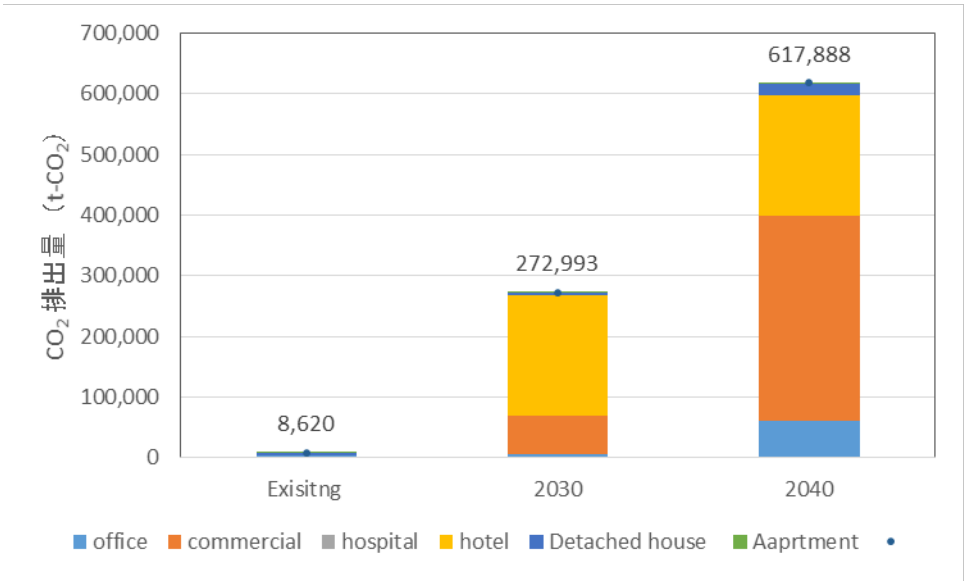


Fig. 4.2-6 Master plan for Alue Naga

Source: NSRI

4.2.2. Define BAU of CO2 emission baseline in transportation sectors

CO2 in the traffic field is mainly emitted by private automobiles. One reason for this is because, as compared with public transportation such as railways and buses, automobiles emit a large amount of CO2 per person. In order to reduce CO2, it is effective to control the traffic volume of automobiles, use forms of public transportation with less CO2 emissions, reduce travel distance and reduce the amount of CO2 emitted by each car. In addition, it is effective to change bus transportation, which is the main form of public transportation, to vehicles with low CO2 emissions, and to reduce the amount of CO2 emitted by each bus.

CO2 emission = Σ {Floor Area (㎡) × person trip (person TE / ㎡) × Modal share (%) × Trip distance (km/ person TE) × CO2 emission indicator (g-CO2/km)}

Ulee Lheue

Table. 4.2-4. CO2 emission baseline in Ulee Lheue

Source: NSRI

		Floor Are (㎡)	Generation intensity (person/ha・day)	Person TE (person/day)	Person TE (person/year)
2018	Office	21,422	2,900	6,212	2,267,519
	Commercial	4,896	10,600	5,190	1,894,262
	Hospital	0	1,783	0	0
	Hotel	0	600	0	0
	Residential	121,800	700	8,526	3,111,990
		148,118		19,928	7,273,771
2030	Office	19,310	2,900	5,600	2,043,911
	Commercial	24,934	10,600	26,430	9,646,965
	Hospital	43,278	1,783	7,716	2,816,478
	Hotel	490,480	600	29,429	10,741,512
	Residential	81,690	700	5,718	2,087,180
		732,266		74,893	27,336,045
2040	Office	619,010	2,900	179,513	65,522,209
	Commercial	490,480	10,600	519,909	189,766,712
	Hospital	619,010	1,783	110,369	40,284,861
	Hotel	490,480	600	29,429	10,741,512
	Residential	721,054	700	50,474	18,422,930
		2,940,034		889,694	324,738,223

Alue Naga

Table. 4.2-3. CO2 emission baseline in Alue Naga

Source: NSRI

		Floor Are (㎡)	Generation intensity (person/ha・day)	Person TE (person/day)	Person TE (person/year)
2018	Office	0	2,900	0	0
	Commercial	0	10,600	0	0
	Hospital	0	1,783	0	0
	Hotel	0	600	0	0
	Residential	0	700	0	0
		0		0	0
2030	Office	0	2,900	0	0
	Commercial	45,079	10,600	47,784	17,441,142
	Hospital	0	1,783	0	0
	Hotel	84,377	600	5,063	1,847,852
	Residential	0	700	0	0
		732,266		52,847	19,288,994
2040	Office		2,900	0	0
	Commercial	201,466	10,600	213,554	77,947,041
	Hospital		1,783	0	0
	Hotel	84,377	600	5,063	1,847,852
	Residential	254,910	700	17,844	6,512,951
		540,752		236,460	86,307,843

Figure presents the mode used for the survey respondents travel. Motorcycle is the most dominant mode, accounting for approximately 77% of all trips.

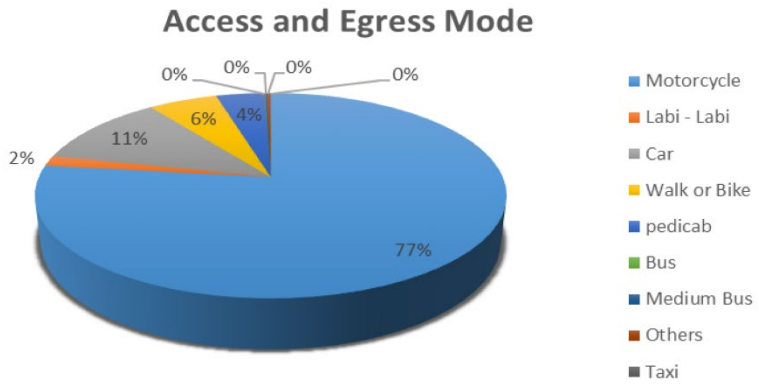


Fig. 4.2-7. Access and Egress Mode

Source: Banda Aceh Bus Rapid Transit Network Improvement, 2017

Based on the share ratio, we estimated automobile volumes in each vehicle types by 2040.

Table. 4.2-4. Number of vehicle in Ulee Lheue

	Share ratio	2018	2030	2040
Car	11%	800,115	3,006,965	35,721,205
Lolly	4%	290,951	1,093,442	12,989,529
Motorcycles	77%	5,600,804	21,048,754	250,048,432
Total		6,691,869	25,149,161	298,759,166

Source: NSRI

Table. 4.2-5. Number of vehicle in Alue Naga

	Share ratio	2018	2030	2040
Car	11%	0	2,121,789	9,493,863
Lolly	4%	0	771,560	3,452,314
Motorcycles	77%	0	14,852,526	66,457,039
Total		0	17,745,875	79,403,216

Source: NSRI

In the context of future capacity of an improved public transport network, the need for effective policies will be required for public transport to make a discernible impact on the traffic and urban mobility of Banda Aceh. Based on the above, measures to reduce CO2 emissions in the transport sector are as follows.

Railway / BRT

Railway and BRT have been planned to improve the commute system according to a master plan. It will contribute to accelerating utilization of public transportation.

Electric vehicle

An introduction to Electric Vehicles would be effective in reducing CO2 emissions. It will contribute to the Low carbon model town in accordance with the promotion of utilization for public transportation.

IoT platform

Enabling new types of transport service, also known as MaaS. Banda Aceh can be data-driven city based on ICT platform for making low carbon model town.

TOD (Transit Oriented Development)

Making pedestrian networks and increase high-density development around stations. TOD lead to turn train stations into a highly effective hub while curbing impact on the environment.

We estimated the amount of CO2 reduction of vehicles such as automobile, Rolly, bus and motorcycle for the study area.

Table. 4.2-6. CO2 emissions (BAU)

	2018	2030	2040
Car	1,193 t-CO2	7,649 t-CO2	67,434 t-CO2
Lolly	369 t-CO2	2,368 t-CO2	20,879 t-CO2
Motorcycles	1,498 t-CO2	9,605 t-CO2	84,684 t-CO2
Total	3,061 t-CO2	19,623 t-CO2	172,998 t-CO2

Source: NSRI

4.3. Low carbon measures for target areas

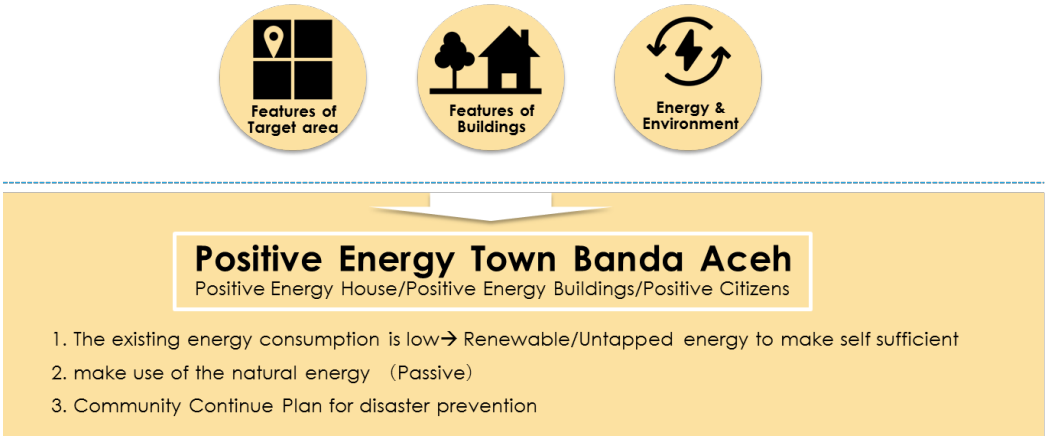


Fig. 4.3-1.PROPOSAL FOR LOW-CARBON CONCEPT Banda Aceh
Source: NSRI

According to the existing analysis, there has three key words for Banda Aceh.

The existing energy consumption is low and has an energy increasing potential with the tourism development.

Further, nature is an important factors for both the people and the town of Banda Aceh. In the residential housing, people like the natural ventilation, daylight and outdoor activity. The culture of living with nature should be preserved in the future urban and building development.

The last point is the city is always face to the disaster, that the community continue plan is necessary for disaster prevention.

The main concept for Banda Aceh is “Positive Energy Town”, which means the energy generation are more than energy consumption. It is implemented by the plan of community based on Community based Micro Grid with Distributed energy resource

Community are the basic unit for the town that the whole town is consisted with different kind of community, the communities in the CBD area, seaside and inland. Every community has their own grid with formed by domestic grid or utility grid. The town is formed by these grid.

The proposals for every micro grid include the energy conservation methods for the types in that communities to lower the energy consumption first. Secondly, the potential renewable energy, untapped energy will be proposed as the onsite distributed energy resource both for carbon reduction in the normal time and also the BCP in the disaster time. Finally, the management for the optimization of the demand and the supply side.

In this research, the four targets areas are located in communities of the coastal area with different features of building. The low carbon measures are proposed according to the concept above.

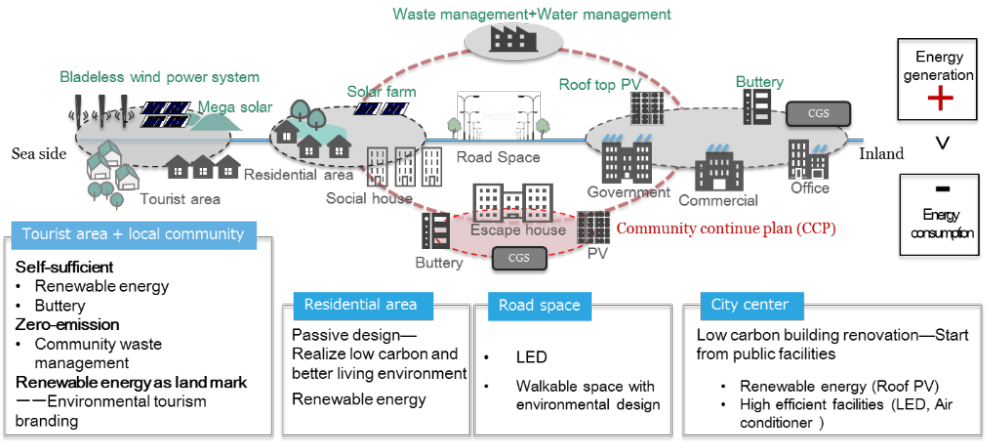


Fig. 4.3-2.Image of Micro Grid for Target area
Source: NSRI

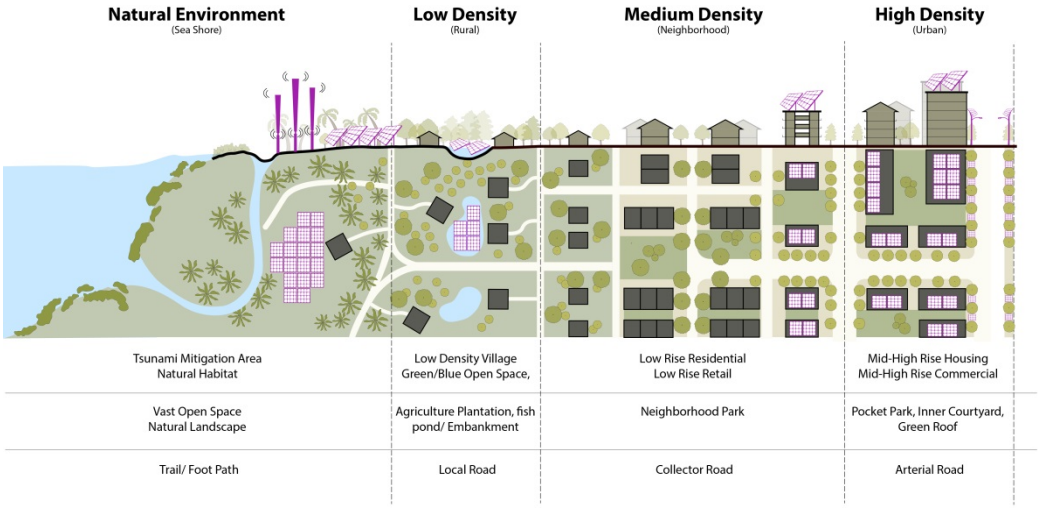


Fig. 4.3-2.Image of Micro Grid implementation based on the Transect

Source: PSUD

Transportation

Promote the use of low-carbon vehicles and reduce the carbon through traffic restrictions.

- The transportation sector contributes 67% of total emission.
- The motorcycle shows about 80% of the traffic share ratio. Measures to promote the spread of EV motorcycles are required.
- The share of public transportation (Bus, Labi-Labi, Pedicab, Taxi) is only 6%. It is necessary to low-carbon vehicles such as EV and Hybrid. Also, it is necessary to extend BRT route.

4.3.1. Tourism District and Ulee Lheue Port

1) Ulee Lheue - Sea Port+ Beach view＋Land Mark renewable energy

The Ulee Lheue area are port areas that will be developed in the tourists areas. Therefore, the low carbon method in this area are as below:

- Short-term development
  - Urban development: Develop the port part and the station centered community
  - Low carbon method:

    Short –term Building energy conservation methods

    Bladeless wind power system, Roof PV for Commercial Buildings
- Long-term development
  - Urban development: Develop the community
  - Low carbon method:

    Long ‐term Building energy conservation methods

    Roof PV for Community, LPG cogeneration system in escaped house

Fig. 4.3-3.Image of Bladeless wind energy system.
Source: PUSD

As an gate of the town, the symbolic factors as an low carbon town are also important.

Bladeless wind energy system is one of the example.

- An alternator system, made by coils and magnets, adapted to the vortex dynamics
- The Vortex Tacoma (2,75m) estimated rated power output is 100w.
- In wind energy conversion, power generation is proportional to the swept area of the wind turbine. Vortex currently sweeps up as much as 30 % of the working area of a conventional 3-blades-based wind turbine of identical height.
- Low cost, easy installation and soft maintenance

Fig. 4.3-4.Feature of bladeless wind energy system
Source: Vortexbladeless.com

Fig. 4.3-5. Illustration of Bladeless wind energy system that applied on Alue Naga sea shore area.
Source: PSUD

2) The traffic plan is a challenges when the tourists and port users are increasing as the resort development.

- The development of transportation
- New access : Bridge/Sea bus
- Low carbon zone: Only low carbon vehicles are permitted to enter the zone

Fig. 4.3-6. Location of new bridge
Source: NSRI

EV Vehicle

Introduction of floating EV as a means of transportation for local people and hotels in the area, responding to low carbon emissions in the normal situation and disasters preventions

Fig. 4.3-7.FOMM EV (LEFT) and Floating in water at the time of flood damage (RIGHT)
Source: FOMM

4.3.2. Desa Mandiri Energy Alue Naga

Alue Naga, Kecamatan Syiah Kuala is planned as a resort, which low carbon building technologies for resort hotels, environmental planning, and smart mobility.

The low carbon technologies in this community are introduced as the following two steps:

- **Short-term development**

Urban development: Develop the costal area

Low carbon method: Short‐term Building energy conservation methods, Bladeless wind power system, Float PV

- **Long-term development**

Urban development: Develop the community

Low carbon method: Long‐term Building energy conservation methods, Roof PV for Community, LPG cogeneration system in escaped house

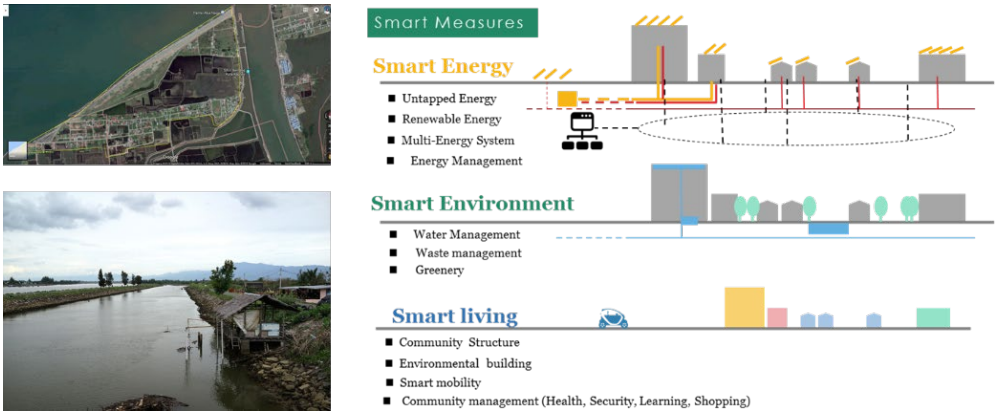
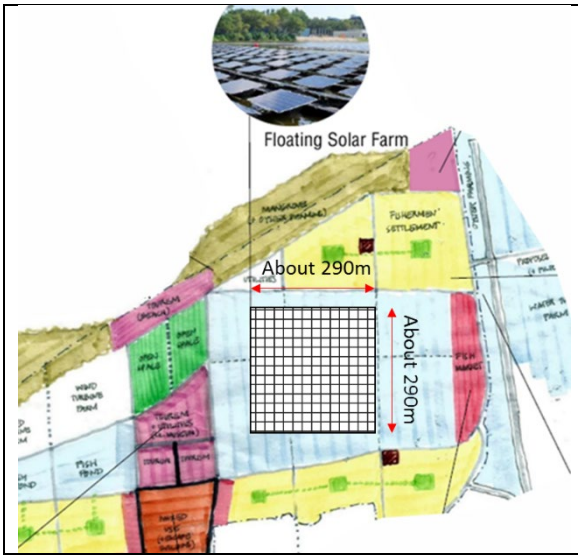


Fig. 4.3-8.Low carbon technology for Alue Naga
Source: NSRI

1) Potential power generation by Float PV



Solar radiation：1600 kwh/m2

The area for setting float PV：
84,100 m2

Area of PV panel: 30,276 m2

Capacity of PV: 3,927kW

Yearly power generation:
2,751,710 kWh

(It is based on the experience of Japan)

Source: NSRI, PSUD

2) Solar Street Light

Fig. 4.3-9.Solar street light
Source: http://solektra-international.com

4.3.3. TPA and IPLT Gampong Jawa alos The Surrounding Settlement

1) Two method of waste management

There are usually two method for the waste management, the biomass power plant and the Biogas power plant

a. Biomass power

Biomass powergeneration is a system that directly combusts organic waste such as animal manure, food waste, and wood waste, and uses the generated heat to turn turbines with steam. It may be easier to understand if you think that the fuel of thermal power generation (oil, coal, natural gas) has been transformed into organic garbage. Biomass is a generic term for biological resources derived from animals and plants.

b. Biogas power generation

Biogas power generation produces flammable biogas by fermenting organic wastes such as animal manure, food waste, sewage, and sewage. This system uses biogas to turn gas engine generators. The rest of the gasified bio-raw material (digestive fluid) can be used as a safe fertilizer free of weed seeds and pathogens.

There are two proposals for Gampong Jawa Landfill

① Existing Landfill-Gas to electricity system (Biomass)

The land is quite limited with the existing land fill. The system which can make use of the existing landfill-gas to electricity can efficiently reduce the land for landfill

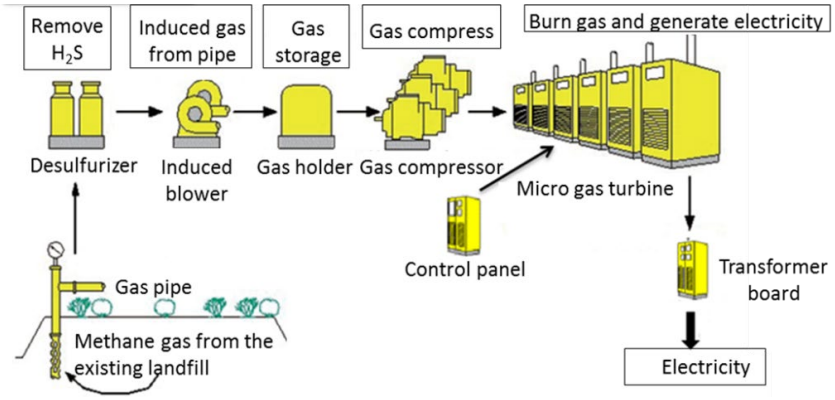


Fig. 4.3-10.Process for Biogas plant Source: NSRI

② Landfill to power plant (Biogas)

The landfill to power plant incinerates RDF, which is produced from both landfill-mining waste and fresh waste disposed to a landfill site, to produce power. The plant supplies electricity to grid venue for operation.

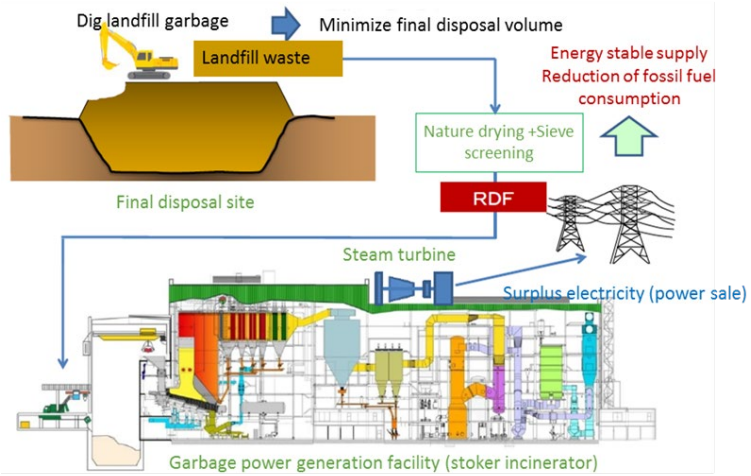


Fig. 4.3-11.Process for Biogas Plant Source: NSRI

1) The comparison of Biomass and Biogas plant are as below

Table. 4.3-1. Comparison of Biomass and Biogas plant

	Biomass power generation	Biogas power generation
Power generation method	Burn organic garbage directly	Burn biogas produced by the fermentation of organic garbage
Stability	High	High
Power generation efficiency	High	High
Installation costs	High	Low
Maintenance cost	High	Low
CO2 emissions	Many	Few

Source: NSRI

In this project, the more environmental biogas power plant system is preferable.

2) The potential electricity and capacity of Biomass plant

In the survey, the Gampong Jawa land fill process 250 ton waste from the city and has the potential to produce 4000m3 Methane gas per day.

Table. 4.3-2. Capacity of methane gas power generation

Methane Gas (Nm3/day)	Gas power generation unit (kWh/Nm3)	Power generation (kwh/day)
4000	1.9	7600

Source: NSRI

It is assumed that the plant is working 8 hours per day, from 8 am to 5 pm.

