FY2022 Project for Ministry of the Environment Japan

# FY2022
# City to City Collaboration for Zero-carbon Society

## Carbon-Free Model Area Development Project (Phase 1)
## (City of Kitakyushu－Iskandar Regional Development Authority Collaboration Project)
## Report

March 2023

NTT Data Institute of Management Consulting, Inc.

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# Chapter 1. Overview and Background

## 1.1 Overview

### 1.1.1 Objective

The 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21) was held in Paris, France in December 2015. Attended by all nations that make up the United Nations Framework on Climate Change, the session saw the adoption of the Paris Agreement, a legal framework for taking fair and effective measures to combat climate change in 2020 and beyond. The Paris Agreement promotes efforts aimed at decarbonisation, calling for nations to keep global temperature rise well below 2 degrees centigrade compared to pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees centigrade. At COP21, it was decided that stakeholders would be asked to be aware of the actions of non-state actors such as municipalities, welcome the efforts of all non-governmental actors (municipalities and other local public bodies), and scale up their efforts.

COP22 was then held in Marrakesh, Morocco in November 2016. This session saw the delivery of the Marrakesh Action Proclamation for our Climate and Sustainable Development, which reemphasized the urgent need to address global warming of an unprecedented scale. It also served as a substantial opportunity to reconfirm the importance of global actions by states as well as local governments and to achieve further prosperity and sustainable development through economic change.

These sessions were followed by COP23 held in Bonn, Germany (host country: Fiji) in 2017; COP24 held in Katowice, Poland in 2018; and COP25 held in Madrid, Spain in December 2019). Japan expressed its proactive stance towards decarbonisation to all nations present at the sessions.

In 2020, the Paris Agreement finally entered the implementation phase. The Paris Agreement calls for accelerating climate change by nongovernmental entities, including municipalities and cities, in addition to the central government, and the "Online Conference" on Recovery from the New Coronavirus and Climate Change and Environmental Measures held in September 2020 was a key event in this regard. The "Platform" ministerial-level meeting also confirmed the need for local government decarbonisation policies for activities directly related to communities and the importance of a local community-led development approach. In Japan, too, the goal of a decarbonized society by reducing overall greenhouse gas emissions to zero by 2050 has been declared, and the number of municipalities declaring virtually zero CO2 emissions has skyrocketed to more than 800.

As described above, the role of cities and municipalities in considering and implementing specific local climate change measures and projects is becoming increasingly important. In

order to realize a decarbonized society in the world as a whole, it is necessary to accelerate the movement toward building a sustainable decarbonized society, especially in Asia, where economic growth is remarkable, and there is a growing international movement to support cities' efforts toward decarbonisation and low-carbon cities, which are places of activity that support socioeconomic development. The number of companies that are currently in the process of developing their own business models is increasing.

In addition, under the current situation of the spread of the novel coronavirus, cities are being forced to readjust and consider new measures to achieve sustainable development while dealing with challenges related to the spread of the virus, and it is extremely important to build new methods and new cities through collaboration among cities.

In light of the above, this project aims to develop a new approach and new cities through collaboration between Kitakyushu City and the Iskandar Regional Development Authority (IRDA), both of which have experience and expertise in the formation of decarbonized societies, and to develop a new approach for the realization of a decarbonized society as well as a new approach for the creation of new cities that can achieve sustainable development. The project will conduct a research project to support initiatives in overseas municipalities, etc. for the formation of a decarbonised and low-carbon society, the realisation of a decarbonisation domino, and the introduction of equipment that contributes to the formation of a decarbonised and low-carbon society, targeting inter-industry collaboration in industrial parks, the introduction of solar power generation in commercial facilities and the introduction of waste-to-energy.

### 1.1.2 Activities

This study will be conducted with support from Malaysia's Iskandar Regional Development Authority and Kitakyushu and will involve the following activities aimed at promoting decarbonisation in Malaysia and achieving a JCM project that will contribute to this goal.

- Activity 1: Create inter-industry collaboration projects for decarbonisation of the industrial sector
- Activity 2: Introduce renewable energy for decarbonisation of the consumer sector

### 1.1.3 Project methodology

(3)-1. Activity 1: Create inter-industry collaboration projects for decarbonisation of the industrial sector

| | The activity item | What's in the activity? |
|---|---|---|
| 1. | Detailed understanding of waste heat generation and feasibility study | Through activities 1) to 3), studies will be conducted aiming at energy management for the entire industrial park beyond the boundaries of industries and companies, based on the waste heat |
| 2. | Survey on the status of | |

| | | |
|---|---|---|
| | drainage facilities, pipelines, and other infrastructure in the industrial park | and waste water treatment status of each company, and batch supply and batch treatment of waste water for use.<br>Specifically, pilot projects will be created to identify the waste heat generation status of each company in real time, optimise the use of heat pumps and demand response in collaboration with other companies, and reduce incineration energy by enabling the treatment of highly concentrated organic waste water through dilution in batch waste water treatment, introduction of advanced treatment, etc. |
| 3. | Selection of candidate companies<br>(local companies and Japanese companies with related technologies) | |

(3)-2. Activity 2: Introduce renewable energy for decarbonisation of the consumer sector

| | The activity item | What's in the activity? |
|---|---|---|
| 1. | Introduction of solar PV facilities based on '100% Renewable Energy Kitakyushu Model' | Using the '100% Renewable Energy Kitakyushu Model', a study will be conducted on the feasibility of introducing renewable energy, particularly in shopping malls, which account for approximately 65% of the energy demand in the consumer and commercial sector.<br>(1) Investigation of the potential for Solar PV installation in the consumer sector.<br>(2) Consideration of technologies to be introduced.<br>(3) Consideration of economic feasibility.<br>(4) Trial calculation of emission reduction effects.<br>(5) Consideration of how administrative support systems etc. should be formulated for the introduction of renewable energy. |
| 2. | Realize Waste-to-Energy as a base-load power source | Check the progress of waste-to-energy projects in the Iskandar region, and examine and upgrade project proposals in collaboration with local companies (SWM Environment Sdn. Bhd. and others). |

### 1.1.4 Action framework for study

As shown in Table 1, this survey is conducted in collaboration with City of Kitakyushu, NTT Data Institute of Management Consulting, Nippon Steel Engineering, and the Iskandar Regional Development Agency.

Table 1-1 Implementation System Diagram

| Business operators | Role |
|---|---|
| Kitakyushu | ・ Coordination of consultations with IRDA, etc.<br>・ Activities aimed at realizing an industrially symbiotic eco-town |
| NTT Data Management Laboratories | ・ Compilation of the Project<br>・ Coordination of meeting discussions with IRDA and others<br>・ Study on the realisation of inter-industry collaboration in industrial estates<br>・ Study on the introduction of Solar PV in commercial premises |
| JAPAN STEEL ENGINEERING | ・ Technical considerations for the realization of waste power generation |
| Iskandar Regional Development Authority(IRDA) | ・ Collection of inventory data on waste discharged from factories<br>・ Collection of local information on waste power generation |

### 1.1.5 Study schedule

The three-year business plan envisioned for this project is shown in Figure 1. This year is the first of the three-year period. The project period is from 21 June 2022 to 10 March 2023.

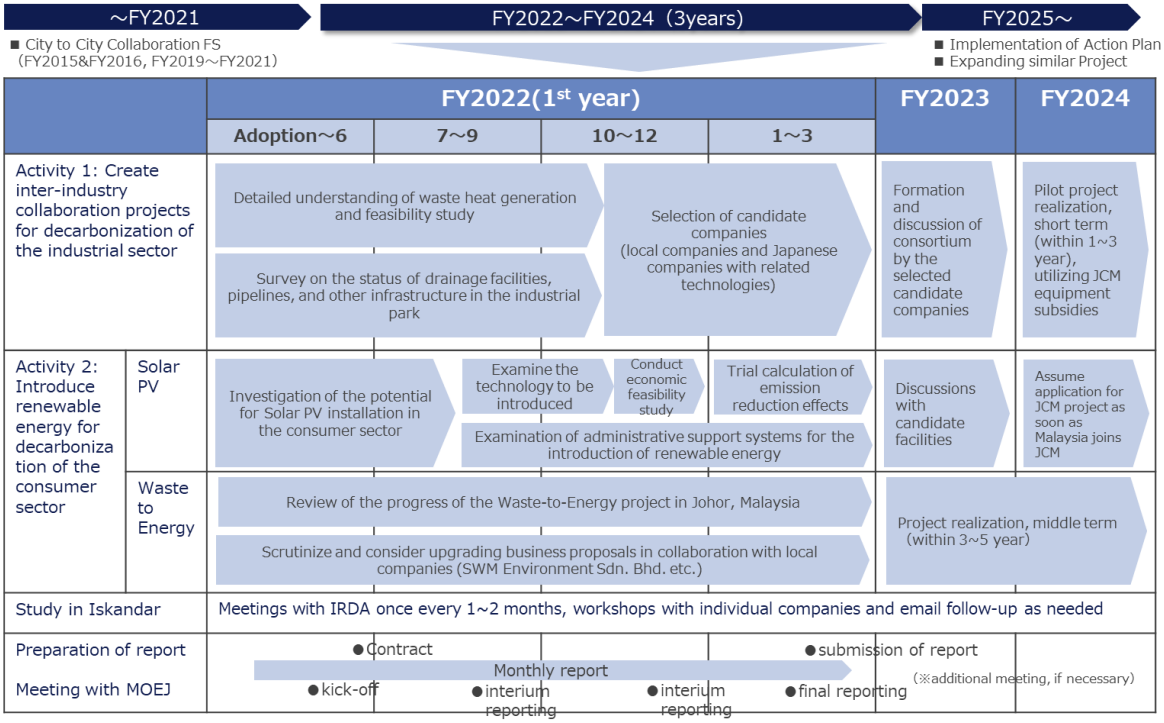


Figure 1-1 Tentative study schedule

## 1.2 Background

### 1.2.1 Overview of the IRDA

(1) About the IRDA

The Iskandar Regional Development Authority (IRDA) is a governmental agency established in 2007 to direct efforts at promoting Iskandar Malaysia. By regulating public and private interests, it aims to promote the development of a sustainable international city. The IRDA has three core functions and areas of legal authority for achieving the above objectives.

(a) Planning

Integrating and recommending planning policy from the federal government, the state of Johor, and local governments to help improve well-being in Iskandar Malaysia. Identifying and developing strategies to enhance infrastructure, skills, and scientific research for Iskandar Malaysia development.

(b) Promotion

Undertaking broad-based promotion of Iskandar Malaysia to the general public and potential investors. Driving, coordinating, and monitoring the development of economic sectors and social infrastructure for both local and overseas.

(c) Facilitation

Providing consultation and information on investing in Iskandar Malaysia. Acting as the principal coordinating agent on behalf of relevant government agencies in relation to receiving, processing, and expediting requisite approvals for investors in Iskandar Malaysia. Assisting existing investors in resolving issues affecting their business environment.

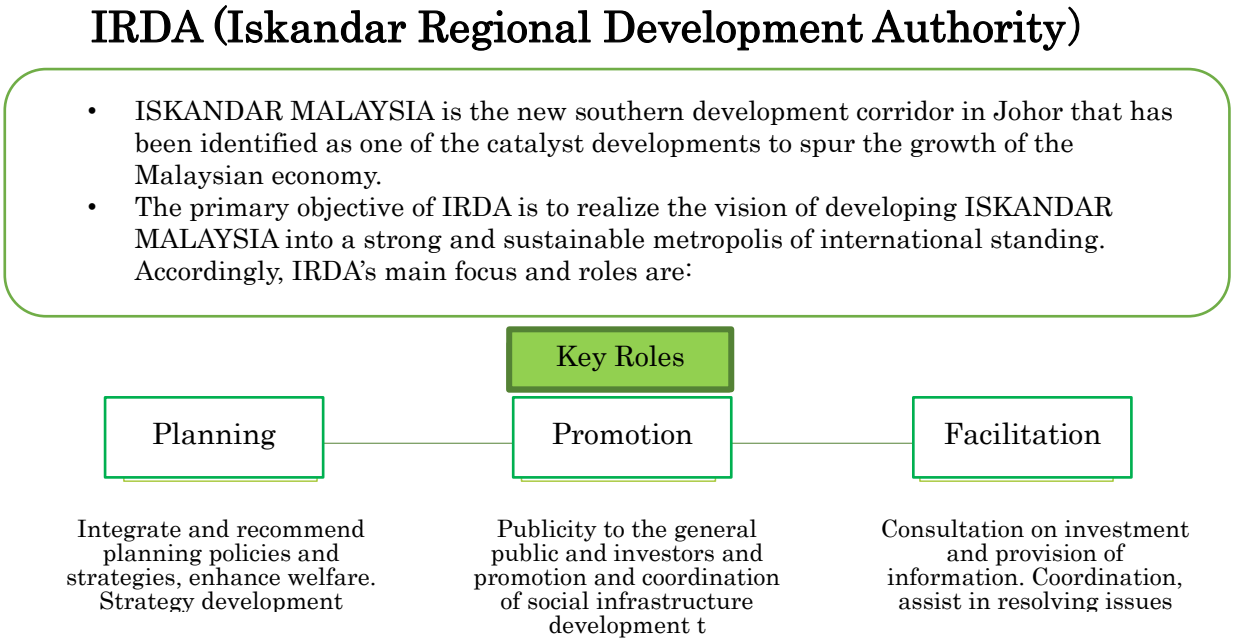


Figure 1-2 Functions of the Iskandar Regional Development Authority[1]

(2) Iskandar Development Region

The Iskandar Development Region lies at the southern edge of the Malay Peninsula in southern Johor, a Malaysian state on the coast across from Singapore. With a population of around 1.9 million, it is the country's second most important centre for economic activity after Kuala Lumpur. Malaysia's federal government established five economic corridors (key development regions) during the period of the Ninth Malaysia Plan (2006-2010), with comprehensive regional development projects being conducted in Iskandar Malaysia. The Eleventh Malaysia Plan (2016-2020), submitted to the Parliament of Malaysia by former prime minister Najib Razak in 2015, also establishes the Iskandar Development Region as a key development region. The five-year plan focuses on five main initiatives: environmental education and creative clusters, tourism and logistics centres, environment and energy, food, and the development of manufacturing industries focused on oleo chemistry. Iskandar Malaysia occupies 2,217 square kilometres and comprises five flagship zones, namely [A] Johor Bahru City Centre, [B] Iskandar Puteri (formerly

[1] Prepared by NTT Data Institute of Management Consulting, Inc. based on data from the Iskandar Regional Development Authority's website

Nusajaya), [C] Western Gate Development, [D] Eastern Gate Development, and [E] Senai-Skudai. This is roughly the same area as the Tokyo Metropolitan area and three times the size of Singapore. On February 22, 2019, Prime Minister Mahathir Mohamad announced that Iskandar Malaysia would be expanded to 4,749 square kilometres, suggesting even more active development is in store for the Iskandar Development Region.

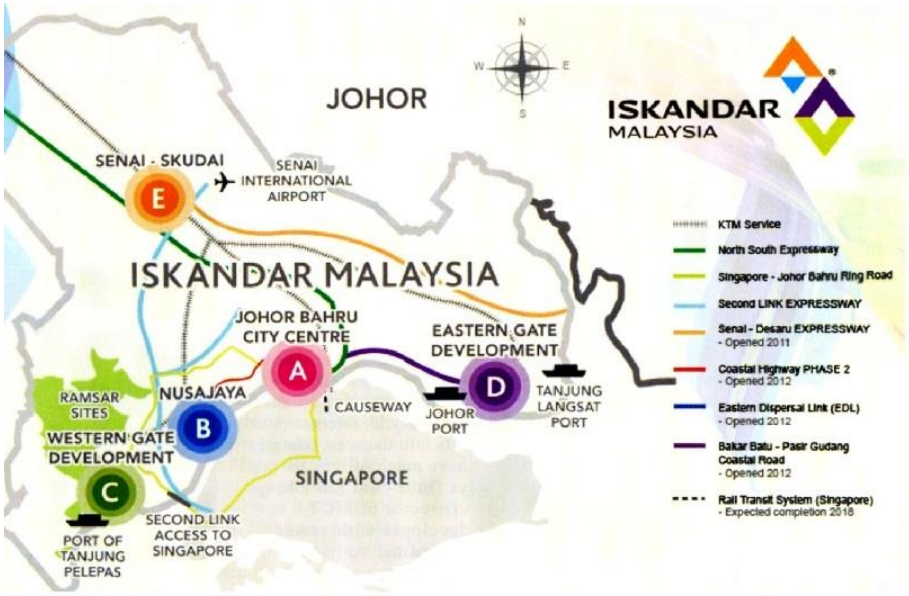


Figure 1-3 Map of the Iskandar Development Region[2]

The aforementioned five flagship zones making up the Iskandar Development Region have the following functions and characteristics.

Zone A: Johor Bahru City Centre

This zone focuses on, among other things, business centre development, culture and tourism, strengthening immigration functions, and waterfront property development. It has trading infrastructure, a financial centre, and a service centre (linked to Singapore via the Johor-Singapore Causeway).

Zone B: Iskandar Puteri (formerly Nusajaya)

Zone activities include Johor state government building construction, attracting education, medicine, and entertainment industry players, and Puteri Harbour development. Specifically, the zone comprises an academic city with universities offering foreign curricula, entertainment functions that include a movie filming studio as well as LEGOLAND and other theme parks, medical tourism and other service industries, and state government functions.

[2] New Straits Times article published February 22, 2019 entitled "Iskandar Malaysia to be extended, covering more areas in Johor"

Zone C: Western Gate Development

This zone is centred on marine logistics centre and power plant development and contains physical distribution, free trade, and oil storage port facilities. It links to Singapore via the Malaysia–Singapore Second Link.

Zone development leverages the Port of Tanjung Pelepas's geographical advantage of being near Singapore and other Southeast Asian nations and water deep enough to accommodate even larger vessels. Connected by sea routes to ports around the world, the Port of Tanjung Pelapas is the second largest in Malaysia in terms of container transaction volume and the 18th in the world[3]. [3]The port has a total area of roughly 7.8 square kilometres and comprises a container port and an adjoining free-trade zone.

Zone D: Eastern Gate Development

This zone's functions consist of electrical, chemical, and oleo chemical product manufacturing and has a petrochemical storage port. Comprising Pasir Gudang Port, Tanjung Langsat Port, and Tanjung Langsat Technology Park, the zone occupies a total of approx. 15 square kilometres. It also contains Pasir Gudang Industrial Park, which has attracted foreign manufacturing firms from around the world.

Zone E: Senai-Skudai

This zone's functions consist of Senai International Airport, a logistics centre, a high-tech industry, a space-related industry, a shopping centre, and a cyber-city. Home to University of Technology, Malaysia (UTM), one of Malaysia's most prestigious national universities, the zone also has Johor Bahru Premium Outlets, the first of its kind in Southeast Asia, making it an attractive area for tourism as well as industry.

[3] Ministry of Land, Infrastructure, Transport and Tourism, Ranking of Global Container Handling Volume by Port (2018 preliminary figures)https://www.mlit.go.jp/common/000228237.pdf

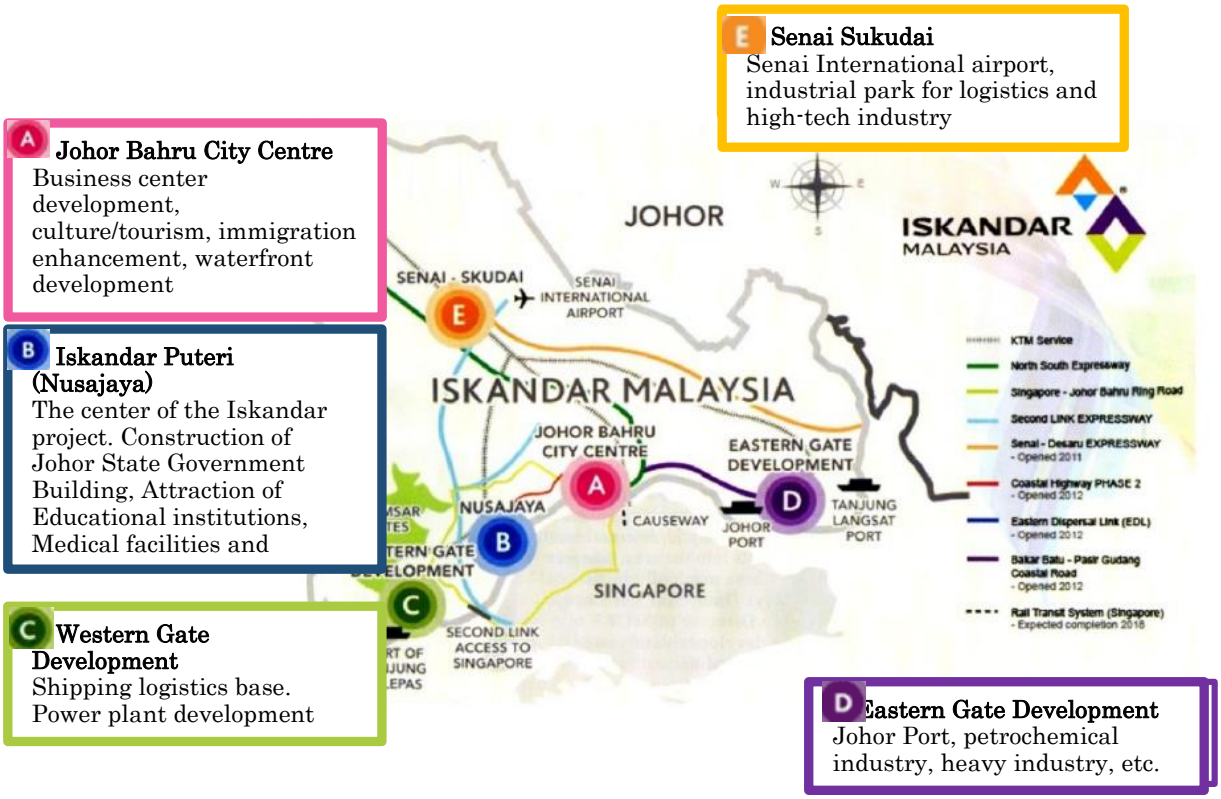


Figure 1-4 Characteristics of the Iskandar Development Region's flagship zones

(3) Industrial areas subject to the study

(a) Pasir Gudang Industrial Park

This industrial park was established 30 years ago. The area has long been a location of business expansion into Malaysia by Japanese and other firms. Among enterprises who arrived in the early years, many are now dealing with aging facilities and equipment at their plants and are facing efficiency problems.

| Industrial park name | Pasir Gudang Industrial Park |
|---|---|
| Distance from major city | 36 km from Johor Bahru |
| Japanese firms with a presence[4] | · Adeka Foods (Asia) Sdn. Bhd.<br>· Aida Manufacturing (M) Sdn. Bhd.<br>· Hitachi Chemical (Johor) Sdn. Bhd.<br>· Demits Chemical (M) Sdn. Bhd.<br>· Palau Edible Oil Sdn. Bhd. and others |

(b) Kaasen Preindustrial Senai Industrial Park

[4] Toyo Keizai Inc.: Excerpt from the Overseas Japanese Companies Database, By Country, 2019 edition

| Industrial park name | Kaasen Preindustrial Senai |
|---|---|
| Distance from major city | 32 km from Johor Bahru |
| Japanese firms with a presence | · Panasonic System Networks Malaysia Sdn. Bhd.<br>· Mitsubishi Electric (Malaysia) Sdn. Bhd.<br>· Hickok (Malaysia) Sdn. Bhd.<br>· Hitachi Cable (Johor) Sdn. Bhd.<br>· Matsushita Precision Industrial Co. Sdn. Bud and others |

(c) Kaasen Preindustrial Terbium Industrial Park

| Industrial park name | Kaasen Preindustrial Terbium |
|---|---|
| Distance from major city | 15 km from Johor Bahru |
| Japanese firms with a presence | · Dan Café (Malaysia) Sdn. Bhd.<br>· J.K. Sumi Wire Harness Sdn. Bhd.<br>· Southern Lion Sdn Bud<br>· Mizuho Precision Engineering (M) Sdn. Bhd.<br>· Chiyoda Integer Co. (Johor) Sdn. Bhd. and others |

(d) Other areas

In addition to the above, studies are also focusing on finding private companies not located in the area (those in the Johor Bahru and Kuala Lumpur areas) for high-potential JCM equipment subsidy projects.

### 1.2.2 The Malaysian Government's Efforts to Reduce Greenhouse Gas Emissions

(1) Environmental Administration in Malaysia

Prior to the 2018 general elections, ministries dealing with environmental and climate change issues included the Ministry of Natural Resource and Environment and the Ministry of Energy, Green Technology and Water ( The Mahathir administration, formed in May 2018, merged them into the Ministry of Energy, Green Technology, Science, Environment and Climate Change ( Ministry of Energy, Green Technology, Science and Climate Change (MEGTSCC), a new ministry responsible for environment and climate change, waste management (designated garbage), and social experimentation.

The Muhyiddin administration, which came to power in March 2020 after a realignment of the ruling and opposition parties, reorganized the ministries again, with the Ministry of Science, Technology and Innovation (MSTI) and other ministries operating independently of

MEGTSCC. The The Ismail Sabri administration that subsequently came to power in August 2021 has not renamed or reorganized any ministries from the previous administration.

(2) Efforts in the Environmental Sector under the 12th Malaysia Plan

(Summary)

In September 2021, Malaysian Prime Minister Ismail Sabri announced the 12th Malaysia Plan (12MP) (2021-25), a new five-year plan for national development. The three major objectives of the Plan are as follows.

(1) To create a prosperous, inclusive, and sustainable Malaysia

(2) Economic revitalization under the Corona

(iii) Laying the foundation to position Malaysia as a country with high technological and economic power.

It is also positioned as "the first five years of the Shared Prosperity Vision 2030" and "the final reform within the National Recovery Plan.

(Scheme)

Three pillars of the plan and four supporting policies are presented, and 14 game changers have been established for each.

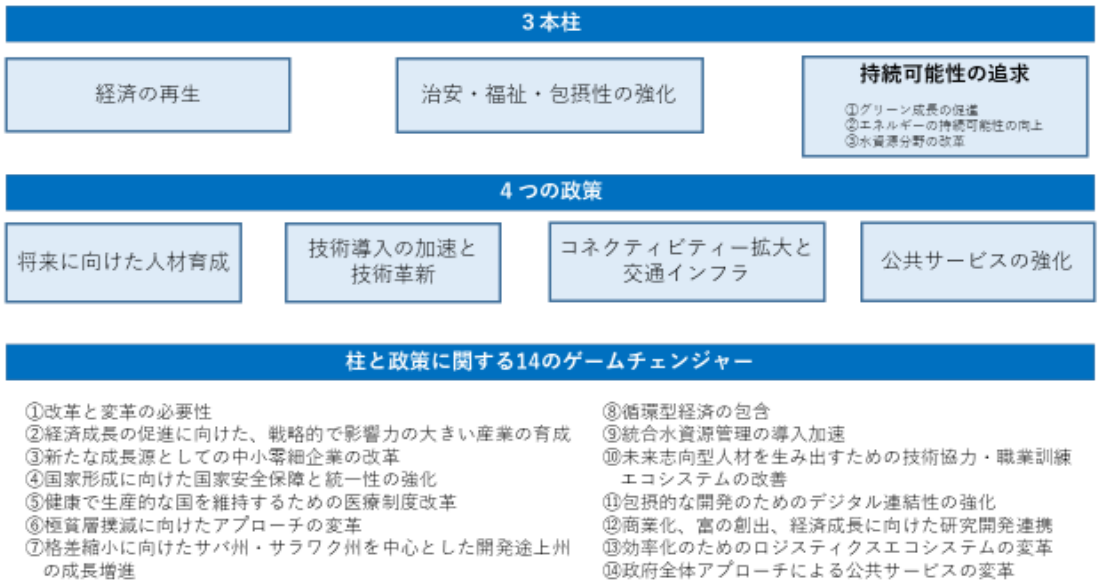


Figure 1-5 Overall picture of the 12th Malaysia Plan

(Theme 3: Pursuit of Sustainability)

The pursuit of sustainability not only promotes continued economic growth and improved quality of life, but also preserves the environment and natural resources. It is also important to understand that economic development does not necessarily have negative impacts on the environment or result in unsustainable use of natural resources.

Therefore, Theme 3 sets forth three strategies. Promote green growth to enhance

sustainability and resilience in the country, in light of recent global trends such as the shift toward sustainable economic activities and lifestyles. Energy and water resources will be managed holistically and sustainably, taking into account the balance between supply and demand. These three strategies to achieve Theme 3 complement Themes 1 and 2.

I. Promoting Green Growth

To promote green growth, society as a whole must share the responsibility of transitioning to a low-carbon society, as well as properly manage natural resources and equally share the benefits derived from them. It is also important to accelerate the formation of a circular economy, which will not only generate more responsible business and investment, but also expand green markets and generate new business opportunities.

(→ Game Changer 8: Inclusion of the Circular Economy)

<Indicators>

Reduce greenhouse gas emission intensity to GDP to 45% of 2005 levels by 2030.

Increase the percentage of green procurement by the government to 25

Increase the percentage of land and inland water conservation to at least 20

Increase the percentage of coastal and marine areas to at least 10%.

Introduce legislation on disaster risk management

II. Improving Energy Sustainability

Improving energy sustainability requires adequate supply of energy and related infrastructure, as well as proper addressing of the energy trilemma problem (3E problem). To this end, a comprehensive national energy policy should be developed that integrates existing energy-related policies and provides a framework for addressing various issues in the energy sector. In addition, the use of renewable energy as an alternative energy source should be expanded, focusing on the demand side.

<Indicators>

Introduce a comprehensive domestic energy policy.

Increase the share of renewable energy to 31%.

III. Reform of the water resources sector

The highest priority for Integrated Water Resources Management (IWRM) will be to achieve the government's long-term goals of water resource management efficiency, wealth creation, and job security. (→ Game Changer 9: Accelerating the adoption of Integrated Water Resources Management) To this end, the focus will be on strengthening water resources governance and sustainable financial conditions.

<Indicators>

Increase the percentage of people with access to clean and safe water to 98% in rural areas.

(Consideration of a carbon tax on businesses)

In presenting the 12th Malaysia Plan to the Parliament, Prime Minister Ismail Sabri said, "We aim to achieve virtually zero carbon emissions by 2050 at the earliest. Detailed decarbonisation policies will be announced after the completion of the long-term review of low-carbon development strategies at the end of 2022. In addition to a carbon tax, the government is also considering the introduction of a domestic emissions trading scheme (DETS) as an economic policy (carbon pricing).

Although reliable CO2 data is necessary for implementation, it will be difficult to realize this as an immediate policy since many companies are currently only at the Scope 1 (source adjustment) and Scope 2 (identification of some indirect emissions) stages, and few have reached Scope 3 (identification of all CO2 emissions in the value chain).

(Penang Institute's Forecasts and Proposals)

If applied to the electricity, transportation, oil, and gas sectors, the carbon tax would cover more than 70% of annual domestic CO2 emissions. It is also proposed that the initial price of the carbon tax be set at RM35/tCO2 and increased to RM150/tCO2 by 2028. Furthermore, the introduction of the carbon tax is projected to increase annual revenue by RM218 to 246 specie over the next 10 years.

(2) Efforts to reduce greenhouse gas emissions (Green Technology)

In 2009, the Malaysian government established the "Green Technology Policy" based on the belief that green technology will drive economic growth and sustainable development. The policy designates four core areas of green technology: energy, buildings, wastewater and waste, and transportation.

In its National Green Technology Master Plan, the Malaysian government has set a target of 1.5% of GDP (RM60 billion) to come from green businesses by 2030 by promoting the adoption of these green technologies. The goal is to make up a portion of the total.

(National Energy Policy)

The main renewable energy-related policy initiatives in Malaysia are as follows.

Malaysia's basic energy policy aims to "develop the economy through secure and cost-effective energy supply and promotion of efficient energy use" in the 11th National Five-Year Plan (2016-2020), with the goals of "reducing unproductive consumption" and "minimizing environmental additions. In addition, of the budget categorized by the seven strategies in the plan, RM4,342 million (4.9% of the total) has been allocated to "Pursuing green growth for sustainability and resilience".

The main policies related to renewable energy in Malaysia are shown in Table 3. A feed-in tariff (FIT) system was established under the Renewable Energy Act released in 2011 to

promote the use of renewable energy in order to maintain domestic energy production.
The 12th Malaysia Plan in the table is scheduled to be submitted to the National Assembly by March 2021 due to the economic uncertainty caused by the Corona disaster. Currently available information indicates that the plan will focus on "economic empowerment" (creation of new sources of growth such as digital and aerospace industries), "environmental sustainability" (green technology, renewable energy, climate change adaptation and mitigation, etc.), and "economic growth and development" (economic development, economic growth and development, etc.). The plan will combine three aspects of "social reengineering" (increasing people's purchasing power, strengthening social security networks, improving people's well-being, etc.).

Table 1-2 Malaysia's line of policy on renewable energy[5]

| Government Policy on Renewable Energy | |
|---|---|
| **1999** | Five Fuel Diversification Policy |
| **2001** | The Third Outline Perspective Plan (2001-2010)) |
| **2005** | The National Biofuel Policy (NBP 2006) |
| **2009** | The Renewable Energy Act<br>National Renewable Energy Policy |
| **2010** | Green Technology Financing Scheme (GTFS)<br>https://www.asiax.biz/news/21065/<br>Energy Commission Act |
| **2011** | The Renewable Energy Act (Rev.)<br>Sustainable Development Business Law<br>Sustainable Energy Development Authority Act 2011 |
| **2013/2014** | The Renewable Energy Act and Sustainable Energy Development Authority Act |
| **2015** | The Eleventh Malaysia Plan (11MP) (2016-2020) |
| **2017** | Green Technology Master Plan 2017-2030) (GTMP) |
| **2019** | Preapration of the Twelfth Malaysia Plan, 2021-2025 |

(Status and goals for renewable energy deployment)
With the exception of solar power, whose price was initially set at a high level, the feed-in-tariff system implemented under the Renewable Energy Act announced in 2011 has seen little renewable energy proliferation due to a degression rate marked by perennial option price

[5] Prepared by NTT Data Institute of Management Consulting, Inc. based on NEDO's Survey Report on Smart Community-related Technology and Service Standardization and International Trends

decline. Within the FIT system, a premium rate is set on products produced in Malaysia. Solar power, for example, carries a premium price with no degression rate, creating advantageous conditions for companies producing in Malaysia.

Table 1-3 Renewable energy deployment (installed capacity, unit: MW)[6]

| Year | Biogas | Biogas (埋立て、農業廃棄物) | Biomass | Biomass (固形廃棄物) | Small Hydro | Solar PV | Geo-thermal | Total |
|---|---|---|---|---|---|---|---|---|
| 2012 | 2.00 | 3.16 | 36.90 | 8.90 | 11.70 | 31.54 | 0.00 | 94.20 |
| 2013 | 3.38 | 3.20 | 0.00 | 0.00 | 0.00 | 107.00 | 0.00 | 113.58 |
| 2014 | 1.10 | 0.00 | 12.50 | 0.00 | 0.00 | 65.15 | 0.00 | 78.75 |
| 2015 | 0.00 | 5.40 | 12.50 | 7.00 | 6.60 | 60.34 | 0.00 | 91.34 |
| 2016 | 0.00 | 15.46 | 19.50 | 0.00 | 12.00 | 77.81 | 0.00 | 124.77 |
| 2017 | 0.00 | 22.54 | 0.00 | 0.00 | 0.00 | 38.09 | 0.00 | 60.63 |
| 2018 | 0.00 | 3.60 | 0.00 | 5.85 | 0.00 | 1.54 | 0.00 | 10.99 |
| 累積 | 6.48 | 53.36 | 80.90 | 21.75 | 30.30 | 381.47 | 0.00 | 574.26 |

Annual renewable energy generation from 2011 to 2050, shown in Table 5, suggests deployment is still insufficient to achieve target levels.

Table 1-4 Renewable energy environmental targets for 2011 to 2050[7]

| 年 | 年間バイオマス GWh | 年間バイオマス GWh | 年間小水力発電 GWh | 年間太陽光発電 GWh | 年間 固形廃棄物 GWh | 年間再生可能エネルギー電力 (GWh) | 年間CO2回避 (t/年) | 累積CO2回避 (t) | 再生可能エネルギー累積 (MW) |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | 675 | 123 | 300 | 7.7 | 123 | **1,228** | **846,975** | **846,975** | **217** |
| 2015 | 2,024 | 613 | 1,450 | 61 | 1,223 | **5,374** | **3,707,825** | **10,816,136** | **975** |
| 2020 | 4,906 | 1,472 | 2,450 | 194 | 2,208 | **11,229** | **7,747,900** | **41,803,181** | **2,065** |
| 2025 | 7,297 | 2,146 | 2,450 | 456 | 2,330 | **14,680** | **10,128,817** | **88,071,821** | **2,809** |
| 2030 | 8,217 | 2,514 | 2,450 | 1,019 | 2,392 | **16,592** | **11,448,339** | **143,444,366** | **3,484** |
| 2035 | 8,217 | 2,514 | 2,450 | 2,128 | 2,453 | **17,762** | **12,255,721** | **202,908,742** | **4,317** |
| 2040 | 8,217 | 2,514 | 2,450 | 4,170 | 2,514 | **19,865** | **13,707,192** | **268,207,951** | **5,729** |
| 2045 | 8,217 | 2,514 | 2,450 | 7,765 | 2,575 | **23,522** | **16,229,914** | **343,765,293** | **8,034** |
| 2050 | 8,217 | 2,514 | 2,450 | 13,540 | 2,637 | **29,358** | **20,256,975** | **436,426,797** | **11,544** |

The FIT system will be abolished in 2019, and NEM (Net Energy Metering) is being introduced as its successor. Under this system, electricity generated by solar panels installed on the roofs of buildings is first consumed by the installers themselves, and then the power company purchases the surplus. The NEM 3.0 scheme, which runs from 2021 to 2023, includes three different schemes: one for households, one for the government and its agencies, and one for commercial and industrial use.

[6] Prepared by NTT Data Institute of Management Consulting, Inc. based on data from SEDA's website (http://seda.gov.my/?omaneg=0001010000000101010)
[7] Ministry of Energy Green Technology and Water : National Renewable Energy Policy &Action Plan

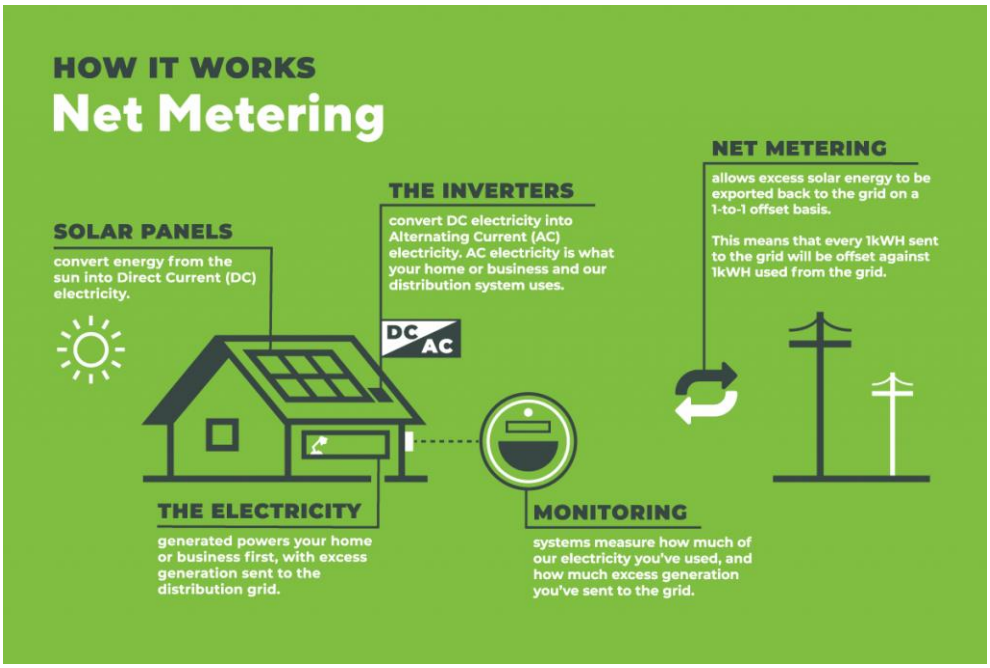


Figure 1-6 Diagram of the NEM System

| | Rakyat<br>Domestic | GoMEn<br>Government Buildings | NOVA<br>Commercial, Industrial, Agriculture and Mining Buildings |
|---|---|---|---|
| Quota Allocation | 100 MW | 100 MW | 600 MW |
| Mechanism (Roll-over) | 1:1 (12 Months) | 1:1 (12 Months) | Average SMP (1 Month) |
| Offer Period | until 31st Dec 2023 | until 31st Dec 2023 | until 31st Dec 2023 |
| Offset Rate | Prevailing Gazetted Energy Rate | Prevailing Gazetted Energy Rate | Average System Marginal Price (SMP) |
| Offset Period | 10 Years | 10 Years | 10 Years |
| Condition after 10 years | Self-Consumption (SelCo) | Self-Consumption (SelCo) | Self-Consumption (SelCo) |
| Capacity limit | Single Phase : 4kWac<br>Three Phase : 10kWac | 1 MWac | Nett offset : 1MWac<br>Nett offset + Virtual aggregation : 5MWac |
| Eligibility | TNB registered consumer under domestic tariff | Goverment agencies under commercial tariff | Non-domestic account holder |

Figure 1-7 Scheme in NEM3.0

(Green Technology Financing Scheme)

The program is designed to encourage producers and users of environmental technologies and green energy providers to incorporate environmental elements into specific projects related to six areas. The government will subsidize 2% of the interest rate for the first seven years and guarantee 60% of the environmental loans received from financial institutions. The GTFS 2.0 will only cover environmental technology or environmental-related costs financed by participating financial institutions and banks.

The program was launched in 2010 and is still ongoing. Certified companies can be found on the official website, but as it has not been updated since August 2017, it may have ceased to function as GTFS 2.0. The program will continue for two years until 2022 as GTFS 3.0 with a total loan amount of RM2 billion; details of GTFS 3.0 are yet to be determined, but it is expected to be similar to GTFS 2.0.

<Examples by field>

(1) Energy: Construction and operation of biomass plants and production of energy efficient products

(2) Water: Recycling of batteries, clothes, and furniture, plastic bag reduction projects

(3) Buildings and cities: Construction of buildings with low heat transmissivity, installation of high-efficiency air conditioning systems

4) Transportation: Bioenergy generation from grain, production of hydrogen and electric vehicles

(5) Waste: Recycling business, fertilizer production from waste

(6) Manufacturing: Use of renewable energy in the manufacturing process

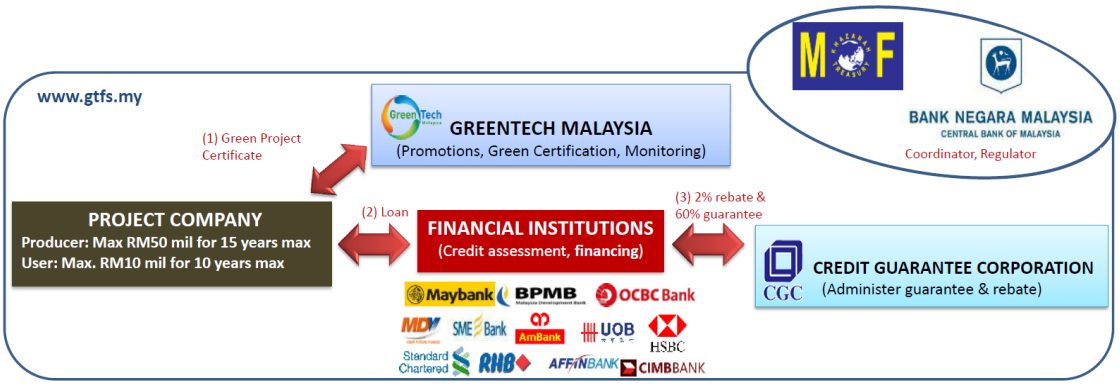


Figure 1-8 Overall view of GTFS

(Tax incentives for green technology)

To achieve the goal of increasing the share of renewable energy in the country's power supply mix to 20% by 2025, it is expected that RM33 billion worth of renewable energy investment will be required. Therefore, in order to encourage the private sector to invest in renewable energy, a green investment tax credit (GITA) for the purchase of green technology equipment and assets and a green income tax exemption (GITE Both GITA and GITE will continue until the end of 2023, as decided in the 2020 national budget.

### 1.2.3 The IRDA's greenhouse gas emission reduction initiatives

(1) Iskandar Malaysia's low carbon society plan for 2025

With support from Japan Science and Technology Agency (a National Research and

Development Agency) and the Japan International Cooperation Agency (JICA), an international research team comprising members from such organizations as Kyoto University, the National Institute for Environmental Studies, Okayama University, University of Technology Malaysia, and the Iskandar Regional Development Authority began activities in 2010 aimed at Iskandar Malaysia and in November 2012 announced the Low Carbon Society Blueprint toward 2025 ("the Blueprint"). The plan was officially approved as an official document for the development program by the Iskandar Regional Development Authority at a March 20, 2014 meeting of the Approvals and Implementation Committee.

The Blueprint was formulated in response to concerns Iskandar Malaysia development projects would bring about a rapid rise in greenhouse gas emissions following the region's being designated a special economic zone in 2006. The Blueprint, a low carbon society plan aimed at making the region into a low-carbon area, establishes a goal of reducing greenhouse gas emissions by 40% by 2025 in a Business as Usual scenario (56% emission strength compared to 2005). The plan outlines 12 Actions and 281 Programs concerning areas such as transportation systems, construction (green buildings), energy systems, waste management, industrial processes, governance, air pollution, urban structure, and education.

A new Low Carbon Society Blueprint Iskandar Malaysia 2030 was formulated and published at the end of 2022. The content of the Blueprint concretises the efforts to tackle climate change in the Iskandar region up to 2030.

Table 1-5 List of actions in Low Carbon Society Blueprint Iskandar Malaysia 2030.

**Iskandar Malaysia 2030 Sectoral GHG Emission Reduction Potential ($ktCO_{2eq}$) and Contributing LCS Mitigation Actions:**

| Actions | Thrusts / Enabler | RES | COM | IND | TRA | MUW |
|---|---|---|---|---|---|---|
| **Action 01** Green Sustainable Value Chain | Enabler | √ | √ | √ | √ | √ |
| **Action 02** Sustainable Smart Farming | Green Economy | | | | | |
| **Action 03** Sustainable, Resilient & Liveable Cities | Green Environment | √ | √ | | √ | |
| **Action 04** Natural Environment & Habitats | Green Environment | | | | | |
| **Action 05** Green Transportation & Mobility | Green Economy | | √ | √ | √ | |
| **Action 06** Sustainable Waste Management | Green Environment | √ | √ | | | √ |
| **Action 07** Consensus Building & Education | Green Community | | | | | |
| **Action 08** Green & Renewable Energy | Green Economy | √ | √ | √ | √ | |
| **Action 09** Low Carbon Green Building & Infrastructure | Green Economy | √ | √ | √ | | |
| **Sectoral Reduction Potential ($ktCO_{2eq}$)** | | **690** | **2,501** | **3,288** | **3,292** | **100** |

(2) Comprehensive Development Plan (CDP)

The CDP is a major plan to guide the economic, social and environmental planning and management of Iskandar Malaysia towards the establishment of an internationally viable and

sustainable metropolis[8]. As Iskandar Malaysia is an economically and geographically significant region, the CDP requires the involvement of stakeholders at all levels. These include, indeed, federal, state and local governments, as well as players from the business community and global industry.

In preparing the CDP, IRDA consulted with the National Physical Planning Council, the State Planning Commission and the local authorities in Iskandar Malaysia to ensure that all the proposals in the CDP are consistent with national and state policies. LCS Blueprints have also been prepared as detailed guidelines for the implementation of the CDP.

CDP adopts a holistic and resilient approach to sustainability, with a core focus on a continuum of Wealth generation, Wealth Sharing and Inclusiveness, Optimising the resources and focusing on low carbon.

(1) Wealth generation

Wealth generation ensures a continuous, stable, strong and resilient income generation for the people living in Iskandar Malaysia. In order to enhance the generation of income of the people in Iskandar Malaysia, three Strategic Thrusts are introduced:

1) Deepen Cluster Linkages and Enhance Enabling Ecosystem
2) Increase Skilled Job Opportunities and Labour Productivity
3) Mainstream Green Economy to Support Low Carbon Initiatives

(2) Wealth sharing and inclusiveness

Wealth Sharing and Inclusiveness promotes social equity and improves quality of life. In order to promotes social equity and improves quality of life in Iskandar Malaysia, three Strategic Thrusts are introduced:

1) Increase Economic Participation Through Knowledgeable and Skilled Human Capital
2) Reduce Inequality and Improve Access to Higher Income and Capital Gain
3) Provide Social Connectedness and Build a Well-Informed and Self-Driven Society

(3) Resource optimization and low carbon

Optimizing the resources and focusing on low carbon will ensure Iskandar Malaysia going towards a sustainable and dynamic economic region

This is achieved by promoting sustainability and efficient resource-use in Five Strategic Thrusts:

1) Promote Balanced Regional Growth
2) Protect and Enhance Natural Ecology and Green Areas
3) Plan and Manage Built Environment
4) Enhance Urban Connectivity and Mobility within Region

[8] https://iskandarmalaysia.com.my/our-development-plan/

5) Promote Integrated Infrastructure Resources

The CDP is reviewed and updated every five years, and currently the plan is in place until FY2025 (CDP: 2006-2025, CDP2: 2014-2025). The latest version, CDP3, is currently under preparation and will cover the period up to 2030. The concepts of "Industrial Symbiosis", "Eco Town" and "Waste to Energy" will be included in the newly developed CDP3.

### NLCCM (National Low Carbon Cities Masterplan)

The NLCCM is designed as a policy document to guide policy makers at all levels of federal, state and local government in their efforts to achieve low-carbon cities, and to address policy gaps in meeting national GHG reduction targets in mitigating climate change. The NLCCM is not intended to replace the policy tools currently used by local governments to achieve low carbon cities, but to extend the National Climate Change Policy of the 2009.

- Absolute carbon reduction targets

NLCCM has proposed GHG reduction targets in the top 33 cities and regions in Malaysia, divided into three implementation phases. The reduction targets, which exceed Malaysia's GHG reduction commitments (the 11th Malaysia Plan sets a 45% reduction in carbon emissions by 2030 compared to 2005 levels), are intended to encourage more influential GHG reduction plans to achieve the targets. The Iskandar region is included among those cities.
The schedule and absolute carbon reduction targets for the target cities for the period 2030-2050 are as follows The Iskandar region is included in Group 1.

Table1-6　Carbon reduction schedule for target cities

| Fiscal year | Each group of target cities | Contents |
|---|---|---|
| 2021,2022 | Group1 | Develop a GHG inventory including baseline emissions and set a target to reduce absolute GHG emissions by 33% by 2030year |
| 2026 | Group2 | Create a GHG inventory and set a target to reduce absolute GHG emissions by 33% by the 2032035year |
| 2030 | Group1 | 33% absolute reduction in GHG emissions and declaration of a "carbon neutral year". |
| 2031 | Group3 | Develop a GHG inventory including baseline emissions and set a target to reduce absolute GHG emissions by 33% by 2040year |
| 2035 | Group2 | Declared a "carbon neutral year" by reducing absolute GHG emissions by 33%. |
| 2040 | Group1<br>Group3 | Group1 cities reduce absolute GHG emissions by 66%.<br>Group3 cities reduce their GHG emissions by 33% and declare a "carbon neutral year |
| 2045 | Group2 | Reduction of absolute GHG emissions by 66%, with carbon neutrality planned for the 2055year |
| 2050 | Group1<br>Group3 | Group1's cities achieve carbon neutrality<br>Group3 cities reduce absolute GHG emissions by 66% and achieve carbon neutrality by the 2060year |

### 1.2.4 Cooperative relationship between Kitakyushu and the Iskandar Regional Development Authority

With the goal of reducing carbon emissions in the Iskandar Development Region, Kitakyushu has worked with the IRDA in fiscal years 2014, 2015, and 2016. The details of these activities are provided below.

(a) Activities in FY 2014

In the FY 2014 Large-scale JCM Project Creation Feasibility Study Project for Realizing Low-carbon Societies in Asia, Kitakyushu conducted a basic study aimed at helping to reduce carbon emissions in an industrial park in the city of Pasir Gudang, while also building a relationship with the city.

The study, which involved holding discussions with Pasir Gudang stakeholders and gathering

information from enterprises in the industrial park, proposed a path towards establishing four key programs for a "Pasir Gudang that aspires to be a green and healthy city."


Figure 1-9 Path to establishing four key programs for Pasir Gudang

(b) Activities in FY 2015

Kitakyushu conducted the Foundation Building Project for Across-the-Board Expansion of Decarbonisation Projects (Kitakyushu-State of Johor Cooperation Project) in Iskandar Malaysia as part of the FY 2015 Cooperation Project for Realization of Low Carbon Societies in Asia. The following three studies were discussed with the goal of industrial park decarbonisation in Pasir Gudang.

- Activity 1: Waste heat collection, cogeneration, and energy-saving efforts in industrial parks
- Activity 2: Industrial waste recycling and general waste power generation
- Activity 3: Developing JCM businesses in Iskandar Malaysia and supporting the design of systems to advance such development

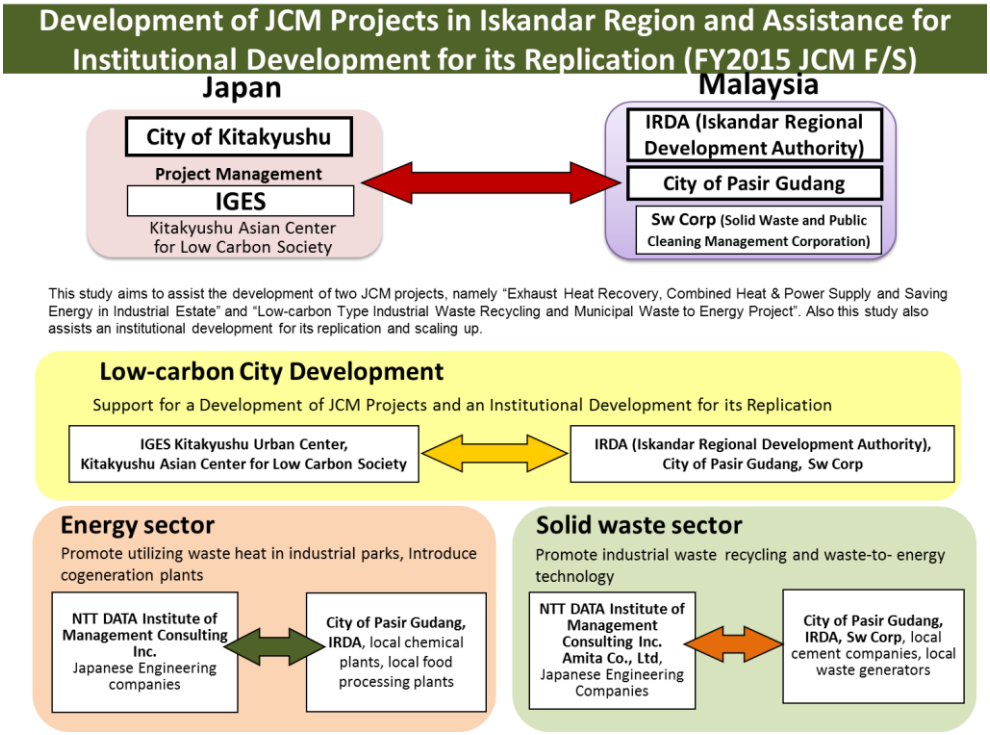


Figure 1-10 Overview of activities for developing JCM businesses in Iskandar Malaysia and supporting the design of systems to advance such development

(c) Activities in FY 2016

Kitakyushu conducted the Project to Accelerate Low Carbonization Model Projects in Iskandar Development Area for Expansion of JCM (Kitakyushu-IRDA Cooperation Project) as part of the FY 2016 Large-scale JCM Project Creation Feasibility Study Project for Realizing Low-carbon Societies in Asia. Following on the FY 2015 study, this study targeted mainly local governments and businesses with their own factories or other production facilities and closely examined the feasibility of JCM adoptability. With the goal of promoting activities aimed at establishing model businesses in order to facilitate Malaysia's timely participation in the JCM, the following two energy-saving related projects were studied.

- Activity 1: Deploying cogeneration technologies at factories that require steam
- Activity 2: Promoting energy-saving efforts for factories and buildings inside factories

Table 1-7 Overview of activities conducted for the Accelerate Low Carbonization Model Projects in Iskandar Development Area for Expansion of JCM

| | Company A | Company B | Company C | Company D | Company E |
|---|---|---|---|---|---|
| Project Content | Surfactant production | Epoxy resin production | Styrene monomer production | Polymer production | Paper bag production |
| Project Possibility | (Low) | (High) | (High) | (Medium) | (Low) |
| Situation toward Energy saving implementation | At the present time, it is not the time to renew various energy-saving equipment. | Already company B is implementing energy conservation initiatives, but, with further energy conservation, it is considering possibility of using the subsidy scheme. | As projects abandoned due to cost reasons in the past, considering possibility of using the subsidy scheme. Renovation to LED lighting in factory is also considered. | As interested in energy saving project, already have project candidates. Under consideration about possibility of utilization of subsidy scheme | Energy saving targets are set in factories, although there's possibility of energy saving with air conditioners, etc., the equipment will not be renewed on timely basis. |
| Local status |  Shot at the site |  Shot at the site |  Shot at the site |  Shot at the site |  Shot at the site |

On August 22, 2016, Kitakyushu concluded a Letter of Understanding with the IRDA which clearly stipulated the city's intention to promote decarbonisation in the Iskandar Development Region.


Figure 1-11 Signature ceremony at the IRDA office

(d)Activities in FY2019

Kitakyushu City implemented the "Project for Promoting Low Carbonization in the Iskandar Region (Kitakyushu City -Iskandar Development Area Collaboration Project)" in the "city-to-city collaboration project for realizing a low-carbon society in 2019". In order to achieve the goals set out in the Low Carbon Society Blueprint, we have developed an action plan until 2025 and carried out the following activities with the aim of creating concrete projects using JCM.