The capacity of the power generation is around 950 kW

4.3.4. Low carbon technical proposal for every target areas

Table. 4.3-3. Low carbon technical proposal for every target areas

Target Area	Low-Carbon Technology								
	Town Structure	Buildings		Renewable Energy			Untapped Energy	EMS	＋α
	Accessibility	Passive design	Active	Wind power system	Roof PV	(Mega) Solar	Waste power generation		Water management
1. Ulee Lheue	★★	★★★	★★★ (LED)	★★★	★★			★★★	★★★
2-1. Keudah Social Housing (Rusunawa) and BNI Trembesi City Forest – Peulangghan		★★★			★★	★★			★★★
3. Alue Naga, Kecamatan Syiah Kuala		★★★	★★★	★★★	★★★	★★		★★★	★★★
4. Gampong Jawa, Juta Raja District							★★★		
Whole City			★★★ (LED)						

Source: NSRI

4.4. Perform scenario analysis for target areas

4.4.1. Energy and Environment Sector

1) The short-term and long-term Low carbon technologies

Table. 4.4-1.Low carbon scenario for target areas

Target area	short-term	long-term
Ulee Lheue	**Urban development:** Develop the port part and the station centered community **Low carbon method:** • Short –term Building energy conservation methods • Bladeless wind power system • Roof PV for Commercial Buildings • Energy management system	**Urban development:** Develop the community **Low carbon method:** • Long –term Building energy conservation methods • Roof PV for Community • LPG cogeneration system in escaped house • Area energy management system • Co-generation system
Keudah Social Housing (Rusunawa) and BNI Trembesi City Forest – Peulangghan	• Short –term residential energy conservation methods • Roof PV for social house • Develop community Eco-education activity in City Forest	• Long –term residential energy conservation methods • PV system with the landscape design in the city forest • Demonstration eco facility model in the city forest for eco education • AEMS
Alue Naga, Kecamatan Syiah Kuala	**Urban development:** Develop the costal area **Low carbon method:** • Short –term Building energy conservation methods • Bladeless wind power system • Float PV • Energy management system	**Urban development:** Develop the community **Low carbon method:** • Long –term Building energy conservation methods • Roof PV for Community • LPG cogeneration system in escaped house • Area energy management system • Co-generation system
Gampong Jawa, Juta Raja District	Biomass power plant	
Whole City	50% of the road lamp change to LED	All the road lamp change to LED

Source: NSRI

2) The Low carbon effect

As the technical plan scenario set as Table. 4.4-1, all target areas can reduce around 43% carbon emission in 2030 and 60% in 2040, compared with BAU.

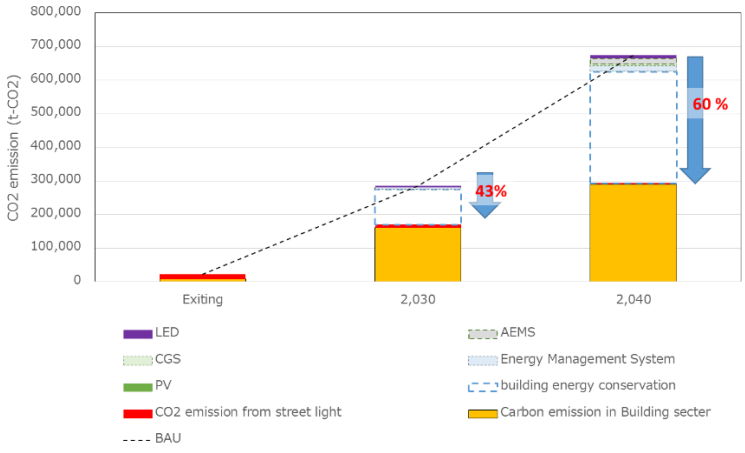


Fig. 4.4-1.Low carbon effect Source: NSRI

3) Initial cost

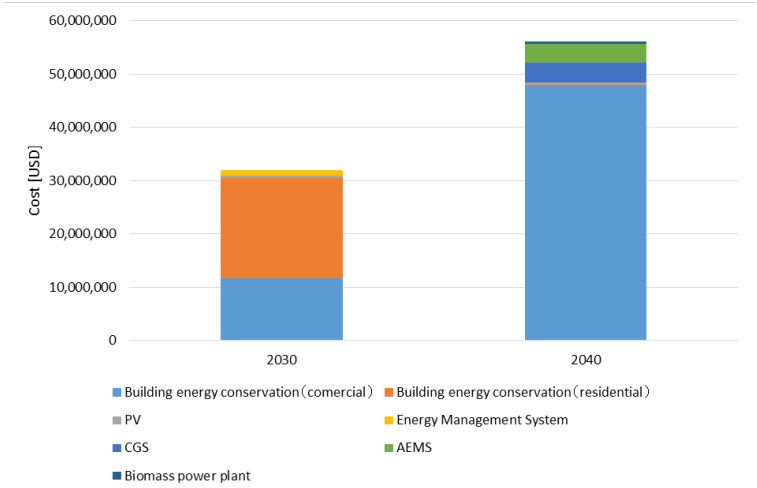


Fig. 4.4-2.Mid-term and Long-term initial cost Source: NSRI

4.4.2. Transportation Sector

The scenario is set based on the five policies such as the introduction of BRT and Loop buses, environment-friendly cars, maintenance of bicycle lane, construction of IoT platform, estimated CO2 reductions by 2040 respectively.

Among these CO2 reduction measures, it became clear that introducing BRT is most contribute. The total reduction rate of other reduction measures was about 60% of the total in the case of the scenario set this time. Therefore, it is important not only to introduce BRT, but also to tackle CO2 reduction through a comprehensive approach including other measures promoting the use of public transportation and Electric vehicle.

We estimated the CO2 emissions in 2018 (BAU) to be 3,061 t-CO2 per year as follows. Although it will be 172,998 t-CO 2 considering the increase rate of automobile by 2040, it can be expected to be reduced to 83,910 t-CO 2 (48% reduction) by promoting the use of public transportation.

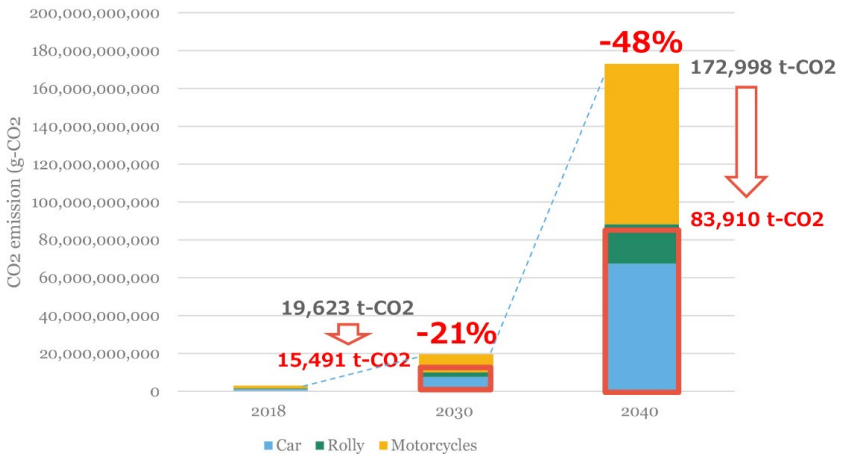


Fig. 4.4-3. CO2 reduction in Transportation Source: NSRI

i) Case where no measure is taken (Business As Usual)

To calculate the mileage per day for the whole city, multiply the population of the city by the average daily trip number per capita and the average mileage per trip. To that value, CO2 emission indicator is integrated to calculate the CO2 emissions of the car. For the average mileage per trip, the numerical value of an equivalent-scale population city in the nationwide urban traffic characteristics survey result shall apply mutatis mutandis.

CO2 emission ＝ Traffic (Traffic volume) × Travel distance (Distance traveled)
×Emission factor (Emission intensity)

※ CO2 emission indicator uses the average value from the Ministry of Land, Infrastructure and Transport's automobile fuel consumption list.

Table. 4.4-2. CO2 emission in 2018 (BAU)

Car type	Number of vehicle	Trip distance (km/vehicle)	CO2 emission indicator (g-CO2/km)	CO2 emission (t-CO2)
Car	5,128,754	10.6	140.7	7,649
Lolly	1,865,002	10.6	119.8	2,368
Motorcycles	35,901,280	5.8	46.4	9,605
Total	42,895,036			19,623

Source: NSRI

ii) Case of 2030

As for CO 2 reduction in 2030, we propose to switch to bus transportation and general automobiles to environmentally friendly vehicles. For conversion of general vehicles to electric vehicles, we have assumed a level of 5% in 2030. In 2040, we further estimated the amount of CO2 reduction, assuming the diffusion of EV and the introduction of EV buses.

Table. 4.4-3. CO2 emission in 2030

Car type	Number of vehicle	Trip distance (km/vehicle)	CO2 emission indicator (g-CO2/km)	CO2 emission (t-CO2)
Car	3,902,811	10.6	140.7	5,820
Lolly	1,865,002	10.6	119.8	2,368
Motorcycles	27,132,702	5.8	46.4	7,301
Total	32,900,514			15,491

Source: NSRI

05

CHAPTER 5. Low-Carbon scenario for Shah Alam City Center Section 14, Selangor of Malaysia

Chapter5. Low-carbon scenario for Shah Alam City Center Section 14, Selangor of Malaysia

5.1. Background research and Define baseline in BAU scenario

5.1.1. Background research for Shah Alam City Center Section 14

i) Present status of City Center Section 14

With the theme of corporate areas, Section 14 consists of business and entertainment center, government offices, educational institution, shopping malls, hotels and office buildings. There are 29 buildings in this section, a typical CBD with various type of buildings. The total building area is around 400,000m2 and 59% of them are commercial buildings.

Fig. 5.1-1. Facilities in Shah Alam City Center Section 14

Source: APERC

ii) Low carbon pilot project

Section 14 has been selected as the pilot implementation area for Low Carbon City Framework (LCCF) by Shah Alam City Council (MBSA). It covers all of the LCCF elements, 9 (out of 13) performance criteria and 30 (out of 35) sub criteria.

The main activities can be summarized as below

Transit oriented development

Under the existing condition, the site is link by Federal Highway and New Klang Valley Expressway (NKVE). In the future, various public transportation, like BRT and LRT will be provided in this area. The target for transit oriented development is shifting to 30% public transportation and 50% with bicycle and pedestrian.

The main efforts include the implementation of

-10 electric buses, 3 parks and ride by 2020.

-1 bus terminal in the city center and 10 central parking facilities provided outside the town center

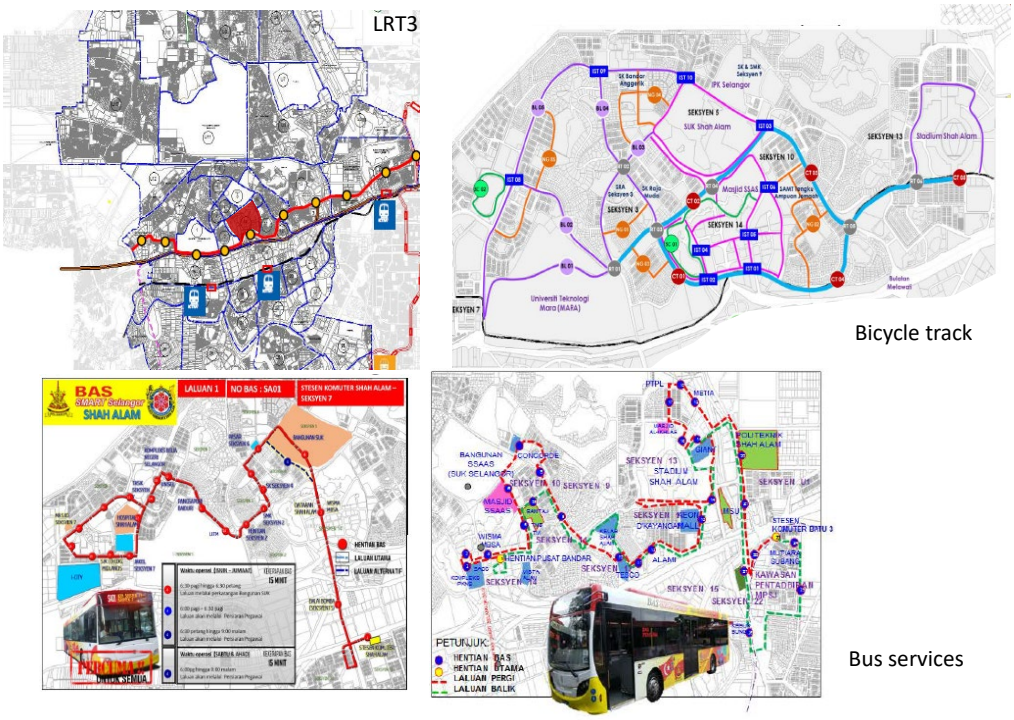


Fig. 5.1-2. Public transportation planning

Source: APERC

Buildings

29 buildings in this district, which is divided into government buildings, commercial buildings and public facilities are involved in the LCCF project. The target of the building sectors is that all of the 29 buildings are supervised and evaluated by LCCF criteria. The phased plan is as below

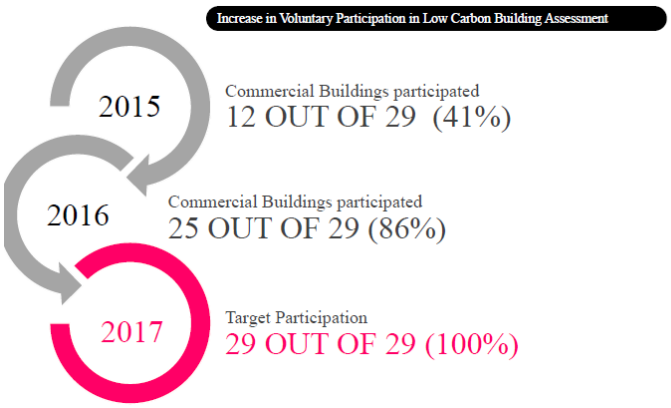


Figure 5.1-3 LCCF target in building sectors

Source: APERC

The method introduced in this area include the low carbon building design and Eco lifestyle on the demand side, untapped energy utilization on the supply-side, as well as effective energy management on both demand and supply side.

Other efforts

Other low carbon efforts including the green technology park, LED street lighting, solar lighting projects, greenery, water and waste management.

Figure 5.1-4 The low carbon efforts in this district

Source: APERC

iii) Potentials and challenges

As the result of LCT-I assessment, low carbon initiatives in Shah Alam has implemented low carbon measurements in demand side, however, the measurements on supply side, governance, and demand & supply management.

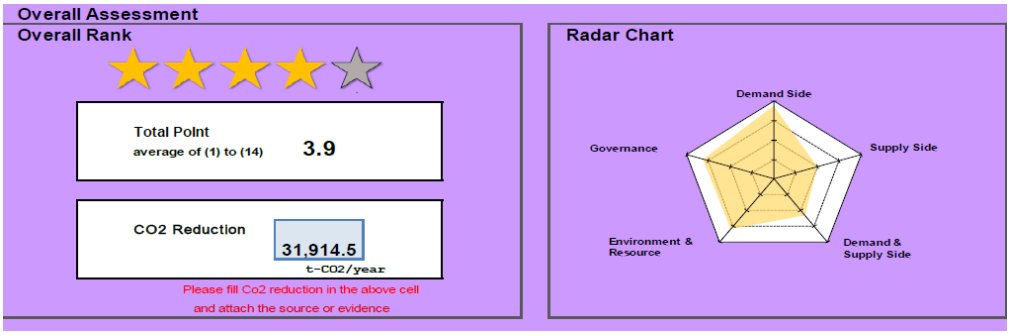


Figure 5.1-5 Evaluation by LCT-I

Source: APERC

5.1.2. Data collection and existing analysis for Shah Alma City Center Section 14

We investigated the energy consumption of the building in section 14 in 2016 and 2015. The primary energy consumption per total floor area of each building is shown below. Energy consumption of the hospital (2718 MJ/m2/year) is the highest for all building uses. This is about 1.5 times larger than that of the office.

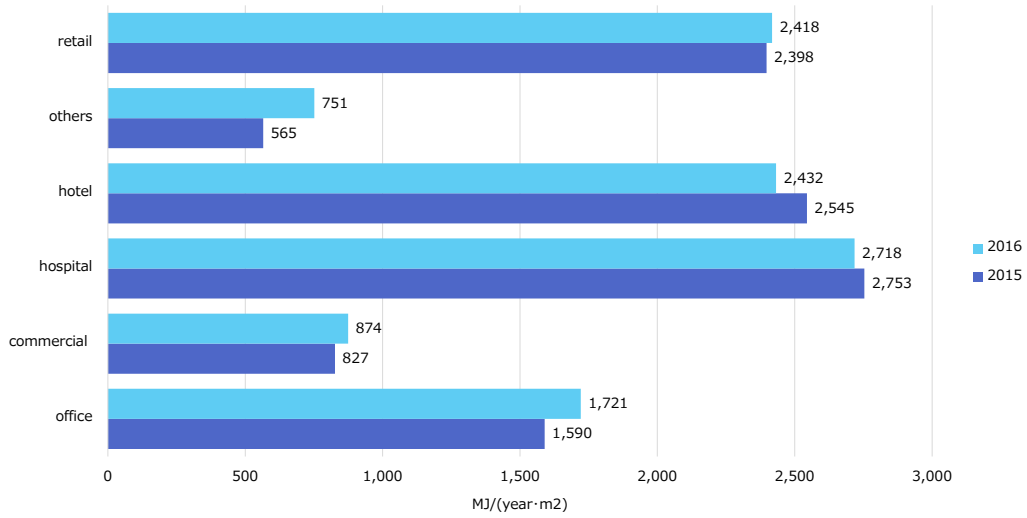


Figure 5.1-6 Primary energy consumption emission of buildings in current status

Source: NSRI

Based on the collected data, we analyzed monthly power usage trends for each building type. There was not much change in electricity consumption by month.

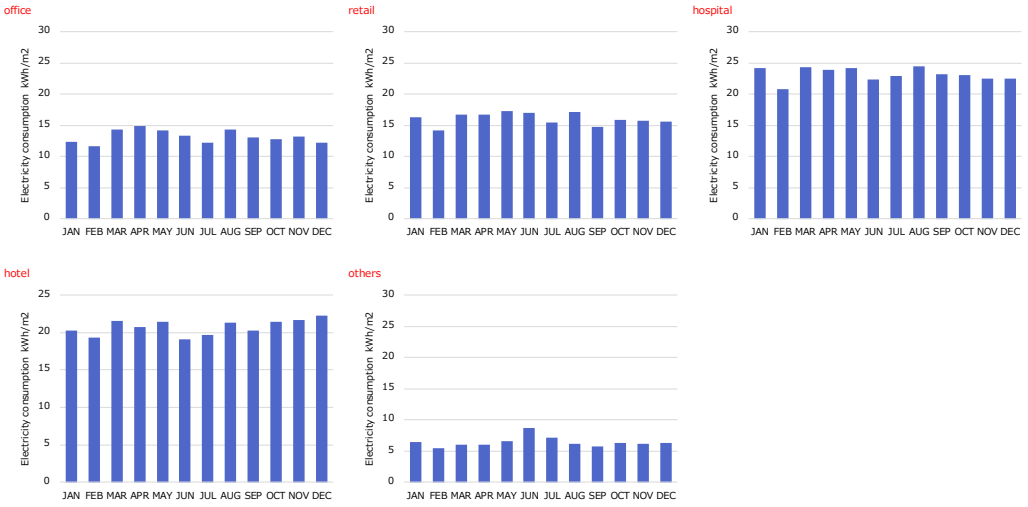


Figure 5.1-7 Estimation of electricity consumption by building use

Source: NSRI

5.2. Define CO2 emission baseline in BAU scenario for Shah Alam City Center Section 14

5.2.1. CO_2 emissions from building sectors

The CO_2 emissions from building sectors is estimated by building floor area and energy consumption unit of different types of building.

Building energy consumption = Σ {Building energy consumption unit according to building use(MJ/ m2) × Building floor area (m2)}

Building energy consumption unit is decided based on the research of JYUKANKYO RESEARCH INSTITUTE INC . To calculate the BAU, energy consumption unit in 2030 and 2040 is assumed according to the GDP growth rate.

The calculation result of BAU is shown (Figure 5.2-1). The annual CO2 emissions in the current situation of building sector in Section 14 is about 100,000 t-co2. We assumed it'll increase about 8 % by 2040.

Table. 5.2-1. Energy consumption unit and building floor area

	Energy consumption unit				Building floor area (m2)
	Exitsting	2030	2040	unit	
office	1,546	1,608	1,639	MJ/m2	218,508
commercial	2,418	2,514	2,563	MJ/m2	338,310
hospital	2,718	2,826	2,881	MJ/m2	56,350
hotel	2,432	2,530	2,578	MJ/m2	25,400

Source: JYUKANKYO RESEARCH INSTITUTE INC

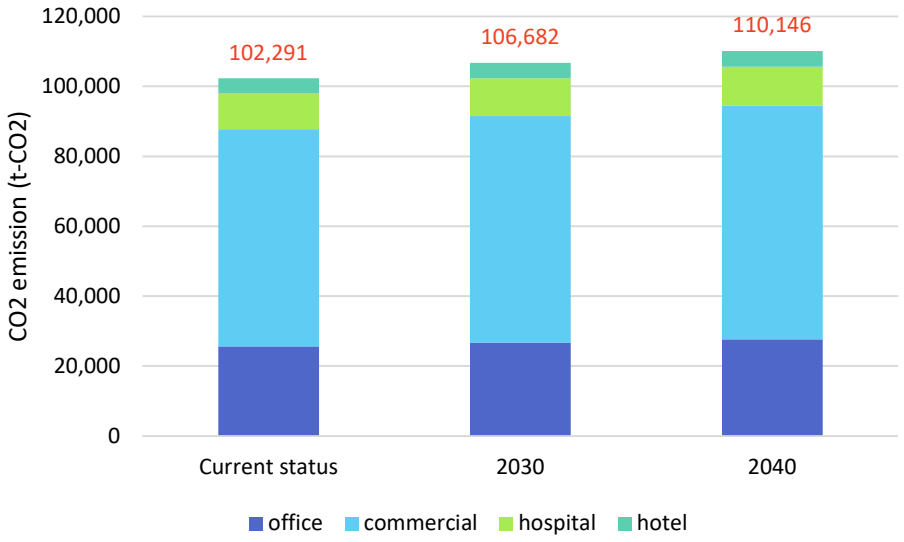


Figure 5.2-1 Estimation of BAU CO2 emission

Source: NSRI

We show the current CO2 emissions plotted on the map (Figure 5.2-2). It is important to take measures prioritizing buildings with high energy consumption.

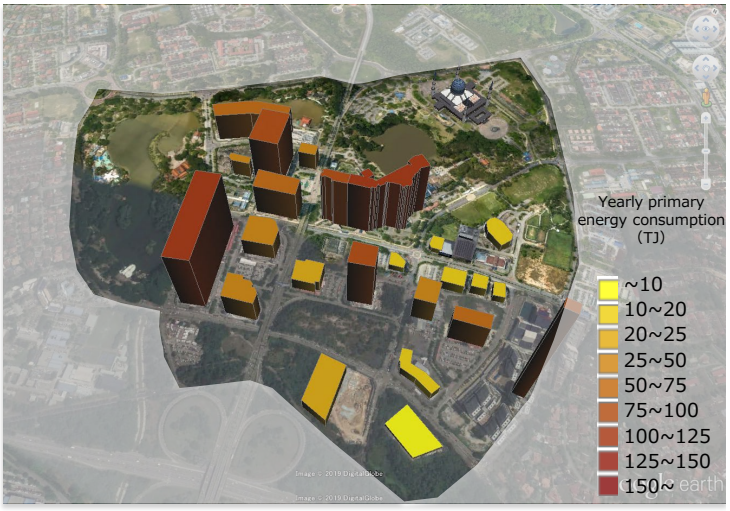


Figure 5.2-2 CO2 emission of buildings in current status Source: NSRI

5.2.2. CO_2 emissions from Transportation sectors

CO2 in the traffic field is mainly emitted by private automobiles. One reason for this is because, as compared with public transportation such as railways and buses, automobiles emit a large amount of CO2 per person. In order to reduce CO2, it is effective to control the traffic volume of automobiles, use forms of public transportation with less CO2 emissions, reduce travel distance and reduce the amount of CO2 emitted by each car. In addition, it is effective to change bus transportation, which is the main form of public transportation, to vehicles with low CO2 emissions, and to reduce the amount of CO2 emitted by each bus.