- Activity 1: Examination of action plan based on the blueprint for a low-carbon society that has already been formulated
- Activity 2 Follow-up survey of surveys conducted in FISCAL 2015 and 2016
- Activity 3 Excavation of waste heat recovery power generation projects with potential

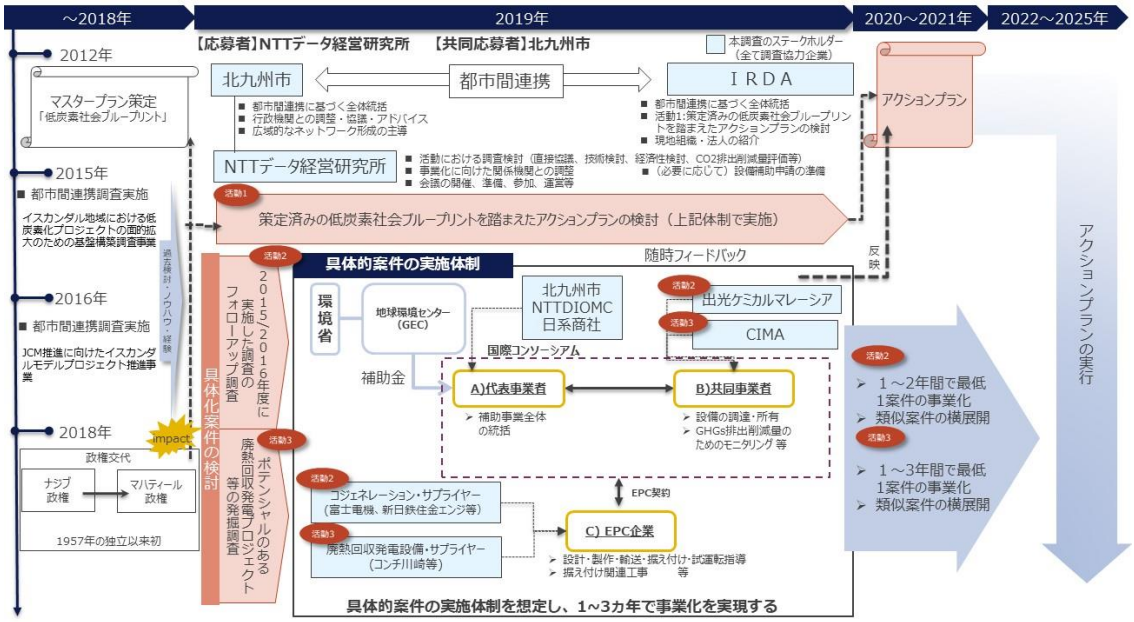


Figure 1-12 FY2019 activities

(e) Activities in FY2020

The City of Kitakyushu implemented the "Low Carbon Promotion Project in Iskandar Region (Kitakyushu-Iskandar Development Region Collaboration Project)" as part of the "Intercity Collaboration Project for Realization of Low Carbon Society in FY2028. In the course of the study in FY2048, the activities indicated in the Blueprint for a Low Carbon Society were steadily developed, and the following three themes were identified by IRDA as important: "Industrial Symbiosis," "Eco Town," and "Waste to Energy". The following three activities were carried out under the keywords.

Activity 1: Activities to realize an eco-town with industrial symbiosis

Activity 2: Activities to realize waste-to-energy generation

Activity 3: Identification of JCM-applicable projects

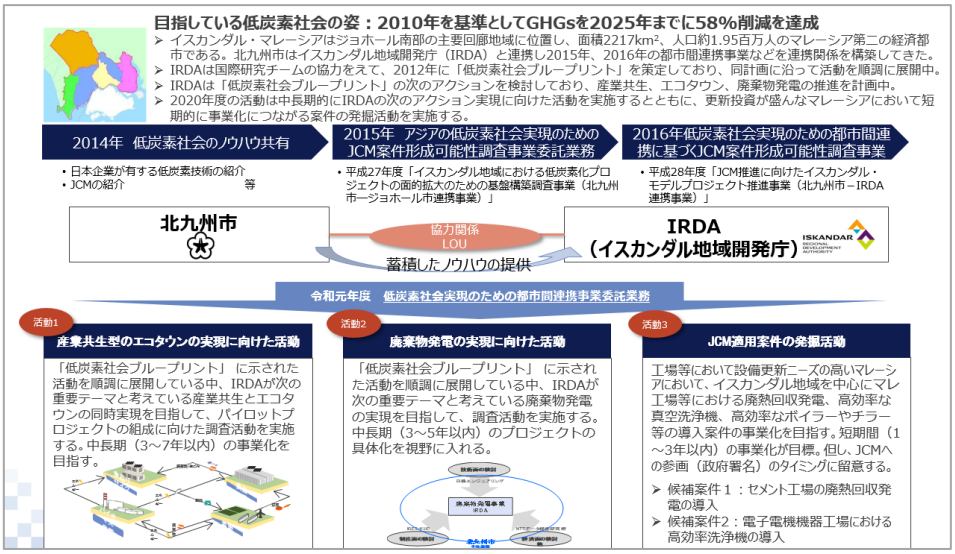


Figure 1-13　Activities in FY2020

As mentioned above, Kitakyushu has steadily built up its interactions with IRDA. In this project, based on the results of past projects, a follow-up survey will be conducted for each project. In addition, activities for the realization of an eco-town with industrial symbiosis and waste power generation, which were promoted in the FY2020 project, will continue to be undertaken. In addition, as this is the final year of the three-year plan, the results of the past three years' activities will be compiled into an action plan for decarbonisation in the Iskandar Development Region, which will be used as the basis for future decarbonisation efforts in the region. The project is being implemented with the expectation that it will contribute to the realization of a society.

(f) Activities in FY2021

In FY2021, the project continued to work on activities for the realisation of an eco-town with industrial symbiosis and waste-to-energy generation, which had been promoted in the FY2021 project. As FY2021 was also the final year of the three-year plan, discussions were held with IRDA on how to utilise the results of the past three years' activities for the decarbonisation of the Iskandar region. In the course of these discussions, it was agreed that the concepts of 'Industrial Symbiosis', 'Eco Town' and 'Waste to Energy', which have been addressed in the project, and the content of future initiatives, would be incorporated into the Comprehensive Development Plan (CDP). It was agreed to include the concepts and future initiatives of 'Industrial Symbiosis', 'Eco Town' and 'Waste to Energy' in the Comprehensive Development Plan (CDP).

The CDP is reviewed and updated every five years, with the current plan in place until 2025 (CDP: 2006-2025; CDP2: 2014-2025). The latest version, CDP3, is currently being prepared and will run until 2030. The concepts of 'Industrial Symbiosis' and 'Eco Town' and 'Waste to Energy' will be included in the newly developed CDP3.

It is considered a significant achievement that the activities in this project have contributed to the decarbonisation efforts in the Iskandar region.

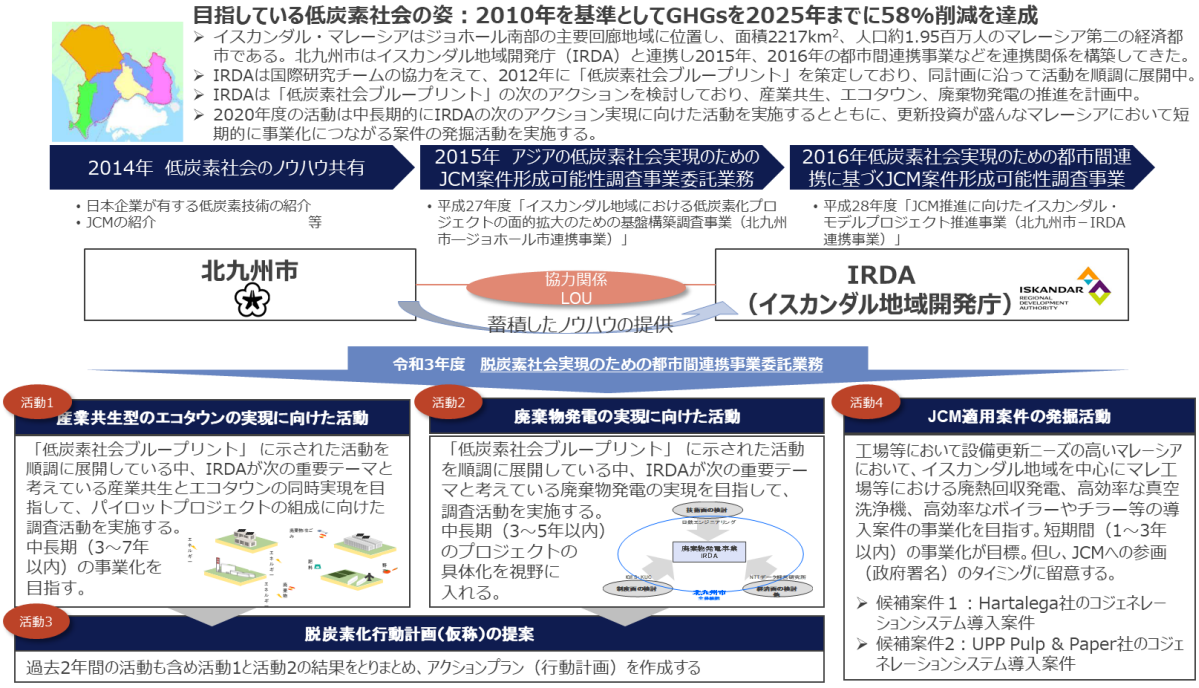


Figure 1-14 Activities in FY2021

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# Chapter 2. Study on creating inter-industry collaboration projects to decarbonize the industrial sector

## 2.1 Overview of the Activity

As part of the "Promotion of Carbon-Free Society in Iskandar Regional Area (City of Kitakyushu-Iskandar Regional Development Authority Collaboration Project)" for FY2020-2021, an industrial park in the Iskandar region was developed as an "Industrial Symbiotic Eco-Town". In this project, the inventory data of each factory in the industrial park in the region was investigated to see if there was any possibility to use the waste from each factory as raw fuel for other factories, and reviewed how to match the needs of each factory. The review showed that the Iskandar region has already developed a certain level of recycling technology, and commercial transactions related to waste disposal are maturing, so it did not immediately lead to the creation of a project to apply Japanese recycling technology.

Meanwhile, waste is not the only thing being discharged from factories. For example, as shown in Table 2-1, the highest energy demand in the Iskandar region is in food, beverage, and tobacco production. These come with heating and cooling processes and waste heat such as exhaust gas is generated, but may be unused due to temperature, location and time constraints of available destinations. Moreover, in many cases, large amounts of water are used as cooling water and then drained away without further use. Wastewater from manufacturing is treated by each company or individual contractor, and there are cases where highly concentrated organic wastewater is incinerated to avoid deterioration of the treated water quality. In addition, water for manufacturing (pure water) is also produced by each company, but due to its aging and extended continuous operation period, there are few maintenance opportunities, which could be a potential risk factor for stable operations.

Table 2-1 Energy consumption by industry in the Iskandar region

| Subsector | Share of energy demand | Consumption in 2019 (ktoe) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Natural gas | Petrol | Diesel | Fuel Oil | LPG | Electricity | Others |
| Food, beverages and tobacco | 37.7% | 484.3 | 7.84 | 10.66 | 7.84 | 0.31 | 73 | - |
| Chemical | 15.8% | 99.2 | 4.36 | 23.10 | 25.20 | 0.81 | 92 | - |
| Non-metallic mineral products | 10.0% | 7.5 | - | 3.22 | 7.23 | - | 35 | Coal: 100.92 |
| Non-ferrous metals | 0.3% | 1.1 | - | - | - | - | 4.26 | - |
| Iron and steel | 4.1% | 39.1 | - | 7.79 | 1.10 | 1.93 | 14 | - |
| Wood and wood products | 0.5% | 0.3 | 0.05 | 0.75 | 1.12 | - | 5 | - |
| Pulp, paper and printing | 0.6% | 2.0 | 0.13 | 1.16 | - | - | 7 | - |
| Textile and leather | 1.6% | 7.9 | 0.25 | 1.92 | 0.71 | 0.05 | 14 | - |
| Machinery | 8.8% | 1.8 | 17.66 | 20.10 | - | - | 97 | - |
| Transportation equipment | 1.7% | 1.9 | - | 15.35 | - | 0.03 | 9 | Kerosene: 0.06 |
| Not specified elsewhere | 18.8% | 38.0 | 1.73 | 8.06 | 24.19 | 14.97 | 204 | - |

Based on the status of waste heat and wastewater treatment at each of these companies, a study was conducted aimed at energy management for the entire industrial park beyond the boundaries of industries and companies, as well as collective supply and collective treatment of wastewater for use.

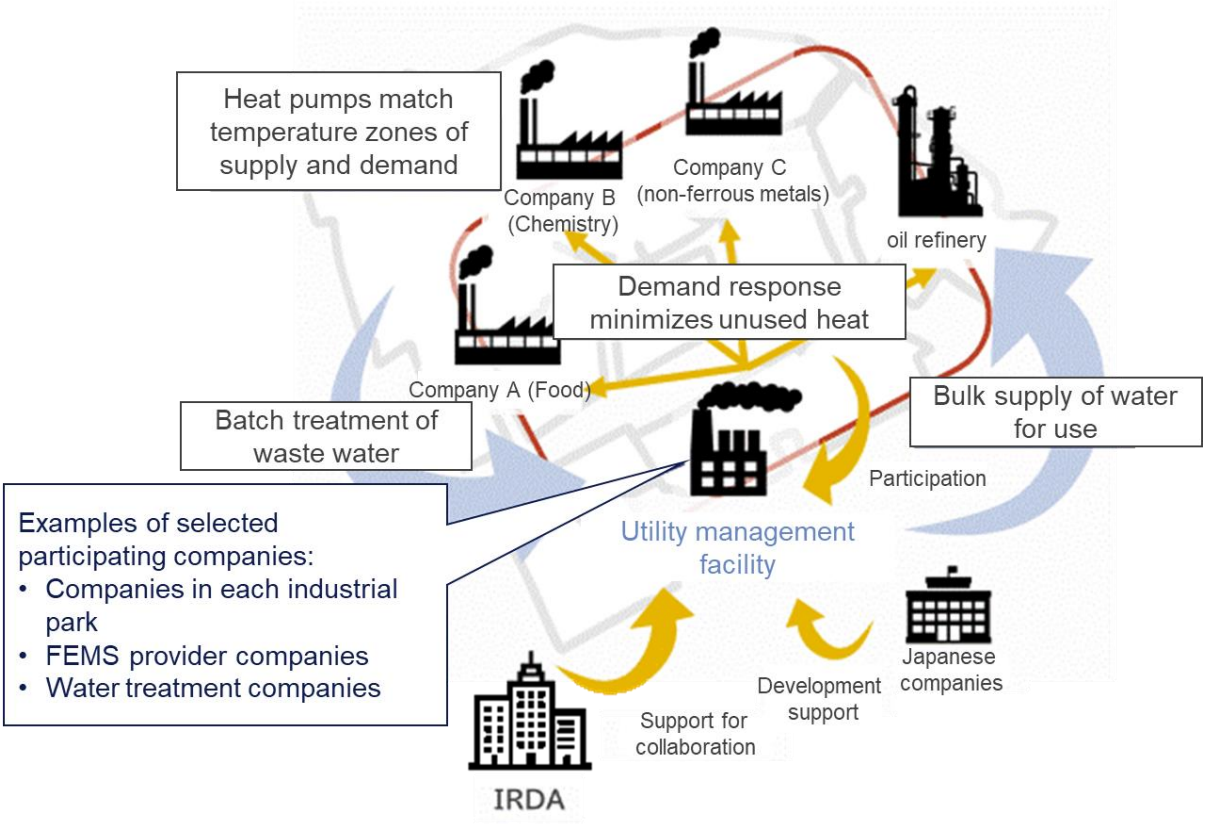


Figure 2-1 Industrial symbiosis in the industrial park (image)

The following activities are envisioned this fiscal year for the creation of pilot projects.

1) Detailed assessment of waste heat generation status, etc., feasibility study
2) Survey on the maintenance status of facilities, pipelines, and other infrastructure for use and drainage of water in the industrial park
3) Selection of potential participating companies (local companies and Japanese companies with the above-mentioned relevant technologies)

For each of the above activities, we will proceed based on the division of roles as shown below in Table 2-2.

Table 2-2 Assignment of roles by each stakeholder

| # | Activities | IRDA | Kitakyushu City | NTTD Institute of Management Consulting |
|---|---|---|---|---|
| 1 | Detailed assessment of waste heat generation status, etc., feasibility study | ● | | ● |
| 2 | Survey on the maintenance status of facilities, pipelines, and other infrastructure for use and drainage of water in the industrial park | ● | | ● |
| 3 | Selection of potential participating companies (local companies and Japanese companies with the above-mentioned relevant technologies) | ● | ● | ● |

## 2.2 Study of inter-industry collaboration concept

In this year's project, details of the inter-industry collaboration concept were first laid out.

### 2.2.1 Advanced Cases in Japan

An example of how the concept of inter-industry collaboration is already being implemented in Japan is the feasibility study conducted by Yokogawa Electric Corporation. Yokogawa Electric Corporation conducted an inter-industry collaboration study in 2021 as a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO), a national research and development corporation. This was done with the cooperation of several business sites in different industries in the Goi district of Ichihara City, Chiba Prefecture, with the aim to achieve carbon neutrality in the industrial complex in the district. The project aims to achieve net zero CO2 emissions from the entire industrial complex in the area by 2050. In pursuit of this goal, it conducts surveys on the current status of energy balance, and capture and reuse of emitted carbon dioxide (CO2) at multiple business sites, and investigates the possibility of establishing a carbon recycling business through inter-industry collaboration.

Specifically, the project covers carbon recycling businesses based on the following three areas: effective utilization of materials and energy throughout the entire complex, CO2 capture and conversion to valuable resources, and hydrogen management.

Yokogawa Solution Service Corporation and KBC Advanced Technologies Limited, which are subsidiaries of Yokogawa Corporation, are also participating in this study. They utilize process knowledge accumulated in the manufacturing sector at various industrial complexes in Japan and overseas, consulting know-how on the improvement of processes and energy efficiency of individual businesses as well as cross-industry collaboration, virtual power plant technology that enables supply and demand control at the regional level, regional energy management systems that enable optimal control according to supply and demand, and simulation technology that supports the execution of optimal production planning, among others.

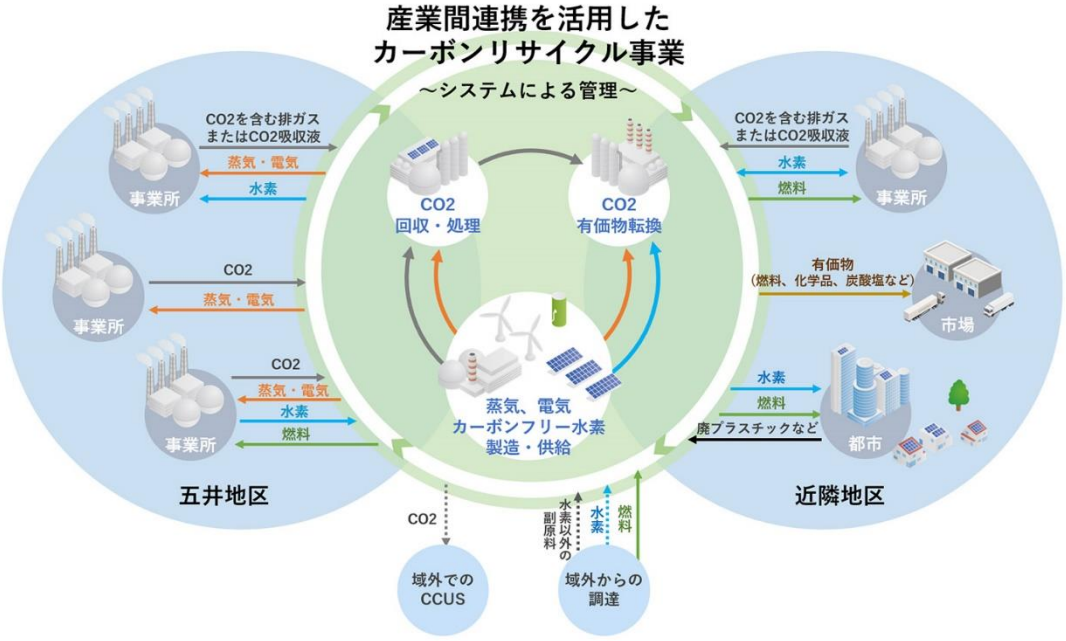


Figure 2-2 Image of a carbon recycling business utilizing inter-industry collaboration
(Source: Yokogawa Electric Corporation press release (2021))

### 2.2.3 Image of implementation envisioned in this project

While using the case study of Yokogawa Electric Corporation as a reference, this project first envisions reducing energy consumption through efficient treatment of waste heat and wastewater. Specifically, the project envisions real-time monitoring of waste heat generation at each company, optimal use of waste heat through heat pumps, demand response, etc., in collaboration with other companies, and reduction of incineration energy by enabling treatment of highly concentrated organic waste water through batch treatment of waste water for dilution and introduction of advanced treatment, etc.
This is expected to lead to the decarbonisation of heat through the optimal use of waste heat, etc., the strengthening of resilience through the integration and large-scale treatment of wastewater, etc., and the establishment of a competitive industrial region through optimization of the entire industrial park.
In addition to waste heat and wastewater, there is also the possibility of CO2 capture, conversion to valuable resources, and ultimately energy conversion. We believe that, under the concept of inter-industry collaboration, we can also implement initiatives such as utilization of waste from each factory as raw materials for the products of other

factories, which had been considered as an "Industrial Symbiotic Eco-Town" until last fiscal year.

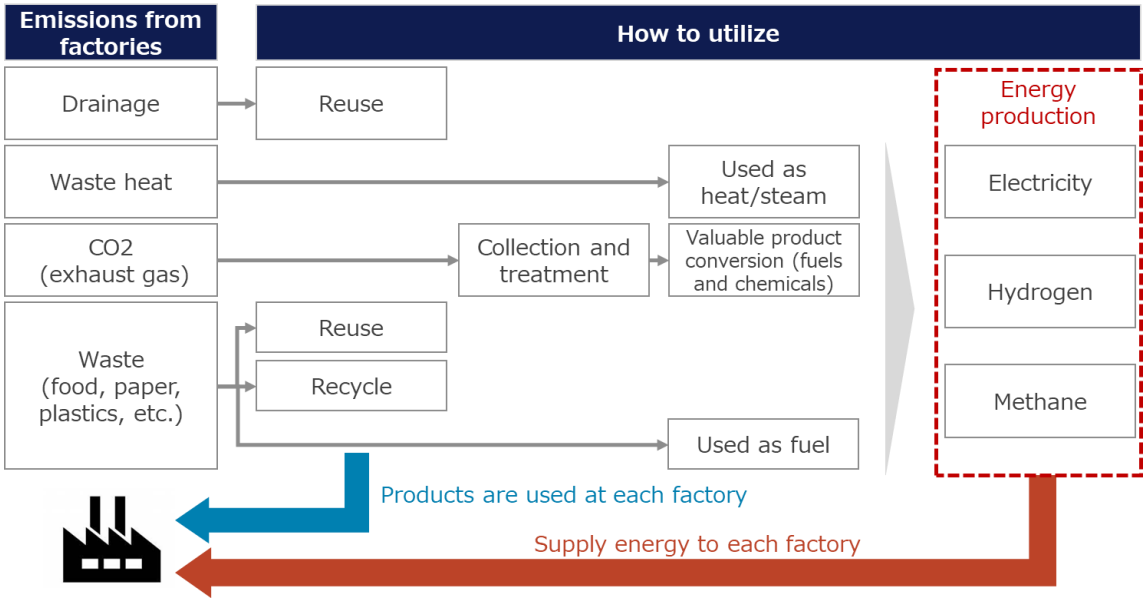


Figure 2-3 Image of utilization of waste and other materials generated by each factory (draft)

## 2.3 Interviews with stakeholders

In order to investigate the feasibility of inter-industry collaboration projects, it is necessary to investigate the actual wastewater and waste heat emissions at the factories and the facilities that each factory has. However, if the industrial park already has centralized drainage and waste heat treatment facilities, it would be difficult to apply this concept; therefore, it is necessary to investigate the situation in the industrial park first. As such, at IRDA's suggestion, the project first conducted interviews with the Federation of Malaysian Manufacturers (FMM) to investigate what kind of industrial parks could be targeted. Interviews were then conducted with the two industrial parks identified by FMM as potential options.

### 2.3.1 Interview with the Federation of Malaysian Manufacturers

To begin with, at IRDA's suggestion, interviews were conducted with the Federation of Malaysian Manufacturers (hereinafter referred to as FMM).

(1) Overview of FMM

FMM is Malaysia's leading economic organization and has consistently led the country's manufacturing industry since its establishment in 1968, spearheading the country's growth and modernization. It is the largest private economic organization in Malaysia, representing over 3,000 manufacturing and industrial service companies of various sizes. The largest number of industries belonging to FMM are in the food, beverage, and tobacco sectors, followed by the chemical and textile industries. (For more information, see Figure 2-4)

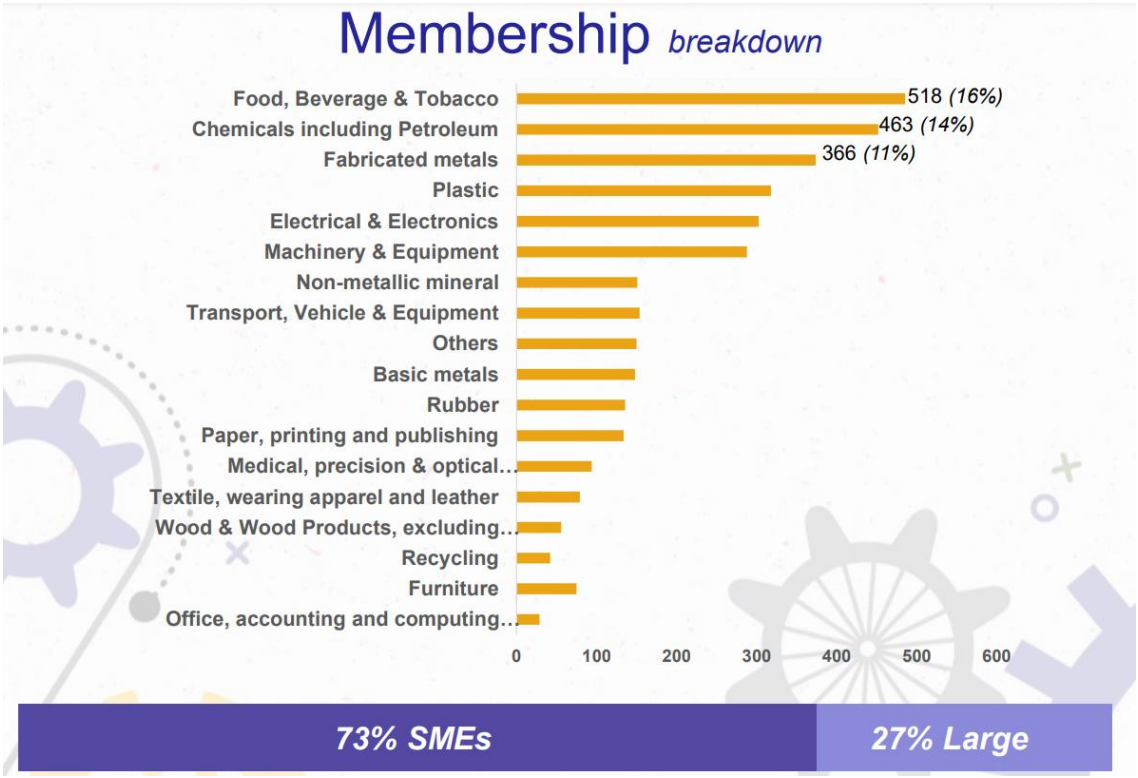


Figure 2-4 FMM membership breakdown by industry
(Source: FMM data)

(2) Contents of the Interview

The following questions were asked during the interviews with FMM.

- What industrial parks should we target for the survey?
- We would like to conduct interviews with industries with high energy consumption.

Which industrial parks would be the most likely targets? (See Table 2-3 for target industries)

Table 2-3 Industries to be Interviewed (Draft)

| # | Type of industry |
|---|---|
| 1 | Food, beverages, tobacco |
| 2 | Chemicals |
| 3 | Non-metallic mineral products |
| 4 | Nonferrous metals |
| 5 | Steel |
| 6 | Wood and wood products |
| 7 | Pulp, Paper & Printing |
| 8 | Textiles & Leather |
| 9 | Machinery |
| 10 | Transportation equipment |

(3) Interview Results

As a result of the interviews, we were able to generate interest in the concept of inter-industry collaboration itself. The interviews also revealed that among the target industries, the food, steel, and transportation industries, among others, are expected to have particularly high CO2 emissions. Some of the participants suggested that a relatively new industrial park would be a good place to test the concept of inter-industry collaboration. Using the potential industrial parks suggested from FMM as reference, IRDA picked the industrial parks and set up meetings.

(4) Interview details

| | | |
|---|---|---|
| Meeting Name | Inter-city collaboration (Kitakyushu City-Iskandar) FMM meeting | |
| Dates | Wednesday, November 23, 2022, 10:00a.m.-10:40a.m. | |
| Location | Microsoft Teams | |
| Attendees | FMM (Federation of Malaysian Manufacturers) | Mr. Saw Seong Ho, Mr. QRE Vincen Lim, Mr. Lo Jian Hou |

| | | |
|---|---|---|
| | IRDA | Ms. Velerie Siambun、Mr. Mamdoh B. Dato |
| | NTT Data Institute of Management Consulting (NDK) | Muraoka, Yoshikawa (notes) |

1. **Activity 1 (Decarbonizing the industrial sector through inter-industry collaboration)**
   - I think inter-industry collaboration is a good concept. If a survey is to be conducted, Senai Airport City is a good place to do it, as it is home to multiple industries. Maybe it would be better to conduct the survey in just one industrial park first (Saw).
     - The industrial park in the Iskandar region has a 60-year history. To test a new concept, it might be better to do it in Senai Airport City, which is a relatively new industrial park (Saw)
   - Is it possible for FMM to arrange a meeting with the management company and other relevant organizations of Senai Airport City? (Muraoka)
     - Senai Airport City's development organization is a member of FMM, but meetings are best coordinated by IRDA (Saw)
     - (To Velerie) Would you be able to coordinate a meeting with Senai Airport Area's representatives and other relevant parties? (Muraoka)
     - Face-to-face meetings would be better if possible. Hope to make adjustments for when I travel next week (Velerie).
     - It would be difficult for FMM to accompany on the 28th and 29th due to commitments on both days (Lim)
   - In fact, the textile industry is not very active in the Iskandar region. But there is naturally a large number of food and steel factories, and I have heard that transportation is a major source of CO2 emissions (Saw).
   - Would you prefer to conduct the survey in a new industrial park or in an existing industrial park where factories are already in operation? (Lim)
     - Since this project is a 3-year program and the main focus this year is to find potentials, there is no problem either way (Muraoka)
     - Senai Airport City does not yet have a factory in operation? (Muraoka)
     - Operations have begun at several factories (Lim).
   - If you want to conduct the survey in a larger place than Senai Airport City, Pasir Gudang Industrial Estate is a good place (Lim).
     - I think we would like to see the potential of the existing factories. In Japan, some factory estates with limited energy-saving effects have set up companies to collectively take charge of energy supply, which may be

applicable to existing industrial parks in Iskandar (Muraoka)

- Since it is difficult to make an appointment with the person in charge of the industrial park for next week's trip, we hope to have another on-site meeting somewhere during the project period (Muraoka)
- Senai Airport City has only 6 industries out of the 10 targets. Does it matter if not all 10 targets are included? (Mamdoh)
  - Since we are simply targeting industries with high energy consumption, it does not matter even if not all are included (Muraoka)
  - Noted. If the target is narrowed down to Senai Airport City and Pasir Gudang, then the contact person for each factory should be identified during the NDK's visit to Iskandar (Mamdoh)

### 2.3.2 Interviews with industrial park management companies

Based on the interview with FMM, IRDA selected two industrial park management companies (AME Development and TPM Technopark) to conduct the interviews. We decided to target Senai Airport City operated by AME Development and Tanjung Langsat Industrial Park operated by TPM Technopark. (See Figure 2-5 for location)

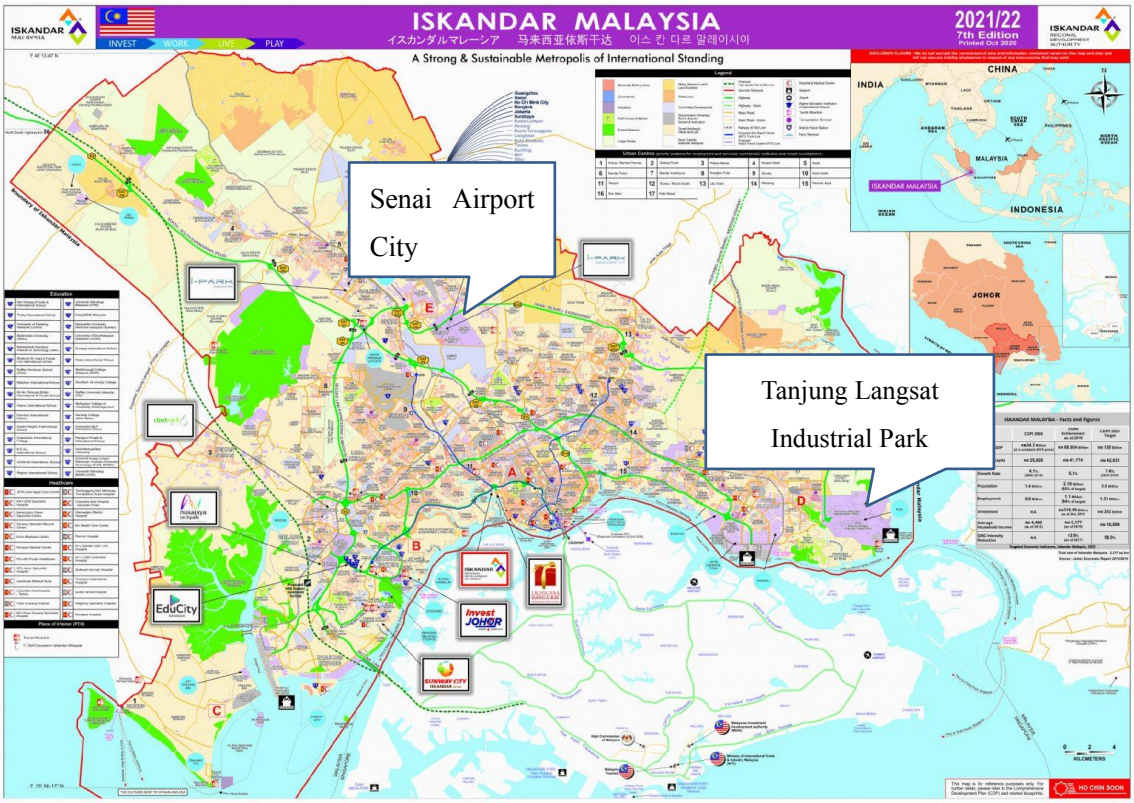


Figure 2-5 Overall map of Iskandar, Malaysia
(Source: Compiled by NTT Data Institute of Management Consulting from IRDA website)

(1) Outline of Interviewees

**AME Development Sdn. Bhd.**

AME Development Sdn. Bhd. (hereafter "AME Development") was established as a real estate developer with a strong commitment to quality and a dynamic results-oriented approach. Over the years, the company has been actively involved in the planning and design of industrial park developments and is now highly regarded as an integrated industrial park developer in Malaysia. In particular, the company has a track record of developing projects such as i-Park, which is managed under the Clean & Green concept. i-Park is AME Development's flagship project, which aims to provide a healthy work-life balance for its employees with facilities such as a gym, swimming pool, health studio, outdoor sports court, jogging track, bike path, and multipurpose offices. The list of industrial parks operated by AME Development is shown in Figure 2-6, but this time we conducted interviews at Senai Airport City, which is relatively new among them.
Senai Airport City is a 195-acre industrial park located near Senai International Airport.

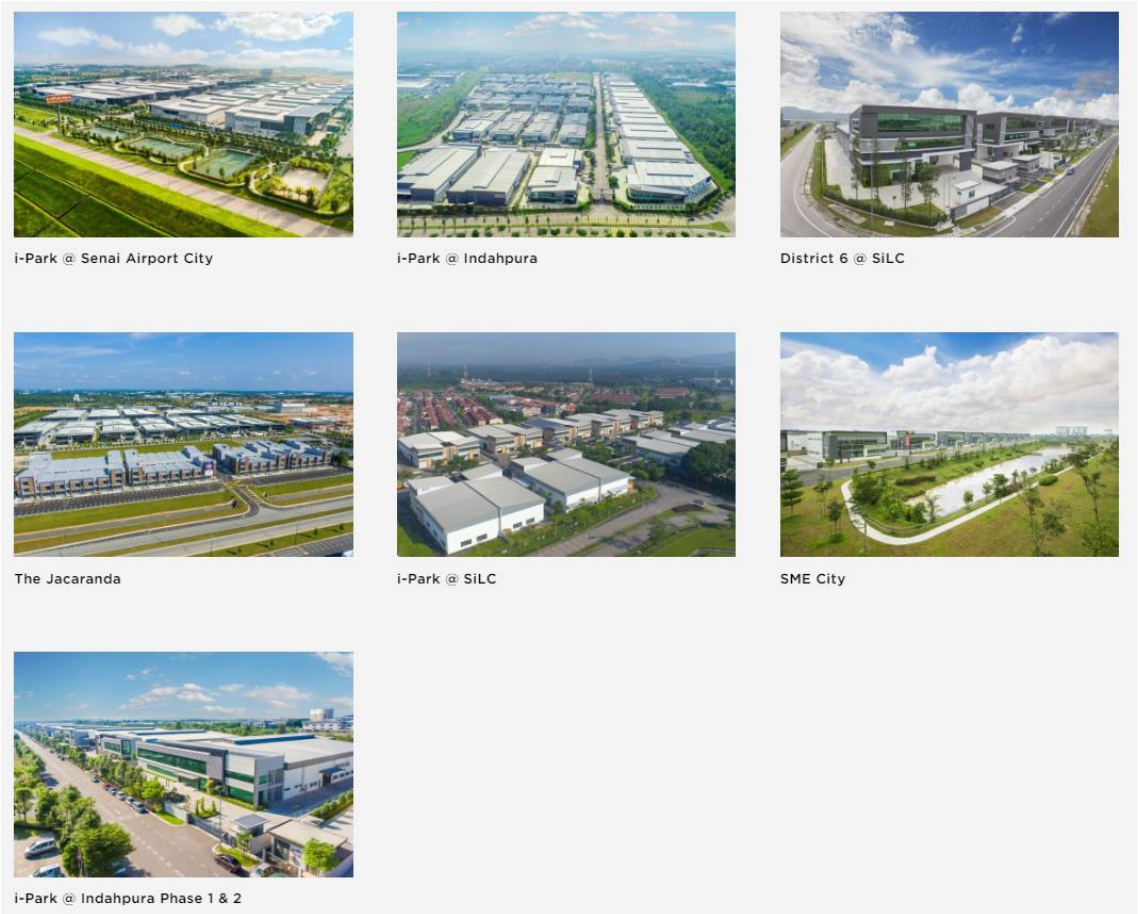


Figure 2-6 Industrial park operated by AME Development
(Source: AME Development website)

**TPM Technopark Sdn. Bhd.**

TPM Technopark Sdn. Bhd. ("TPM Technopark") is a wholly owned subsidiary of the Industrial Development Division (IDD) of Johor Corporation (JCorp) Group. TPM Technopark provides project management services for commercial and industrial development, as well as sales promotion services for industrial sites and properties owned by JCorp. TPM Technopark plays a key role as project manager for JCorp Group's construction projects, as well as for projects commissioned by the federal government through the Johor State Development Office (SDO).

Since 2011, TPM Technopark has managed more than 65 projects with a total value of MYR103.48 million (approximately USD32.25 million).


Figure 2-7 JCorp Organizational Structure
(Source: TPM Technopark website)

This time, we conducted interviews at Tanjung Langsat Industrial Park, one of the industrial parks managed and operated by TPM Technopark.

Tanjung Langsat Industrial Park (TLIC) is one of the few industrial parks in southern Malaysia dedicated to heavy industry. Located right next to the more mature Pasir Gudang Industrial Park, TLIC has a total area of 4,835 acres. It is also a modern integrated industrial park with a Free Commercial Zone (FCZ), warehouses, marine supply base, Palm Oil Industry Cluster (POIC), Johor Skills Development Center (PUSPATRI), centralized workers' dormitory, and port facilities at Tanjung Langsat Port Terminal (TLPT).

The industries covered by TLIC include the construction sector, chemical industry, warehousing, palm oil, port services, and tank storage (see Figure 2-8).

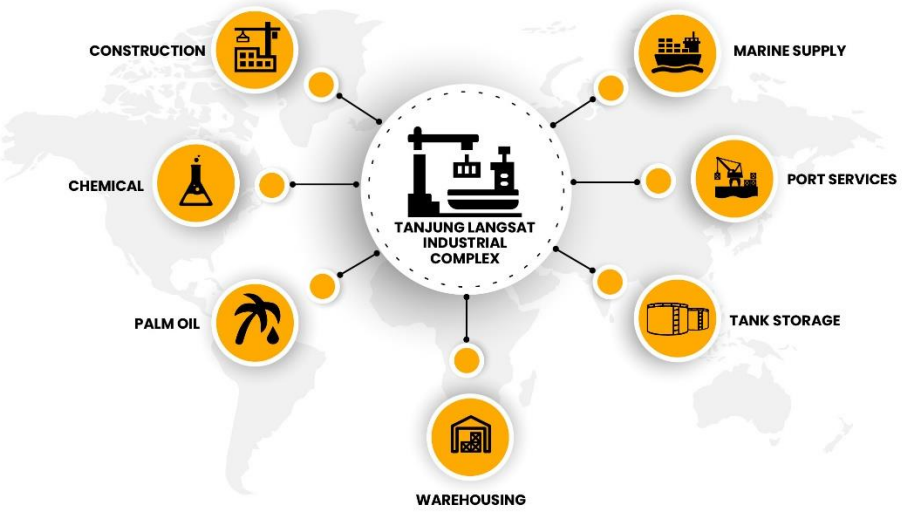


Figure 2-8 Industries covered by TLIC
(Source: TPM Technopark website)

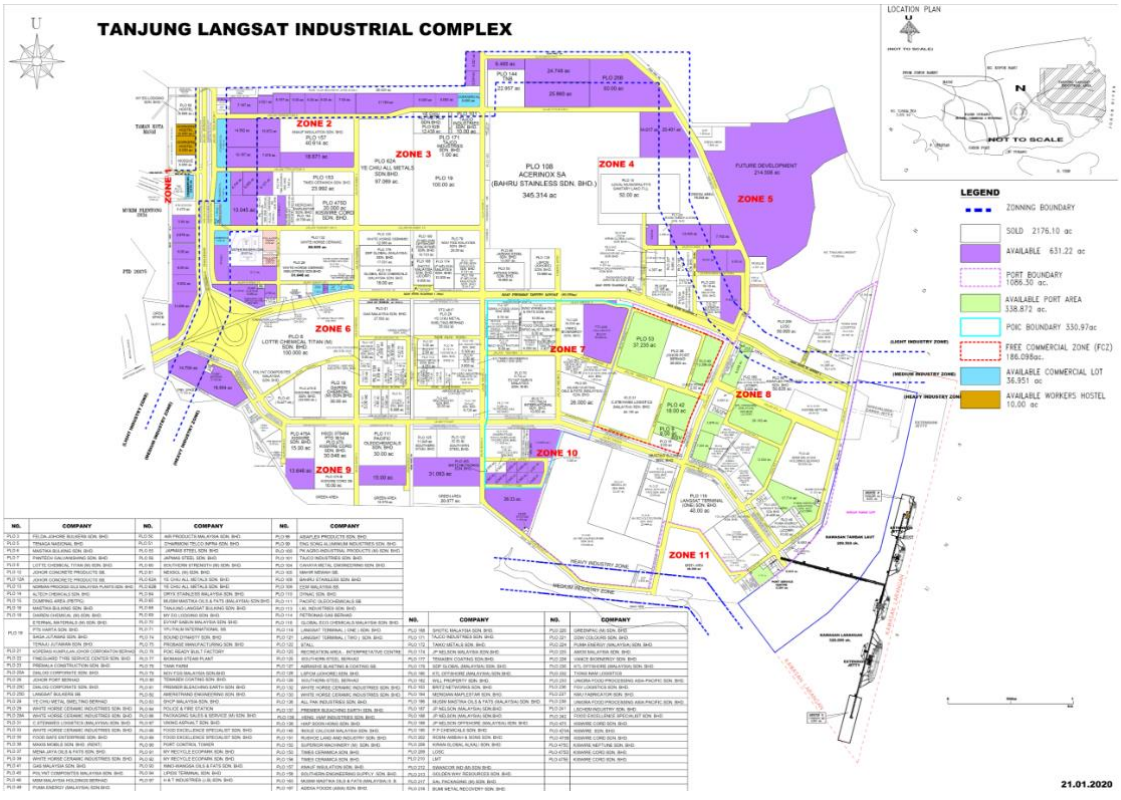


Figure 2-9 Overall view of TLIC
(Source: TPM Technopark website)

(2) Contents of the Interview

The following questions were asked of each company interviewed.

1. Are all facilities in the industrial park supplied collectively with electricity and water?
   - ✓ If so, is the electricity supplied by renewable energy sources?
   - ✓ What percentage of energy used is renewable energy?
2. Are water treatment and waste heat treatment performed collectively in the industrial park, or are they done at each factory?
3. Are initiatives for decarbonisation being implemented?
   - ✓ If yes, what specific initiatives are being implemented? (e.g., promotion of electrification, introduction of energy-saving equipment, etc.)
   - ✓ If not implemented, are there any issues identified as challenges? (e.g., cost effectiveness, etc.)

(3) Interview Results

<u>AME Development</u>

The interviews revealed that the industrial parks managed by AME Development do not emit that much wastewater or waste heat, and therefore, it is possible that they do not have the facilities at their respective factories in the first place. In addition, it was found that each factory has a contract with its own supplier for electricity and water, and that the management company does not supply them collectively.
Although no steps are taken to decarbonize their operations yet, the Malaysian Ministry of Environment has requested them to do so, and the factories are also expected to do so in the future, so they believe that there is interest. AME Development also plans to build an industrial park based on UNIDO's Eco Industrial park*, indicating a high level of interest in decarbonisation efforts.

*UNIDO: Eco Industrial park
UNIDO has identified the promotion of Eco Industrial parks as one of its contributions to the Sustainable Development Goals.
An Eco Industrial park is a community of companies located on a shared site that seeks to improve environmental, economic, and social performance by enabling companies to jointly manage environmental and resource issues. This is called industrial symbiosis and is a means for companies to gain competitive advantage through the physical

exchange of materials, energy, water, and by-products, and to promote inclusive and sustainable development.

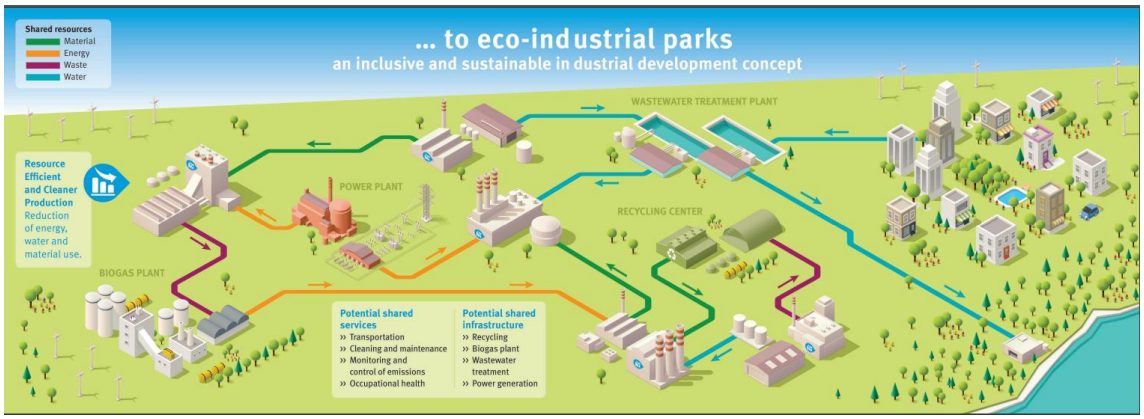


Figure 2-10 UNIDO: Conceptual diagram of Eco Industrial park
(Source: UNIDO (2017))

**TPM Technopark**

The interviews found that, just as AME Development, the industrial parks operated by TPM Technopark also carry out wastewater and waste heat treatment at each factory. Regarding the concept of inter-industry collaboration, there were comments, particularly with regard to wastewater treatment, that there is a high demand for initiatives to reuse industrial water in Malaysia, given the country's water scarcity issues. In addition, since TLIC is primarily focused on heavy industry, it generates a large amount of waste heat and wastewater, making it likely that the concept of inter-industry collaboration could be applied.

Similarly with electricity, for now it is difficult to install enough solar power to generate a surplus due to the contract with TNB, and it is also difficult to supply electricity generated by the solar power to other factories. Unlike in Japan, it is not possible to sell electricity in Malaysia except through TNB, resulting in difficulty sharing electricity among factories.

Meanwhile, some commented that if the concept of inter-industry collaboration is to be implemented, it would be better to do so in newly constructed industrial parks rather than in existing industrial parks where businesses are already in place. This is because the infrastructure is already in place in the existing industrial parks, making it difficult to install new pipes for waste heat and wastewater, and the timing for replacing existing equipment differed from factory to factory, making it difficult to integrate their facilities.

(4) Interview details

**AME Development**

| | | |
|---|---|---|
| Meeting Name | Inter-city collaboration (Kitakyushu City-Iskandar) AME Development meeting | |
| Dates | Monday, February 13, 2023, 9:00a.m.-10:00a.m. | |
| Location | Senai Airport City | |
| Attendees | AME Development（AME） | Ms. Alice Tee, Ms. Lee Ling Sien, Ms. Tan Pei Hui, MS. Tain Siew Fung |
| | FMM (Federation of Malaysian Manufacturers) | Mr. Saw Seong Ho, Mr. Irfan Hakimi Bin Azizi |
| | IRDA | Ms. Velerie Siambun、Mr. Ahmad Sabqi Ismail, Mr. Gerald Woo |
| | NTT Data Institute of Management Consulting (NDK) | Muraoka, Yoshikawa (notes) |

*Honorifics omitted thereafter.

■ Agenda Details

- I have heard that there are examples of such inter-industry collaboration concepts being implemented in places such as commercial facilities in Singapore, albeit only for waste heat (AME).
- Does each industrial facility have a wastewater/waste heat treatment system, or is it managed by the industrial park collectively? (NDK)
  - There is no equipment at each factory in the first place because wastewater and waste heat emissions are not that large (AME)
  - If anything, there is more paper and plastic waste generated (AME).
  - Factory owners are interested in wastewater treatment standards and exhaust emission standards and the like because of the request from DOE, but are only now beginning to consider them (AME).
- How is electricity supplied to each facility? Is power from renewable energy, etc., being supplied? (NDK)
  - Each factory has a contract with TNB. Some factories have installed solar panels (AME)
- Each factory has quite a bit of interest in moving toward zero-carbon. However, at this time, the supply of renewable electricity by TNB is only for commercial

facilities and not for factories (AME).

- Some of the incentives are not yet working that well in Malaysia because electricity prices are not that high (AME).
- 50% of the electricity supplied in the main AME building itself is renewable power (AME)

- Many of the factories in Senai Airport City are medical equipment, machinery and transportation companies (AME)
  - Japanese companies include YKK and Makino factories (AME)
- Are electricity and water supplies, etc., provided throughout the industrial park collectively or at each factory (NDK)?
  - Provided at each factory. AME is only a developer (AME)
- Does AME implement any decarbonisation initiatives or other measures? (NDK)
  - There are plans to build an industrial park using UNIDO's Eco Industrial park as a benchmark (AME)
- Have the CO2 emissions by each factory ever been charted? (NDK)
  - CO2 emissions during the construction of the buildings can be identified, but not down to the emissions of each factory (AME)
- We would like to conduct interviews at each industrial park, is this possible? (NDK)
  - We will cooperate with the survey. We need to explain to each company, so we would like to have some materials, etc., from you (AME)
  - Noted. (NDK)

END

**TPM Technopark**

| | | |
|---|---|---|
| Meeting Name | Inter-city collaboration (Kitakyushu City-Iskandar) TPM Technopark meeting | |
| Dates | Monday, February 13, 2023, 2:30p.m.-4:00p.m. | |
| Location | TPM Technopark　Office | |
| Attendees | TPM Technopark | Mr. Fuad Omar, Mr. Rohaznizam Bin Yon, Ms. Sofia Syahirah Binti Mohd Nasir |
| | FMM (Federation of Malaysian Manufacturers) | Mr. Saw Seong Ho, Mr. Irfan Hakimi Bin Azizi |
| | IRDA | Ms. Velerie Siambun、Mr. Ahmad Sabqi Ismail, Mr. Gerald Woo |

| | | |
|---|---|---|
| | NTT Data Institute of Management Consulting (NDK) | Muraoka, Yoshikawa (notes) |

*Honorifics omitted thereafter.

■ Decisions

- Interviews will be conducted at each factory in the industrial park next fiscal year.

■ Agenda Details

- Are there already centralized water treatment systems in the industrial parks in Malaysia? (Muraoka)
  - No, treatment facilities are managed at each factory (TPM)
  - Japanese companies also have similar facilities, and there is a movement to improve efficiency by centrally managing them within the industrial park (Muraoka)
- Do you provide electricity, water, etc., collectively to each company in the industrial park? (NDK)
  - Since the operator only provides the facilities, each factory contracts separately for electricity and water. We don't know if they use renewable electricity either, unless we ask each factory (TPM)
- Is my understanding correct that Tenaga Nasional Berhad (TNB) has a monopoly on the power business in Malaysia, so even if surplus power is generated by installing solar panels, it cannot be sold to the grid? (NDK)
  - Not for introduction in already existing facilities. However, there is room for negotiation when developing in new fields (TPM)
- Is it possible for TNB to enter into a power contract with the operator of an industrial park, and for that operator to supply power to the industrial park? (NDK)
  - That is not possible. Power must be supplied via TNB (TPM)
  - Is it possible to store surplus energy from solar panels in storage batteries and use those batteries to power another factory in the industrial park? (NDK)
  - Discussion needed, but probably possible (TPM)
- In Japan, the price of electricity has skyrocketed, and companies are in high demand for the introduction of solar panels because it is cheaper to use electricity with them. However, in Malaysia, it is difficult to sell surplus electricity, so the demand from companies is not very high (NDK).
  - As you say, surplus electricity sales are limited. For example, HONDA has installed solar panels at its factory in Malaysia, but not enough to cover the

actual power consumption. Introduced only enough to avoid surplus (TPM)

- Regarding wastewater treatment, is my understanding correct that wastewater is treated at each factory? (NDK)
  - Yes, it is. However, I think there is a demand to implement wastewater treatment in an integrated manner (TPM)
  - The government wants to use as much water as possible for drinking in the midst of water shortages. It would be good if water for factory use could be reduced or reused (TPM)
  - Data centres are of particular interest, as they use an especially large amount of water (TPM)
- What about waste heat treatment? (NDK)
  - I have not investigated how waste heat treatment is performed (TPM)
- For example, in cities like Kawasaki City, waste heat is being utilized by connecting pipes to each factory (NDK).
  - Who invests in it? (TPM)
  - Each factory invests in them and maintains its own pipes. Utilization of waste heat reduces gas consumption, allowing return on investment in 5 to 10 years (NDK)
  - The industrial park we operate is heavily industrialized, with many factories using boilers. Utilization of waste heat may be a possibility (TPM)
- The concept is also close to the ideas we have in mind, as we would like to apply it to waste management. For new factories, some are considering the construction of integrated treatment facilities. However, it would be difficult to implement this concept in a factory that is already built at this time (TPM)
  - It is better to implement in industrial parks where there is some room for investment and space. I think TLIC is better than Pasir Gudang (TPM)
  - I heard that Idemitsu, which has a plant in Pasir Gudang, is planning to replace its cogeneration system with a large-scale one. Therefore, we are looking into selling the waste heat there. It may be possible to switch to an already existing industrial park if they are at the point of replacing their facilities (NDK)
- You are planning to build a new data centre, do you have any plans to install centralized cogeneration system or solar PV? (NDK)
  - Discussions are underway with TNB to install a solar farm to allow for self-consumption. However, a license is required to supply power (TPM).
- If it is necessary to conduct interviews at the factories, we can cooperate. The factories also understand that ESG responses will be necessary in the future

(TPM)

- Since it would be difficult to do so during this fiscal year, we would like to ask for cooperation from next fiscal year onward (NDK).

- Will low electricity prices in Malaysia make solar-powered electricity more expensive? (NDK)
  - No, the price of solar power is equal to the price from TNB (TPM)
- Since there is no carbon tax, each company has no incentive to implement it right now. Therefore, existing industrial parks may be difficult. There would be a better opportunity investing in a new industrial park (TPM)
  - As a side note, NTT Data has data centres all over the world, and recently we are often asked about CO2 emissions by banks and other companies. The criteria for selection has become more focused on how to avoid CO2 emissions (NDK)
  - I don't think there is space for new pipes in an existing industrial park (TPM)
  - Also, since the quality of wastewater differs from one industrial park to another, we wonder whether it is possible to treat it in a centralized facility (TPM)

END

## 2.4 Future Directions

Through this fiscal year's project, a feasibility study was conducted to determine whether the concept of inter-industry collaboration could be implemented in an industrial park in Malaysia. As a result of this project, we first held meetings with the management companies of the industrial parks and were able to interview them about the current status of the industrial parks. The concept of inter-industry collaboration was met with interest, and the fact that integrated wastewater and waste heat treatment has not yet been implemented in the industrial parks showed that there is room for implementation of inter-industry collaboration.
We had also hoped to conduct interviews with individual companies in the industrial parks to find out information such as the status of wastewater and waste heat generation and what facilities they have and to what extent. However, during this fiscal year's project period, we were limited to interviews with the management companies of the industrial parks. However, through a series of activities during this fiscal year, we were able to form connections with FMM and the management companies of industrial parks, and gained a foothold for conducting interviews with companies occupying each industrial park, so we would like to continue our study in the next fiscal year and beyond.

From the next fiscal year onward, questionnaires and interviews will be conducted with individual companies in the industrial parks operated by AME Development and TPM Technopark, where interviews were conducted this year, to carry out detailed surveys on the status of wastewater and waste heat generation and the facilities owned by each company, etc. From the results of the interviews and questionnaires, we expect to select companies that are particularly promising for implementing inter-industry collaboration, and proceed to consider the formation of pilot projects.

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# Chapter 3 Installation of Solar Power Generation Equipment Based on the Kitakyushu Model for 100% Renewable Energy

## 3.1 Overview of the Activity

Since activities up to last year involved studying Eco-Towns based on industrial symbiosis in industrial parks, we mainly focused on efforts to reduce greenhouse gas (GHG) emissions in the industrial sector. However, if we compare energy consumption in the Iskandar region by sector, we can see that electricity consumption by the commercial sector is considerable, second only to the industrial sector. In addition, this year, we are aiming to create a "Zero Carbon Area" in the Iskandar region, which is modelled after the Ministry of the Environment's "Decarbonisation Leading Area"; however, this Japanese model requires greenhouse gas emissions in the consumer sector to be zero in order to qualify as a Decarbonisation Leading Area. Therefore, we propose that, for this year, we move forward with considering the introduction of renewable energy, to promote decarbonisation not only in the industrial sector but also in the commercial sector. When introducing renewable energy, we envision doing so through the "Kitakyushu Model for 100% Renewable Energy" of Kitakyushu City.
The following activities in Table 3-1 were conducted this year to study the introduction of renewable energy.