CO2 emission $=$ Σ {Floor Area (㎡) $\times$ person trip (person TE / ㎡) $\times$ Modal share (%) $\times$ Trip distance (km/ person TE) $\times$ CO2 emission indicator (g-CO2/km)}

The person trip in Section 14 is estimated as shown below. The number is 74,100,710 annually.

Table. 5.2-2. Number of person trip in Section 14, Shah Alam

	Floor Are (㎡)	Generation intensity (person/ha・day)	Person TE (person/day)	Person TE (person/year)
Banking/Financial Services	17,210	2,900	4,991	1,821,669
Entertainment/Public Assembly	66,788	2,900	19,368	7,069,489
Healthcare	19,826	1,783	3,535	1,290,240
Lodging/Residential	7,261	700	508	185,514
Mixed Use	24,376	4,000	9,751	3,558,935
Office	127,706	2,900	37,035	13,517,645
Religious Worship	41,538	2,900	12,046	4,396,846
Retail	109,228	10,600	115,782	42,260,371
Total	413,933		203,016	74,100,710

Source: NSRI

The following is the number of the vehicle for Section 14 during peak hours. It can also be estimated modal share in each type of vehicle, accounting for approximately Then, we will define the CO2 emission baseline as BAU for Shah Alam City Center Section 14.

Table. 5.2-3. Number of Vehicle for Shah Alam

NO	ROAD NAME	TYPE OF VEHICLE (JANUARY-DICEMBER 2017)					TOTAL/Year
		CAR	LORRY	BUS	MPV/SUV	MOTORCYCLE	
1	PERSIARAN DAMAI (1.5km)	2236	88	88	1165	586	4163
2	PERSIARAN DATO MENTERI (1KM)	2756	50	34	1356	78	4274
3	PERSIARAN MASJID (2.5KM)	1853	53	25	1754	222	3907
4	PERSIARAN PERBANDARAN (1.2KM)	787	65	22	832	261	1967
5	PERSIARAN BANDARAYA (1.2KM)	185	15	0	75	124	399
6	PERSIARAN RASIK (800KM)	764	223	76	657	200	1920
7	PERSIARAN SULTAN (BERSAMBUNG LKSA) (1KM)	979	124	275	1760	536	3674
JUMLAH		9560	618	520	7599	2007	
TOTAL							20304

Source: MBSA

The anticipated use of public transport in 2017 will increase by 11% when MRT and LRT services are introduced. Within the next 5 years, the usage is expected to increase to 15 – 20% after LRT 3 services is expected to commence operations by 2020. Public transport usage will continue to increase by 30 -40% when the tram service comes to operate in future. Figure shows the expected forecast of public transport usage of MBSA in 2016, 2017, 2020 and 2030. Table shows the distribution of public transport modes and private vehicle.

Description	2016		2017	2020	2030
Vehicle usage in MBSA	39%	Prediction	<39%	<39%	<39%
Annual Growth Percentage	5%				
No. of Vehicles	273,591	Prediction Based on current study	285,574	324,766	498,590
No. of personnel movement	410,387		428,362	487,150	747,886
Percentage of bus usage	10%	Percentage of increase by 1%-2% / year basis	11%	15%	35%
No. of public bus passengers	41,039		48,191	73,073	261,760
No. of bus under service usage	130		153	231	829
Increase in the no. of bus	0		1.2	1.8	6.4

Public Transport	Year	Personnel Vehicles
10%	2016	90%
15%	2020	85%
35%	2030	65%

Fig 5.2-4. Forecast usage of public transport

Source: NSRI

Based on the share ratio, we estimated automobile volumes in each vehicle types by 2040. The traffic ratio of public transportation is a mere 10 % at the moment. Air quality challenge makes reducing emissions from transport a top priority for Section 14, and increasing the use of public transportation will be an important component.

Table. 5.2-4. Number of vehicle in Section 14, Shah Alam

	Share ratio	2018	2030	2040
Car	85%	62,622,837	92,430,419	109,949,875
Lolly	3%	2,255,429	3,328,982	3,959,964
Bus	2%	1,897,772	2,801,085	3,332,009
Motorcycles	10%	7,324,671	10,811,111	12,860,272
Total	100%	74,100,710	109,371,597	130,102,119

Source: NSRI

We estimated the amount of CO2 reduction of vehicles such as automobile, Lolly, bus and motorcycle for the study area.

Table. 5.2-5. CO2 emissions (BAU)

	2018	2030	2040
Car	93,396 t-CO2	137,852 t-CO2	163,981 t-CO2
Rolly	2,864 t-CO2	4,227 t-CO2	5,028 t-CO2
Bus	10,480 t-CO2	15,469 t-CO2	18,401 t-CO2
Motorcycles	1,959 t-CO2	2,892 t-CO2	3,440 t-CO2
	108,701 t-CO2	160,441 t-CO2	190,852 t-CO2

Source: NSRI

5.3. Low carbon measures for Shah Alam City Center Section 14

5.3.1. Concept and Basic approach

We shows the concept of low carbonization in Shah Alam City Center 14(Figure 5.3-1). There are 3 concept. The first concept is symbolic landscape “Low Carbon Blue Town” realized by laying blue color PV. The second concept is retrofit style low carbonization at existing infrastructures and buildings. The third concept is Area (Section) management collaborated with public and private sectors.

A more specific graphic concept is shown in Figure 5.3-2. In building sector, we propose roof top PV, low carbonization of buildings, floating PV on pond and CGS. In transportation sector, we proposed TOD, EV circulation bus, and ICT platform for AEMS, MaaS. Detailed methods will be described later.

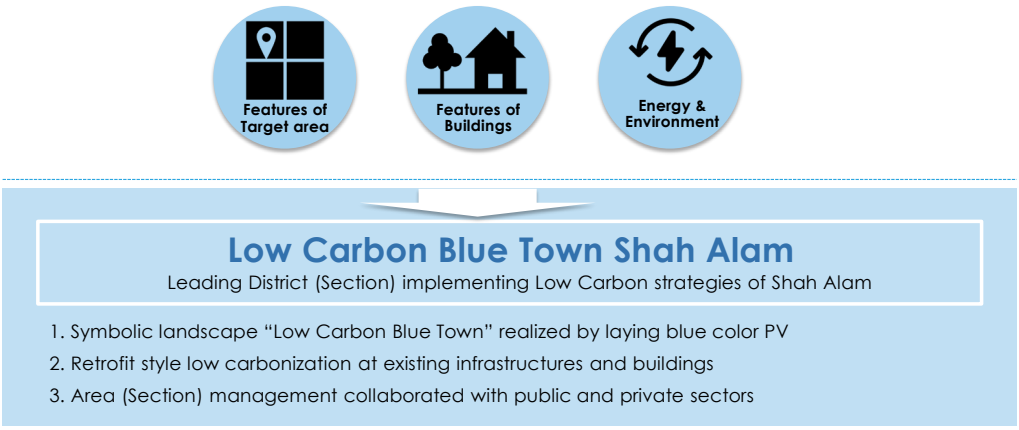


Figure 5.3-1 PROPOSAL FOR LOW-CARBON CONCEPT Shah Alam Source: NSRI

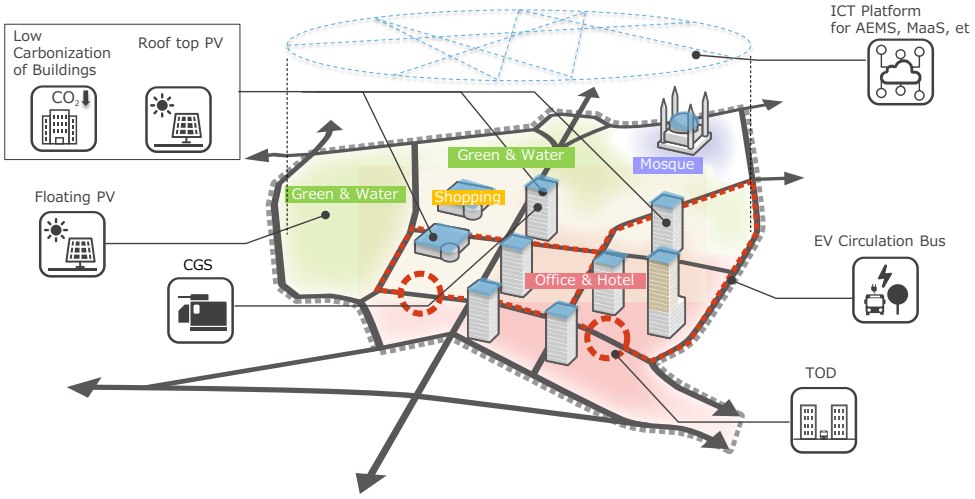


Figure 5.3-2 PROPOSAL FOR LOW-CARBON CONCEPT Shah Alam (Graphic Concept) Source: NSRI

5.3.2. Buildings

It is important for low carbonization to reduce energy consumption by saving as much energy as possible as well as creating energy. Low carbon building image is shown in Figure 5.3-3. In order to achieve low carbonization, the following method can be used.

- High efficiency fan and inverter fan.
- PV on roof (PV supply generated electricity into building.)
- LED lighting
- Illuminance correction
- Lighting Human Sensor
- Total heat exchanger
- CO2 control ventilation and High efficiency fan
- EMS (Energy management system)
- CO control of parking fans
- Glass performance improvement
- COP improvement & Inverter refrigerator
- Inverter pomp

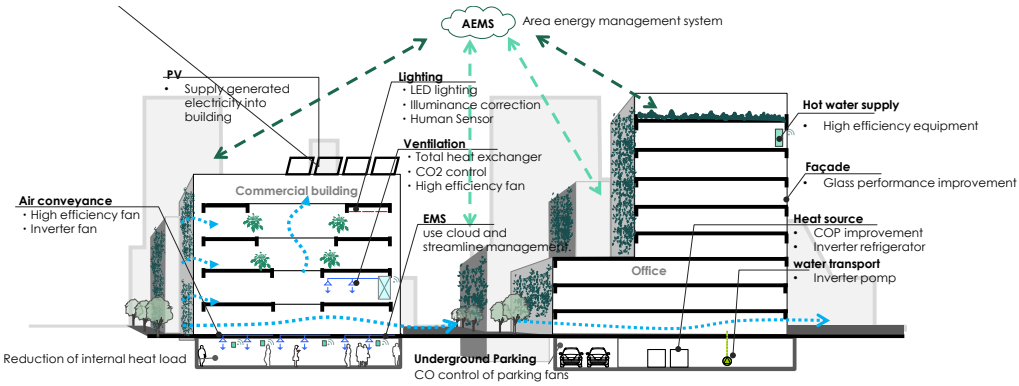


Figure 5.3-3 Low carbon building image Source: NSRI

5.3.3. Transportation

i) TOD (Transit Oriented Development)

Public transportation like LRT has been constructing in Section 14. To enhance Transit Oriented Development (TOD), the Special provisions such as a relaxation of regulations in Floor area ratio (FAR) would be proposed and lead to the TOD promotion in association with a pedestrian network from the stations. While, there are no incentives for developers to contribute public uses there. Giving incentives to private developers and users could contribute to realizing the government's objectives. Also, the developing of pedestrian network from the existing bus terminal can be effective.

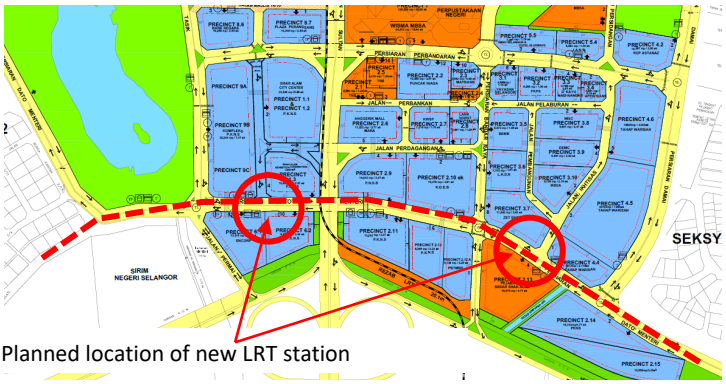


Fig. 5.3-4. Location of TOD station Source: NSRI

ii) Green Mobility Management

In Section 14, although the bike lane has been constructed on the streets, the facility does not get used much. Therefore, to practice effective utilization of the bike lane, we propose to install facilities such as bicycle parking and shower booth for bicycle users at each building. Moreover, it can be introduced Low-speed mobility on the bicycle lane toward green mobility management.

In this case, an introduction of Electric Vehicles would be effective in reducing CO2 emissions. It will contribute to the Low carbon model town in accordance with the promotion of utilization for public transportation.

Fig. 5.3-1. Green Mobility Facilities Source: PEDALRest

iii) Workable Community

The workable community is expected to external environment covered by Tree-shaded spaces and the pedestrian way in the tropical climate like Malaysia. We propose to install PV on the rooftop of walkways to practice effective utilization of the space making Section 14 blue town.

Fig. 5.3-6. PV on the rooftop Source: picsbud

And also, it is difficult for the pedestrian to cross a road due to few crossing points in Section 14. Laying new pedestrian crossing is expected to enhance the environment for pedestrian, lead to the promotion of a walkable community. Furthermore, linking open space within Section 14 could contribute to help people walking along with the network enjoyable.

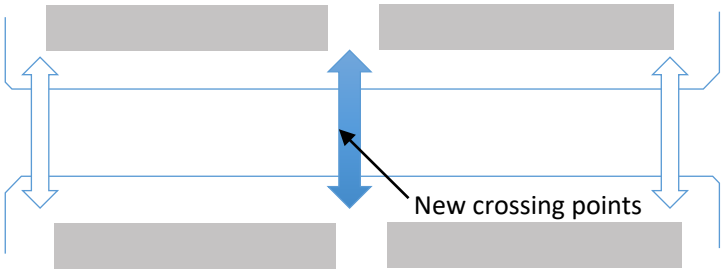


Fig. 5.3-7. Walkable crossing point Source: NSRI

5.3.4. PV on the pond

There are a big pond in section 14. By floating PV on the pond, PV efficiency improves. If the surface temperature of a PV exceeds 25 ℃, the efficiency will be reduced. The PV on water reduces the surface temperature due to the cooling effect of water.

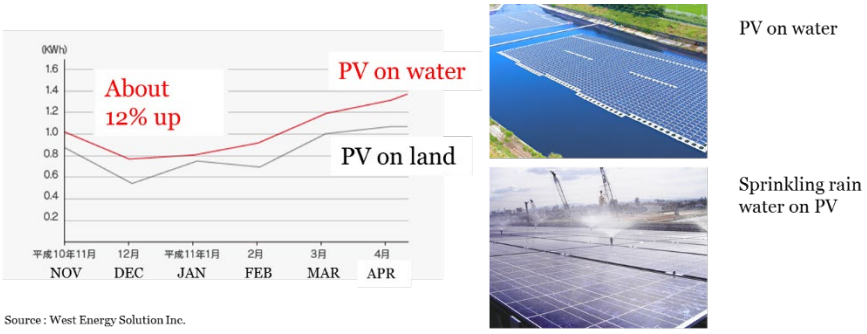


Fig. 5.3-8. Improvement of PV on pond
Source : West Energy Solution Inc.

5.3.5. Multi Energy System (Co-Generation System)

To use co generation system It is possible to reduce energy. Additionally, electricity can be supplied even at the time of power outage, disaster prevention performance can be enhanced at hospitals or government facilities. Below image show simple diagram of co generation system, power generator. A power generator uses gas to make electricity and exhaust heat. To use exhaust heat for absorption chiller, we can make cold water for air conditioning. In building where demand for hot water is high such as hotels and hospitals, exhaust heat can be used as hot water through a heat exchanger.

It is important to introduce CGS with priorities in section 14. In the short term CGS should be installed in government building, and a hotel or a hospital where heat and electricity consumption are large. In Long term we plan to be installed in large scale buildings.

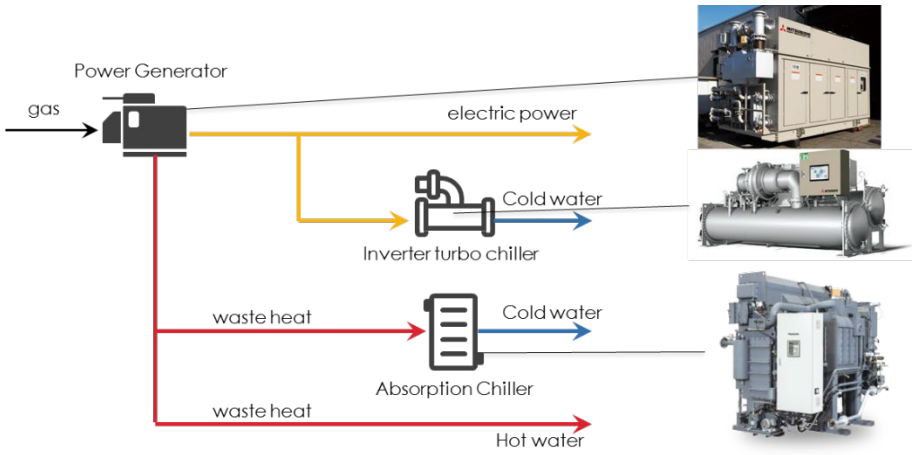


Fig. 5.3-9. Co generation system
Source :MITSUBISHI heavy industries, Panasonic

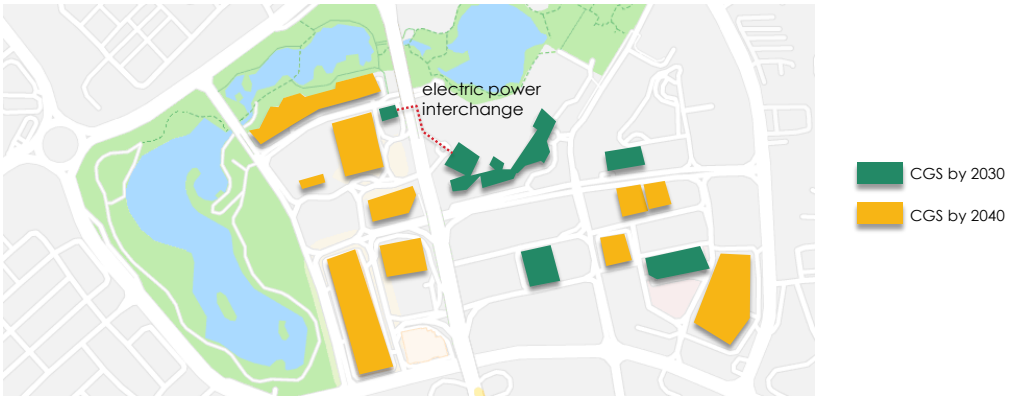


Fig. 5.3-10. Introduction plan for Cogeneration system
Source: NSRI

Table. 5.3-1. Introduction plan for Cogeneration system (CGS capasity)

use	Building named	Building area (BCR)	Net Floor Area (NFA)	By 2030	By 2040	single unit capacity	unit count	System capacity	System capacity/ NFA
		m2	m2			kW	-	kW	W/m2
office	DWI EMAS INTERNATIONAL SCHOOL	3,950	19,748		X	230	1	230	11.6
commercial	SHAH ALAM CONVENTION CENTRE	4,827	19,309		X	230	1	230	11.9
commercial	MUZIUM SULTAN ALAM SHAH	13,846	41,538		X	230	2	460	11.1
hospital	DEMC SPECIALIST HOSPITAL	3,965	19,826	X		230	2	460	23.2
hospital	DEMC HOSPITAL WANITA DAN KANAK-KANAK	6,087	36,524	X		1,040	1	1,040	28.5
hotel	HOTEL GRAND BLUE WAVE	2,553	25,400	X		320	1	320	12.6
commercial	PLAZA PERANGSANG	4,530	24,376		X	320	1	320	13.1
commercial	PLAZA AZALEA	1,964	20,572		X	230	1	230	11.2
commercial	VISTA ALAM	3,259	94,523		X	320	3	960	10.2
office	WISMA MBSA	18,546	64,162	X		320	2	640	10.0
office	BANGUNAN DARUL EHSAN	898	21,552	X		230	1	230	10.7
office	MENARA MRCB	914	20,117		X	230	1	230	11.4
office	WISMA PKPS	1,833	12,831		X	35	4	140	10.9
office	BANGUNAN PKNS	6,725	33,625		X	230	2	460	13.7
office	MEDINAH COURT	1,125	12,379		X	35	4	140	11.3
others	MASJID SULTAN SALAHUDDIN ABDUL AZIZ SHAH	20,769	41,538		X	230	2	460	11.1
commercial	PLAZA ALAM SENTRAL	13,215	37,343		X	230	2	460	12.3
commercial	SACC MALL	6,984	13,980		X	35	5	175	12.5
commercial	KOMPLEKS PKNS	12,116	48,463		X	320	2	640	13.2

Source: NSRI

5.4. Priorities for implementation and Perform scenario analysis

5.4.1. Energy and Environment sector

The CO2 reduction in energy and environment is shown in Fig, 5.4.1. By using the previously mentioned low carbonization method, it was possible to reduce energy by 35% in 2030 and 57% in 2040.

The low carbonization method used for calculation is summarized in the following table. The method was chosen according to use of the building. The energy saving rate was decided based on our design experience in the past.

The CO2 reduction cost in energy and environment is shown in Fig, 5.4.2. Relationship between reduction rate and cumulative cost is shown in Fig, 5.4.3. It is important to introduce it from those that are highly effective and inexpensive.

1) The implementation plan of building energy conservation technologies

Table. 5.4-1.Building Energy Conservation Technologies

●Mid-term low carbon building conservation method

○Long-term low carbon building conservation method

Items	Menu	energy conservation ratio	office	commercial	hospital	hotel
			implementation time			
Heat source	COP improvement	0.282	●	●	●	●
Heat source	Reduction of internal heat generation	0.05	●	●	●	●
Heat source accessories	Inverter	0.13	●	●	●	●
Water transport	Inverter	0.18	●	●	●	●
Air conveyance	High efficiency fan	0.165	●	●	●	●
Air conveyance	Inverter	0.26	●	●	●	●
Hot water supply	Device performance improvement	0.292	–	–	●	●
lighting	Human Sensor	0.03	●	●	●	●
lighting	Illuminance	0.105	●	●	●	●
lighting	High efficiency of lighting equipment	0.376	●	–	●	●
Outlet	Reduced power	0.02	●	●	●	●
ventilation	Total heat exchanger	0.072	●	●	●	●
ventilation	CO2 control	0.057	●	●	●	●
ventilation	High efficiency fan	0.131	●	●	●	●
ventilation	Introduction of CO concentration control of parking fans	0.2	●	●	●	●
Water supply and drainage	Improve pump performance	0.15	●	●	●	●
Elevator	Smart operation	0.1	●	●	●	●
Other	Introduction of high efficiency	0.085	●	●	●	●
facade	Glass performance improvement	0.1	○	○	○	○

Source: NSRI

2) Implementation plan of other low carbon technologies

Table. 5.4-2.Low-Carbon Technologies

Tier 1	Tier 2	Low carbon measurements	Mid-term (2030)		Long-term	
			Low carbon methods	Conservation ratio (%)	Low carbon methods	Conservation ratio (%)
Supply	Area energy system				●	5%
	Renewable energy	PV (govwerment building)	●			
		PV (all)			●	
	Multi energy system	CGS			●	5%
Demand and Supply	Energy Management System		●	5%		
Government	Policy Framework					
	Education & Managem	Local rule/guideline for low carbonization			●	

Source: NSRI

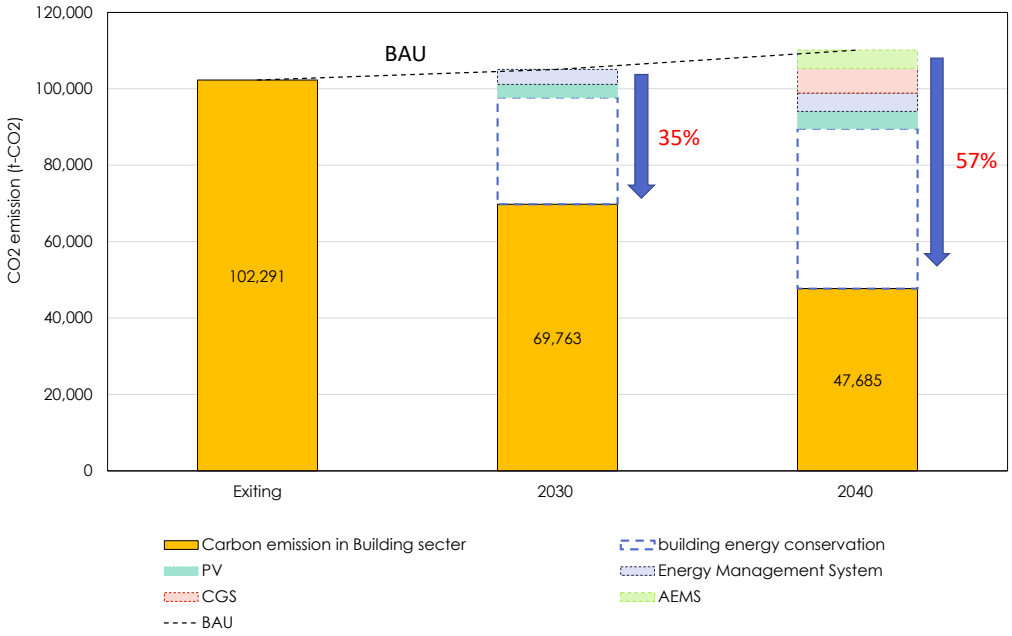


Fig. 5.4-1. CO2 reduction in energy and environment
Source: NSRI

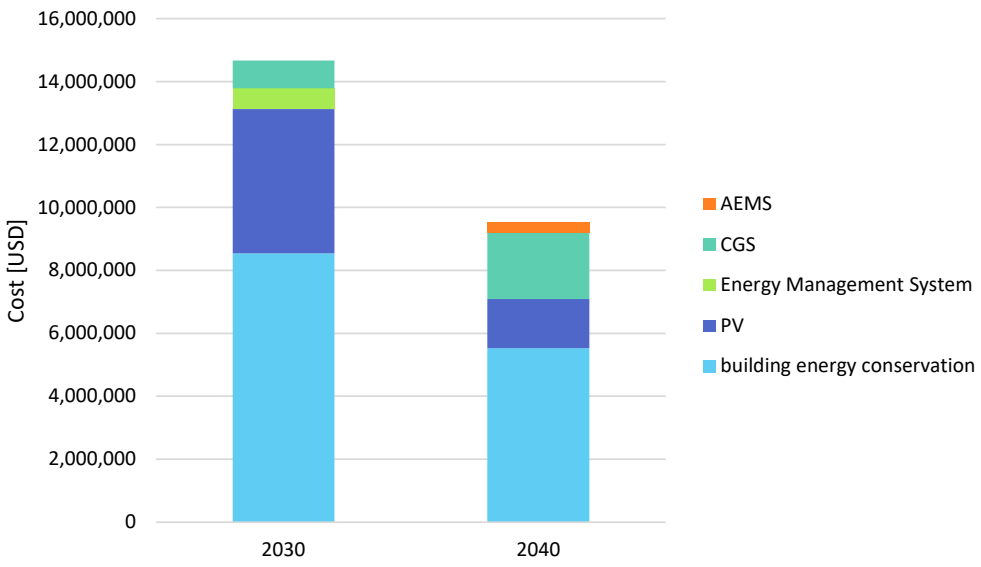


Fig. 5.4-2. CO2 reduction cost in energy and environment
Source: NSRI

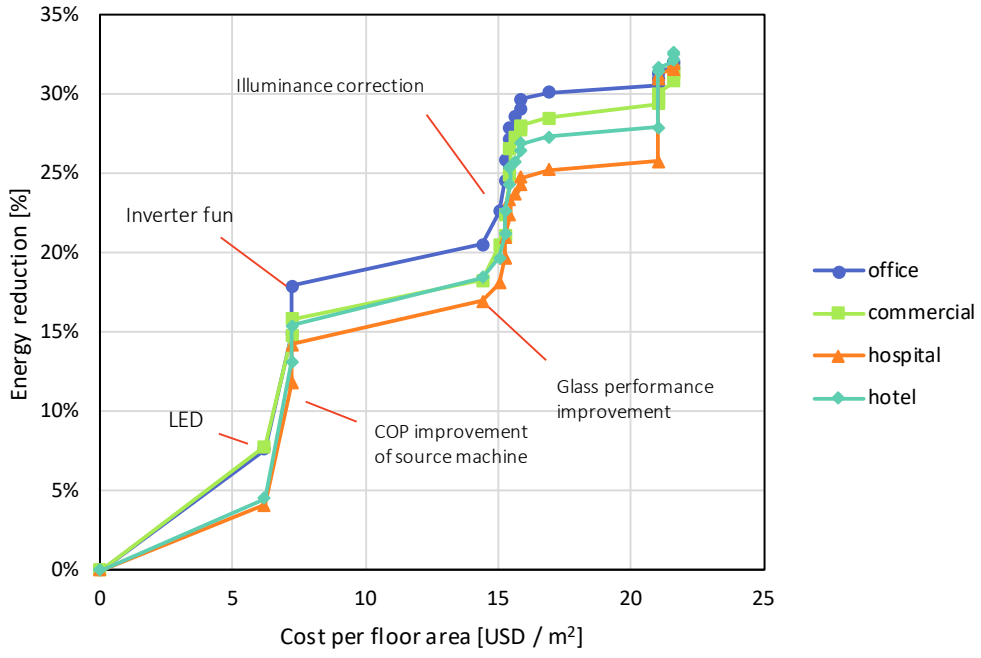


Fig. 5.4-3. Relationship between reduction rate and cumulative cost
Note: Measures automatically introduced at the time of updating equipment are supposed to be free of additional cost.

5.4.2. Transportation

The scenario is set based on the five policies such as the introduction of BRT and Loop buses, environment-friendly cars, maintenance of bicycle lane, construction of IoT platform, estimated CO2 reductions by 2040 respectively.

Among these CO2 reduction measures, it became clear that introducing BRT is most contribute. The total reduction rate of other reduction measures was about 60% of the total in the case of the scenario set this time. Therefore, it is important not only to introduce BRT, but also to tackle CO2 reduction through a comprehensive approach including other measures promoting the use of public transportation and Electric vehicle.

We estimated the CO2 emissions in 2018 (BAU) to be 108,701 t-CO2 per year as follows. Although it will be 190,852 t-CO 2 considering the increase rate of automobile by 2040, it can be expected to be reduced to 130,428 t-CO 2 (31% reduction) by promoting the use of public transportation.

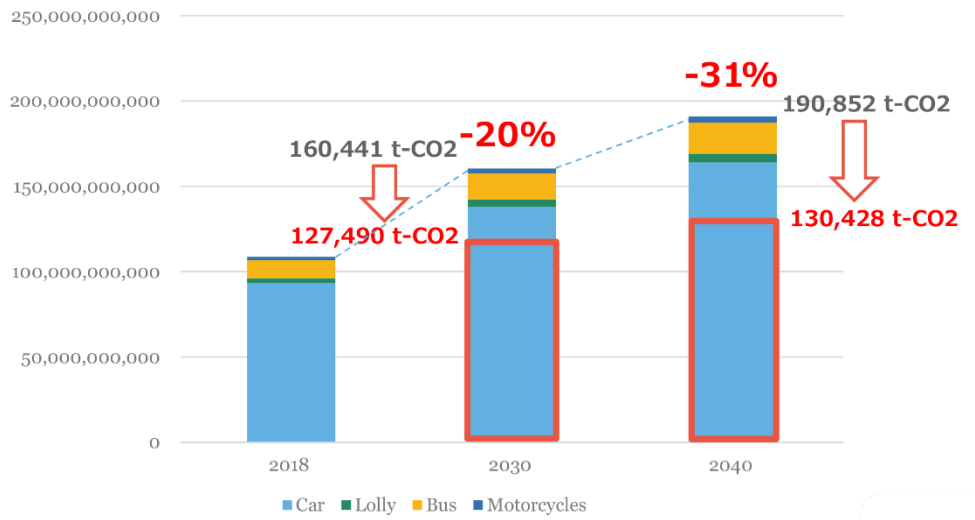


Fig. 5.4-4. CO2 reduction in Transportation Source: NSRI

i) Case where no measure is taken (Business As Usual)

To calculate the mileage per day for the whole city, multiply the population of the city by the average daily trip number per capita and the average mileage per trip. To that value, CO2 emission indicator is integrated to calculate the CO2 emissions of the car. For the average mileage per trip, the numerical value of an equivalent-scale population city in the nationwide urban traffic characteristics survey result shall apply mutatis mutandis.

CO2 emission = Traffic (Traffic volume) × Travel distance (Distance traveled)
×Emission factor (Emission intensity)

※ CO2 emission indicator uses the average value from the Ministry of Land, Infrastructure and Transport's automobile fuel consumption list.

Table. 5.4-3. CO2 emission in 2018 (BAU)

Car type	Number of vehicle	Trip distance (km/vehicle)	CO2 emission indicator (g-CO2/km)	CO2 emission (t-CO2)
Car	62,622,837	10.6	140.7	93,3968
Lolly	2,255,429	10.6	119.8	2,864
Bus	1,897,772	10.6	521.0	10,480
Motorcycles	7,324,671	5.8	46.4	1,959
Total	74,100			108,701

Source: NSRI

ii) Case of 2030

As for CO 2 reduction in 2030, we propose to switch to bus transportation and general automobiles to environmentally friendly vehicles. For conversion of general vehicles to electric vehicles, we have assumed a level of 5% in 2030. In 2040, we further estimated the amount of CO2 reduction, assuming the diffusion of EV and the introduction of EV buses.

Table. 5.4-1. CO2 emission in 2030

Car type	Number of vehicle	Trip distance (km/vehicle)	CO2 emission indicator (g-CO2/km)	CO2 emission (t-CO2)
Car	70,336,461	10.6	140.7	104,901
Lolly	3,328,982	10.6	119.8	4,227
Bus	2,801,085	10.6	521	15,469
Motorcycles	10,748,481	5.8	46.4	2,892
Total	87,215,009			127,490

Source: NSRI

06

CHAPTER 6. Low-Carbon scenario for Hang Tuah Jaya, Melaka of Malaysia

Chapter6. Low-carbon scenario for Hang Tuah Jaya, Melaka of Malaysia

6.1. Background research and Define baseline in BAU scenario

6.1.1. Background research for MITC, Hang Tuah Jaya

i) Low carbon pilot project

Hang Tuah Jaya is selected and supported to become the first green city in Melaka. The study area for the pilot project is 1,956.57 acre, including government building area and residential area. All developments and buildings shall comply with building rating certifications i.e. GBI, LEED, Green Star, Green Mark and Melaka Green Seal. Besides, the key projects are:

-PERKESO Rehabilitation Centre (Complete in June 2014)

-8 MW Solar Farm Project (Dis 2014)

-Rumah Citra Pontian (June 2014)

-Green Restaurant (July 2014)

Fig. 6.1-1. Study area and main projects
Source: APERC

In July 2012, Hang Tuah Jaya city become the pioneer for LCCF though MOU and get the status of “pilot partner”. Therefore, more projects are developed as Figure 2.3-24. They cover 4 elements, 13 performance and 35 sub-criteria in LCCF.

-Energy Efficiency & Renewal Energy – Solar Farm Project: Green Plus Solar Farm(capacity – 50 MW)

-Melaka Smart Grid Pilot Project – Smart Meter

-Electric bus

-Electric Car Charging Station

-Bike Rental

Fig. 6.1-2. Hang Tuah Jaya City Low Carbon Initiative
Source: APERC

ii) Potentials and challenges

The various low carbon actions are evaluated by LCT-I, it can suggest that the Hang Tuah Jaya has a score in governance, demand side and environmental & resource aspect, however, has challenges on supply side and demand & supply management.

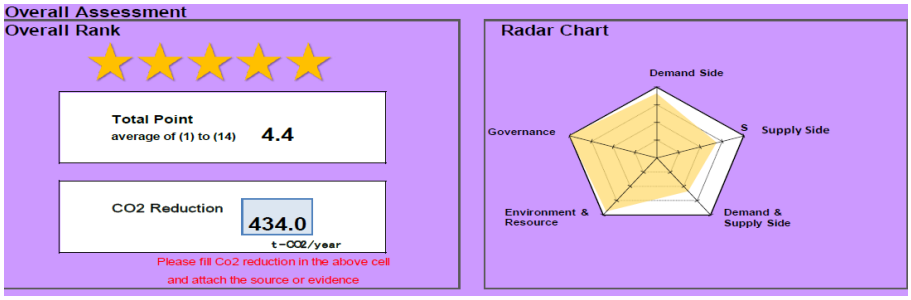


Fig. 6.1-3. Evaluation result of LCT-I
Source: APERC

6.2. Define CO2 emission baseline in BAU scenario for Hang Tuah Jaya

Hang Tuah Jaya is a new established town that near the tourism spot. Therefore, it is a model that consider both local people and increasing tourists. It has plenty of land that can be implemented with renewable energy. Therefore, both the demand and supply side low carbon measures should be considered in this city. It is a model with the stakeholders as town government, developers, as well as the energy company. The energy from this town can serve both in and outside the town. It can make use of the future development and make a balance between demand and supply-side.

The urban development as the master plan are assumed as below.

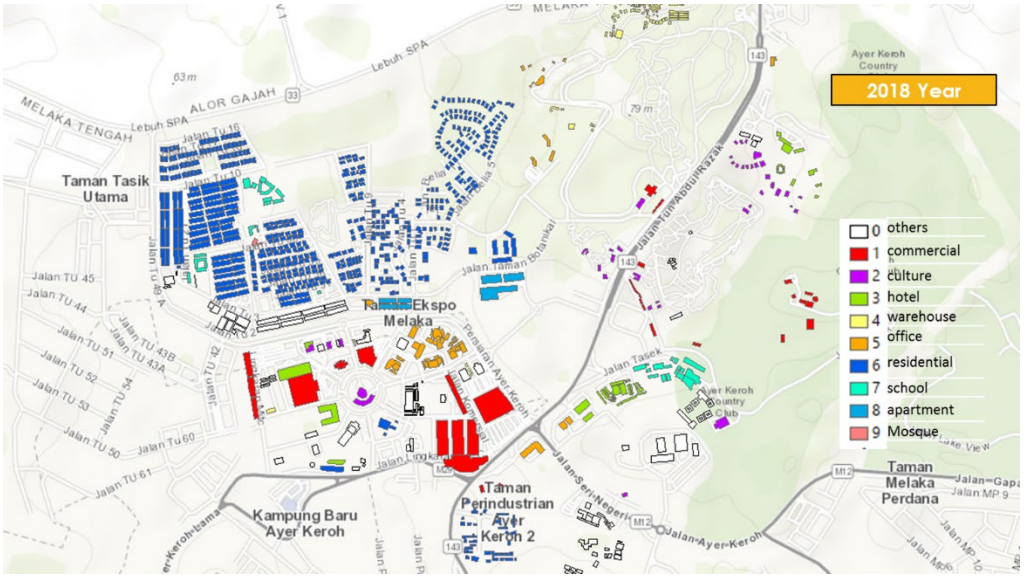


Fig. 6.2-1. Current situation
Source: NSRI

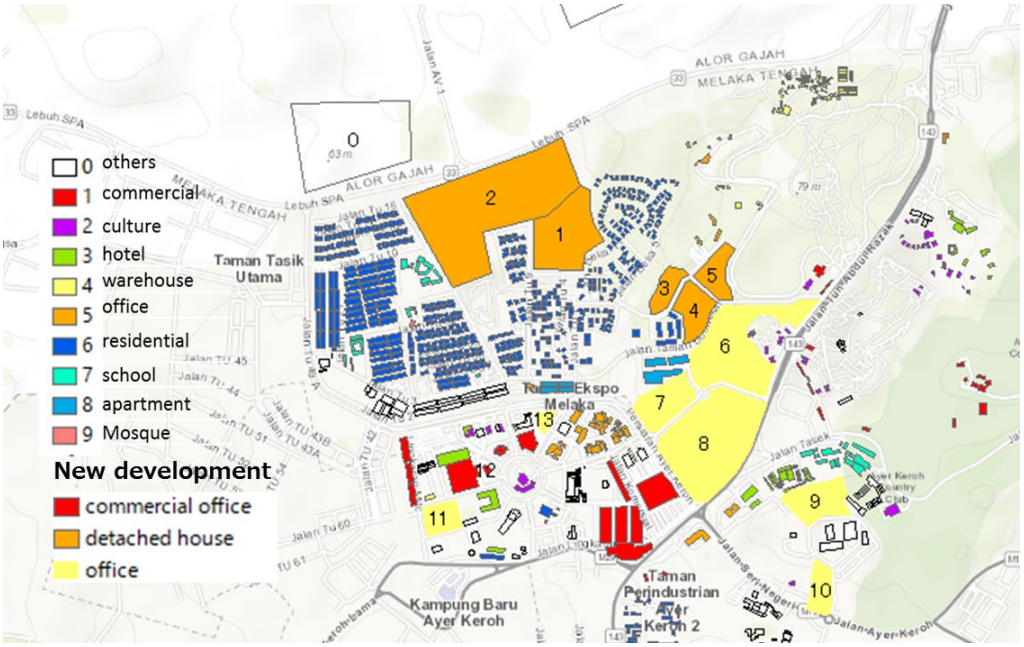


Fig. 6.2-2. Mid-term urban development
Source: NSRI

The CO_2 emissions from building sectors is estimated by building floor area and energy consumption unit of different types of building.

Building energy consumption＝ Σ ｛Building energy consumption unit according to building use(MJ/ m2) × Building floor area (m2)｝

Building energy consumption unit is decided based on the research of JYUKANKYO RESEARCH INSTITUTE INC . To calculate the BAU, energy consumption unit in 2030 and 2040 is assumed according to the GDP growth rate.

The calculation result of BAU is shown below. The annual CO2 emissions in the current situation of building sector in Hang Tuah Jaya is about 147,000 t-co2. We assumed it'll increase about 52 % by 2040. This is because areas are developed.

Table. 6.2-1. Energy consumption unit and building floor area

	Energy consumption unit				Building floor area (m2)
	Exitsting	2030	2040	unit	
office	1,546	1,639	1,715	MJ/m2	505,039
commercial	2,418	2,563	2,681	MJ/m2	260,266
hotel	2,432	2,578	2,697	MJ/m2	133,146
Residencial_detached house	167	177	185	MJ/m2	507,174
residential_apartment	286	303	317	MJ/m2	167,150

Source: JYUKANKYO RESEARCH INSTITUTE INC

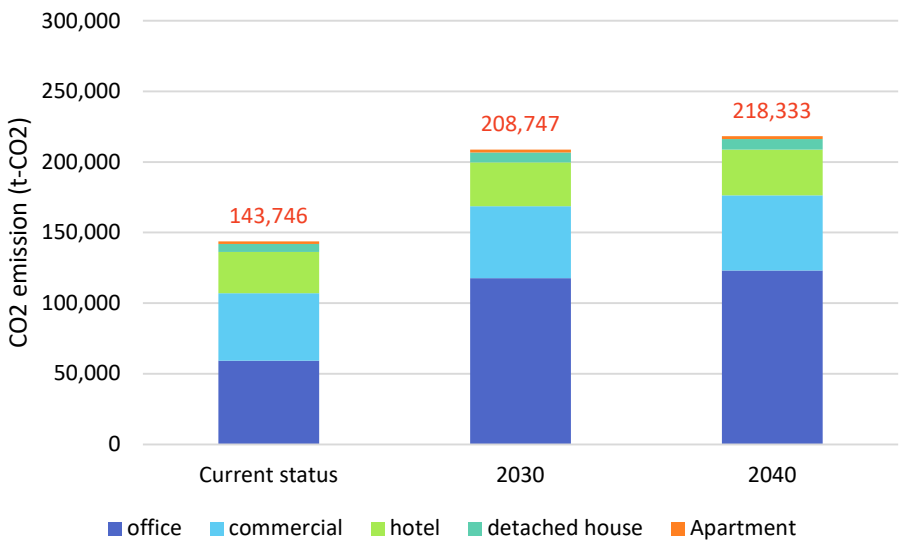


Figure 6.2-3 Estimation of BAU CO2 emission in Hang Tuah Jaya

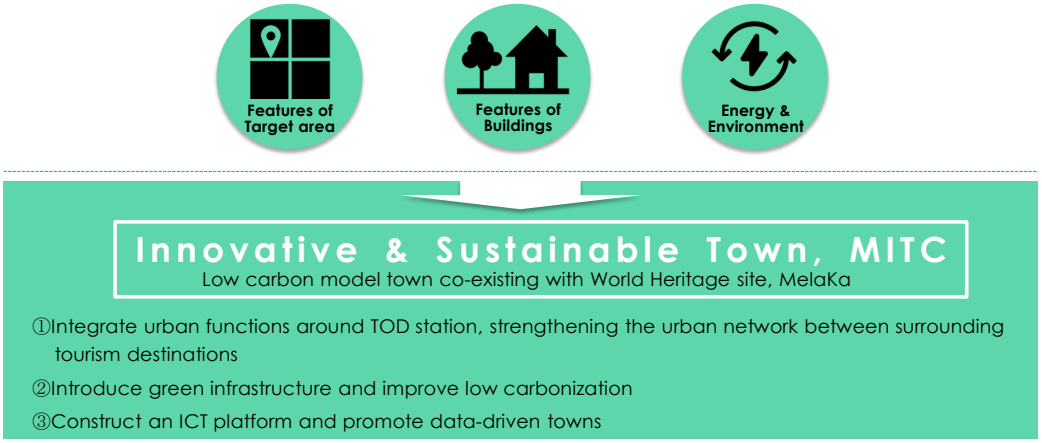
Source: NSRI

6.3. Low carbon measures for Hang Tuah Jaya

6.3.1. Concept and Basic approach

We shows the concept of low carbonization in Hang Tuah Jaya. There are 3 concept. The first concept is integrate urban functions around TOD station, strengthening the urban network between surrounding tourism destinations. The second concept is introduce green infrastructure and improve low carbonization. The third concept is Construct an ICT platform and promote data-driven towns.

A more specific graphic concept is shown in Figure 6.3 2. As Town and transportation measures, we propose Promotion of Transit Oriented Development (TOD), Introduction of low-carbon urban transport, Introduction of Future mobility, and Construction of ICT platform / Area management. As Environment and Energy measures, we propose promotion of low carbonization in facilities, Utilization of renewable energy and Implement Comprehensive Area Energy Management System (AEMS).



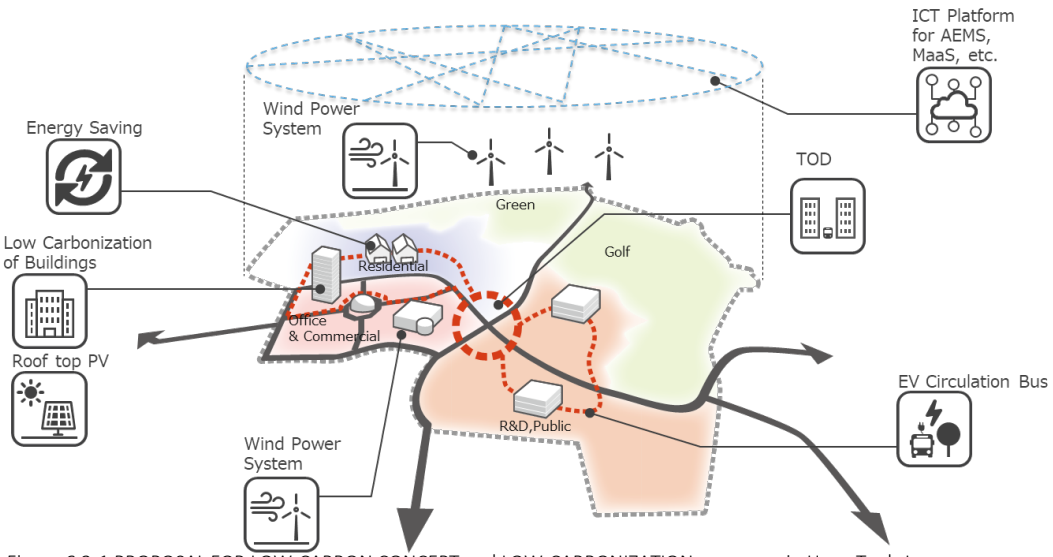


Figure 6.3-1 PROPOSAL FOR LOW-CARBON CONCEPT and LOW-CARBONIZATION measures in Hang Tuah Jaya

Source: NSRI

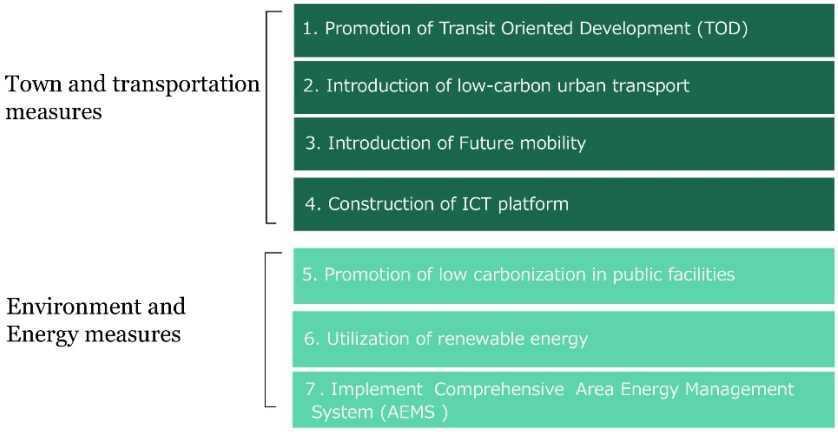


Figure 6.3-2 Basic approach Source: NSRI

6.3.2. Town Structure and Building

State of Melaka Administrative Centre is the civic center containing administrative agency such as court of justice, fire station and religious facility. It is located near the station, which will be planned LRT toward 2025. And bus services is also proposed connecting each TOD station. Hang Tuah Jaya has been selected and supported to become the first green city in Melaka.