Table 3-1 Activities conducted to study the introduction of renewable energy

| # | Activities |
|---|---|
| 1 | Investigation of the potential for Solar PV installation in the consumer sector. |
| 2 | Consideration of technologies to be introduced |
| 3 | Consideration of economic feasibility |
| 4 | Trial calculation of the emission reduction effect |
| 5 | Consideration of how administrative support systems etc. should be formulated for the introduction of renewable energy |

### 3.1.1 What is the Kitakyushu Model for 100% Renewable Energy?

（1） Objectives and features of the Kitakyushu Model for Renewable Energy

The Kitakyushu Model for 100% Renewable Energy is a program that aims to (1) establish a system that can introduce 100% renewable energy stably and at low cost, (2) improve the competitiveness of small and medium-sized businesses that need 100% renewable energy, and (3) achieve a "virtuous cycle between the environment and the economy", through encouraging the introduction of renewable energy, energy conservation, and optimal operation and maintenance of equipment, etc. This model aims to introduce renewable energy and energy-saving measures through a so-called "third-party ownership method", in which energy-saving equipment such as solar panels, storage batteries, and air conditioners are installed by the power company. Furthermore, by introducing an energy management system that utilizes IoT and AI for optimal operation, maintenance, and management, the model also aims to contribute to a circular economy by lowering the price of renewable electricity and extending the service life of equipment.

### （２） 3 Steps

The following three introductory steps are shown in the Kitakyushu Model for 100% Renewable Energy.

- Step 1: Switch to 100% renewable energy sources generated by Kitakyushu Power etc. for public facilities, and supply 100% renewable energy to public facilities.
- Step 2: Install solar power equipment for self-consumption, electric vehicles (EVs), and storage batteries through third-party ownership.
- Step 3: In addition to Step 2, reduce total energy consumption further by installing energy-saving equipment such as air conditioners and LEDs through third-party ownership. Also, extend service life and lower maintenance costs by monitoring energy-saving equipment through IoT and AI.

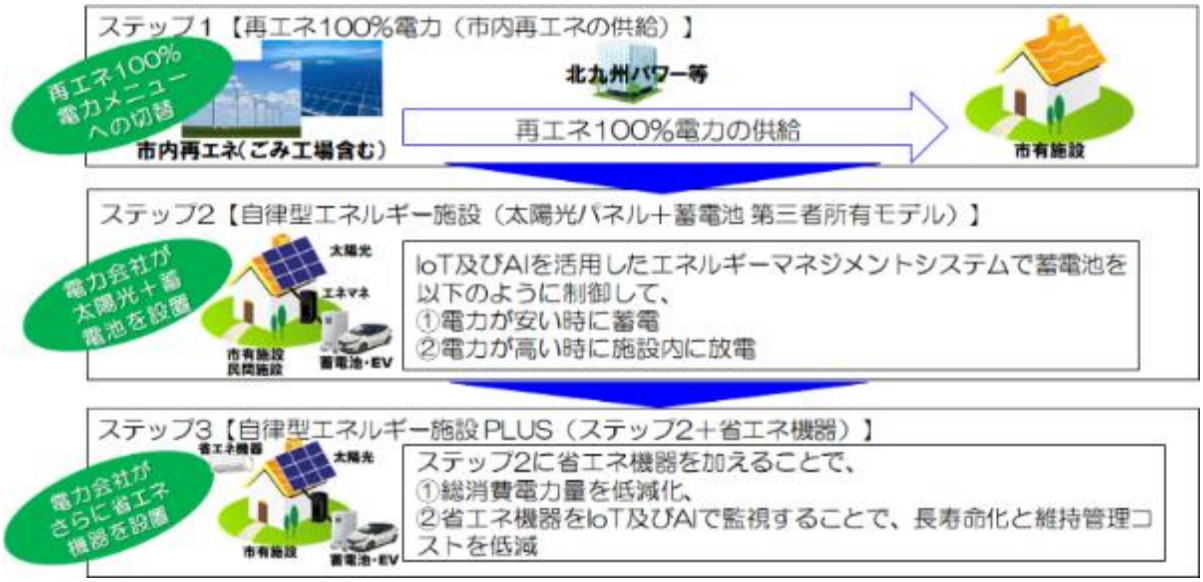



Figure 3-1 Steps for the introduction of the Kitakyushu Model for 100% Renewable Energy

(Source: Kitakyushu City homepage)

（３） Role of Kitakyushu Power

Kitakyushu Power is a regional electricity retail company established in 2015 through investment by the City of Kitakyushu, local companies, financial institutions, and others. It supplies 100% renewable electricity from renewable energy power plants (wind power, solar power, and power generated by incineration) to the city's public facilities, and also provides installation services of solar power generation equipment, storage batteries, EVs, energy-saving equipment, etc. through third-party ownership in the city's public facilities, in cooperation with financial institutions. It is also expected to play a role in distributing surplus electricity that could not be self-consumed from the renewable electricity installed and generated in Step 2 to other public facilities. In other words, Kitakyushu Power plays an essential and central role in the Kitakyushu Model for 100% Renewable Energy. In addition, Kitakyushu Power, being backed by a local government (Kitakyushu City) with a high credit rating, is distinctively able to enjoy an advantage when pursuing cooperative relationships with financial institutions, compared to ordinary private-sector businesses. The Kitakyushu Model for 100% Renewable Energy was initially envisioned with public facilities in mind, but installing equipment in private-sector facilities is also being considered, for the facilities that express interest.

（４） Third-party ownership

In conventional equipment procurement methods used by local governments, local governments used to own their equipment outright, but for equipment such as that for

solar power generation, the number that can be installed per year is limited due to the significant burden of large initial investments. Therefore, Kitakyushu City has been installing equipment under third-party ownership, as a means of introducing renewable energy etc. as early as possible and on a larger scale. In general, third-party ownership is a "PPA model", in which a power company installs solar power generation equipment on the consumer's equipment, and supplies the generated power to the consumer under a power purchase agreement (PPA). In this model, equipment can be installed without any initial investment, and the consumer can have the equipment installed by paying the electricity bill monthly during the contract period.

### 3.1.2 Greenhouse gas emissions in the consumer sector in Iskandar

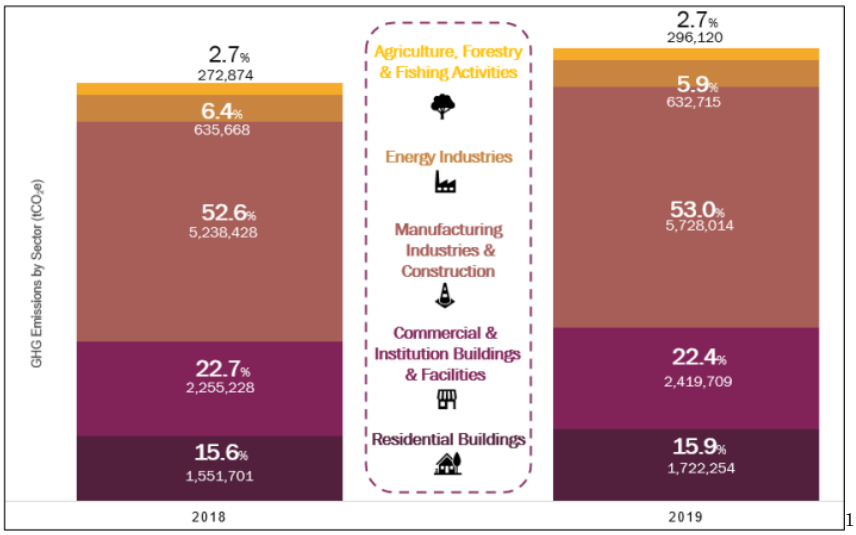
GHG emissions from energy sources in the Iskandar region were approximately 10 million tCO2e in 2018 and 10.8 million tCO2e in 2019. The manufacturing and construction industries account for the highest share of GHG emissions, followed by the commercial and institutional buildings and facilities industry, the residential and building industry, the energy industry and finally the agriculture, forestry and fishing industry. Comparing GHG emissions in 2018 and 2019, emissions in 2019 increased by approximately 8.5% compared to 2018. GHG emissions from the energy sector are attributable to fossil fuel combustion and grid electricity consumed within the geographical boundaries of Iskandar Malaysia.

（1） GHG emissions from fuel consumption

GHG emissions from the energy sector due to fuel consumption in 2018 were approximately 3.3 million tCO2e and GHG emissions in 2019 were approximately 3.5 million tCO2e. They increased by an average of 2.7% per year between 2010 and 2019, showing an increasing trend.

（2） GHG emissions from grid electricity

In 2018, GHG emissions from the energy sector due to grid electricity were approximately 6.7 million tCO2e, and in 2019 GHG emissions will be approximately 7.3 million tCO2e. This is an increasing trend, with an average annual increase of 3.0% between 2010 and 2019, and is more than twice the GHG emissions from fuel consumption.



[1]

Figure3-2　GHG emissions by sector in the energy sector in 2018 and 2019
(Source：IRDA: GHG2018&2019)

### 3.1.3　Targets for the introduction of solar power generation in Malaysia

Malaysia's plans for introducing renewable energy are laid out in the "Renewable Energy Policy and Action Plan". To reduce its dependence on fossil fuels, Malaysia aims to raise the share that renewable energy takes up among the country's installed power capacity to 31% by 2025, and even further, to 40%, by 2035. The table below shows the targets from 2011 to 2050 for installing solar power (cumulative installed capacity), the energy (amount of electricity) produced as a result, and the targets for carbon dioxide reduction based on those.

Table3-2 Targets for the installation of solar power from 2011 to 2050, etc.

| Year | Installation Target (MW) | Annual Power Generated (GWh) | Annual Reduction in Carbon Dioxide (t-CO2) |
|---|---|---|---|
| 2011 | 7 | 7.7 | 4.41 |
| 2015 | 55 | 61 | 38.43 |
| 2020 | 175 | 194 | 110.25 |
| 2025 | 399 | 456 | 251.37 |
| 2030 | 854 | 1,019 | 538.02 |

[1] IM GHG 2018&2019 - Executive Summary_01112021 (non-printing version).pdf (iskandarmalaysia.com.my)

| | | | |
|---|---|---|---|
| 2035 | 1,677 | 2,128 | 1056.51 |
| 2040 | 3,079 | 4,170 | 1939.77 |
| 2045 | 5,374 | 7,765 | 3385.62 |
| 2050 | 8,874 | 13,540 | 5590.62 |

The figures in the table above are calculated under the following assumptions.

- There is no loss of installed capacity for solar power generation (old plants will be replaced or upgraded).
- 1 MW of solar power generation produces 1,100 MWh/year of electricity (facility utilization rate of 13%; however, significant growth is expected in the future).
- 1 MW of electricity from renewable energy reduces 0.63 tons of carbon dioxide emissions.

*Source: National Renewable Energy Policy and Action Plan (viewed on October 22, 2018)*

Figure 3-3 shows the changes in installed capacity for solar power generation in Malaysia that has started operating since the introduction of the FIT system under the Renewable Energy Act enacted in 2011. Since the FIT system ended in 2017, switching to a different system, not much capacity has been added after 2018.

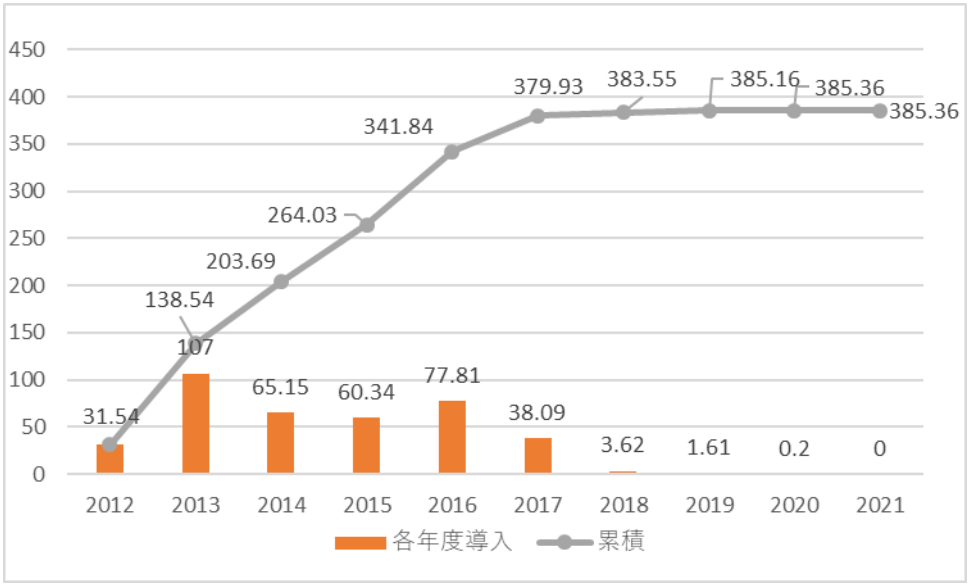



Figure3-3 Installed capacity for renewable energy (MW) that started operating under the FIT system

(Source: Sustainable Energy Development Authority Malaysia homepage)

### 3.1.4 Implementation targets in the Iskandar region

The Low Carbon Society Blueprint for Iskandar Malaysia 2030 Climate Action Plan, which has been developed as a roadmap for achieving a low carbon society in the Iskandar region, has nine major action plans. One of them is 'Green & Renewable energy'.
The sub-actions of 'Green & Renewable energy' are shown in Table 3 3.

Table 3-3　List of sub-actions under 'Green & Renewable energy'

| Sub-Action | Measures |
|---|---|
| RE 8.1 Promotion and Implementation of Renewable Energy (RE) and Energy Efficiency (EE) Projects | RE 8.1a: Enhancing RE and EE Installation Projects |
| | RE 8.1b: Facilitation of RE and EE Licensing Approval Process |
| | RE 8.1c: Enhancing RE and EE Commercial R&D and Human Capacity Building |
| RE 8.2 Enhance Development and Establishment of Advanced RE and EE System | RE 8.2a: Promote Adoption of Advanced RE and EE System |
| | RE 8.2b: Promote Adoption of Battery Energy Storage System (BESS) |
| RE 8.3 Enhance Funding & Incentives for Sustainable Energy and Energy Efficiency Initiatives | RE 8.3a: Fiscal incentives for commercial RE and EE projects |
| | RE 8.3b: RE and EE subsidy and tax incentives for SME and homeowners |
| RE 8.4 Decarbonise Industries | RE 8.4a: Encourage efficient usage of resources & industrial inputs |
| | RE 8.4b: Promote sustainable industrial production process for lower energy intensity |

（Source：Low Carbon Society Blueprint for Iskandar Malaysia 2030 Climate Action Plan）

Indicators within 'Green & Renewable energy' include targets for the introduction of renewable energy. To achieve this target, it is said that a total of 42,486 hectares of residential, commercial, industrial and public facilities must be supplied with renewable energy.

Table 3-4　Indicator Targets in 'Green & Renewable energy'.

| Indicator Targets | 2010 | 2030 | 2050 |
|---|---|---|---|
| Renewable Energy (GW・GWh/yr) | Base Year | 4.1/5,190 | 17.4/22,206 |
| Carbon Dioxide Reduction (ktCO2) | Base Year | 3,187 | 13,635 |
| Energy Efficiency (BEI Reduction kWh/㎡/yr) | Base Year | 47.0 | 69.0 |

※BEI＝Energy intensity/index for buildings

Sub-action 8.1 states 'Promotion and implementation of renewable energy (RE) and energy efficiency (EE) projects'. With regard to renewable energy, particular emphasis is to be placed on the installation of solar PV. In particular, roof-mounted installations are envisaged for residential, commercial and industrial premises. As 76% of electricity demand is concentrated in commercial and industrial installations such as office buildings and factories, the focus is on these facilities. The target for the installation of solar power in residential and commercial facilities is to supply 10% of facilities in 2030 and 40% in 2050, compared to 2010.

## 3.2 Investigation of the potential for PV installation in the private sector

### 3.2.1 Solar PV installation potential in Malaysia

Solar PV has by far the largest potential for renewable energy in Malaysia at 269 GW, followed by bioenergy (biomass from agricultural waste, biogas and solid waste) at 3.6 MW, small hydro (less than 100 MW) at 2.5 MW, and finally, geothermal is estimated at 0.23 MW (see Figure3-4).

Located near the equator, Malaysia's solar irradiance is approximately 1,575-1,812 kWh/m2, which is close to the average solar irradiance in South-East Asia (1,500-2,000 kWh/m2). Due to the relatively high solar irradiance, the introduction of solar power is considered a viable renewable energy option for Malaysia. The potential for PV installation in Peninsular Malaysia alone, where the Iskandar region is located, is estimated at 137.5 GW.

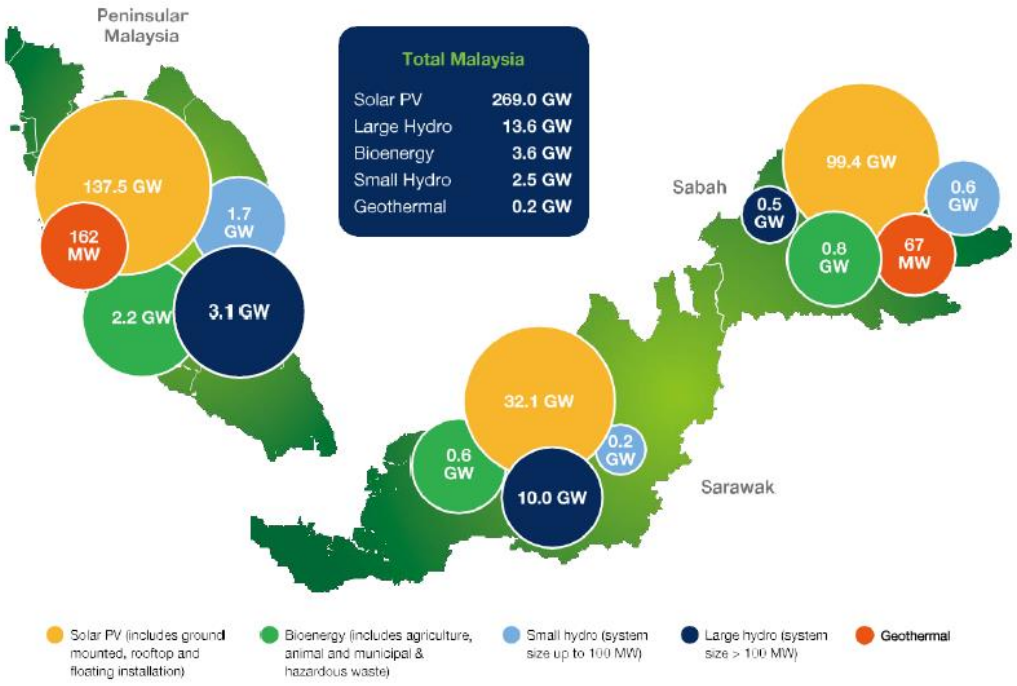



Figure3-4 Potential for the introduction of renewable energy in Malaysia
(Source: SEDA Malaysia, Renewable Energy Roadmap)

When restricted to PV systems installed on building roofs, approximately 42 GW of rooftop PV resources are available from 4.6 million buildings and 43 university campuses in Malaysia. This includes residential (landed and high-rise) buildings, commercial buildings (hotels, shopping malls, offices and shop houses), industrial buildings (industrial offices and factories) and public institutions (primary and secondary schools, universities and hospitals). When restricted to Peninsular Malaysia,

the potential for roof-mounted is high, at 37.4 GW, as many areas are highly urbanised.

The majority of roof-top PV resources are targeted at residential buildings, with a potential of 22.7 GW from approximately 3.9 million residential buildings. Another 115,000 industrial buildings have a potential of 9.9 GW, and for commercial buildings there are 520,000 buildings with a potential of 5.2 GW.

Countries such as Japan, India and China have adopted national rooftop PV programmes to support the growth of rooftop PV. With the right strategy, Malaysia could unlock some of its estimated 42 GW of rooftop solar PV resources. The programmes in place in Malaysia are described at 3.2.1.

### 3.2.2 Potential for the introduction of solar power generation in the Iskandar region

Table 3-5 shows the potential for the introduction of solar power generation in the Iskandar region. The potential for the introduction of solar power generation for business and public use is approximately 2,112 GWh per year. However, looking at annual electricity consumption, the commercial sector consumes 3,643 GWh per year, which is more than the amount that can potentially be supplied through the introduction of solar power generation, so it is also necessary to reduce power consumption through energy conservation.

Table3-5 Potential for the introduction of solar power in the Iskandar region (2013)
(Source: NEXSTEP, Sustainable Energy Transition Roadmap for Iskandar Malaysia)

Table3-6 Annual electricity consumption by the commercial sector in the Iskandar region (2019)
(Source: NEXSTEP, Sustainable Energy Transition Roadmap for Iskandar Malaysia)

Since there was no data available on the potential for introduction limited to business facilities, the potential for introducing solar power generation was calculated based on the total floor area, limited to shopping malls with particularly high electricity consumption. The calculation has been done referencing the Ministry of the Environment's method for calculating the potential for renewable energy.

Calculations based on the total floor area of shopping malls in the Iskandar region (1,913,000 $m^2$) × installation factor for business facilities (0.05) × installed capacity per unit area (0.083 $kW/m^2$) resulted in a total installable capacity of 7,939 kW.

## 3.3 Consideration of technologies to be introduced

### 3.3.1 Solar PV installation programme in Malaysia.

There are various programmes and incentives introduced to promote solar energy in Malaysia. Details of each programme are provided in Table 3 7.

Table 3-7 Solar PV installation programme in Malaysia

| Programme | Year Started | Key Insights |
|---|---|---|
| Feed-in-Tariff (FIT) | 2011 | ● Discontinued in 2017 and replaced by both LSS, SELCO and NEM<br>● Only P. Malaysia and Sabah |
| Large-scale Solar (LSS) | 2016 | ● 4 auctions completed<br>● Only P. Malaysia and Sabah |
| Net Energy Metering (NEM) | 2017 | ● Cumulative of 1 GW capacity to promote rooftop solar market<br>● Revision of compensation rate to 'one-on-one offset' for 10 years in 2020 to induce uptake<br>● Implementation of VNM allowing excess energy to be exported to designated premises under wholly owned subsidiary company<br>● Only P. Malaysia |
| Self-consumption (SELCO) | 2011 | ● SELCO replaced NEM in Sabah starting 2019 |
| SARE | 2019 | ● The system was started in 2019<br>● Solar panels are leased and installed with no initial investment in the system |

（1） Feed-in tariffs ("FIT") for solar power

FIT is a scheme that obliges distribution licence holders (DLs) to purchase electricity produced from renewable energy sources (e.g. biomass, biogas, small hydropower and solar power) from feed-in tariff holders (FIAHs) at the prescribed FIT rate for a specified period. The term 'DL' refers to companies that hold licences to distribute electricity in Malaysia, such as Tenaga Nasional Berhad (TNB), Sabah Electricity Sdn. Bhd. and NUR

Power Sdn Bhd, while the term 'FIAH' refers to a renewable energy licence issued by SEDA and Refers to individuals or companies that hold a feed-in tariff approval certificate entitling them to sell energy at the FIT rate.
Through the FIT scheme, FIAHs are entitled to a range of benefits, including payment of electricity payments for electricity produced by the generator, payment of export duties on electricity generated and other incentives offered under green technology/ or renewable energy programmes can be made available. However, the feed-in tariff for solar PV, introduced in 2011, has been closed to registration since 2016 and has been replaced by Net Energy Metering (NEM).

（2） Large-scale Solar (LSS)

The Large Scale Solar (LSS) competitive tendering programme was introduced in 2016 with the aim of reducing energy costs for large scale PV plants. The LSS programme is implemented by the Energy Commission, which organises tenders to build, own and operate LSS PV plants. Shortlisted bidders will then sign a PPA with TNB or Sabah Electric Sdn Bhd ('SESB').

Tenders have been conducted a total of four times since 2016. The minimum bid price has been lower each time, with a price range of approximately RM0.14/kWh in LSS4 in 2020.

Table 3-8 LSS tender results

| | Year | Capacity | Minimum bid price |
|---|---|---|---|
| LSS1 | 2016 | 371MW | 0.39RM/kWh |
| LSS2 | 2017 | 526MW | 0.34RM/kWh |
| LSS3 | 2019 | 491MW | 0.17RM/kWh |
| LSS4 | 2020 | 1,000MW | 0.14RM/kWh |

According to the Energy Commission's requirements, prospective participants in the LSS must be local companies with at least 51% Malaysian shareholding or a consortium of legal entities consisting of at least one local company with 51% Malaysian shareholding. This effectively limits the foreign shareholding of participants to 49%.

（3） Net Energy Metering (NEM)

The Net Energy Metering (NEM) scheme for solar PV subtracts on-site consumption from the amount of electricity generated by solar PV and sells the surplus electricity to the state-owned electricity company, Tenaga Nasional Berhad (TNB). Generally, consumers registered with TNB in Peninsular Malaysia and SESB in Sabah and the

Federal Territory of Labuan are eligible to apply for NEM. There are no equity restrictions on companies wishing to implement the NEM scheme and the scheme applies to all domestic, commercial, industrial and agricultural sectors.
From 2016, when the scheme was introduced, until the end of 2018, surplus electricity generated was sold at a price lower than the average retail rate, resulting in only 10 MW of installations and low NEM penetration, but in January 2019, the price of surplus electricity for new NEM applications was raised to match the retail price increased, the NEM spread quickly and all of the originally allocated 500 MW quota was applied by 31 December 2020.
The overwhelming response from the PV industry and efforts to promote the use of solar energy led to the introduction of a new programme in 2021, called NEM 3.0. NEM 3.0 is valid from 2021 to 2023 and the total quota allocated is up to 800 MW. NEM 3.0 falls into three new initiatives/categories.

Table 3-9　Overview of the NEM3.0

| Initiatives / Categories | Quota (MW) | Allotment date |
|---|---|---|
| NEM Rakyat Programme | 100MW | 2021/2/1～2023/12/31 |
| NEM GoMEn Programme<br>(Government Ministries and Entities) | 100MW | 2021/2/1～2023/12/31 |
| NOVA Programme<br>(Net Offset Virtual Aggregation) | 600MW | 2021/ 4/1～2023/12/31 |

（４）　Self-Consumption (SELCO)

Introduced in 2017, the self-consumption programme, known as SELCO, applies to cases where solar PV is generated for self-consumption purposes and the surplus cannot be fed into the grid. No specific incentives are set for self-consumption systems, but the Government encourages consumers in the private, commercial and industrial sectors to install solar PV systems for self-consumption purposes. Self-consumption is a self-regulating system for which the user is responsible, as it is not connected to the grid and no tariffs are payable. Data on the total amount of renewable energy generated for self-consumption is therefore not available. For stand-alone (off-grid) on-site generation, there is no capacity limit set by the Government, but it must be less than 75% of the consumer's current maximum demand. Installation of solar PV systems exceeding 24 kW on a single phase or 72 kW on three phases requires a licence issued by the Energy Commission, and installation of these systems must be carried out by a solar system installer or a qualified electrician certified by the Energy Commission.

（５） Supply Agreement with Renewable Energy (SARE)

SARE is a tripartite agreement between the customer, the investor/owner and the electricity distribution licensee (Tenaga Nasional Berhad, hereafter TNB), which aims to increase accessibility and affordability for customers to adopt solar PV systems. Under the SARE programme, the investor/owner leases the solar PV system to the customer and the customer's purchase of solar energy is charged by TNB. Under this arrangement, TNB assumes the role of contracting and billing agent. The customer pays the lease fee to the investor/owner via the TNB and in return, the consumer does not have to pay the initial cost of installing the solar PV system, making the investment in the solar PV system more affordable for the customer. This programme is a so-called PPA and is the closest form to the initiatives implemented by the Kitakyushu City Model. However, to participate in the SARE programme, the investor/owner must be registered with SEDA.

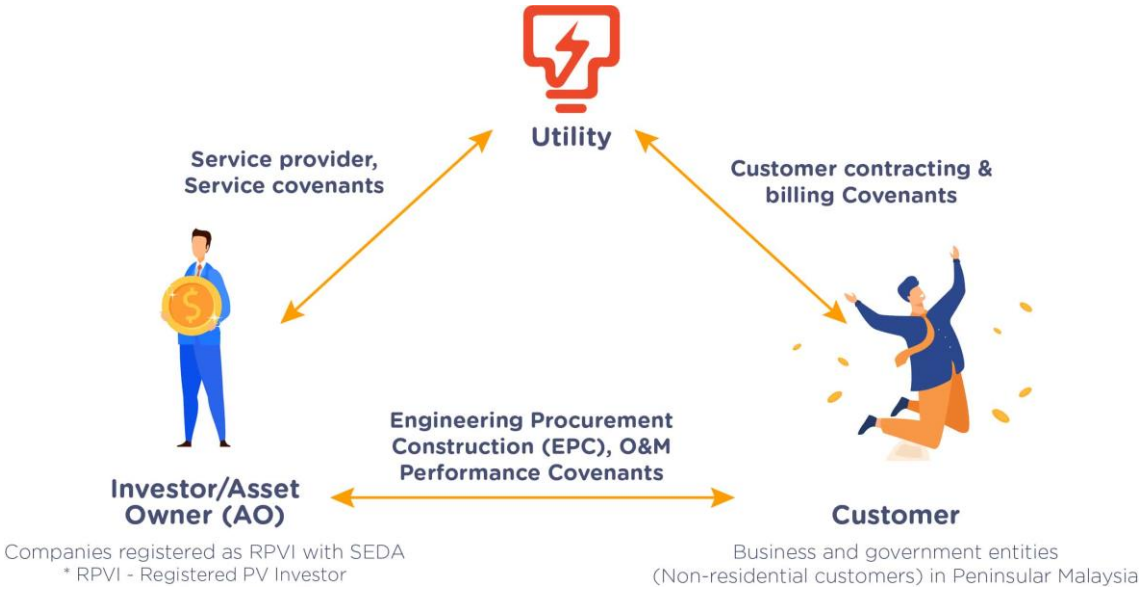



Figure 3-5 SARE programme scheme

(Source：OpenSys Technologies Sdn Bhd HP)

The registered operators within Johor are listed in Table 3 10.