The study area for the pilot project is 1,956.57 acre, including administrative area and residential area. Low carbon building construction can be driven by green building rating systems, which is a first-generation rating tool for energy efficient buildings in Malaysia (GBI).

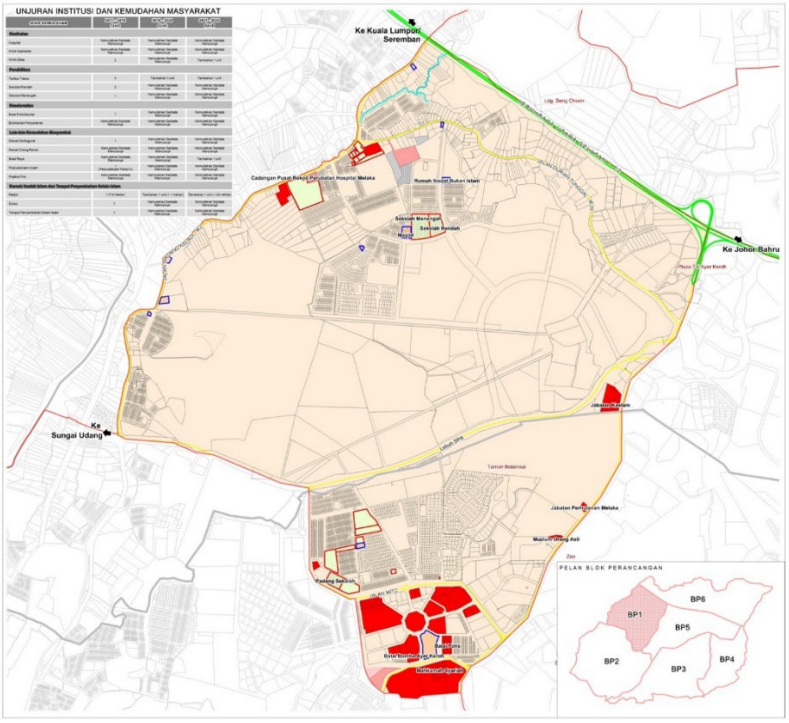


Fig. 6.3-3.Institution and Public facilities plan
Source: EDP

Meanwhile, a low carbon town can be affected in the land use, and buildings are the dominant energy consumers in cities. The efforts have been configured on the basis of the following activities:

i) Transit oriented development (TOD)

The land use can be evaluated so as to implement Transit oriented development (TOD) and concentrate urban activities around railway stations. By increasing the density of urban development around the station, we aim to enhance pedestrian networks and reduction of environmental impact.

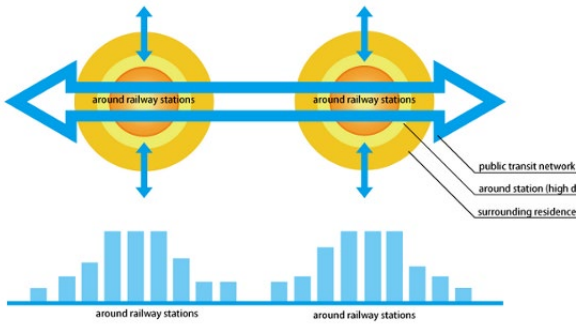


Fig. 6.3-4. Transit Oriented Development (TOD) concept
Source: Nikken Sekkei

Example: Tsukuba science city

The most distinctive feature of the configuration is to have a network of walkways which separates pedestrians from automobile traffic. Facilities for the residents, like parks, schools and shopping centers are built along them. Other characteristics of the city include taking advantage of its rich natural environments such as existing forests and securing land for the future projects such as the construction of a new transportation system and cultural facilities.

There were two purposes in building Tsukuba Science City:

1. To meet the needs of the times for the promotion of science and technology and the improvement of higher education

2. To cope with the overcrowded conditions in Tokyo.

Fig. 6.3 5. Tsukuba science city Source: Tsukuba city

ii) Mixed Use development

Attracting private investment by taking advantage of tourism resources including the famous town, UNESCO World Heritage sites, Hang Tuah Jaya aim for expansion as a low carbon model town in Malaysia.

iii) low carbon building

It is important for low carbonization to reduce energy consumption by saving as much energy as possible as well as creating energy. Low carbon building image is shown in Figure 6.3-6. In order to achieve low carbonization, the following method can be used.

- High efficiency fan and inverter fan.
- PV on roof (PV supply generated electricity into building.)
- LED lighting
- Illuminance correction
- Lighting Human Sensor
- Total heat exchanger
- CO2 control ventilation and High efficiency fan
- EMS (Energy management system)
- CO control of parking fans
- Glass performance improvement
- COP improvement & Inverter refrigerator
- Inverter pomp

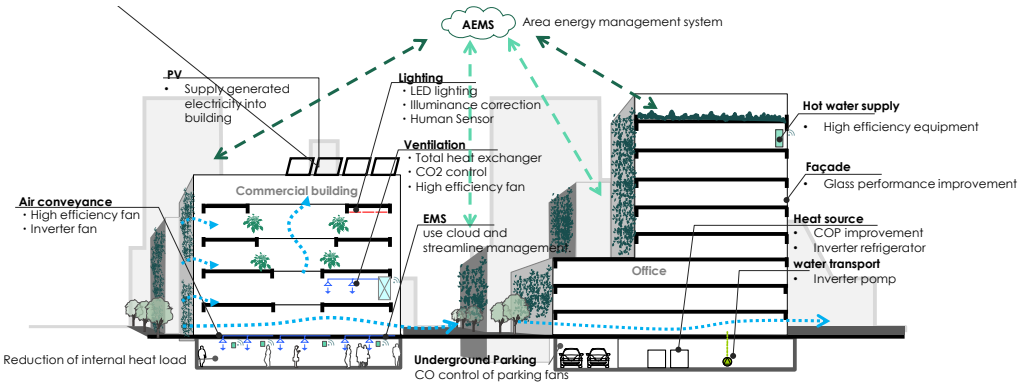


Figure 6.3-6 Low carbon building image Source: NSRI

iv) Low carbon residential houses

Passive and active design strategies is important for residential facilities. Passive methods are more important in houses rather than buildings. Passive design is a method of passively using "natural energy" such as sunshine, heat, and wind without using a machine. It is a design philosophy and design method to make comfortable housing.

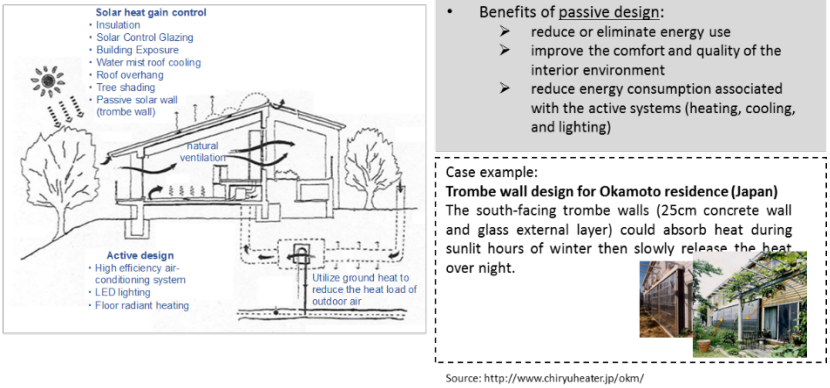


Figure 6.3-7 Low carbon building image

Source : http://www.chiryuheater.jp/okm/

6.3.3. Transportation

The North South Expressway (green line) has been constructed, linking in western Peninsular Malaysia and connect with Kuala Lumpur to Melaka. The majority of logistics rely on the road network rather than railway, causing a traffic congestion.

Hang Tuah Jaya Outer Circle (pink line) and Bandar Hijau Outer Circle (blue lie) has been proposed in order to realize smooth and efficient traffic within the district. And also, Four Lanes Road (orange line) has been proposed to upgrade road from two lanes to four lanes with a bicycle lane.

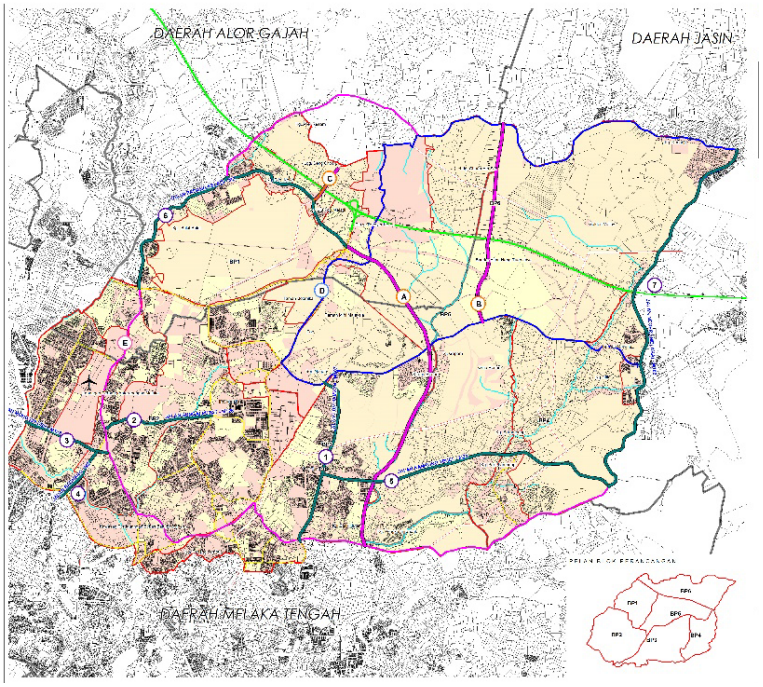


Fig. 6.3-8. Proposed new road upgrading road
Source: MPHTJ

Public transportation such as Bus and LRT has been planned to improve the commute system. And also, Transit Oriented Development (TOD) is proposed around the Melaka International Trade Centre (MITC). The bus route (Orange lines) pass through the TOD station such as Ayer Keroh and MITC, contributing to accelerate utilization of public transportation.

Hang Tuah Jaya also has steadily developed LRT plan, making progress in their master plan. On the other hand, railway connecting Kuala Lumpur and Melaka remain weak, although it seems to increase the traffic volume along with economic growth.

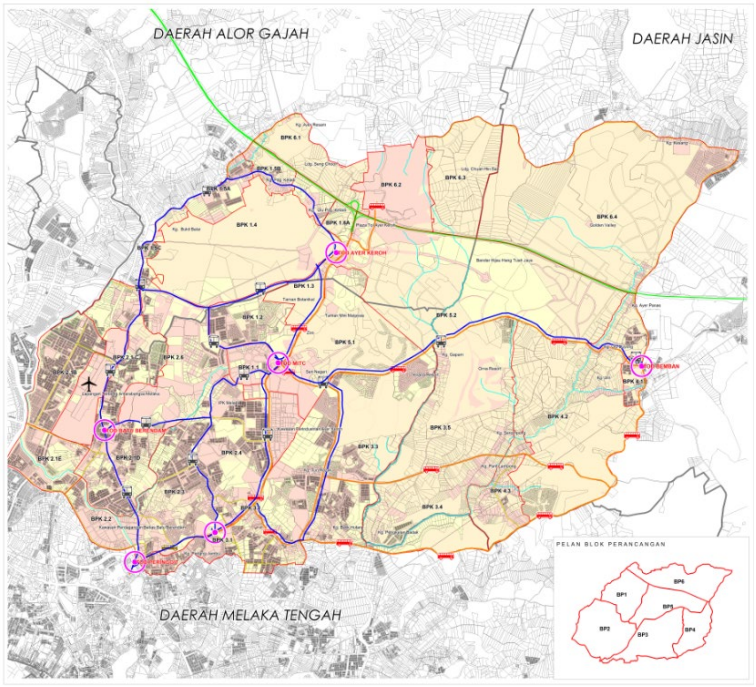


Fig. 6.3-9. Commute system and public transport
Source: MPHTJ

Our vision for Hang Tuah Jaya is of a city where people choose to take the bus instead of driving. Providing more appealing walking, cycling and public transport options is the best way to reduce car use which causes carbon dioxide emissions. The efforts have been configured on the basis of the following activities:

i) Loop bus service

Loop bus connect MICT terminal, business and commercial area and residential area around the MICT. This bus is EV mini bus and it has advanced technology functions (free wifi, smart card, USB, CCTV). Passengers can confirm bus location by their smart phone.

Fig. 6.3-10. Loop bus service
Source: NSRI

ii) Walkable street

Increasing number of people walking, cycling and using public transport has the potential to transform Hang Tuah Jaya and improve lives. We propose high-quality environment with enough space and accessible sidewalk and crossing for walking and cycling use in cooperation with parking systems such as fringe parking, which is an area for parking usually located outside the central business district.

iii) Bike sharing

Promoting efforts such as bike sharing lead to the use of public transportation and bike sharing has great potential to reduce energy consumption and emissions. From a spatial perspective, environment benefits can be much higher in more developed districts in Hang Tuah Jaya.

iv) Future mobility

As the district in which aim for an advanced low carbon development, Hang Tuah Jaya will have promoted Electric Vehicles (EVs) and Autonomous vehicles (AVs) with improved air quality and energy savings.

v) App-based services

People have been empowered by the spread of smartphone technology, enabling new types of transport service, also known as MaaS. Hang Tuah Jaya can be data-driven city based on ICT platform for making low carbon model town.

6.3.4. Untapped Energy and Renewable energy

i) Wind power

Wind energy increases in proportion to the cube of wind speed, so selection of a place with good wind conditions is essential for improving economic efficiency. Mean wind speed 7 m/s or more is preferable. So Hang Tuah Jaya has low potential of wind power generation. Mean wind speed in Hang Tuah Jaya is low as 2 - 4 m/s. The amount of power generation is not so much, so we don't recommend wind power.

Wind power generation is often installed in a relatively quiet area, so even if the level of noise generated from it is relatively low, it may affect the surrounding area (Fig.6.3-12).

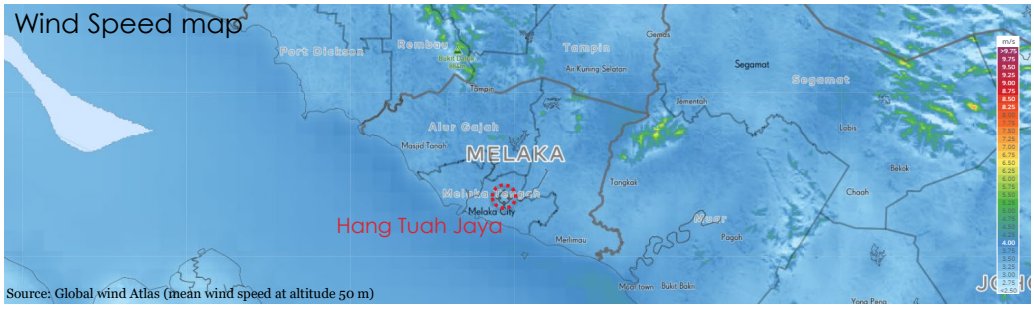


Fig. 6.3-12. Wind speed map in Hang Tuah Jaya
Source: Global wind Atlas (mean wind speed at altitude 50 m)

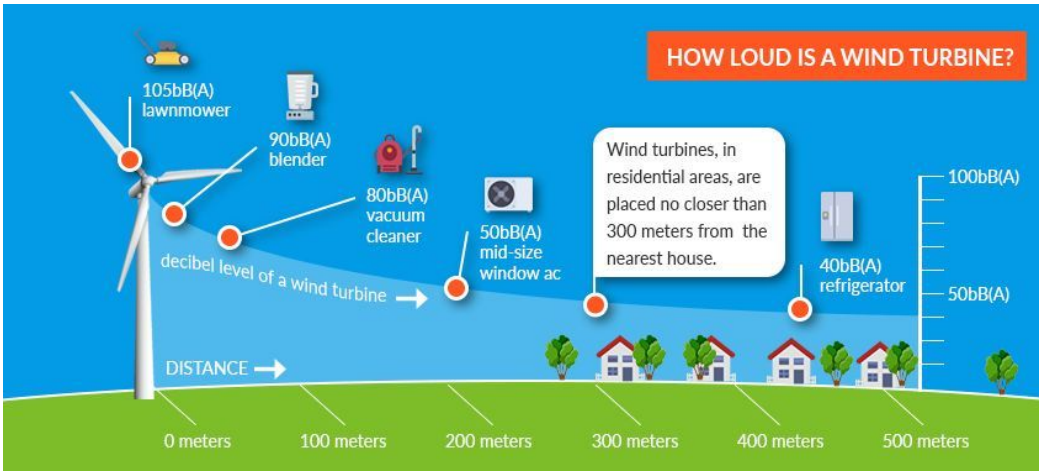


Fig. 6.3-13. Noise of wind power
Source: https://www.letsgosolar.com/consumer-education/solar-power-wind-power/

I will introduce a case of bladeless power generation instead of normal wind power generation. Bladeless wind energy system is

- An alternator system, made by coils and magnets, adapted to the vortex dynamics
- The Vortex Tacoma (2,75m) estimated rated power output is 100w.
- In wind energy conversion, power generation is proportional to the swept area of the wind turbine. Vortex currently sweeps up as much as 30 % of the working area of a conventional 3-blades-based wind turbine of identical height.
- ``Low cost, easy installation and soft maintenance.

The amount of power generation is small and it does not contribute much to low carbonization, but it can be expected to function as a landmark and enlightenment.

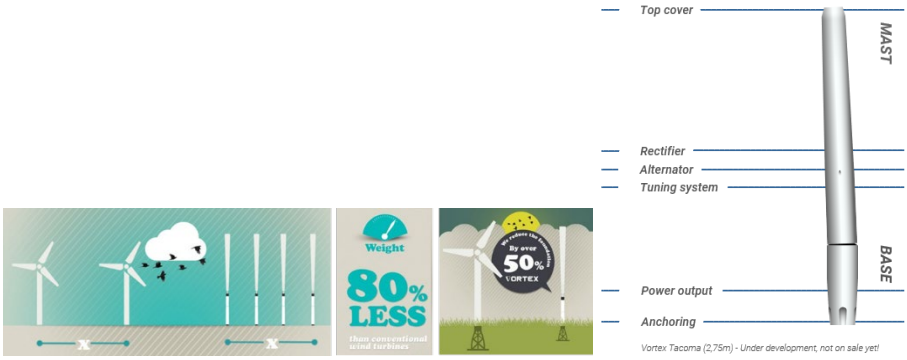
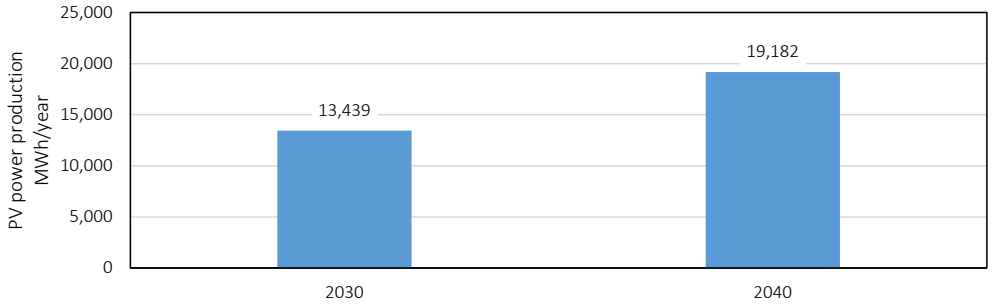


Fig. 6.3-14. Bladeless wind energy system (In development)
Source: Vortexbladeless.com

Fig. 6.3-15. Make a new land mark for the town (image) Source: Vortexbladeless.com

ii) PV

We propose to install PV power generation on roofs of offices or commercial buildings. The power generation potential of PV in the current building in Hang Tuah Jaya is about 13 MWh/year, and it increases to about 19 MWh / year as development progresses.



Ep = H×K×P
P = 0.0667 (kW/m2)×S, S＝Roof area×50%, Ep: Estimated power generation (kWh/year), H: solar radiation (1,600 kWh/m2/year), K: Loss factor（73%）, P: PV capacity (0.0677 kW/m2)　Source: NSRI, Ministry of the Environment, Japan

Fig. 6.3-16. Power generation potential of PV in Hang Tuah Jaya
Source: NSRI

6.3.5. Area Energy System and Energy Management

AEMS realize energy conservation by changing the life style of the people (a.k.a. Nudge), which supported by the energy visualization system.

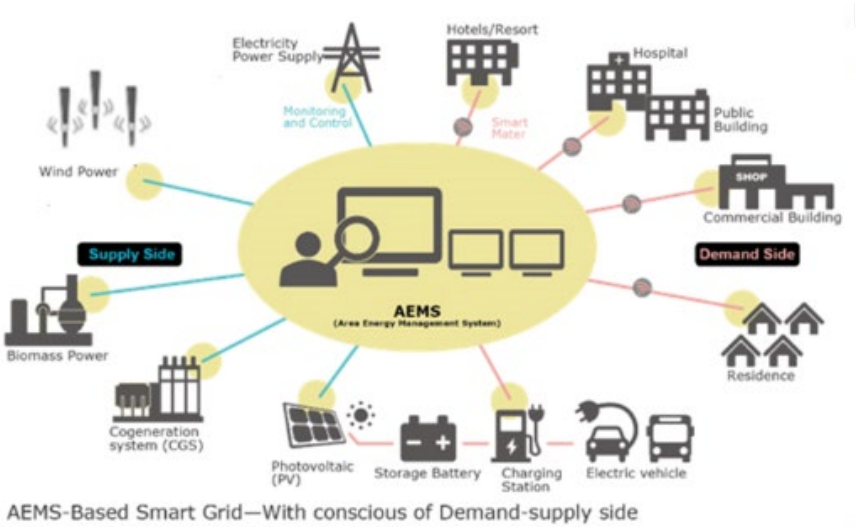


Fig. 6.3-16 AEMS image
Source: NSRI

6.4. Priorities for implementation and Perform scenario analysis

6.4.1. Energy and Environment sector

The CO2 reduction in energy and environment is shown in Fig.6.4-1 By using the previously mentioned low carbonization method, it was possible to reduce energy by 33% in 2030 and 43% in 2040.

The low carbonization method used for calculation is summarized in the following table. The method was chosen according to use of the building. The energy saving rate was decided based on our design experience in the past.

The CO2 reduction cost in energy and environment is shown in Fig. 6.4-2. Relationship between reduction rate and cumulative cost is shown in Fig.6.4-3. It is important to introduce it from those that are highly effective and inexpensive.

Table. 6.4-1. Energy and environmental sector Low carbon plan in Hang Tuah Jaya

Time	Technologies
2030	• Short-term low carbon measures in public buildings （Toward Zero-energy building） • Short-term low carbon measures in Residential buildings（Toward Zero-energy houses） • Introduction of Building energy management system and town platform • Wind power (bladeless)
2040	• Long-term low carbon measures in public buildings • Long-term low carbon measures in Residential buildings • Introduction of AEMS

Source: NSRI

Table. 6.4-2 The implementation plan of building energy conservation technologies Source: NSRI

Items	Menu	energy conservation ratio	office	commercial	hospital	hotel
			implementation time			
Heat source	COP improvement	0.282	●	●	●	●
Heat source	Reduction of internal heat generation	0.05	●	●	●	●
Heat source accessories	Inverter	0.13	●	●	●	●
Water transport	Inverter	0.18	●	●	●	●
Air conveyance	High efficiency fan	0.165	●	●	●	●
Air conveyance	Inverter	0.26	●	●	●	●
Hot water supply	Device performance improvement	0.292	–	–	●	●
lighting	Human Sensor	0.03	●	●	●	●
lighting	Illuminance	0.105	●	●	●	●
lighting	High efficiency of lighting equipment	0.376	●	–	●	●
Outlet	Reduced power	0.02	●	●	●	●
ventilation	Total heat exchanger	0.072	●	●	●	●
ventilation	CO2 control	0.057	●	●	●	●
ventilation	High efficiency fan	0.131	●	●	●	●
ventilation	Introduction of CO concentration control of parking fans	0.2	●	●	●	●
Water supply and drainage	Improve pump performance	0.15	●	●	●	●
Elevator	Smart operation	0.1	●	●	●	●
Other	Introduction of high efficiency	0.085	●	●	●	●
facade	Glass performance improvement	0.1	○	○	○	○

●Mid-term low carbon building conservation method ○Long-term low carbon building conservation method

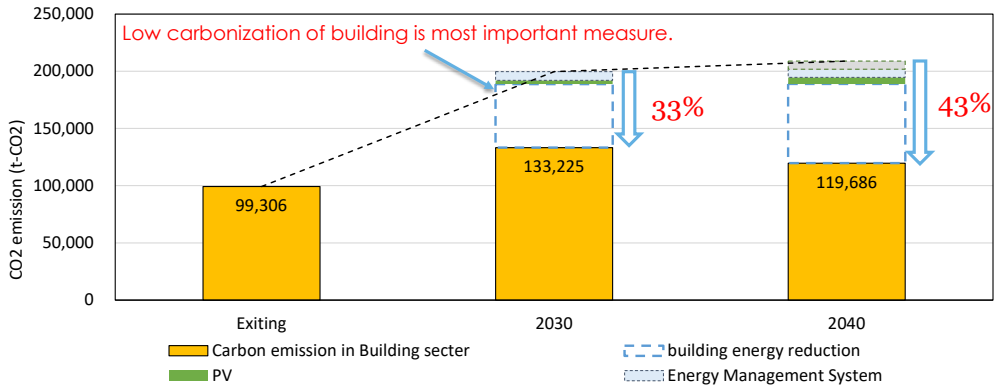


Fig. 6.4-1. CO2 reduction in energy and environment
Source: NSRI

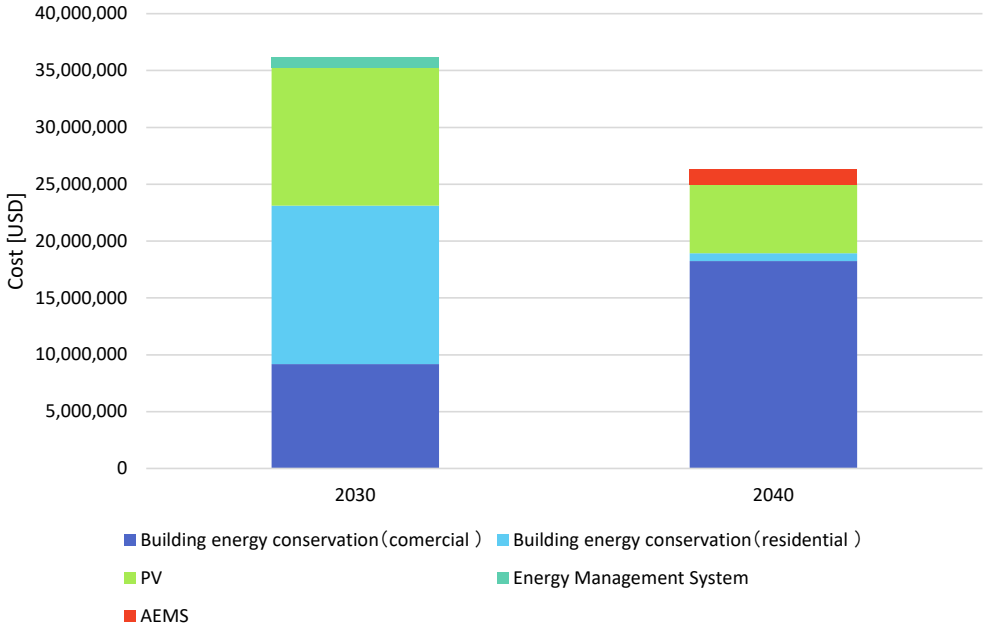


Fig. 6.4-2. CO2 reduction in energy and environment
Source: NSRI

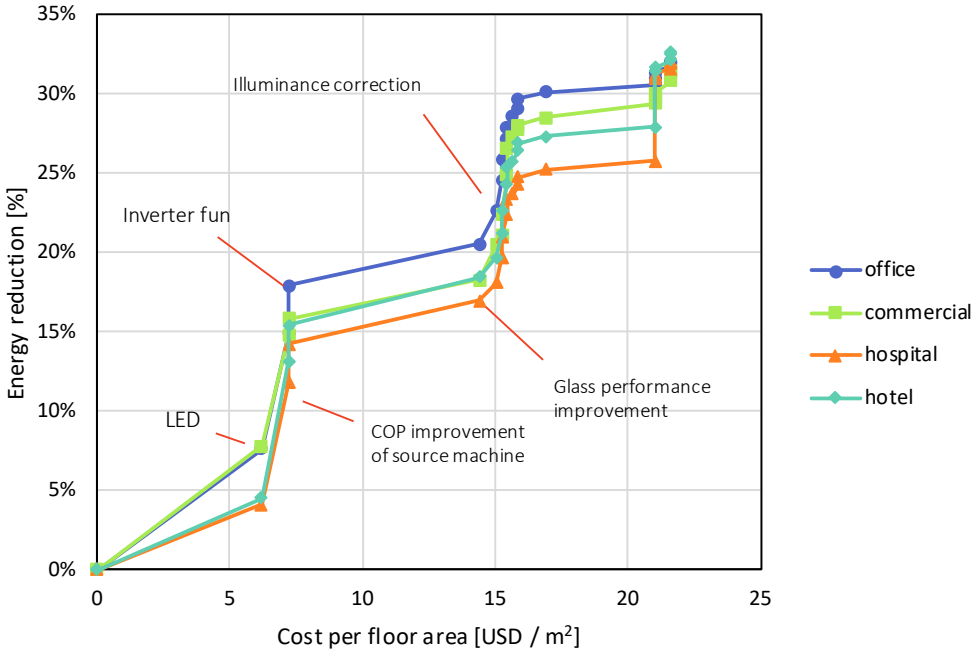


Fig. 6.4-3. Relationship between reduction rate and cumulative cost (reprint) Source: NSRI

Note: Measures automatically introduced at the time of updating equipment are supposed to be free of additional cost.

6.4.2. Transportation sector

CO2 in the traffic field is mainly emitted by private automobiles. One reason for this is because, as compared with public transportation such as railways and buses, automobiles emit a large amount of CO2 per person. In order to reduce CO2, it is effective to control the traffic volume of automobiles, use forms of public transportation with less CO2 emissions, reduce travel distance and reduce the amount of CO2 emitted by each car. In addition, it is effective to change bus transportation, which is the main form of public transportation, to vehicles with low CO2 emissions, and to reduce the amount of CO2 emitted by each bus.

We estimated the amount of CO2 reduction of vehicles such as automobile, Rolly, bus and motorcycle for areas centered on Melaka International Trade Center (MITC).

Table. 6.4-3. CO2 emission in 2018 (BAU)

	2018	2030	2040
Car	45,841 t-CO2	80,221 t-CO2	83,430 t-CO2
Rolly	4,683 t-CO2	8,196 t-CO2	8,524 t-CO2
Bus	2,263 t-CO2	2,878 t-CO2	4,119 t-CO2
Motorcycles	1,644 t-CO2	3,960 t-CO2	2,993 t-CO2
	54,432 t-CO2	95,257 t-CO2	99,067 t-CO2

Source: NSRI

The scenario is set based on the five policies such as the introduction of LRT and Loop buses, environment-friendly cars, maintenance of bicycle lane, construction of IoT platform, estimated CO2 reductions by 2040 respectively.

Among these CO2 reduction measures, it became clear that introducing LRT is most contribute. The total reduction rate of other reduction measures was about 60% of the total in the case of the scenario set this time. Therefore, it is important not only to introduce LRT, but also to tackle CO2 reduction through a comprehensive approach including other measures promoting the use of public transportation and Electric vehicle.

Table. 6.4-4. CO2 emission through scenarios

	2018	2030	2040
Car	45,841 t-CO2	57,035 t-CO2	56,894 t-CO2
Rolly	4,683 t-CO2	8,196 t-CO2	8,524 t-CO2
Bus	2,263 t-CO2	3,960 t-CO2	466 t-CO2
Motorcycles	1,644 t-CO2	2,878 t-CO2	2,864 t-CO2
	54,432 t-CO2	72,070 t-CO2	68,749 t-CO2

Source: NSRI

We estimated the CO2 emissions in 2018 (BAU) to be 54,432 t-CO2 per year as follows. Although it will be 99,067 t-CO 2 considering the increase rate of automobile by 2040, it can be expected to be reduced to 68,749 t-CO 2 (31% reduction) by promoting the use of public transportation.

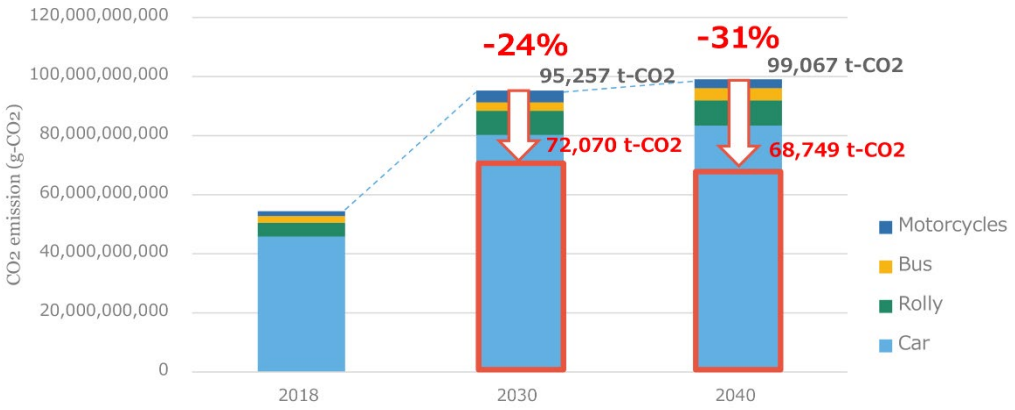


Fig. 6.4 4. CO2 reduction in Transportation

Source: NSRI

i) Case where no measure is taken (Business As Usual)

To calculate the mileage per day for the whole city, multiply the population of the city by the average daily trip number per capita and the average mileage per trip. To that value, CO2 emission indicator is integrated to calculate the CO2 emissions of the car. For the average mileage per trip, the numerical value of an equivalent-scale population city in the nationwide urban traffic characteristics survey result shall apply mutatis mutandis.

CO2 emission ＝ Traffic (Traffic volume) × Travel distance (Distance traveled)
×Emission factor (Emission intensity)

※ CO2 emission indicator uses the average value from the Ministry of Land, Infrastructure and Transport's automobile fuel consumption list.

Table. 6.4-5. CO2 emission in 2018 (BAU)

Car type	Number of vehicle	Trip distance (km/vehicle)	CO2 emission indicator (g-CO2/km)	CO2 emission (t-CO2)
Car	30,736,493	10.6	140.7	45,841
Rolly	3,688,379	10.6	119.8	4,683
Bus	409,820	10.6	521.0	2,263
Motorcycles	6,147,299	5.8	46.4	1,644
Total	40,981,991			54,432

Source: NSRI

ii) Case of 2030

As for CO 2 reduction in 2030, we propose to switch to bus transportation and general automobiles to environmentally friendly vehicles. For conversion of general vehicles to electric vehicles, we have assumed a level of 5% in 2030. In 2040, we further estimated the amount of CO2 reduction, assuming the diffusion of EV and the introduction of EV buses.

Table. 6.4-6. CO2 emission in 2030

Car type	Number of vehicle	Trip distance (km/vehicle)	CO2 emission indicator (g-CO2/km,)	CO2 emission (t-CO2)
Car	53,788,863	10.6	140.7	80,221
Rolly	6,454,664	10.6	119.8	8,196
Bus	717,185	10.6	521.0	3,960
Motorcycles	10,757,773	5.8	46.4	2,878
Total	71,718,483			95,257

Source: NSRI

BUSINESS SCHEME

07

CHAPTER 7. Business Scheme for Three Volunteer Town

Chapter7. **Business Scheme for Three Volunteer Town**

7.1. Banda Aceh City of Indonesia

7.1.1. Concept of Business scheme setting

Among the four target areas in this survey, two areas (Ulee Lehue and Alue Naga) are selected to assume business schemes since certain scale of urban development projects are forecasted in future in those 2 areas.

For these sites, 3 business schemes are proposed: Neighborhood Solar Farm in the energy sector, EV Circulation Bus Service and Area-based MaaS in the transport sector based on characteristics of each site.

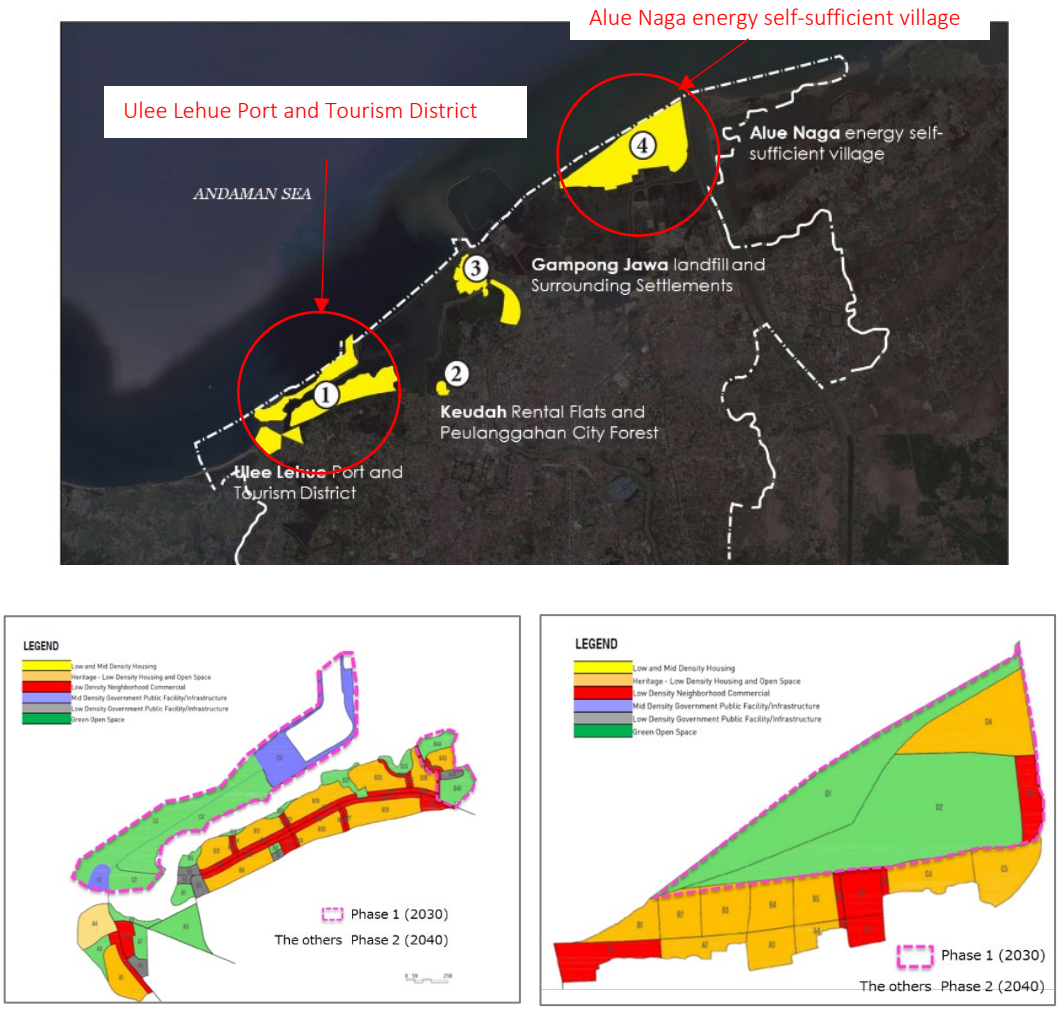


Fig. 7.1-1 Overview of targeted area for business scheme in Banda Aceh

Source: NSRI

7.1.2. Neighborhood Solar Farm

According to the existing master plan, open and green spaces are planned on both sites and it is conceivable to introduce solar power generation system utilizing some of these spaces. Also, in the area where currently detached houses are being maintained, middle and low-rise housing developments are planned in the medium to long term in future, and it is conceivable to utilize those roof area as a space for photovoltaic panels.

Local municipality or area management body installs PV panels by utilization of rooftop of building and unused land / open space within the designated area, and gain an income by selling electricity through the FIT system.

In case the FIT system is terminated, Virtual PPA should be considered as an alternative scheme.

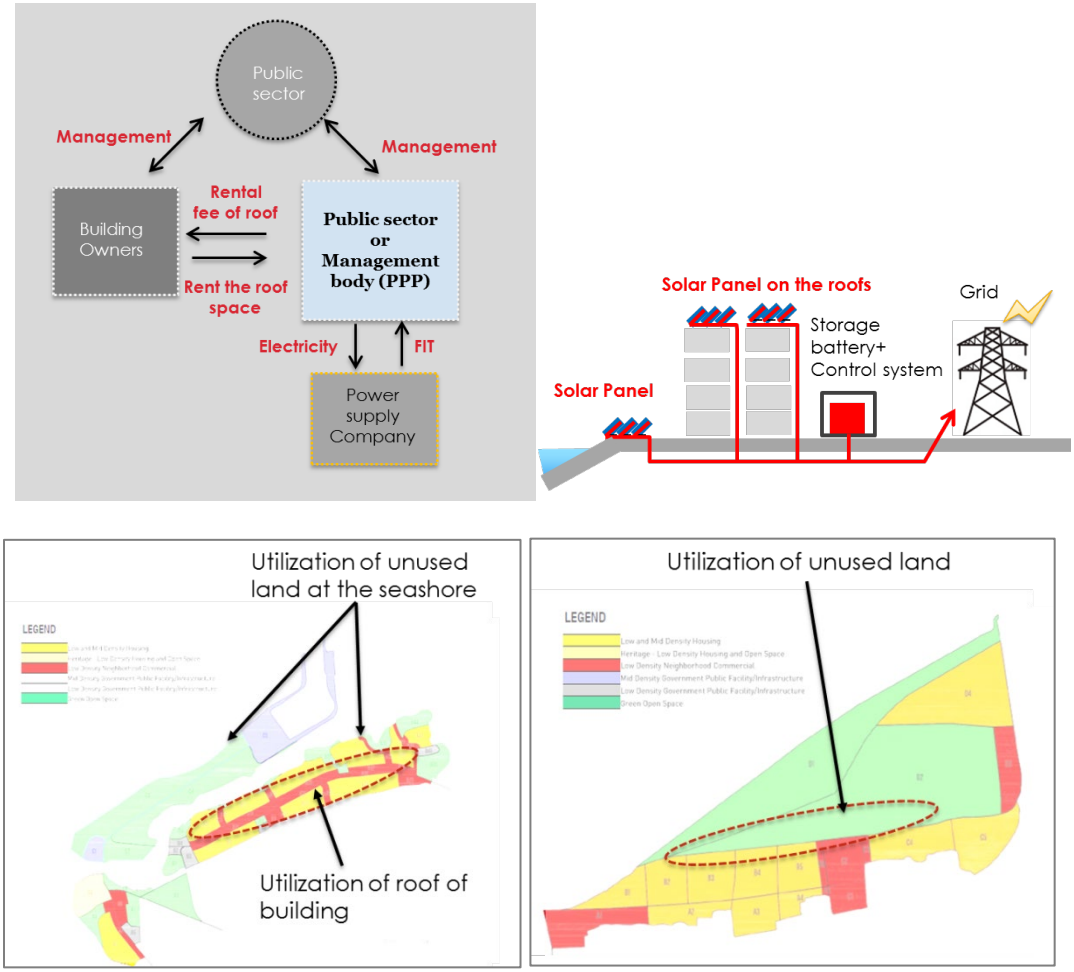


Fig. 7.1-2. Implementation plan of Neighborhood Solar Farm in Banda Aceh

Source: NSRI

7.1.3. EV Circulation Bus Service

In the Ulee Lehue district, the ferry terminal is already located, and public transportation (LRT) to connect the existing CBD and surrounding areas is planned in the future. Historical assets for tourists are also located in this district. Based on the above conditions, it is considered there is a need for circulating public transportation within the district for visitors and residents.

In the Alue Naga area, since large-scale parks and resort facilities are planned in the coastal area in the future, it is considered that there is a need for circulating public transport for visitors and residents.

Public sector or area management body leases EV bus from the company and manages circulation bus service inside of the designated area.

Management body gains basic service fee from building owners who benefit from the service, and advertisement fee caused by ads put at the bus body and bus station.

By using both circulation network done by EV, it can be regarded as an infrastructure superior in disaster prevention such as utilization as a backup power supply in case of disaster.

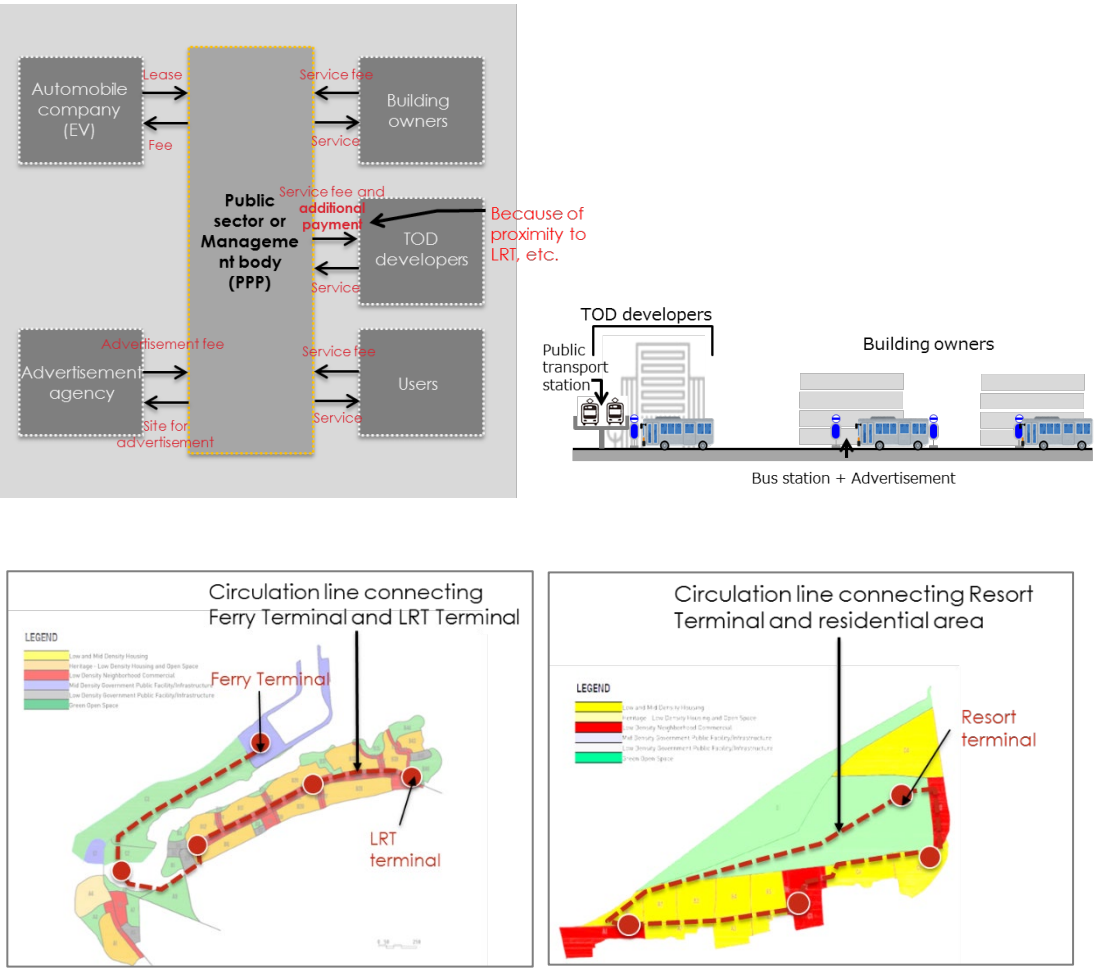


Fig. 7.1-3. Implementation plan of EV Circulation Bus Service in Banda Aceh

Source: NSRI

<Roadmap for EV Circulation bus Service>

Roadmap defines medium (2030) and long-term (2040) actions and transition needed to reach the vision. Key enabling technologies exist, but infrastructure investment must be flexible with respect to uptake of other low carbon transport fuels.