Table 3-10 Registered Solar PV Investors (RPVIs) in Johor

| # | Company Name | | State |
|---|---|---|---|
| 1 | DITROLIC ENERGY SOLUTION 2 SDN. BHD. | Ditrolic Energy Towards Energy Independence | JOHOR BAHRU, JOHOR DARUL TAKZIM |

| | | | |
|---|---|---|---|
| 2 | DYNAC ENERGY SDN BHD |  | JOHOR, JOHOR DARUL TAKZIM |
| 3 | ELECTRON HARVEST SDN BHD |  | SKUDAI, JOHOR DARUL TAKZIM |
| 4 | NEUTO SDN BHD |  | JOHOR, JOHOR DARUL TAKZIM |
| 5 | SOLSTICE SOLAR SDN. BHD. |  | JOHOR BAHRU, JOHOR DARUL TAKZIM |

### 3.3.2 Regulations regarding the supply of renewable energy

In Malaysia, while there are programs in place to support the installation of solar power on the consumer side as described above, there are restrictions regarding the electricity suppliers that are the providers of such programs.

The following rules, etc., are assumed to be complied with when envisioning "a scheme to supply electricity by installing, owning, and operating a small-scale power source at the customer's site with current legal assets" as an electricity supply business.

First, under Malaysia's Electricity Supply Act (1990), there are two types of licenses, "public installation" and "private installation". Both types of licenses are granted by the Energy Commission.

"Public installation" refers to the installation of equipment to supply electricity to any person other than the licensee, while "private installation" refers to the installation of equipment for the supply and use of electricity on the licensee's property or premises. Since, at this time, we are envisioning the supply of power through third-party ownership, a "private installation" license is required. For reference, specific examples of businesses that require a "private installation" license are as follows.

- Private installation :

(1) Overhead and underground cables that intersect with roads, bridges, rivers, communication lines, and railroads owned by others
(2) Power generation for self-consumption in places where there is no power supply from the power grid, power companies, or licensed businesses
(3) Temporary power generation for self-consumption at construction sites, exhibitions, etc.
(4) Power generation for self-consumption using efficient technologies such as cogeneration
(5) Power generation for self-consumption using renewable energy sources such as solar power generation

On the other hand, specific examples of businesses that require a "public installation" license are as follows.

- Public installation :
  (1) Supplying electricity to consumers by power companies such as TNB and SESB
  (2) Generation of electricity to supply and sell to power companies such as IPP- and FIT-licensed businesses
  (3) Power generation for self-consumption that use renewable energy sources such as solar power generation, and the surplus power of which is sold to the grid through the NEM scheme
  (4) Power generation for self-consumption that use efficient technologies such as cogeneration, and the surplus power of which is sold to a multi-functional facility or specified area, such as the Gas District Cooling Sdn. Bhd. at the Kuala Lumpur International Airport.
  (5) Purchasing electricity from a power company, and supplying, selling, or providing other services to a multi-functional facility or high-rise building, such as how Malakoff Utilities operates for Kuala Lumpur's KL Sentral

Private or public installations of a capacity of 5 MW or more is reviewed by the Department of Industry Development and Electricity Market Regulation, a licensing unit of the Energy Commission. Private installations with a capacity of 5 MW or less are subject to a simplified review process. Online application is available for all of the reviews above.

### 3.3.3 Energy conservation policies in Malaysia

The Kitakyushu Model for 100% Renewable Energy features not only expanding the introduction of renewable energy through the introduction of solar power generation, but also efforts to reduce energy consumption through the use of energy-saving appliances.

Regarding energy conservation in Malaysia, the National Energy Efficiency Program was established in 1991 to encourage the development of systems, equipment, and buildings that contribute to improved efficiency in the use of energy. In May 1998, the Malaysia Energy Centre (Pusat Tenaga Malaysia, PTM) was established as an independent non-profit corporation to promote the government's energy conservation policies. It is also working to strengthen the capacity for various research and development in the energy field and to create a database of energy-related information for efficient energy management.

Major developments in policy have been as follows.

- The 11th Five-Year Plan (2016-2020)

As a priority area for energy conservation in the 11th Five-Year Plan, a Demand Side Management Master Plan was drawn up to expand demand side management in buildings and the industrial and residential sectors. The following initiatives are also planned:

(1) Set the ratio of green procurement by government agencies at 20%.
(2) Encourage environmentally friendly buildings to obtain qualifications, and strengthen the evaluation system.
(3) Expand the MyHIJAU mark program.
(4) Encourage low-carbon mobility, especially the use of energy efficient vehicles (EEVs), as well as CNG and biofuels.

- Minimum energy efficiency standards for appliances

Currently, five items are subject to mandatory compliance: refrigerators, air conditioners, televisions, household fans, and lighting (fluorescent, CFL, LED, and incandescent lamps).

- Labeling system

With the revision of the 1994 Electricity Regulations in May 2013, four products - refrigerators, air conditioners, televisions and household fans - became subject to the labeling system.

- Green Building Index (GBI)

Implemented in May 2009 as a voluntary scheme. It has set certification standards for new business buildings, residences, townships, and for industrial and factory uses. GBI's evaluation criteria consist of energy efficiency, indoor environment, sustainable building management practices, and efficient use of materials, heat, and water, and based on these criteria, new business buildings are accorded a rating of silver, gold, or platinum.

- Rebate program for energy-saving home appliances (Sustainability Achieved via Energy Efficiency, SAVE Program)

The program, which was implemented on July 7, 2011, aims to encourage the use of energy-saving home appliances by providing subsidies to consumers when they purchase such appliances. The three product categories covered are refrigerators, air conditioners, and commercial freezers.

- Establishment of national programs and targets related to energy conservation

Major developments related to the establishment of programs and targets related to energy conservation are as follows.

(1) 1991: Launched the National Energy Efficiency Program.
(2) 1998: Establishment of the Malaysia Energy Centre → Promotion of energy conservation, etc.
(3) 2010: Established strategies for encouraging energy conservation in homes, towns/cities, industries, and buildings in the "10th Malaysia Plan" → Incandescent lamps were phased out by 2014.
(4) 2010: Completed studies for the National Energy Efficiency Master Plan.
(5) 2011: An energy conservation act was being drafted, to be introduced in 2013
(6) January 2014: The draft of the National Energy Efficiency Master Plan was unveiled.
(7) December 2015: Submitted to COP21 the target of cutting CO2 emissions per GDP from 2005 levels by 45% by 2030.
(8) September 2022: National Energy Policy 2022-2040. Sets targets for 'increasing industrial and commercial energy efficiency savings (from less than 1% to 11%)' and 'increasing residential energy efficiency savings (from less than 1% to 10%)'.

- Development of promotion systems and plans for encouragement regarding energy

conservation

(1) Established the Energy Conservation Promotion Centre.
(2) Introduced augmented and diversified tax schemes, incentive programs and measures for assistance.
(3) Energy conservation in the industrial sector: Focus on encouraging energy conservation through support from international organizations and other donors – the Global Environment Fund, United Nations Development Programme, Danish International Development Assistance, etc.
(4) ESCO program
(5) Energy conservation in buildings: Introduced guidelines for energy conservation and the Green Building Index; energy-conserving building project – Zero Energy Office Building, Low Energy Office Building, Energy Commission Headquarters Building
(6) Activities to raise public awareness, energy conservation education campaigns
(7) Rebate program for energy-saving home appliances (corresponds to Japan's eco-point system)

As outlined above, Malaysia has been active in taking energy conservation promotion measures, but no laws have been enacted, and energy-conserving practices are not necessarily widespread, partly due to low energy costs. In particular, the ESCO program is considered to be at a standstill, as it was noted that although the concept is well known, there is only one ESCO project that operates as a business, apart from demonstrative examples. However, it is expected that the new Energy Efficiency and Conservation Act (EECA) will be drawn up within the National Energy Policy, which will lead to stricter regulations on energy efficiency and conservation measures.

### 3.3.4 Application of the Kitakyushu Model for 100% Renewable Energy

Comparing the government programs described in 3.3.1, it can be said that SARE, which also implements the PPA model, is the closest to the Kitakyushu Model for 100% Renewable Energy. However, the situation is different from that in Japan, where deregulation of electricity is progressing, because the only power company that can enter into contracts under the SARE model is TNB. Therefore, it is difficult to apply the methods through which new power companies affiliated with local government such as Kitakyushu Power conduct business to Malaysia.

Regarding the promotion of energy conservation, which is a feature of the Kitakyushu

model, we believe that in Malaysia, incentives for energy conservation are low, since the ESCO program has failed to make progress and energy costs are low. In order to implement the Kitakyushu model in Malaysia, it is necessary to consider a mechanism to implement efforts toward energy conservation together with that for renewable energy.

## 3.4 Consideration of economic feasibility

In this section, we will make trial calculations to determine whether, if solar power generation is introduced under the Kitakyushu Model for 100% Renewable Energy, it will result in a profit. This project will target shopping malls in particular, which among business facilities consume large amounts of electricity, and make trial calculations of the greenhouse gas emission reduction effect and the cost-effectiveness of introducing solar power generation.

### 3.4.1 Prerequisites

（1） Calculation of the amount of electricity that can be generated

The amount of electricity generated relative to installed capacity is calculated based on data on solar radiation in Malaysia. The data on solar radiation is taken from the Solar Radiation Database for the Asian region, a supporting tool for designing solar power generation systems, etc., made available by the New Energy and Industrial Technology Development Organization (NEDO), a national research and development institute. From among the data available for viewing, we have used the time-series METPV-ASIA solar radiation data for Kuala Lumpur, Malaysia, which is closest to the Iskandar region and for which 24-hour x 365-day data is available. The solar radiation data in METPV-ASIA does not adopt the data of an average year as is, but is artificially created by selecting the most average year by month for the period for which data is aggregated, and smoothing over the data at the boundaries of each month.

Year Figure 3-6 shows the change in the amount of electricity that can be generated over the course of a year when a maximum of 7,939 kW is installed in shopping malls, based on solar radiation data. A total of 8,729,703 kWh can be generated. The facility utilization rate averages 12.55% over a year.

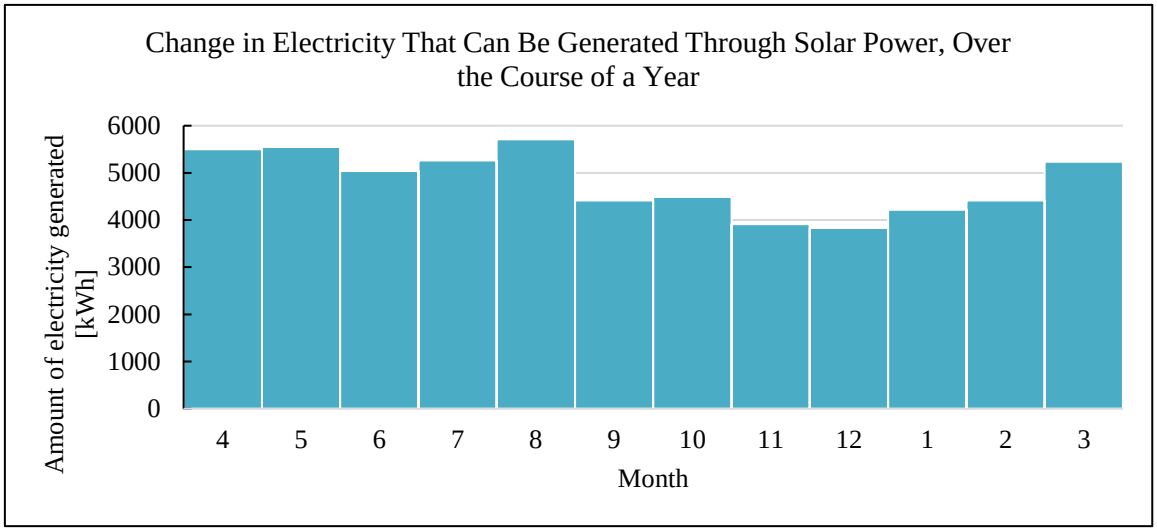



Figure3-6 Change in Electricity That Can Be Generated Through Solar Power in Shopping Malls, Over the Course of a Year

（２） Grid electricity rates

The price at which electricity generated by solar power is sold shall be deemed to be the same as the price at which TNB sells electricity. Rates were set as follows, based on TNB's general business rates.

- Per KW: 30.3 RM/kW
- Per kWh: 0.365 RM/kWh

（３） Costs of introducing solar power generation

Regarding the cost of introducing solar power generation in Malaysia, the total installation cost for a 12 kW grid-connected PV system is about 93,480 RM, according to a study by M. A. Islam et al., 2018.[2] Using this figure as a reference, we assumed that the cost per kW would be 7,790 RM for the purposes of the trial calculation. Conversion to the Japanese yen was calculated at 1 RM = 30.65, referencing the Bank of Japan's Ministerial Order Rate for Reports applicable to February 2023.

### 3.4.2 Trial calculation of the emission reduction effect

（１） Calculation method

The JCM equipment subsidy program, which offers financial support for equipment corresponding to the reduction in GHG emissions, is a very useful subsidy program from the viewpoint of ensuring economic feasibility when faced with the initial cost, which

[2] https://iopscience.iop.org/article/10.1088/1757-899X/358/1/012019/pdf

requires the most investment when installing equipment. Being able to reduce the burden posed by the initial cost through the use of JCM equipment subsidies will greatly contribute to ensuring economic and business feasibility. Since there is no JCM agreement with Malaysia at this time, we will use the MRV method for JCM equipment subsidies in Thailand for trial calculations of the reduction in emissions.

$$RE_p = \sum_i EG_{i,p} \times EF_{RE}$$

REp : Base emissions for period p [tCO2/p]
EG i,p: Electricity generated by solar power generation system / Volume of electricity in period p [MWh/p] [MWh/p]
EFRE: Standard CO2 emission factor for grid electricity and self-generated electricity [tCO2/MWh]

In this study, the emission factor of 0.6448 kg-CO2/kWh[3], which is the emission factor for grid electricity in Malaysia, is applied, since we are considering the introduction of solar power generation in this study.

### 3.4.3 Evaluation incorporating consideration of JCM equipment subsidies accompanying GHG reductions

In order to calculate economic feasibility as well, the following initial costs for solar power generation facilities were assumed.

| | |
|---|---|
| Installation costs for solar power generation equipment | 7,790 RM (238,764 JPY)/kW |
| Service life | 17 years |
| Emission factor | 0.6448 kg-CO2/kWh |
| JCM equipment subsidy rate | 50% |

Based on the above conditions, the cost required to install 7,939 kW comes to 61,844,810 RM (1,895,547,396 JPY), and if JCM's equipment subsidy (50%) is utilized, investment in equipment would come to 30,922,405 RM (947,773,698 JPY).
Based on the amount of electricity generated and electricity prices, the annual sales of

[3] https://www.iges.or.jp/en/pub/list-grid-emission-factor/en

electricity from solar power generation would be 3,426,893 RM per year, which means that the investment would pay for itself in about 9 years.

Regarding cost-effectiveness, the JCM standard of 4,000 JPY/tCO2 is used as a guideline. The method used for calculation is as follows.

| |
|---|
| Cost vs. reduction in GHG emissions =<br>Amount of subsidy/annual reduction in GHG emissions [tCO2/y] x legally defined service life |

Since the annual reduction in GHG emissions is about 5,629t-CO2, applying it to the above formula yields

30,922,405 RM/5,107t-CO2 x 17 years = 323 RM

Converting at 1 RM=30.65 JPY, the cost-effectiveness comes to 9,904 JPY/tCO2.

Table3-11 Results of cost-effectiveness calculations

| | |
|---|---|
| Annual reduction in GHG emissions | 5,629t-CO2 |
| Amount of subsidy | 30,922,405 RM (947,773,698 JPY) |
| Reduction in GHG emissions during the project period | 95,692t-CO2 |
| Cost vs. reduction in GHG emissions | 323 RM (9,904 JPY)/tCO2 |

The reason the calculations yielded a figure higher than the JCM standard of 4,000 JPY/tCO2 may be attributed to the fact that the cost of introducing solar power generation is higher than in other countries. Figure 3-7 shows a comparison of the cost of introducing solar power generation in each country. The cost of introducing solar power generation in this trial calculation is at the same level as in Russia and Japan, where the cost for installation is the highest.

A cost-effectiveness of 4,000 JPY/t-CO2 would be easily achieved if the price range was at the same level as in Germany, etc., where prices are relatively low.


Figure3-7 Comparison of the cost of introducing solar power generation by country (Source: IRENA, Renewable Power Generation Costs in 2021)

## 3.5 Consideration of how administrative support systems etc. should be formulated for the introduction of renewable energy

Various programmes are being implemented by the Government to introduce renewable energy, particularly solar PV, as discussed in 3.3. Similarly, Iskandar Malaysia is also providing support for the introduction of renewable energy.
The Low Carbon Society Blueprint for Iskandar Malaysia 2030 Climate Action Plan states that the introduction of renewable energy will be promoted in Table 3.12. As well as promoting the introduction programmes already offered by the government (e.g. NEM, SARE), initiatives include facilitating the licensing process for renewable energy and energy efficiency and strengthening human capacity development in the RE/EE sector.

Currently, the application and approval process for electricity supply projects takes three to six months, while installation and commissioning of electricity supply systems takes between one week and one month. There is a need to streamline and shorten the application process for the installation of RE and EE between federal agencies such as the Energy Commission and SEDA, the national electricity grid owner TNB and local authorities. In addition, delays in RE/EE installation have been attributed to a lack of skilled personnel capable of designing, installing and commissioning RE/EE projects. Therefore, it is considered important to prioritise the development of human resources in the RE/EE sector and to ensure that they are able to meet the increasing demand for RE/EE implementation.

The report also states with regard to financial support for initiatives. It is envisaged that incentives and subsidies will help to further the introduction of renewable energy. Incentives and subsidies are important to accelerate the deployment of renewable energy. It is envisaged that IRDA will coordinate with agencies to develop additional incentives to promote investment and implementation of RE/EE projects in Iskandar Malaysia. In particular, subsidies and tax incentives will be targeted towards SMEs and homeowners, who have a high investment burden for the introduction of renewable energy such as solar PV.

Table 3-12 Initiatives for the introduction of renewable energy in Low Carbon Society Blueprint for Iskandar Malaysia 2030 Climate Action Plan

| Enhancing RE and EE Installation Projects | |
|---|---|
| | ・ Conduct stocktake exercise programme with Suruhanjaya Tenaga Malaysia (ST) and SEDA (recommended every 3 months) to identify existing RE and |

| | |
|---|---|
| | EE baseline and annual review for Iskandar Malaysia as of 2020<br>· Promotional programme on RE and EE to encourage participation of RE and EE amongst government, private and public stakeholder within Iskandar Malaysia<br>· Roll Out and Implementation of Government Zero Cost RE programme for C&I buildings through Net Energy Metering (Self Consumption ( and Supply Agreement Renewable Energy (initiatives via power purchase agreement or leasing with zero cost capital expenditure and operation and maintenance to the premise owner<br>· Development and Establishment of Zero Cost RE programme for residential premise owner<br>· Development and Establishment of Zero Cost EE programme for C&I building owner especially on baseline energy audits<br>· Promotional programme on RE and EE to attract participation of RE and EE amongst local and foreign investors to invest in Iskandar Malaysia<br>· Promotional programme on RE and EE amongst housing, township and infrastructures developers to install RE and EE system in their new development<br>· Promote MyHIJAU SME Entrepreneur Development Programme and other green certification schemes |
| Facilitation of RE and EE Licensing Approval Process | |
| | · To develop and establish a one stop centre ( programme between federal agencies, TNB and the local authority to streamline and shorten the application submission and approval process for RE and EE installation projects<br>· To standardise guidelines and requirements for RE and EE installation by local authority through SUKT and to make mandatory RE and EE installation for new development<br>· An incentive can be offered by local authority to lower yearly assessment fees for RE and EE installation and fees for application on temporary structure<br>· To shorten the approval process with the local authority for temporary<br>· structure approval for RE Building Integrated Photovoltaic (installation for ground mounted structures and for retrofitting of EE systems in buildings<br>· To shorten the approval process for generating license issued by ST and |

| | |
|---|---|
| | · to allow for temporary license issuance for RE and EE installation<br>· To shorten the approval process for RE and EE certification issued by SEDA<br>· To shorted the approval process for testing and commissioning by TNB on<br>· RE installations<br>· To allow for floating chargemen on installed RE facilities by ST |
| Enhancing RE and EE Commercial R&D and Human Capacity Building | |
| | · Cross government and private agencies collaboration for commercial R&D grants programme related to RE and EE technology development and implementation<br>· Cross government and private agencies collaboration for training grants programme related to RE and EE human capacity building<br>· Promotional awareness programme among graduates and existing technical skilled workers on RE and EE and the potential of RE and EE as a long term career |
| Fiscal Incentives for Commercial RE and EE Projects | |
| | · Promotional and awareness programme on RE and EE for commercial and industrial premise owner and developers<br>· Cross agencies programme to connect government agencies, financial institutions, commercial and industrial premise owner and developers to provide easy access to financing for RE and EE and its associated energy efficiency systems and green mobility products (EVs and Ebikes)<br>· Development and establishment of a special RE and EE tax incentive programme for commercial and industrial premise owner and developers<br>· Establishment of subsidy and grant for cooperatives to venture into RE and EE<br>· Establishment of grant for commercial and industrial premise owner and developers to venture into RE and EE<br>· Promote incentives and subsidies of tariff rate to promote the utilisation of RE and EE |
| RE and EE Subsidy and Tax Incentives for SME & Homeowners | |
| | · Promotional and awareness programme on RE and EE for SMEs and residential home owners<br>· Cross agencies programme to connect government agencies, financial institutions, SMEs and residential home owners to provide easy access financing access for RE and EE and its associated products such as energy |

| | |
|---|---|
| | efficiency products and green mobility products (EVs and Ebikes)<br>・ Development and establishment of a special RE and EE tax incentive programme for residential home owner<br>・ Development and establishment of a special RE and EE tax incentive programme for SMEs<br>・ Development and establishment of RE and EE subsidy programme for residential home owners in the M 40 and B 40 economy bracket |

One of the reasons why solar PV is not yet widespread in Malaysia is that the low price of electricity does not provide incentives for people to install solar PV on their own. Ways to encourage uptake include, as explained above, promotion of government programmes already in place, mechanisms to make the system more accessible, and human resource development to cope with increased demand later on. In addition, if electricity prices are a barrier to uptake, subsidies and tax incentives may be more effective.

## 3.6 Future Directions

In this activity, we considered the potential for introducing solar power generation in Malaysia, and the business model to be introduced. Malaysia has set targets for the introduction of renewable energy for the years 2030 and 2050, and as the government is committed to introducing solar power generation especially in the Iskandar region, the need was found to be high.

The government is also implementing various programs to expand the introduction of solar power generation, and programs that implement the PPA model in the same way as the Kitakyushu Model for 100% Renewable Energy also exist. However, we have discovered that it would be difficult to apply the Kitakyushu model as is directly to the Iskandar region, due to the significant differences between Japan and Malaysia in terms of how the electricity market is structured.

In the future, it will be necessary to consider what kind of business model that includes energy conservation, which has yet to make headway, is best suited for implementation; in other words, a Malaysian version of the Kitakyushu Model for 100% Renewable Energy.

In addition, we have carried out trial calculations this year to measure the potential for introducing solar power generation and its cost effectiveness for all shopping malls in the Iskandar region, but since the results differ depending on the capacity introduced to each facility, it will be necessary to select specific facilities and to work out the details in the future.

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# Chapter 4. Realize Waste-to-Energy as a base-load power source

## 4.1 Overview of Activities

Malaysia has been facing serious problems in recent years in terms of increasing amount of municipal solid waste (hereinafter “MSW”) and its management due to the nation's rapid economic growth. In Iskandar Malaysia, IRDA in collaboration with City of Kitakyushu, Japan and NTT Data Institute of Management Consulting, Inc. has conducted the “City-to-City Collaboration for Low-Carbon Society” organized by the Ministry of Environment, Japan since 2019, and has shown its interest in developing a Waste to Energy (hereinafter “WTE”) project. In the "Project to Promote Low Carbonization in the Iskandar Region (City of Kitakyushu -Iskandar Development Area Collaboration Project)" implemented in FY2019, "Waste to Energy" was indicated as one of the keywords in the activities of the next step of the Low Carbon Society Blueprint from the Iskandar Regional Development Agency (IRDA). IRDA expects to conduct a detailed study in the future based on the technology, “FY2020 City-to-City Collaboration for Low-Carbon Society (Phase 2)” and “FY2021 City-to-City Collaboration for Low-Carbon Society (Phase 3)” included within its activities, a preliminary study for exploring possibilities to implement the WTE project in Iskandar Malaysia.

This “Promotion of Carbon-Free Model Area in Iskandar Region (Phase 1)”, being selected by the Ministry of Environment, Japan as one of the projects in “FY2022 City-to-City Collaboration for Low-Carbon Society”, is a continuation project of the aforementioned project conducted in FY2020 and FY2021, and aims to investigate further the feasibility of introducing a WTE plant in Iskandar Malaysia.

In this fiscal year, based on the results of the activities in FY 2021, we confirmed the progress of the WTE project being promoted by the Malaysian government and continued our discussions with SWM Environment Sdn. Bhd. which manages the Seelong Landfill, and visited the Seelong Landfill to collect data on the volume of waste. In summary, activities in FY2022 were as follows.

1) Review of the progress of the Waste-to-Energy project in Johor, Malaysia
2) Investigate the possibility of collaboration with local companies (SWM Environment Sdn. Bhd., etc.)

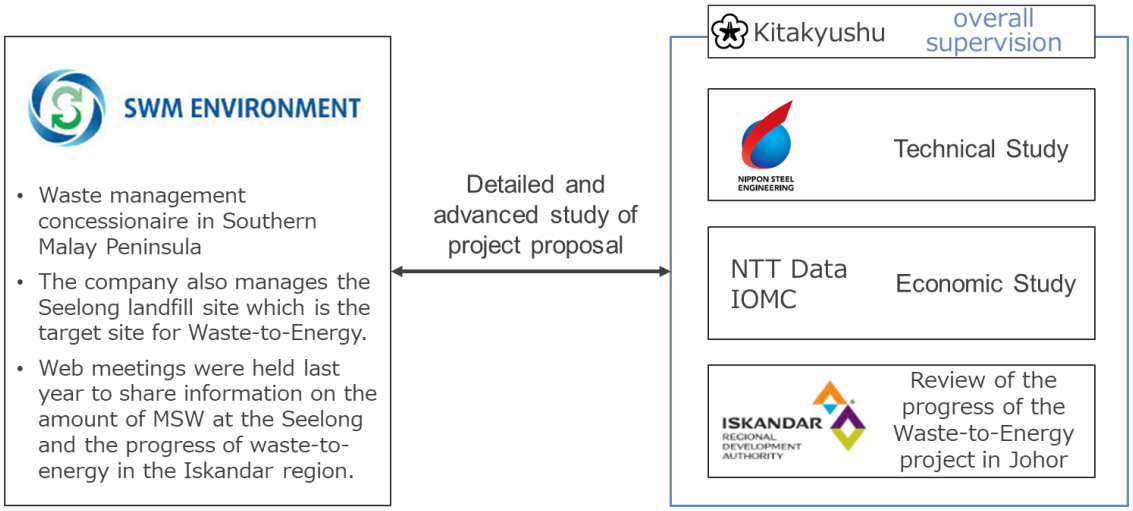


Figure 4-1 Implementation structure of the 2022 project

### 4.1.1 Technology Applied

In this Technical Study, grate-type incineration technology is applied as the technology for the presumed WTE plant. Japan is one of the most advanced countries in the world in terms of thermal treatment of MSW. Japan has one the largest number of WTE plants installed, which comprises of WTE plants with various kind of technologies applied, such as grate-type incineration, fluidized-bed-type incineration and gasification, which all successfully demonstrates stable operation for a long period of time. Furthermore, advanced ash treatment and stabilization technologies and flue gas treatment technologies has been developed and installed in the WTE plants, which are propelled by the need to comply with stringent Japanese environmental standards with additional technical requirements implemented by each local governments. Given the above, this Project aims to study the promotion of this advanced Japanese WTE technology in Malaysia.

NSE has a track record of over 500 units of WTE plants which has utilized its grate-type incineration technology and been installed all over the world. Such WTE plant installed by NSE is designed to be capable of achieving continuous annual operation days of 300 to 330 days, and has been proven to realize long continuous operation. Longer annual operation days generally entails higher annual power generation amount (power sales amount). On the other hand, shorter annual operation days would result in the need to construct a WTE plant with larger waste treatment capacity, in addition to the need to consider alternative methods for disposal of MSW during the non-operational days, whereby resulting in a higher initial investment cost. Therefore, NSE's technology, being

able to attain longer annual operational days, is capable of satisfying local needs for achieving proper waste management in a cost effective manner.

In addition, through attaining high steam parameters for boilers, optimizing materials for super heaters, reduction of combustion air ratio, reduction of flue gas temperature and reduction of turbine exhaust pressure, NSE has realized improvements in power generation rate ranging up to 25% to 28%. These efforts which results in higher electric power sales amount through high power generation efficiency, is welcomed by local governments that face problems in securing adequate financial resources for waste management.

NSE's grate-type WTE plant technology proposed in this Technical Study comprises of the following technological features. Additionally, the overall flowchart (reference only) is shown in Figure 4-2 in the following page.