2018 Status	2030	2040
- Depot charging infrastructure required - Bus operation follows regular route to use charging facilities - Depot and workplace car park installation could be expected	- Shift work and operation of EV buses gives an unfavorable diversity factor - Synergies between regular fleet operation and network management system could bring benefits	- Battery swap infrastructure for commercial fleets could provide a more cost effective option - Ultra High power charging stations - Infrastructure to support heavy duty vehicle

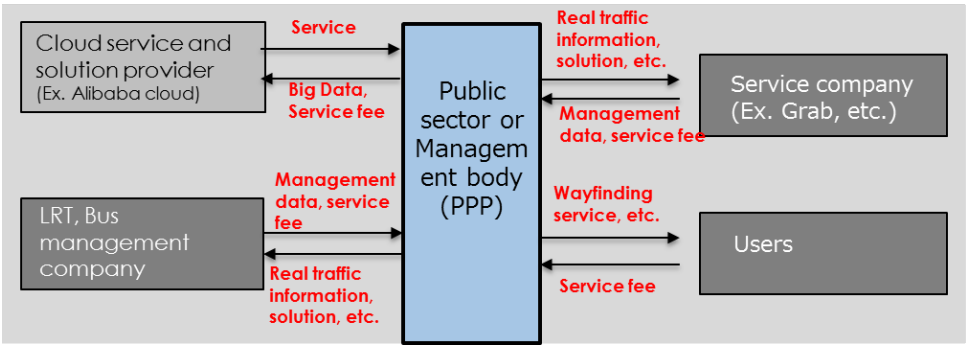
Fig. 7.1-4. Roadmap for EV Circulation Bus Service in Banda Aceh

Source: NSRI

7.1.4. Area-based MaaS (Mobility as a Service)

Currently in Indonesia, sharing mobility services such as Grab, GO-JEK are popular, and it is no exception at the site.

Public sector or management body runs traffic information platform at the designated area. Management body effectively collaborates the existing business such as Grab, GO-JEK, etc. It is forecasted that more incubator business happens by utilizing the platform.



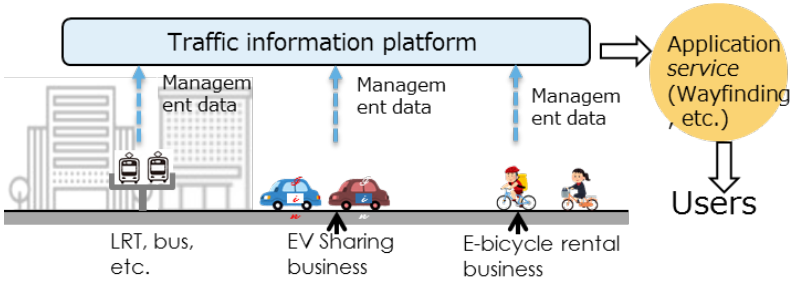


Fig. 7.1-5. Implementation plan of Area-Based MaaS in Banda Aceh

Source: NSRI

<Roadmap for MaaS>

Roadmap defines short (1-3 years) and medium-term (4-9 years) actions and transition needed to reach the vision. Key enabling technologies exist, but challenges are related to open interfaces, privacy and standardization.

Status quo	1-3 years	4-9 years
- Imbalance between transport modes (private car prioritised) - Need to open up data / interfaces / APIs - Lack of digital information - No common platforms - Low level of service integration	- Opening data, interfaces and APIs - Personal data management (secured information sharing between organization under development) - Easy access to information	- User friendly interfaces and higher transparency - Common interfaces for service providers - Improved data and use of data analysis to support decision making - Customer oriented and the possibility of choice

Fig. 7.1-6. Roadmap for MaaS in Banda Aceh

Source: NSRI

7.2. Shah Alam City Center SECTION 14, Selangor of Malaysia

7.2.1. Concept of Business scheme setting

Since several urban development projects have already been conducted in the target districts, adequate business schemes mainly for introduction to existing facilities are considered.

For these districts, 4 business schemes are proposed: Area-based Green Lease and Neighborhood Solar Farm in the energy sector, EV Circulation Bus Service and Area-based MaaS in the transport sector based on characteristics of each site.

Fig. 7.2-1. Overview of targeted area for business scheme in Shah Alam

Source: APERC

7.2.2. Area-based Green Lease

There are many office buildings in this districts, and if building owners try to carry out low carbonization, they individually introduce energy saving measures by themselves and their own risk. In this scheme, building owner who has a strong intention of low carbonization contract a “Green Lease” with the public sector. Public sector (local municipality, etc.) provide subsidy to building owner as a part of additional cost for low carbonization.

After building owner improves building equipment, reduction of utility costs caused by the above improvement, is divided by tenants and owner as an incentive of low carbonization for both sides.

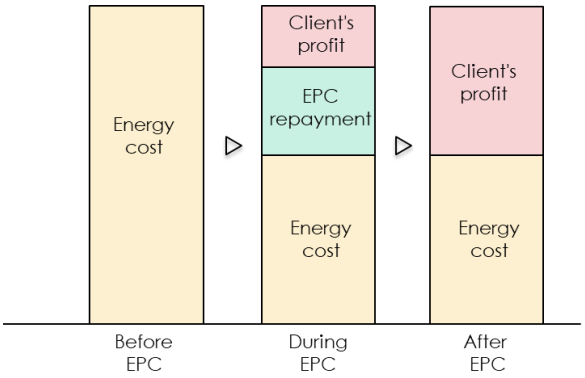
It has already been introduced in Tokyo Metropolitan Government to promote low carbonization of private buildings.

Fig. 7.2-2. Implementation plan of Area-Based Green Lease in Shah Alam

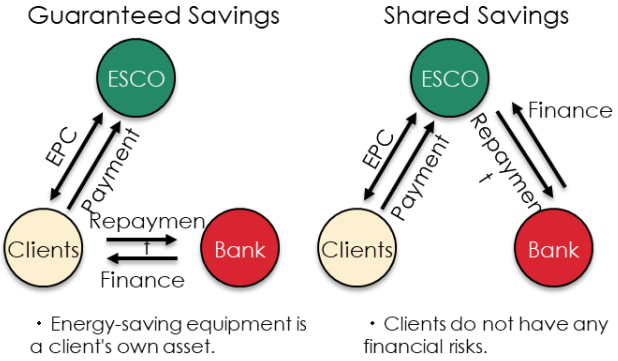
Source: NSRI, Tokyo Metropolitan Government

(Reference) Energy performance Contracting

Energy performance Contracting (EPC) in the government sector was started in Jan 2013 in Malaysia. In Japan and the United States, the private sector has also made great results through EPC.



Major contract methods

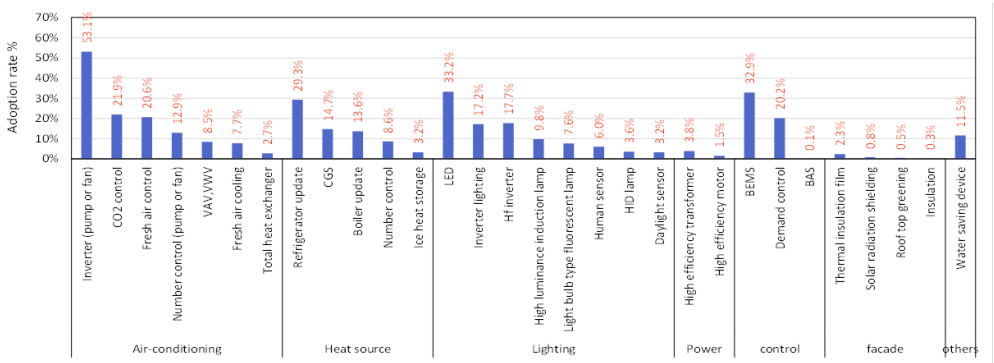


・Energy-saving equipment is a client's own asset.

・Clients do not have any financial risks.

Major energy saving methods through EPC are inverter of pumps and fans, renewal of refrigerator, LED lighting. By using the EPC scheme, LEDs and inverters in our proposal are more quickly installed.

Energy saving technology adopted by EPC (2001~2015, office & commercial building)



Source: Japan Association of Energy Service Companies

7.2.3. Neighborhood Solar Farm

Local municipality or area management body installs solar panels by utilization of rooftop of building and unused land / open space within the designated area, and gain an income by selling electricity through Virtual PPA (Power Purchase Agreements) system.

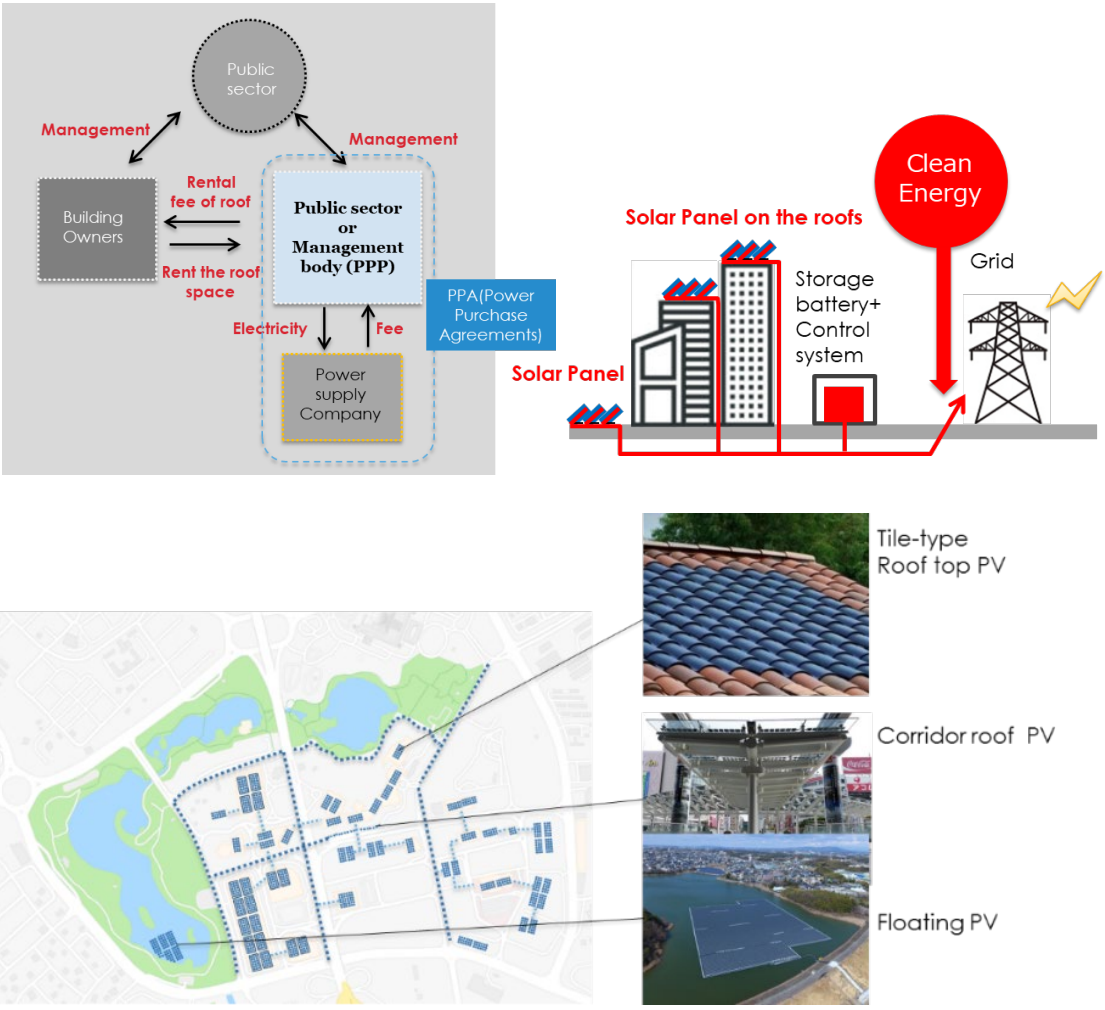
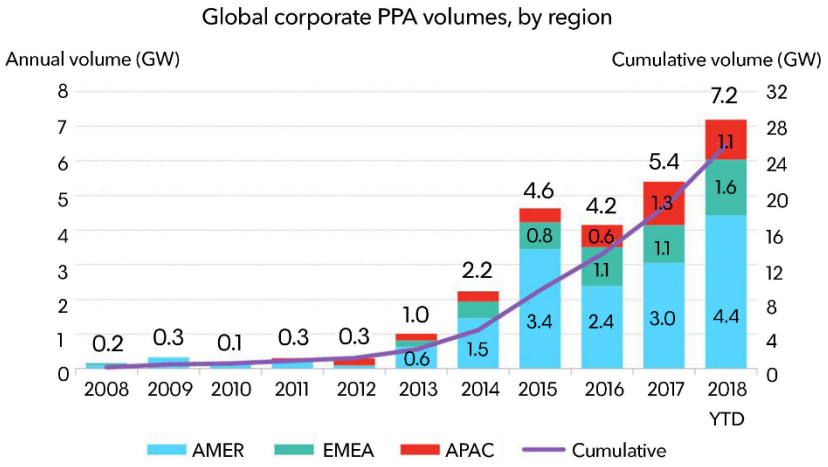


Fig. 7.2-3. Implementation plan of Neighborhood Solar Farm in Shah Alam

Source: NSRI

(Reference) Current status of PPAs

PPAs has been increased even in APA (Asia Pacific Area). In Malaysia, as TIF system terminated, an example of PPA has been appeared as stated below.



Source: Bloomberg NEF. Note: Data is through July 2018. Onsite PPAs not included. APAC number is an estimate. Pre-market reform Mexico PPAs are not included. These figures are subject to change and may be updated as more information is made available.

Example: PPAs between energy company and SPCs in Malaysia

Tenaga Nasional Bhd (TNB) has signed six large-scale solar (LSS) photovoltaic power purchase agreements (PPAs) with special-purpose companies (SPCs) set up by the winners of a bidding exercise organized by the Energy Commission in the first quarter of 2017.

https://www.thestar.com.my/business/business-news/2018/03/27/tnb-inks-six-solar-power-purchase-agreements/

7.2.4. EV Circulation Bus Service

Since urban facilities are accumulated such as offices, commerce, administrative facilities, parks, mosques and other facilities in this district, it is considered that there is a need for circular transportation within the district centering on public transportation facility such as LRT station and bus terminal. Although the circulation transportation system exists now, it is considered to catch a wider range of needs by reshuffling its route and contribute to countermeasures in case of natural disaster or blackout. By utilizing EV, it can be regarded as an infrastructure superior in disaster prevention such as utilization as a backup power supply in case of disaster.

Public sector or area management body leases EV bus from the company and manages circulation bus service inside of the designated area.

Management body gains basic service fee from building owners who benefit from the service, and advertisement fee caused by ads put at the bus body and bus station.

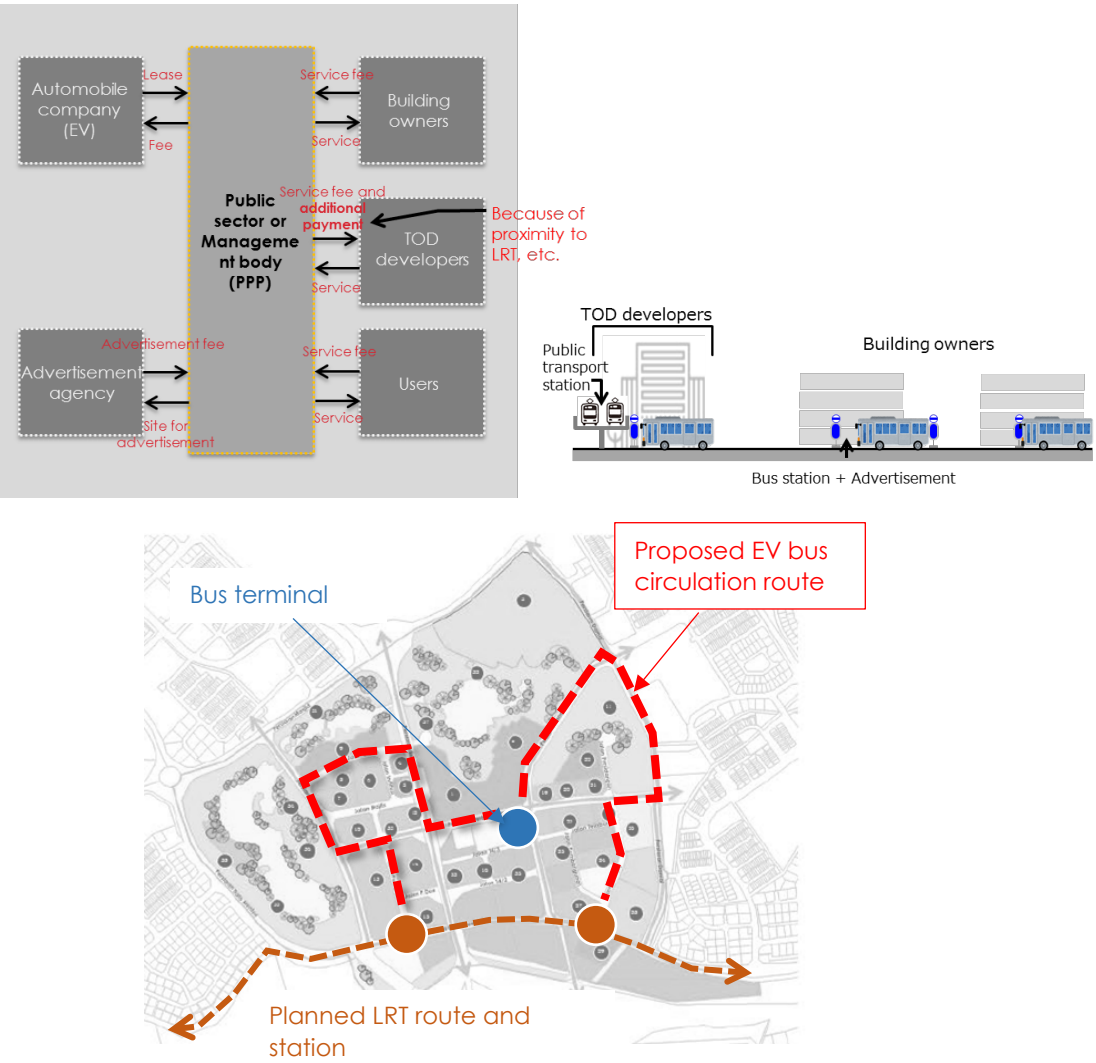


Fig. 7.2-4. Implementation plan of EV Circulation Bus Service in Shah Alam

Source: NSRI

7.2.5. Area-based MaaS (Mobility as a Service)

Currently in Malaysia, sharing mobility services such as Grab are popular, and it is no exception at the site.

Public sector or management body runs traffic information platform at the designated area. Management body effectively collaborates the existing business such as Grab, etc. It is forecasted that more incubator business happens by utilizing the platform.

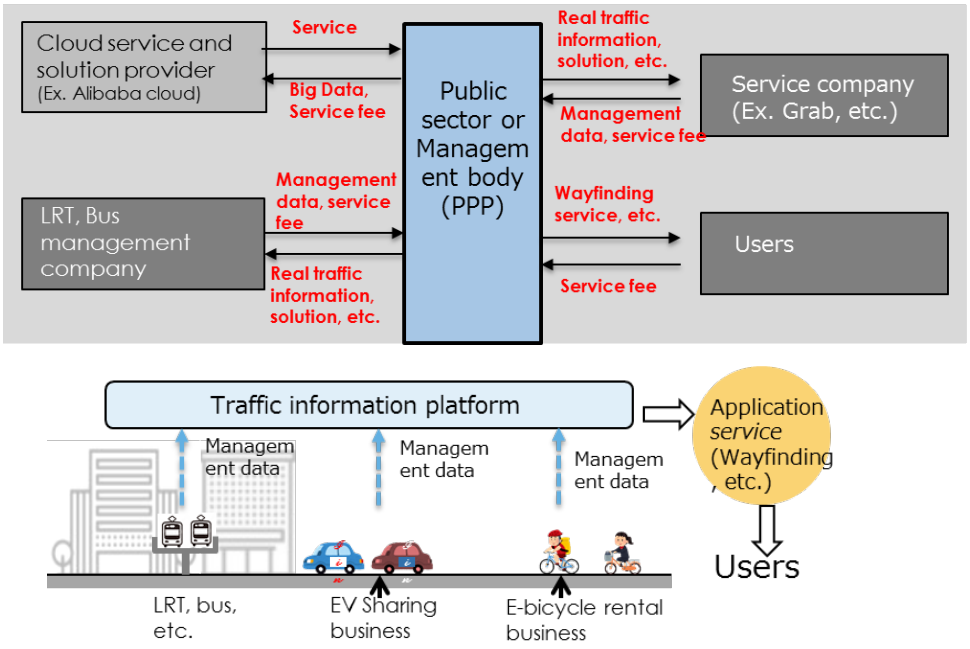


Fig. 7.2-5. Implementation plan of Area-Based MaaS in Shah Alam

Source: NSRI

7.3. Hang Tuah Jaya, Melaka of Malaysia

7.3.1. Concept of Business scheme setting

Since several urban development projects have already been conducted and developable areas are still left in the target districts, adequate business schemes both for introduction to existing facilities and for introduction to newly developed facilities are considered.

For these districts, 4 business schemes are proposed: Area-based Green Lease and Neighborhood Solar Farm in the energy sector, EV Circulation Bus Service and Area-based MaaS in the transport sector based on characteristics of each site.

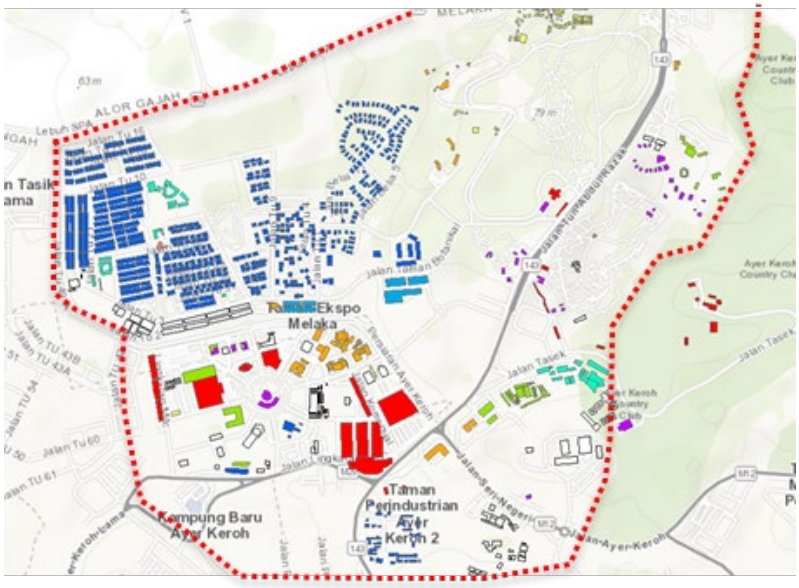


Fig. 7.3-1. Overview of targeted area for business scheme in Hang Tuah Jaya

Source: NSRI

7.3.2. Area-based Green Lease

There are several office buildings in this districts, and if building owners try to carry out low carbonization, they individually introduce energy saving measures by themselves and their own risk.

In this scheme, building owner who has a strong intention of low carbonization contract a “Green Lease” with the public sector. Public sector (local municipality, etc.) provide subsidy to building owner as a part of additional cost for low carbonization.

After building owner improves building equipment, reduction of utility costs caused by the above improvement, is divided by tenants and owner as an incentive of low carbonization for both sides.

It has already been introduced in Tokyo Metropolitan Government to promote low carbonization of private buildings.