1) Accommodates a wide range of waste quality
   - Stable combustion possible for waste with calorific values ranging from 1,200 kcal/kg up to 5,000 kcal/kg
2) Scale-up properties
   - Treats waste up to a maximum of 1,200 tons/day per line
3) High power generation efficiency
   - Achieves maximum of 30% power generation efficiency
4) Advanced flue gas cleaning system
   - Provides various treatment technologies which suits the client's needs (dry, semi-dry, wet)
5) Long continuous operation
   - Achieves high plant availability of over 8,000 hours

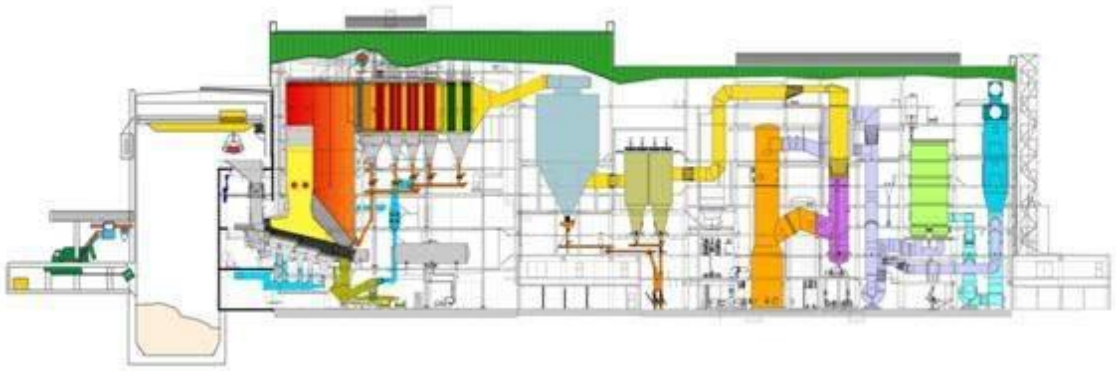

Figure 4-2: Waste-to-Energy Plant Overall Flowchart (reference)

### 4.1.2 3 Year Study Plan

The following lists the items which needs investigation in order to assess the feasibility of implementing WTE plant in Iskandar Malaysia, and is based on a study period of 3 years. Furthermore, this study is to be executed by a team consisting of City of Kitakyushu together with IRDA under the city-to-city collaboration scheme, NTT Data Institute of Management Consulting, Inc., who will be responsible for institutional and economic study, such as research of applicable laws and regulation and assessment of financial viability among others, and NSE will be responsible for technical study such as the plant design and estimation of project costs.

1) Investigation of pre-requisite information for plant design
    i) Waste amount and quality data
    ii) Laws and regulations applicable to plant design (air emission standards, wastewater standards, seismic standards, ash handling conditions, etc.)
    iii) Project site (existence of basic infrastructure such as water, electricity, access road, etc.)
2) Investigation of laws and regulations pertaining to project execution
    i) Energy (electricity sales)
    ii) Environmental Impact Assessment
    iii) Construction Law (contractor's license, permits, etc.)
    iv) Tax, customs clearance procedure
3) Conditions for project execution
    i) Appropriate division of responsibility between public and private entity
    ii) Expected role of IRDA
4) Investigation of project scheme

5) Assessment of project feasibility

i) Estimation of project cost (CAPEX and OPEX)

ii) Assessment of financial viability (incl. quantifying environmental benefits)

## 4.2 Review of the progress of the Waste-to-Energy project in Johor, Malaysia

In this year's project, we confirmed the progress of the WTE project being promoted by the Malaysian government.

According to the federal government's plan, 11 WTE projects are planned in Malaysia as a whole and two in Johor (see the table below). The target project in Iskandar region is No. 11 in the table below.

Table 4-1 candidate sites under consideration for installation of WTE facilities

| No. | state | Candidate sites | Current volumes (t/day) |
|---|---|---|---|
| 1 | Kedah | Semeling Landfill, Gurun | 450 |
| 2 | Pulau Pinang | Pulau Burong Landfill, Seberang Prai | 2,000 |
| 3 | Perek | Lahat Landfill, Ipoh | 650 |
| 4 | Selangor | Jeram Landfill, Klang | 3,000 |
| 5 | Kuala Lumpur | Taman Beringin Transfer Station | 2,300 |
| 6 | Melaka | Sungai Udang Landfill | 900 |
| 7 | Terengganu | Marang Landfill, Marang | 100 |
| 8 | Pahang | Jabor-Jerangau Landfill, Kuantan | 500 |
| 9 | Negeri Sembilan | Tanah Merah Landfill, Port Dickson | 585 |
| 10 | Johor | Bukit Payung Closed Landfill, B. Pahat | 2,875 |
| **11** | **Johor** | **Seelong Landfill, Johor Bahru** | **3,164** |

There are two potential WTE sites in Johor: the Seelong Landfill (No. 11 in the above table) and the Bukit Payung Closed Landfill (No. 10 in the above table). Of these two sites, one site outside the Iskandar region (Bukit Payong) has started bidding for the WTE project in 2020. We believe that there is a possibility that a similar tender will be held for WTE in the Iskandar region, so we will check the progress of the tender for Bukit Payong.

### 4.2.1 About the Waste-to-Energy Facility Construction Project in Bukit Payong

According to the Request for Proposal (RFP) announced in August 2020 for the construction of a WTE facility in Bukit Payong, Johor, and the project will be implemented through a PPP contract for design, construction, financing, operation, maintenance and closure. At the end of the concession period, the concessionaire will dismantle all the facilities and transfer the land and related assets to the Malaysian government. Payment will be based on performance and service level compliance.
As a project requirement, the Government of Malaysia requires the procurement of a solid waste management facility with a capacity of at least 800 t/day (292,000 t/year), including commercial, industrial and institutional waste generated from the northern part of Johor. In addition, bidders will need to demonstrate compliance with the following parameters.

- company with at least 51% Malaysian owned entity;
- experienced in managing Municipal Solid Waste Treatment Facility and landfilling;
- experienced in managing similar Municipal Solid Waste Management Facility as proposed by bidder with a minimum capacity of 800 tonnes per day;
- the proposed technology solution has at least 3 years track record; and
- the proposed technology has minimum 8000 operating hours per annum.

In addition to the treatment and disposal of contracted solid waste, the concession agreement shall also include the management of all outputs from waste management, including the movement and sale of recovered materials or products (including energy (or power)), and the movement, transportation, and disposal of waste and processing residues. The bidder shall include in the solution details regarding the management and disposal of all contracted solid waste when the facility is not operational due to planned and unplanned maintenance. All costs related to the above items shall be recovered through gate fees and shall not be payable separately by the Government of Malaysia.

The Schedule is given in Table 12. This schedule lists the key dates associated with the project that are either critical in terms of overall delivery or have contractual implications in case of delay.

Table 4-2 Key Dates

| Milestone | Date | Contractual Consequence |
|---|---|---|
| Contract signing | 1 August 2021 | |

| | | |
|---|---|---|
| DEIA completion | 31 July 2022 | |
| Planning application submission | 31 July 2022 | |
| Planning permission | 31 July 2022 | |
| Planning Application Longstop Date | 31 October 2022 | Failure to submit Planning Application by Planning Application Longstop Date by the Longstop may lead to CA being void. |
| Planned Works Commencement Date | 1 August 2022 | Failure to commence the Works by 6 Months after the Planned Works Commencement Date is a Concessionaire's Default |
| Testing and Commissioning Period | 1 May 2025 to 31 July 2025 | |
| Planned Services Commencement Date | 1 August 2025 | |
| Readiness Longstop Date | 6 Months after the Planned Readiness Date | Failure to obtain Readiness Certificate by Readiness Longstop Date is a Concessionaire's Default |
| Acceptance Longstop Date | 6 Months after the Planned Services Commencement Date | Failure to obtain Acceptance Test Certificate by Acceptance Longstop Date is a Concessionaire's Default |

| | | |
|---|---|---|
| Expiry Date | The 25th anniversary of the Services Commencement Date, unless extended by mutual agreement | |

### 4.2.2 Progress

This year, information was again collected on the WTE tender project in Bukit Payong, including the progress of the selection of the contractor and the selected candidate, but no clear information could be obtained.

In July 2022, the Malaysian Minister of Housing and Local Government at the time, Reezal Merican Naina Merican, told Parliament that "Bukit Payong in Johor and Sungai Udang in Malacca are in the process of finalising the main terms of the concession contract." It is therefore assumed that a certain degree of progress has been made on the Bukit Payong concession contract.

The Minister further stated that 'in order to ensure that the construction of an integrated facility for solid waste management is not risky and harmful to the health of the population, the Ministry of Housing and Local Government has set a number of rules, including that the technology proposed by the bidder must be proven effective'. This was said to include requirements for the release of gas and treated leachate (effluent) and, in addition, an Environmental Impact Assessment (EIA) would have to be carried out to identify issues relating to pollution and disturbance to residents and the environment.

As various regulations are expected to be established for WTE construction, it is necessary to continue to review and update the current waste standards as well as the conditions of Bukit Payong.

## 4.3 Investigation of regulations related to waste-to-energy

### 4.3.1 Laws and regulations applicable to plant design

( 1 ) Environmental standards

The following environmental standards for WTE facilities in Malaysia are (i) air emission standards, (ii) noise and vibration standards and odour standards, and (iii) wastewater standards.

(i) Air Emission Standard

Air emission standard applicable for WTE plants (Environmental Quality (Clean Air) Regulations, 2014) is as shown in Table 4-3.

Table 4-3: Air Emission Standards in Malaysia

| Parameter | Unit | Standard |
|---|---|---|
| $O_2$ reference content | % | 11 |
| Total PM | $mg/Nm^3$ | 100 |
| NMVOC as total organic carbon | $mg/Nm^3$ | 10 |
| Hydrogen chloride (HCl) | $mg/Nm^3$ | 40 |
| Hydrogen fluoride (HF) | $mg/Nm^3$ | 1 |
| Carbon monoxide (CO) | $mg/Nm^3$ | 50 |
| Sum of $SO_2$ and $SO_3$ expressed as $SO_2$ | $mg/Nm^3$ | 50 |
| Sum of NO and $NO_2$ expressed as $NO_2$ | $mg/Nm^3$ | 200 |
| Mercury and its compounds, expressed as mercury (Hg) | $mg/Nm^3$ | 0.05 |
| Cadmium and its compounds, expressed as cadmium (Cd)<br>Thallium and its compounds, expressed as thallium (Tl) | $mg/Nm^3$ | Total 0.05 |
| Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), Vanadium (V), and their compounds expressed as the element | $mg/Nm^3$ | Total 0.5 |
| PCDD/PCDF | $ng\text{-}TEQ/Nm^3$ | 0.1 |

*Source: Environmental Quality (Clean Air) Regulations, 2014*

(ii) Noise and Vibration, and Odour Standards

Regulations for noise and vibration, and odour pertaining to WTE plants is yet to be implemented in Malaysia. Hence, this Technical Study will assume that limit values which are similar to those in Japan are applicable.

(iii) Wastewater Standard

Wastewater standard applicable for WTE plants (Environmental Quality (Industrial Effluent) Regulations 2009) and Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009) is as shown in Table 4-4.

Table 4-4 Wastewater Standards in Malaysia

| Parameter | Unit | A [1)] | B [1)] | Leachate[2)] |
|---|---|---|---|---|
| Temperature | ℃ | 40 | 40 | 40 |
| pH Value | - | 6.0-9.0 | 5.5-9.0 | 6.0-9.0 |
| BOD at 20℃ | mg/L | 20 | 50 | 20 |
| COD | mg/L | 120 | 200 | 400 |
| Suspended Solids | mg/L | 50 | 100 | 50 |
| Mercury | mg/L | 0.005 | 0.05 | 0.005 |
| Cadmium | mg/L | 0.01 | 0.02 | 0.01 |
| Chromium, Hexavalent | mg/L | 0.05 | 0.05 | 0.05 |
| Chromium, Trivalent | mg/L | 0.20 | 1.0 | 0.20 |
| Arsenic | mg/L | 0.05 | 0.10 | 0.05 |
| Cyanide | mg/L | 0.05 | 0.10 | 0.05 |
| Lead | mg/L | 0.10 | 0.5 | 0.10 |
| Copper | mg/L | 0.20 | 1.0 | 0.20 |
| Manganese | mg/L | 0.20 | 1.0 | 0.20 |
| Nickel | mg/L | 0.20 | 1.0 | 0.20 |
| Tin | mg/L | 0.20 | 1.0 | 0.20 |
| Zinc | mg/L | 2.0 | 2.0 | 2.0 |
| Boron | mg/L | 1.0 | 4.0 | 1.0 |
| Iron | mg/L | 1.0 | 5.0 | 5.0 |
| Silver | mg/L | 0.1 | 1.0 | 0.10 |
| Aluminium | mg/L | 10 | 15 | - |
| Selenium | mg/L | 0.02 | 0.5 | 0.02 |
| Barium | mg/L | 1.0 | 2.0 | 1.0 |
| Fluoride | mg/L | 2.0 | 5.0 | 2.0 |
| Formaldehyde | mg/L | 1.0 | 2.0 | 1.0 |
| Phenol | mg/L | 0.001 | 1.0 | 0.001 |
| Free Chlorine | mg/L | 1.0 | 2.0 | - |
| Sulphide | mg/L | 0.50 | 0.50 | 0.50 |
| Oil and Grease | mg/L | 1.0 | 10 | 5.0 |
| Ammoniacal Nitrogen | mg/L | 10 | 20 | 5 |
| Colour | ADMI | 100 | 200 | 100 |

*Source: 1) Environmental Quality (Industrial Effluent) Regulations 2009, 2) Control of Pollution from Solid Waste Transfer Station and Landfill) Regulations 2009*

（２） Seismic standards

For building codes, the Malaysian Federal Government enacts and enforces

regulations, and there are no private building codes. The regulations refer to codes of practice, standards and design guidelines formulated, promulgated and enforced by the Malaysian Standards Department, a department under the Ministry of Science, Technology and Innovation. Local governments are not required to follow federal building codes and may develop, enforce and operate their own building codes, although many local governments have adopted the central government's building bylaws for building administration.

The main building regulations in Malaysia are the Street, Drainage and Building Act (1974), Uniform Building Bylaws (1984), Building (Federal Territory of Kuala Lumpur) Bylaws 1985 (mandatory). These legal measures provide guidelines for the approval of building plans and stipulate construction regulations. These legal measures provide guidelines for the approval of building plans and stipulate construction regulations. Together with these laws, the Fire Service sets fire safety requirements for buildings through the provisions of the Fire Services Act 1988 and Fire Service guidelines.

Most standards refer to the Malaysian Standards (MS), but legislation may also make reference to British Standards, ASHRAE, AS/NZS, ASTM and other standards in addition to the MS. Local authorities are free to adopt standards themselves. For example, for standards on codes of practice for the design of structures against earthquakes, the Industry Standardisation Committee for Building, Construction and Civil Engineering (ISCD) recommends the use of European standards. The referenced European standards and corresponding Malaysian standards are summarised in Table 4-5.

Table 4-5 Referenced European standards and corresponding Malaysian standards

| Referenced European standards | Corresponding Malaysian standards |
|---|---|
| EN 1990, Eurocode – Basis of Structural design | MS EN 1990, Eurocode – Basis of Structural design |
| EN 1992-1-1, Eurocode 2 – Design of concrete structures – Part 1-1: General – Common rules for building and civil engineering structures | MS EN 1992-1-1, Eurocode 2 – Design of concrete structures – Part 1-1: General – Common rules for building and civil engineering structures |
| EN 1993-1-1, Eurocode 3 – Design of steel structures – Part 1-1: General – General rules | MS EN 1993-1-1, Eurocode 3 – Design of steel structures – Part 1-1: General – General rules |
| EN 1997-1, Eurocode 7 – Geotechnical design – Part 1: General rules | MS EN 1997-1, Eurocode 7 – Geotechnical design – Part 1: General |

| | |
|---|---|
| | rules |

（３） ash handling conditions,

The waste management process in Malaysia, from generation, storage, handling, treatment and final disposal of waste, is governed by the Environmental Quality Act 1974 as the basic legislation, on which other environmental legislation and policies are built. The following regulations have been established for the management of scheduled wastes.

Table 4-6 Regulations on the management of scheduled wastes

| Regulations | Description |
|---|---|
| ① Environmental Quality (Schedule Wastes) Regulations ) (Established in 1989, revised in 2005) | Sets out the types of scheduled waste and the responsibilities of the generator |
| ② Environmental Quality (Prescribed Premises) (Schedule Wastes Treatment and Disposal Facilities) Order ) (Established in 1989) | Sets out the types of scheduled waste treatment and disposal facilities and stipulates that a permit is required |
| ③ Environmental Quality (Prescribed Premises) (Schedule Wastes Treatment and Disposal Facilities) Regulations (Established in 1989) | Requires procedures in the event of a change of ownership of treatment/disposal facilities and notification of the amount received, treated, stored and disposed of, etc. |

Environmental Quality (Schedule Wastes) Regulations provide categories of scheduled wastes, of which incinerator ash belongs to SW 406. (SW 406: clinker, slag and ash from scheduled waste incinerators)

In addition, those who generate scheduled waste in Malaysia are generally controlled in terms of:

- Notification requirements for the generation of designated waste
- Requirements for the determination of
  - Storage and labelling
  - Transport
  - Treatment and disposal
- Reporting obligations and record keeping for designated waste inventories

- Application of special controls for designated waste
- Qualified/trained staff

There are facilities specified as 'specified facilities' in the 1989 Environmental Quality (Prescribed Premises) (Schedule Wastes Treatment and Disposal Facilities) Order, which also includes schedule waste incinerators. Any company or investor that plans to build on any land or structure, or to carry out works on land or buildings that would result in a specified facility as defined in the Environment Act, must obtain prior written permission from the Environment Agency.
In addition to a written permit, a licence is required to occupy and operate the specified facility and a licence fee is charged for the issue of each licence. Only after obtaining a written permit can an application for a licence be made.

### 4.3.2 Environmental Impact Assessment

When building WTE projects, the government will also require the identification and assessment of the environmental impacts of the development. In Malaysia, under Section 34A (2C) of the Environmental Quality Act (EQA), 1974 (Act 127), EIA guidelines have been developed, which set out the procedures and review methods for environmental impact assessment (EIA).
The EIA report serves as a decision-making tool for the project approving authority to decide whether it can approve the implementation of the proposed project.
The procedural flow of an EIA is shown in Figure 4-3.

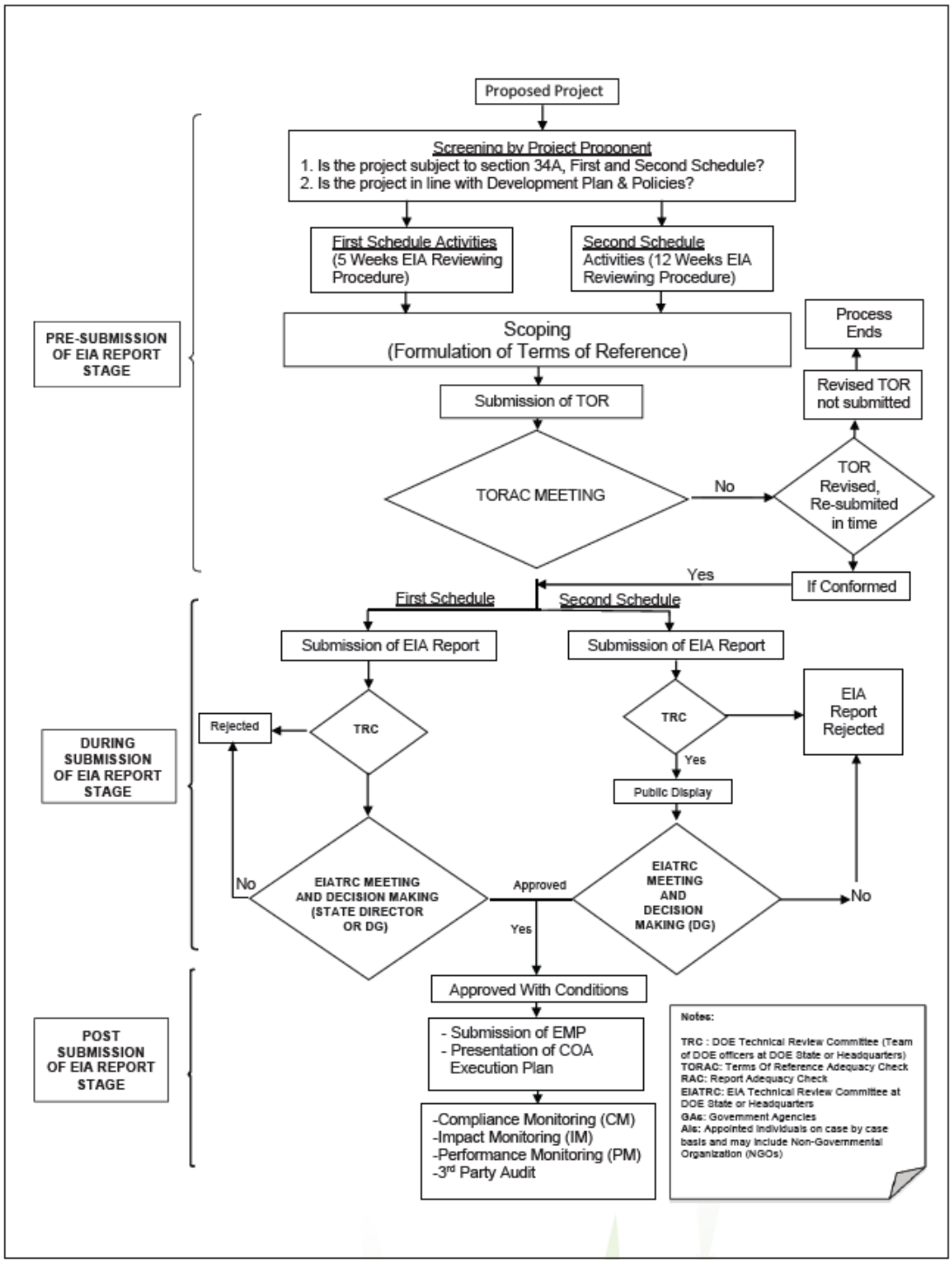


Figure 4-3　Procedural flow of an EIA

（1）　Roles and Responsibilities of Parties Involved in the EIA Procedure

Several individuals and organizations play important and specific roles and shoulder different responsibilities in the EIA procedure. The roles and responsibilities are briefly described Table 4-7.

Table 4-7 Roles and Responsibilities of Parties Involved in the EIA Procedure

| | |
|---|---|
| a) The Project Proponent | · The Project Proponent (PP) is an individual or organization that is proposing to undertake the development of a prescribed activity.<br>· The PP may be from the public or the private sector and he may be represented by a consultant.<br>· The PP is responsible for all aspects related to the development of the project including the environmental planning of the project and its associated cost.<br>· He may delegate the task of conducting the environmental impact assessment of the project to his project consultant or to another organization but he remains ultimately responsible for the content of the EIA Report on his project. |
| b) The EIA Consultant | · The EIA Consultant is an individual who has been tasked by the Project Proponent to conduct the Environmental Impact Assessment (EIA) of the project.<br>· The Consultant is typically the leader of a team of consultants from various disciplines relevant to the proposed project and is responsible to the Project Proponent.<br>· The EIA team leader who may work for an EIA consulting firm and the subject matter experts shall be DOE-registered consultants who shall maintain professionalism in conducting a comprehensive EIA study and produce a quality EIA Report that is useful for decision-making purposes. |
| c) The Environmental Related Agencies and Experts | · Environmental related agencies and individuals who have vast technical expertise and experience in specific areas have an important role to play in providing relevant inputs on environmental |

| | |
|---|---|
| | impacts, impact study techniques, and pollution prevention and mitigation measures.<br>· The inputs from these agencies and individuals may be sought by the DOE whenever deemed necessary. |
| d) The Public | · Public participation is an essential and integral part of project development to provide an avenue for the public to channel their views on the proposed project.<br>· Some form of public participation to obtain their inputs to the EIA study, shall be implemented which may include public engagement and public display of EIA Reports. |
| e) The Technical Review Committee | · The review of the EIA Reports is carried out by a committee known as the EIA Technical Review Committee (EIATRC) established both at the DOE state office and at the DOE Headquarters. The EIATRC at the DOE state office reviews the EIA Reports of activities under the First Schedule while the EIATRC at the DOE Headquarters reviews Reports of activities under the Second Schedule.<br>· Members of both EIATRCs are the TRC members, representatives from relevant government agencies (GAs), and individuals appointed (AIs) from within or outside of the DOE, who have vast technical experiences in the relevant areas related to the proposed project.<br>· The technical areas may include potential project environmental impacts, impact study methodologies, and applicable pollution prevention and mitigation measures.<br>· Additionally, Non-Governmental Organizations (NGOs) may also be invited to sit on the committees as general representatives or as Appointed Individuals (AIs). |

（２） The Approving Authority

The approving authority is the Government Authority that has the task of deciding, in view of the environmental and development costs, and the benefits of the proposed project to the community, how (or whether) a project should proceed. The project approving authorities include:

i. The National Development Planning Committee (NDPC) for Federal Government sponsored projects;
ii. The State Executive Council (EXCO) for State Government sponsored projects;
iii. The various Local Authorities or Regional Development Authorities (RDA) with respect to planning approval within their respective areas;
iv. The Ministry of International Trade and Industry or MIDA for industrial projects.

（３） EIA Review Process Timeline

The timeline for the EIA review process and decision is as follows:

i. For EIA Reports of projects falling under the First Schedule
   - 25 working days (5 weeks)
ii. For EIA Reports of projects falling under the Second Schedule
   - 60 working days (12 weeks)
iii. The general requirements on EIA Report review are summarized in Table, while the committees involved in the review process are summarized Table.

Table 4-8 Summary of General Requirements on EIA Report Review

| Components of EIA Review Process | First Schedule Activities | Second Schedule Activities |
|---|---|---|
| Submission of EIA Report | Submit to DOE State Office | Submit to DOE HQ |
| Public participation in EIA study | Not required | Required |
| Public display of EIA Report | Not required | Required |
| Web display of EIA Report | Required. Submit softcopy of the EIA Report to DOE State Office | Required. Submit softcopy of the EIA Report to DOE HQ |
| Advertisement of EIA Report | Not required | Required. Advertise in two major newspapers |

| Details of Review Committee | Personnel involved | |
|---|---|---|
| | First Schedule Activities | Second Schedule Activities |
| Name of Review Committee | DOE State Office EIA Technical Review Committee (EIATRC) | DOE Headquarters EIA Technical Review Committee (EIATRC) |
| Chairperson of Review Committee | Director of DOE State Office | Director General of Environment |
| Members of Review Committee | DOE state officers, appointed individuals (AIs) – in certain circumstances, representatives from Government Agencies (GAs) and NGOs | DOE Head Office officers, appointed individuals (AIs), representatives from Government Agencies (GAs) and NGOs, if required |

Table 4-9 Summary of Committees Involved in EIA Report Review Process

（4） Review Process

i. Procedural steps for assessment of EIA Report for First Schedule Activities-EIA Report Review Stage

Figure 4-4 shows procedural steps for assessment of EIA Report for First Schedule Activities-EIA Report Review Stage. This First Schedule assessment procedure is characterized by the following:

- A minimum of 12 hard copies and 1 softcopy (in PDF format) of the EIA Report are to be submitted to the DOE State Office and 1 softcopy to the DOE Headquarters.
- The submitted EIA Reports will firstly be checked for "Report Adequacy" (RAC) by a technical committee comprised of a team of DOE officers (TRC). This quality check process will check the EIA Report for compliance with the EIA Report format, absence of obvious technical errors, coherence of the report, environmental pledge by the Project Proponent, etc. An EIA Report which does not pass the RAC will be rejected. The EIA Report which passes the RAC will be reviewed by the EIATRC.
- The EIA Report which passes the RAC will be distributed to relevant government agencies (GAs) for written comments and a minimum of three working days will be given before comments are due.

- A visit to the project site by the DOE officers (TRC) (if necessary).
- A presentation to the DOE State EIA Technical Review Committee (EIATRC) by the Project Proponent and his Consultant. As mentioned earlier section 3.2.8.1 of this EIA Guideline, members of EIATRC are TRC members (DOE state officers), representatives from government agencies (GAs) and in certain circumstances whenever needed, appointed individuals (AIs) from within the DOE or outside of DOE, who possess vast experience or specific expertise relevant to the EIA study will be appointed on a case to case basis. Non-Governmental Organizations (NGOs) may also be invited to attend the EIATRC meeting as general representatives or as Appointed Individual (AIs).
- The EIA review meeting will be conducted in the third week from date of submission of the EIA Report to the DOE.
- The outcome of the EIA review meeting may lead to:
  - Approval of the EIA Report, provided: The EIA Report meets with the requirements of the section 34A(3) of EQA 1974;
- Rejection of EIA Report, if: The EIA Report that does not meet the requirements of the section 34A (4) of EQA 1974.