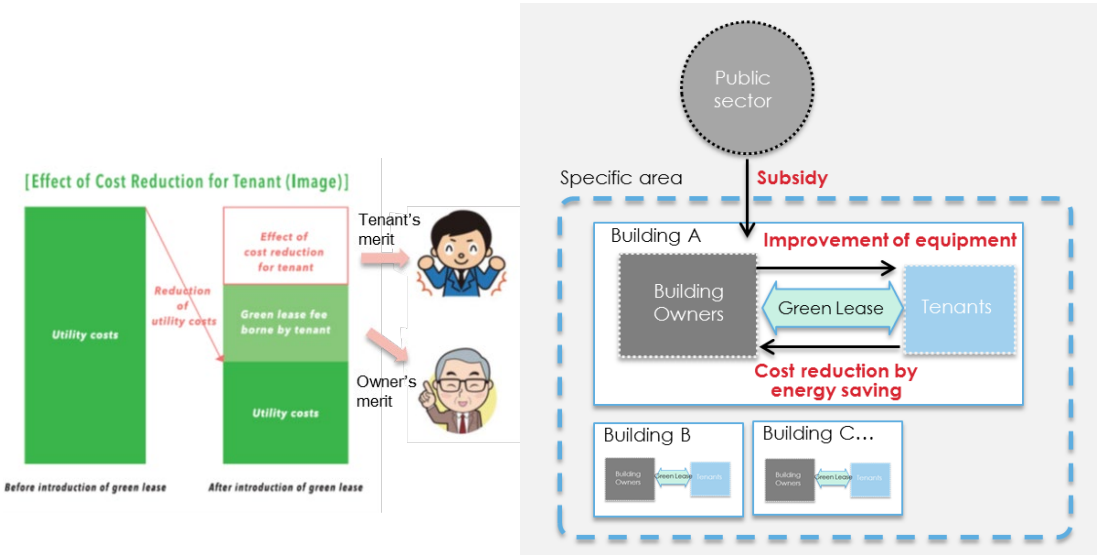


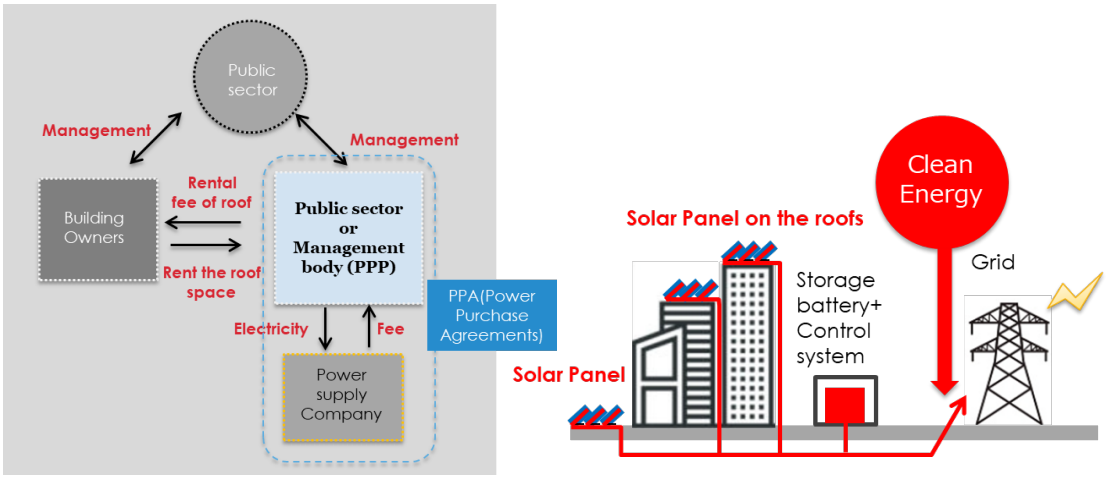
Fig. 7.3-2. Implementation plan of Area-Based Green Lease in Hang Tuah Jaya

Source: NSRI, Tokyo Metropolitan Government

7.3.3. Neighborhood Solar Farm

Local municipality or area management body installs solar panels by utilization of rooftop of building and unused land / open space within the designated area, and gain an income by selling electricity through the FIT system.

In case the FIT system is terminated, Virtual PPA should be considered as an alternative scheme.



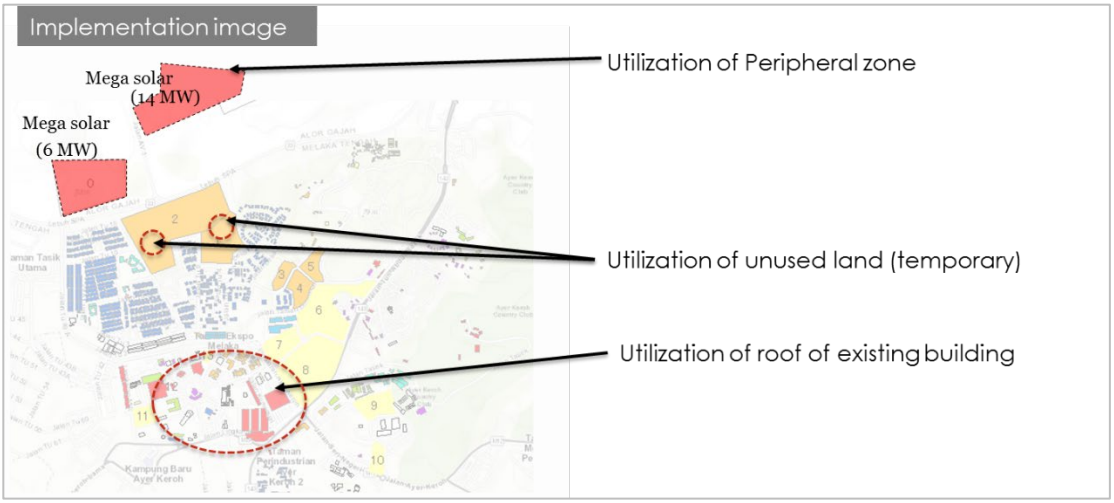


Fig. 7.3-3. Implementation plan of Neighborhood Solar Farm in Hang Tuah Jaya

Source: NSRI

7.3.4. EV Circulation Bus Service

Since there are administrative facilities, offices, residential areas and recreational facilities such as golf courses are located in the district, and a wide area public transport network is planned in the future, it is considered there is a need for circulating public transport within the district for residents and visitors.

Public sector or area management body leases EV bus from the company and manages circulation bus service inside of the designated area.

Management body gains basic service fee from building owners who benefit from the service, and advertisement fee caused by ads put at the bus body and bus station.

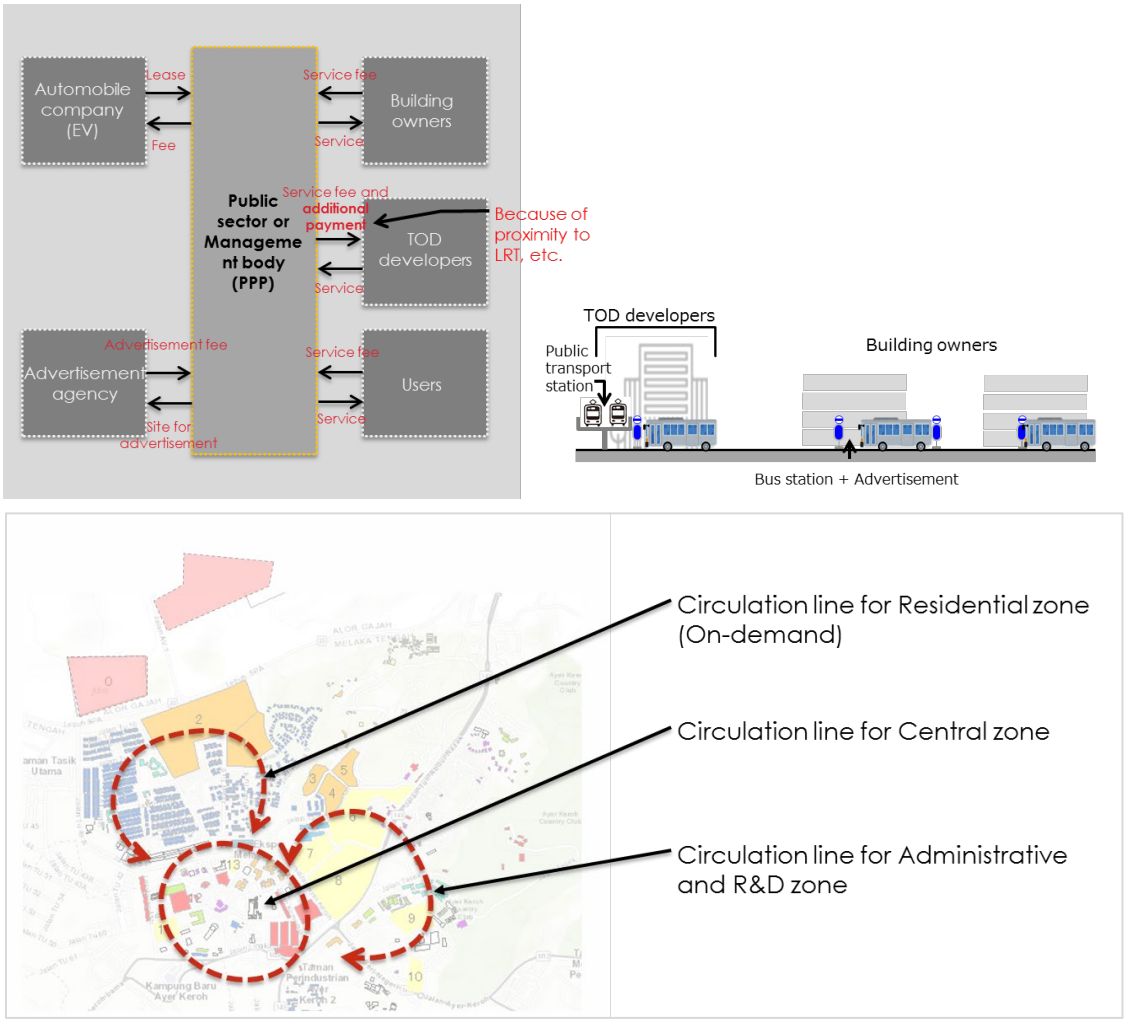


Fig. 7.3-4. Implementation plan of EV Circulation Bus Service in Hang Tuah Jaya

Source: NSRI

7.3.5. Area-based MaaS (Mobility as a Service)

Currently in Malaysia, sharing mobility services such as Grab are popular, and it is no exception at the site.

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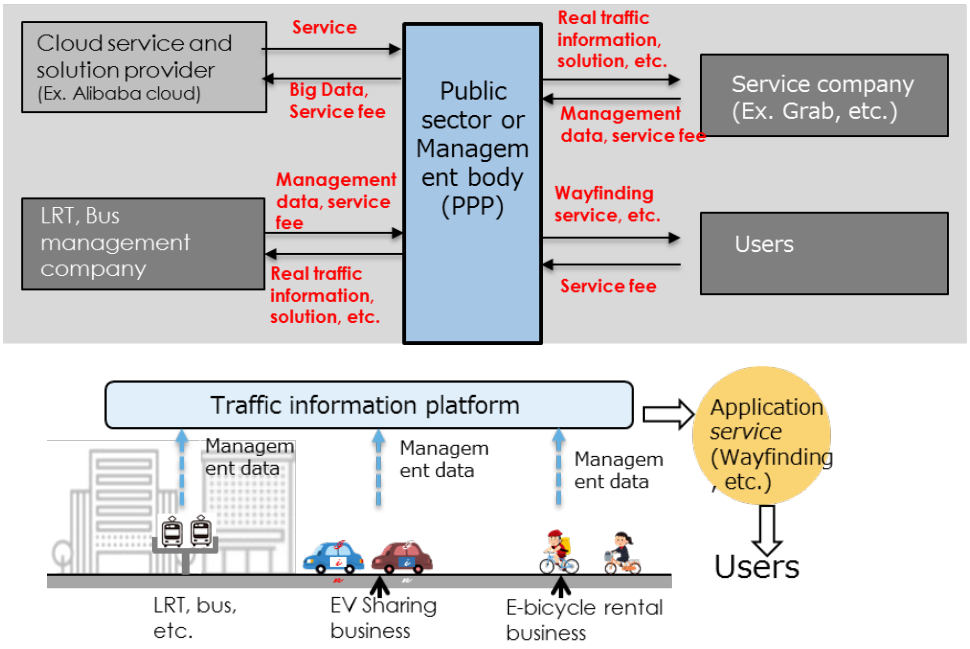


Fig. 7.3-5. Implementation plan of Area-Based MaaS in Hang Tuah Jaya

Source: NSRI

APPENDIX: Feasibility study of business scheme

For quantitative analysis, two business schemes (Neighborhood Solar Farm and EV Circulation Bus) are chosen and rough feasibility study is conducted

APPENDIX-1. Neighborhood Solar Farm

Neighborhood Solar farm Feasibility Study was conducted for a grid-tied photovoltaic system in each city. This report describes the estimated costs, anticipated annual solar power produced for the region, and Life Cycle Cost Analysis (LCCA) for this system.

The simple payback periods calculated are based solely on the overall estimated project cost and the cost savings energy costs. Also factored into the calculations are the following assumptions:

- PV installation cost varies depending on the location, but it was estimated trestles and panels cost to be placed on the roof surface.
- The rent for the installation was set at 25% of the office rent in each city, as the rent at the roof top tends to decrease as compared with the general floor. Also, the maintenance cost was estimated at 1% of the PV installation cost.
- Purchase price referred to Feed-in-tariff (FIT) supposing to contract with Power Purchase Agreement (PPA) program.
- Study period was considered for the LCCA calculations as 15 years.

1) Study in Banda Aceh

The payment is calculated based on installed capacity as we proposed for Banda Aceh:

Installed Capacity [A]	3,927 kWp
Generation per month [B]	229,309 kWh per month
Rate of PPA [C]*	USD 0.3 per kWh
Duration [D]	15 years
Payment per month [B] x [C]	USD 68,792 per month
Capital Investment (assuming USD 1,800 per kWp)**	USD 7,068,600
Maintenance cost (assuming 1% of investment)	USD 70,686
Rent for the installation (assuming 25% of floor)***	USD 1.25 per spm
Simple Payback Period	**10.1 years**

* Assume USD 0.3/month equated with FIT payment in Indonesia

**Assume USD 1,800/kWp by referring to FIT paper in Indonesia

*** Assume USD1.25/sqf per month equating with 25% of the office rent

The life cycle income was estimate at 12.3 million USD and life cycle consumption was estimated at 8.9 million USD in 15 years. Results conclude that the payback period for the described system is about 10 years.

In order to account for reducing the rate of PPA, the life cycle cost analysis take into consideration an anticipated purchase price decrease. This report evaluates a theory with Sensitivity analysis.

i) Assume 70% of USD 0.3 per month

The life cycle income was estimate at 8.6 million USD and results conclude that the payback period is about 15 years.

ii) Assume 50% of USD 0.3 per month

The life cycle income was estimate at 6.1 million USD and results conclude that the payback period is over 20 years.

2) Study in Shah Alam

The payment is calculated based on installed capacity as we proposed for Section 14:

Installed Capacity [A]	5,350 kWp
Generation per month [B]	504,779 kWh per month
Rate of PPA [C]*	USD 0.37 per kWh
Duration [D]	15 years
Payment per month [B] x [C]	USD 186,768 per month
Capital Investment (assuming USD 3,250 per kWp)**	USD 17,387,500
Maintenance cost (assuming 1% of investment)	USD 173,875
Rent for the installation (assuming 25% of floor)***	USD 1.88 per spm
Simple Payback Period	9.7 years

* Assume RM 1.49/month equated with FIT payment in Malaysia

**Assume RM 13,000/kWp by referring to FIT brochure in Malaysia

*** Assume RM 0.75/sqf per month equating with 25% of the office rent

The life cycle income was estimate at 33.8 million USD and life cycle consumption was estimated at 22.1 million USD in 15 years. Results conclude that the payback period for the described system is about 9 years.

In order to account for reducing the rate of PPA, the life cycle cost analysis take into consideration an anticipated purchase price decrease. This report evaluates a theory with Sensitivity analysis.

i) Assume 70% of RM1.49 per month

The life cycle income was estimate at 23 million USD and results conclude that the payback period is about 13 years.

ii) Assume 50% of RM1.49 per month

The life cycle income was estimate at 17 million USD and results conclude that the payback period is over 20 years.

3) Study in Hang Tuah Jaya

The payment is calculated based on installed capacity as we proposed for Hang Tuah Jaya:

Installed Capacity [A]	14,773 kWp
Generation per month [B]	1,598,500 kWh per month
Rate of PPA [C]*	USD 0.37 per kWh
Duration [D]	15 years
Payment per month [B] x [C]	USD 591,445 per month
Capital Investment (assuming USD 3,250 per kWp)**	USD 48,012,250
Maintenance cost (assuming 1% of investment)	USD 480,123
Rent for the installation (assuming 25% of floor)***	USD 1.88 per spm
Simple Payback Period	7.7 years

* Assume RM 1.49/month equated with FIT payment in Malaysia

**Assume RM 13,000/kWp by referring to FIT brochure in Malaysia

*** Assume RM 0.75/sqf per month equating with 25% of the office rent

The life cycle income was estimate at 107 million USD and life cycle consumption was estimated at 62 million USD in 15 years. Results conclude that the payback period for the described system is about 7 years.

In order to account for reducing the rate of PPA, the life cycle cost analysis take into consideration an anticipated purchase price decrease. This report evaluates a theory with Sensitivity analysis.

i) Assume 70% of RM1.49 per month

The life cycle income was estimate at 75 million USD and results conclude that the payback period is about 11 years.

ii) Assume 50% of RM1.49 per month

The life cycle income was estimate at 53 million USD and results conclude that the payback period is about 18 years.

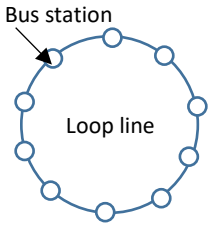
The calculated economic payback period for a Neighborhood Solar farm system, a grid installations in each city. Any financial incentives lowering the initial costs would be the primary consideration in reducing the payback period for such a system, thereby increasing the potential for residents and business in the target area to invest in photovoltaic system technologies. Business may be able to claim accelerated depreciation against the cost of their system. This could result in a substantial reduction in the payback period for solar investment.

APPENDIX-2. Circulation EV Bus System

Followings are rough feasibility study on the Circulation EV Bus proposed in the business scheme. Since situations for circulation bus system varies in every city, typical situation as expected as well in any city is described in this study. Each price is assumed based on basically referential examples in Malaysia and experiences in Japan.

1) Assumption of basic case

1)-1. Bus circulation network



- Loop line, 4km length
- 10 bus terminals (averaged distance between terminals is approximately 400m)
- Approximately 30 minutes per one loop (Appearance speed* approximately 8km per hour)
  * Included time for parking at the signal, getting on and off, etc.
- 3 EV bus (every 10 minutes at peak hour)

1)-2. Expenses

	Item	Unit price	Notes
Initial	Purchase cost of EV bus	240K USD / bus	Assumed EV bus made for “easymile” Resource: *1
	Bus station building cost	40K USD / station	Based on typical examples in Japan
Running	Operating cost of EV bus	34K USD / bus	Assumed EV bus made for ”easymile” Resource: *1
	Labor cost of driver	3,800 USD / person	Assumed semi-skilled worker in Malaysia
	Other cost	5% of above total cost	Based on experiences in Japan

1)-3. Incomes

	Item		Unit price	Notes
Initial	Subsidy from public sector		50% of purchase cost of EV bus	Referred to subsidy system in Japan
Running	Ride fare		0.3USD / ride	Assumed a minimum ride fare of bus in Malaysia
	Number of passengers		100 PAX / day =36K PAX / year	Referred to a number of PAX of community bus at the local city in Japan
	Advertise ment	Bus full body	375 USD / month	Based on public transportation media rate card in Malaysia Resource: *2
		Bus station	2,500 USD / year	
	Development charges from building owners		—	Not assumed in this study

*1: Evaluation of Automated Vehicle Technology for Transit – 2016 Update / April 2016 / National Center for Transit Research (NCTR)
*2: Public Transportation Media Rate Card / vectordesigns

2) Financial study on basic case

- Calculated 15 years of life cycle income and expense. 15 years total income is approximately 1.1M USD and 15 years total expense is approximately 3.7M USD. Balance of income for 15 years (total income / total expense) is approximately 30%.

- Compared to a case operated as a public work, this model can help getting more income as 30% of total expense, however, it is considered difficult to establish as a business project at the present moment. In order to establish it more feasible, economic support from both public and private sectors, as well as positive factors such as increase in users due to system dissemination, price reduction of EV bus related system, etc. are required.

- For further improvement of business performance, several measures are considered.
  - Obtaining more subsidy or development charges from owners who has benefit from this model
  - Reducing operation cost of EV bus and others
  - Increasing passengers by encouraging workers to use public transportation system

Income											
									total		NOTES
Initial	Subsidy		50%						360,000	USD	**% of EV sales cost
	Sub total								360,000	USD	
Running	Fare		0.3	USD	100	users/day	365	days	10,950	USD/year	Minimum bus fare in Malaysia
	Advertisement	For bus	375	USD/ month	3	cars	12	months	13,500	USD/year	Advertisement rate in Malaysia
		For bus stations	2,500	USD/ year	10	stations			25,000	USD/year	
	Development charge			USD	10				0	USD/year	
	Sub Total								49,450	USD/year	
			15	yrs							
Total 15yrs Income									1,101,750	USD	

Expense								
						total		NOTES
Initial	EV Sales	240,000	USD	3	Cars	720,000	USD	
	Bus station	40,000	USD	10	stations	400,000	USD	
	Sub total					1,120,000	USD	
Running	Operating cost for EV bus	34,000	USD	3	Cars	102,000	USD	
	Labor cost	3,750		3	drivers	11,250	USD	Typical labor cost of Malaysian
	Others	5%				56,000	USD	**% of Initial cost
							USD	
	Sub Total					169,250	USD	
		15	yrs					
Total 15yrs Cost						3,658,750	USD	

15 years Balance of Income: **30.11%**

Fig. 7-1. Overview of study of basic case
Source: NSRI

3) Sensitivity analysis

By changing variables, sensitivity of a result of 15 years balance of income has been analyzed.

3)-1. Rate of Subsidy

Although a rate of subsidy is assumed 50% in basic case, other rates are studied as stated below. Even if subsidy is supplied for 100% of purchase cost of EV bus, 15 years balance of income becomes only 40%+.

Subsidy rate for EV bus CAPEX	0%	25%	50%	75%	100%
15ys Income / 15yrs Cost	20.27	25.19	30.11	35.03	39.95

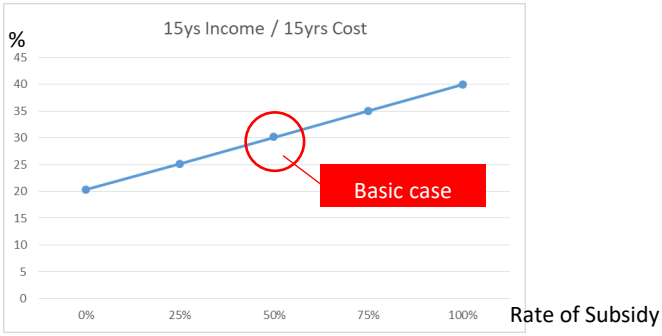


Fig. 7-2. Feasibility study of subsidy rates
Source: NSRI

3)-2. Number of passengers

Although a number of passengers is assumed 100 per day in basic case, other numbers are studied as stated below. Even if a number of PAX is increased to 500 (5 times as a basic case), 15 years balance of income becomes only 50%+.

# of daily pax	0	100	200	300	400	500
15ys Income / 15yrs Cost	25.62	30.11	34.6	39.09	43.58	48.07

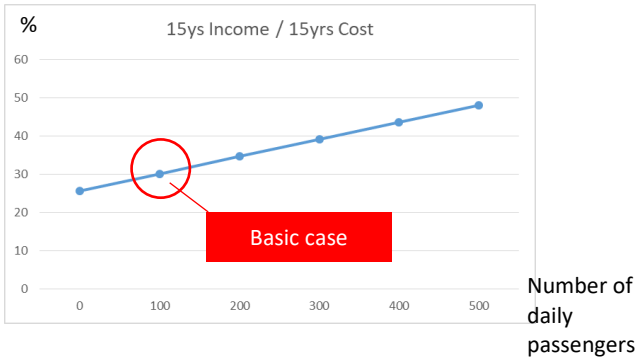


Fig. 7-3. Feasibility study of number of PAX
Source: NSRI

FINAL REPORT

APEC Low Carbon Model Town (LCMT) Project Dissemination Phase 1

Asia-Pacific
Economic Cooperation

APEC Energy Working Group

April 2019