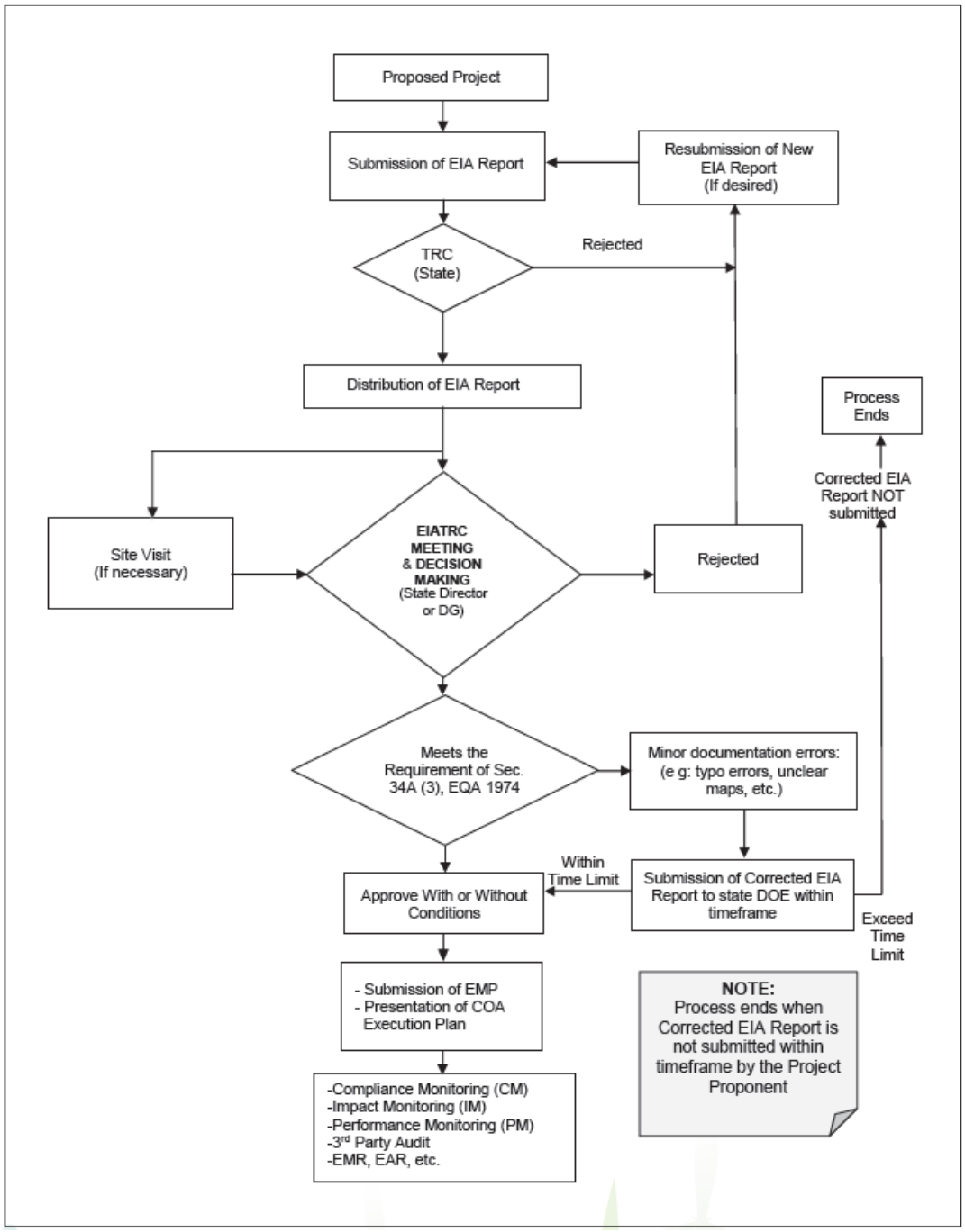


Figure 4-4 Procedural steps for assessment of EIA Report for First Schedule Activities-EIA Report Review Stage

(Source: Environmental Impact Assessment Guideline in Malaysia)

ii. Review Process of EIA Report for Second Schedule Activities

Figure 4-5 shows the EIA Report Review Process for Second Schedule Activities. The review process is characterized by the following:

- The review process will be completed within a period of 12 weeks.
- A minimum of 35 hard copies and 1 softcopy (in PDF format) of the report shall be submitted to the DOE HQ. Additional copies are to be submitted whenever necessary. The DOE will distribute the Report through the Project Proponent to the relevant government agencies and members of the EIATRC. The Project Proponent shall display the Report at specified locations. Additionally, the Project Proponent/ Consultant may also recommend suitable display locations besides those specified by the DOE. This is to allow as many affected or interested parties to review the Report and submit comments to the DOE. This has to be done within one week from the date of submission of the EIA Report.
- Upon submission of the EIA Report, the Project Proponent shall advertise in major newspapers to announce the availability of the EIA Report for public review. This entails placing advertisements in at least two (2) major newspapers for three (3) consecutive days (a total of 6 advertisements). A draft copy of the advertisement shall be submitted to the EIA Secretariat for approval prior to the placement. The advertisement shall include information on the project and the locations where copies of the Reports may be reviewed or purchased. For projects in Sabah and Sarawak, the advertisement must be placed in at least one regional newspaper. The Project Proponent may also choose to advertise in on-line news portals, subject to agreement by the DOE.
- The Project Proponent and or the Consultant shall make available the EIA Report, both in the form of hard copies and soft copies (in PDF format) for purchase by the public. The price of the Report in hard copy shall be affordable to the public and shall normally be equivalent to its printing cost.
- The EIA Report shall be displayed for 30 days from the date of announcement. The time frame for public to submit their comments to the DOE is 45 days.
- A visit to the project site by the DOE officers (TRC) (if necessary).
- The Project Proponent and the Consultant shall respond to all the written comments received from the public. The responses are to be submitted to the DOE Headquarters for review.
- The outcome of the EIA review meeting may lead to:

- Approval of the EIA Report, provided: The Report meets with the requirements of the section 34A (3) of EQA 1974.
- Rejection of the EIA Report, where: The Report does not meet the requirements of the section 34A (4) of the EQA 1974.

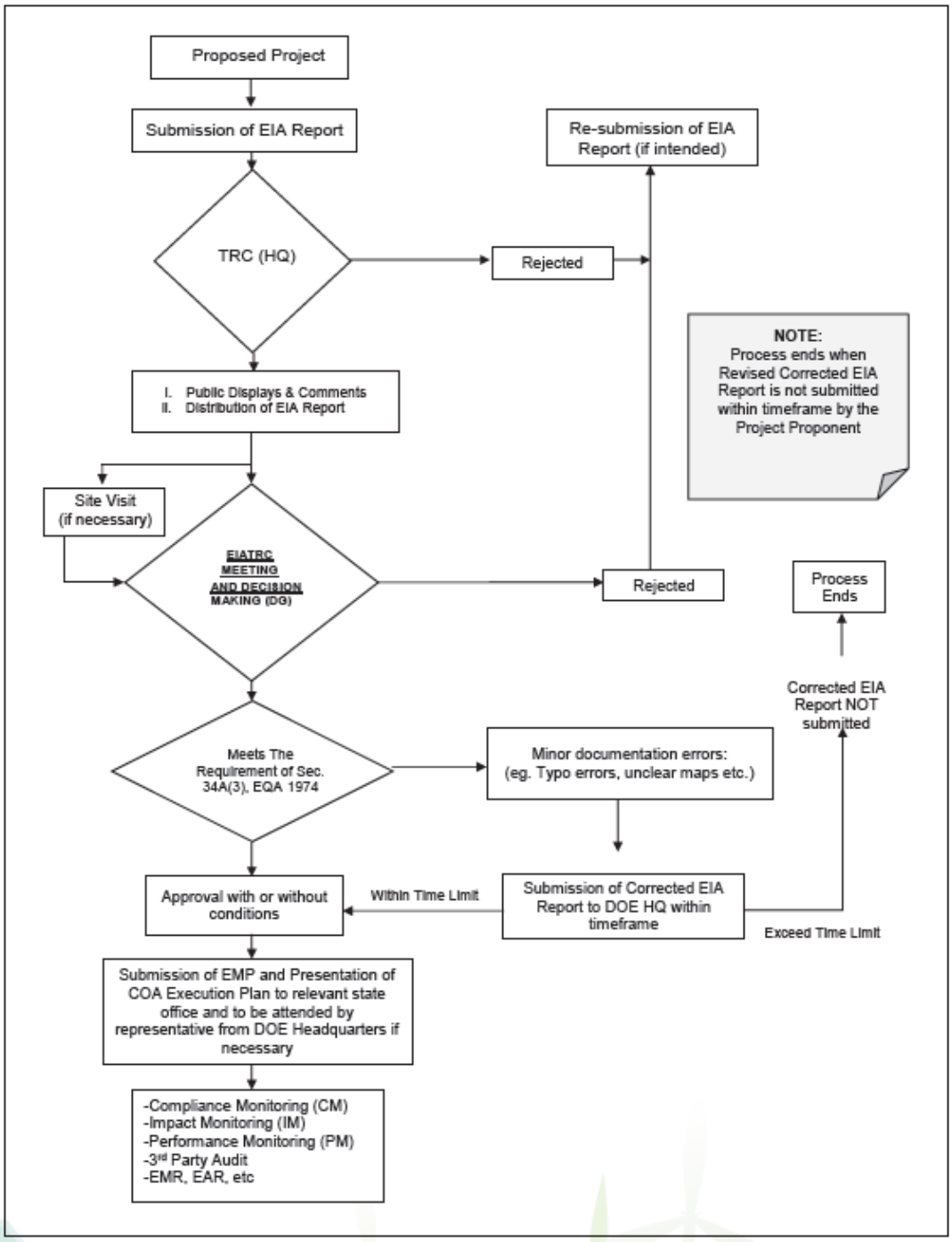


Figure 4-5 Procedural steps for assessment of EIA Report for Second Schedule Activities – EIA Report Review Stage

(Source：Environmental Impact Assessment Guideline in Malaysia)

## 4.4 Technical aspects of the introduction of waste-to-energy facilities

### 4.4.1 Study Plan for this Project

Since travel restrictions imposed in Malaysia in response to the global spread of COVID-19 has eased in 2022, the study plan for FY2022 Project was discussed with IRDA and SWM Environment Sd. Bhd. (hereinafter "**SWME**") the operator of Seelong Sanitary Landfill with the plan of conducting a site visit and was actually conducted for two days in 28~29 November 2022. In addition, upon face-to-face discussion with SWME in Iskandar, it was revealed that SWME does not conduct waste analysis for itself, and hence does not possess any waste quality data. Therefore, in order to plan for conducting a waste sampling and analysis activity at Seelong Sanitary Landfill in the next fiscal year's project, online meeting with a research team from Department of Chemical Engineering of Universiti Teknologi Malaysia (hereinafter "**UTM**") who has extensive experience in conducting waste sampling and analysis was conducted.

Table 4-10: Contents of FY2022 Study

| Activity | Contents | |
|---|---|---|
| 1. Discussion on study plan | Date & time: | 25 August 2022, 13:00~13:45 |
| | Purpose: | Discussion with IRDA on planning of site visit in November |
| | Place: | Web meeting |
| | Attendees: | • Malaysia side: IRDA/ Ms. Kamisah Mohd Ghazali (President, Environment), Ms. Siambun (Vice-President, Environment)<br>• Japan side: City of Kitakyushu, NTT Data Institute of Management Consulting, Inc., NSE |
| | Date & time: | 31 October 2022, 15:30~16:30 |
| | Purpose: | Discussion with SWME on planning of site visit in November |
| | Place: | Web meeting |
| | Attendees: | • Malaysia side: IRDA/ Mr. Mamdoh B. Dato' Hj. Yusof Malim Kuning (Vice-President, Resilient Environment), Ms. Siambun (Vice-President Environment), SWME/ Mr. Nordin (General Manager)<br>• Japan side: City of Kitakyushu, NTT Data |

| | | |
|---|---|---|
| | | Institute of Management Consulting, Inc., NSE |
| 2. Site Visit | Date & time:<br>Purpose:<br>Place:<br>Attendees: | 28 November 2022, 10:00~16:00<br>Meeting with SWME and Seelong Sanitary Landfill Visit<br>Seelong Sanitary Landfill (Iskandar Malaysia)<br>• Malaysia side: IRDA/ Ms. Siambun (Vice-President, Environment), SWME/ Mr. Nordin (General Manager)<br>• Japan side: City of Kitakyushu, NTT Data Institute of Management Consulting, Inc., NSE |
| | Date & time:<br>Purpose:<br><br>Place:<br>Attendees: | 29 November 2022, 14:00~15:30<br>Discussion with IRDA on waste management in Iskandar<br>IRDA Office (Iskandar Malaysia)<br>• Malaysia side: IRDA/ Mr. Mamdoh B. Dato' Hj. Yusof Malim Kuning (Vice-President, Resilient Environment), Ms. Siambun (Vice-President, Environment), Mr. Pang<br>• Japan side: City of Kitakyushu, NTT Data Institute of Management Consulting, Inc., NSE |
| 3. Planning of waste survey | Date & time:<br>Purpose:<br>Place:<br>Attendees: | 21 December 2022, 11:00~12:00<br>Discussion with UTM on waste survey method and schedule<br>Web meeting<br>• Malaysia side: IRDA/ Mr. Mamdoh B. Dato' Hj. Yusof Malim Kuning (Vice-President, Resilient Environment), Ms. Siambun (Vice-President, Environment), UTM/Dr. Arif, Dr. James, Ms. Atikah, Mr. Iqbal (Department of Chemical Engineering)<br>• Japan side: City of Kitakyushu, NTT Data Institute of Management Consulting, Inc., NSE |

### 4.4.2 Study Results

This chapter reports the findings on the state of waste collection and disposal in Iskandar Malaysia as outcome of FY2022 Project, which were acquired through site visit conducted on 28~29 November 2022, consisting of discussion with IRDA, visit of Seelong Sanitary Landfill operated by SWME and discussion with SWME.

（1） Overview

In Malaysia, the Federal Government's National Solid Waste Management Department (JPSPN: Jabatan Pengurusan Sisa Pepejal Negara) is responsible for developing regulatory framework and policies, and the Solid Waste Management and Public Cleansing Corporation (SWCorp) is responsible for the actual implementation of solid waste management. On the other hand, IRDA is a Malaysian Federal Government statutory body (Co-Chaired by Prime Minister of Malaysia and Chief Minister of Johor) tasked with the objective of regulating and driving various stakeholders in both public and private sector towards realizing the development of Iskandar Malaysia, and is not responsible for regulating solid waste management in Iskandar. IRDA is organized into divisions based on "key strategic drivers" and the appointed personnel in this Project is assigned under "Resilient Environment".

The below figure shows the flow of waste collection and disposal flow in Iskandar region. Iskandar region has 2 landfill sites, and the waste delivery amount is approx. 1,600 tons/day at Seelong Sanitary Landfill, and approx. 400 tons/day at Tanjung Langsat Landfill.

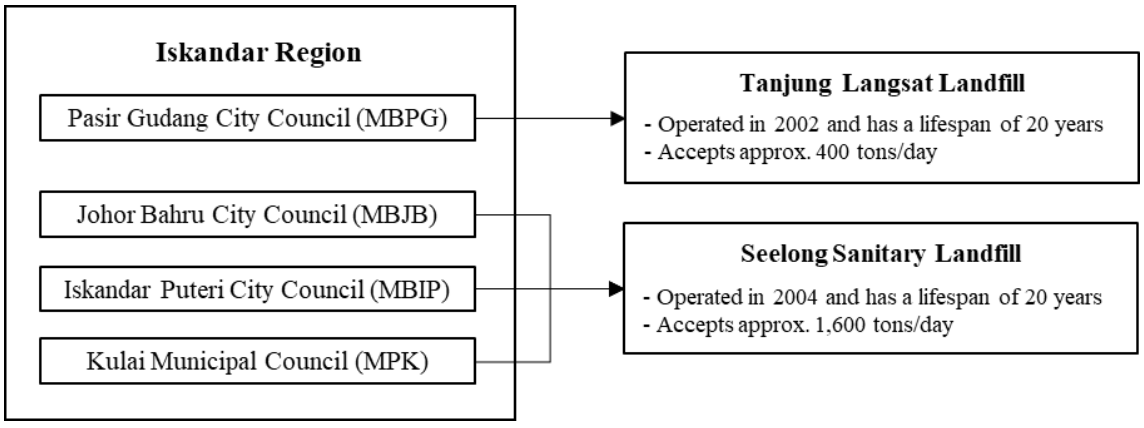


Figure 4-6 Waste disposal sites in Iskandar Malaysia
(Source: Universiti Teknologi Malaysia)

（２） Site Visit of Seelong Sanitary Landfill

The following is a report on the results of a site visit to Seelong Sanitary Landfill, operated by SWME, which processes the majority of the waste generated in the Iskandar region.

i. Overview of Seelong Sanitary Landfill

Seelong Landfill is sanitary landfill (leachate-controlled-type landfill), located in Seelong, Iskandar Development Region, Johor, Malaysia. The landfill has an area of 275 acres (approximately 1.11 km2) and its capacity is 18.8 million m3 (approximately 15 million ton). They receive waste from Johor Bahru area (MBJB), Iskandar Puteri area (MBIP) and Kulai area (MPK) in Iskandar Development Region. On the other hand, waste collected in Majlis Bandaraya Pasir Gudang area (MBPG), located in eastern Iskandar, and is disposed in Tanjung Langsat Landfill.

SWME has been contracted by the federal government (central government) to dispose waste for 20 years since 2004.

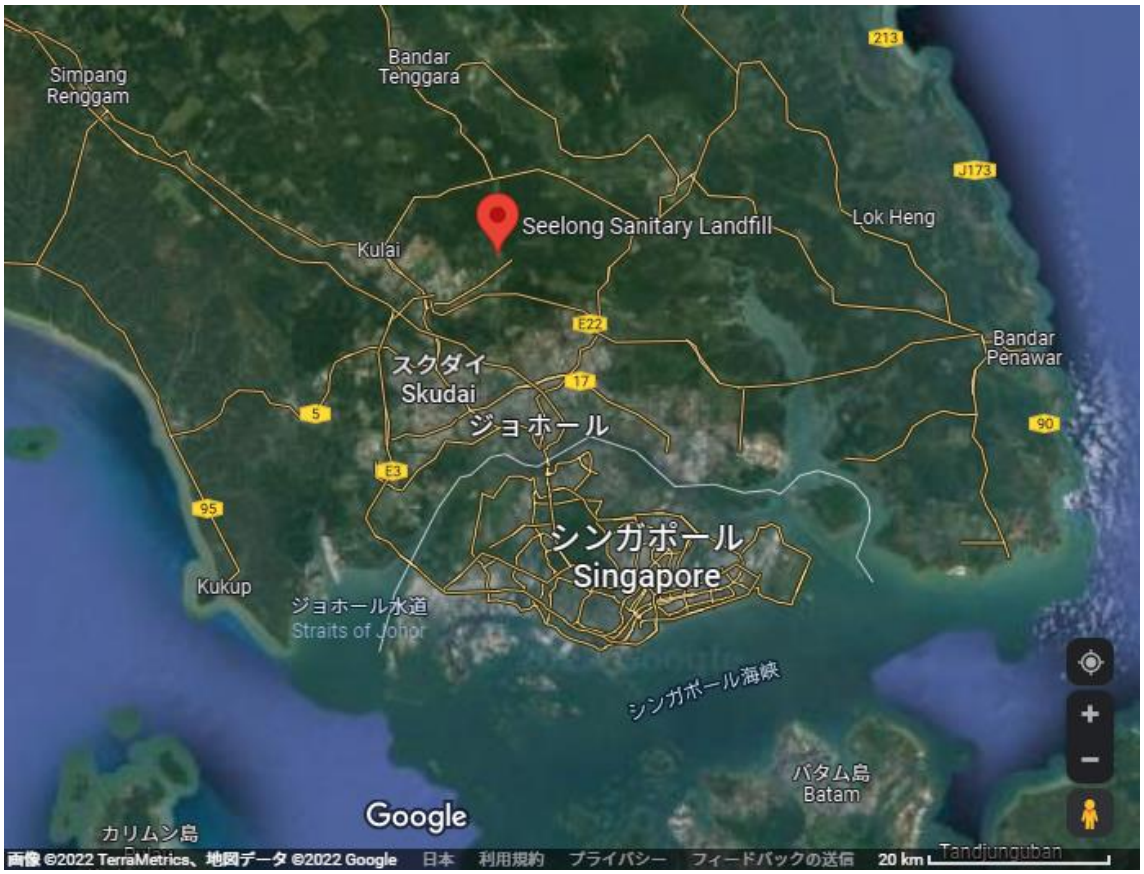

Figure 4-7 : Location of Seelong Sanitary Landfill (Source: Google Map)

Table 4-11 Waste treatment and disposal processes at Seelong Sanitary Landfill

| Process | Treatment / Disposal | Remarks |
|---|---|---|
| 1) Weigh Bridege | Weigh and record a compaction car | Measured at entry and exit, respectively |
| 2) Transfer Station | Transship collected waste<br>Sorting and removal of plastic waste | To reduce congestion at landfill sites<br>(Only some vehicles are transshipped.) |
| 3) Landfilling | Dump waste to the landfill | Currently landfilling in cell No.7 (out of 13 total cells) |
| 4) Leachate Treatment Plant (LTP) | After biological, chemical and physical treatment, discharged into river | Water quality is measured Daily (for internal control), Weekly, Monthly (for reporting to authorities) |
| 5) Landfill Gas Utilization | Power generation by gas engine | Updated from flare stack (previous installation) |
| 6) Recyclable waste segregation | Waste home appliances, cardboard, and bottles are sorted and sold | |

Waste treatment and disposal at Seelong Sanitary Landfill consists of the following 6 processes: 1) Weigh Bridge, 2) Transfer Station, 3) Landfilling, 4) Leachate Treatment Plant, 5) Landfill Gas Utilization and 6) Recyclable Waste Segregation (Table 4-11). The detail of each process is described later in this report. SWME processes leachate properly just as in Japan and discharge it only after appropriate water quality control. In addition, they proactively recover landfill gas (methane gas), known as a greenhouse gas, and generate electricity by use of gas engine. Through our visit, it was confirmed that SWME is a reliable waste landfill operator who has managed wastes properly.

Waste delivery to Seelong Sanitary Landfill is 628,346 t/year (1,721 t/day) as of 2021. This value includes the weight of recyclable waste such as waste home appliances. Figure 4-8 shows the trend in the annual amount of waste collected for the last 10 years. This figure shows that the amount of waste delivered to the Seelong Landfill is increasing at a faster rate than the population growth rate in Malaysia.

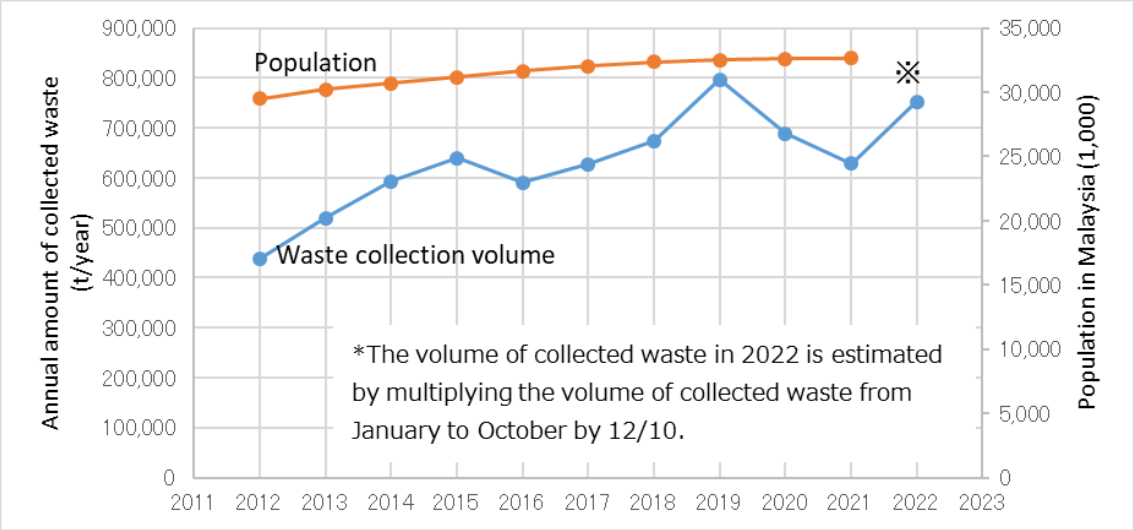


Figure 4-8：Trend of the annual waste delivery in the Seelong Sanitary Landfill
(Malaysia Population Data：Department of Statistics Malaysia Official Potal
(https://www.dosm.gov.my/v1/index.php))

Figure 4-9 shows the monthly trend of waste delivery in Seelong Sanitary Landfill. From this figure, it can be assumed that the seasonal change of moisture content is not significant because the waste delivery remains almost stable. Relatively large change in waste delivery is found only in January and February (+10% and -10% from the annual average delivery, respectively). According to the SWME administrator, the two-month period was possibly influenced by consumption activities associated with the Chinese New Year, but the detailed cause is revealed.

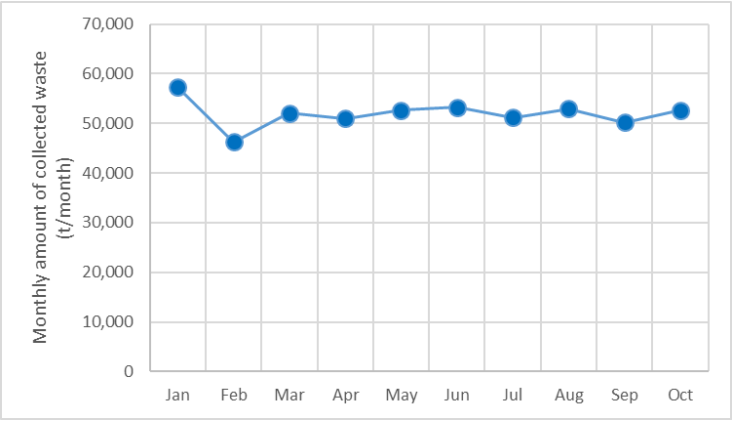


Figure 4-9：Trend in the monthly waste delivery in Seelong Sanitary Landfill (2022)

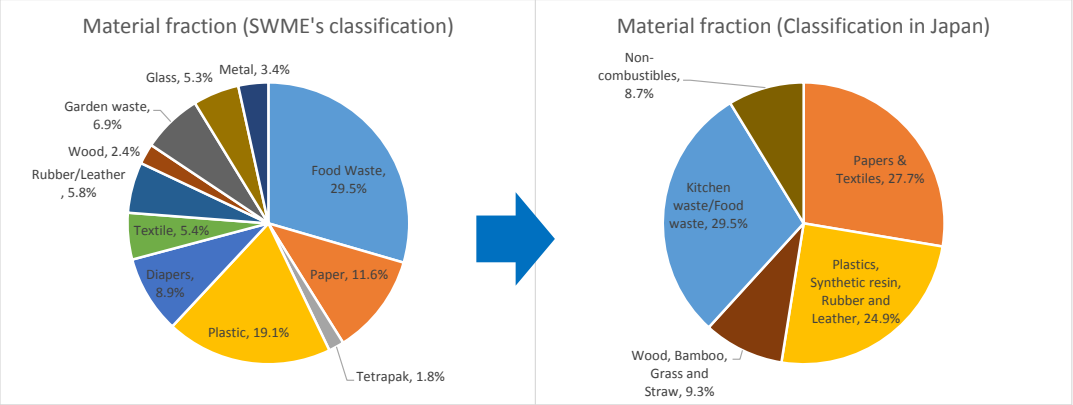


Figure 4-10: Material fraction analysis results in Seelong Sanitary Landfill

Figure 4-10 shows the results of material fraction analysis conducted by SWME voluntarily in August 2022. The left figure shows the material fraction according to SWME's classification, whereas the right shows re-categorized one according to the standard classification in Japan. When compered qualitatively with waste delivered in WtE plant, the percentage of Kitchen waste/Food waste looked to be higher, and that of Papers & Textiles looked to be lower in Seelong Sanitary Landfill.

ii. Waste Collection and Transportation

Waste collection method in Iskandar area is "curb side collection". SWME have distributed (or sold?) a waste bin (container with lid) for household waste that allows them to throw waste semi-automatically into their own compactor vehicle. They collect waste in front of each household on the designated day of week. They collect waste 3 times a week; 2 times a week for residential waste and once for recyclable waste (Non-hazardous industrial waste (IW), Bulky waste, E-waste). Non-hazardous IW mainly consist of packaging and wooden pallets. Recyclable waste is also collected in front of each household using the similar bin as residential waste collection.

Figure 4-11 : A waste bin for collection distributed by SWME.

(Source: https://www.johorkini.my/kaunter-pengambilan-tong-sampah-beroda-di-johor-kembali-beroperasi-swm-

environment/)

SWME mainly uses the following two types of vehicle for waste collection and transportation:

(1) Compactor (16t compaction car): For Residential waste collection

(2) Small Lorry (5t vehicle): For Non-hazardous IW, Bulky waste and E-waste collection


Picture 4-1 (1) Compactor（16t compaction truck）

Picture 4-2 (2) Small Lorry (5t vehicle)

Picture 4-3 On-site transportation vehicle (10t: load capacity is an estimate)

iii. Waste treatment and disposal process 1) Weigh Bridge

When coming in to and out from the landfill, waste trucks record its weight by placing the pre-registered card at the weigh bridge. The following items are recorded for waste management at Seelong Sanitary Landfill: Vehicle number, Waste collected area, Type of waste, Time in, Time out, Weight at entry, Weight at exit and etc.

Picture 4-4 Weigh Bridge


SWM ENVIRONMENT SDN BHD
Gst: 001516347392
LONG ENVIRONMENTAL CENT
ulai - Ulu Tiram, Mukim
Bahru, Johor Darul Ta'

Ticket No. :2102157 Date :28/11/202
2

| | |
|---|---|
| Vehicle No. | :WXX6709 |
| Minimum Balance (RM) | :0.00 |
| Customer | :SLGGENERAL |
| MATERIAL SUPPLY | |
| Area | :BAHAN |
| Materials Supply | |
| Waste | :MTSP |
| MATERIALS SUPPLY | |
| Time In | :11:18 |
| Time Out | :12:19 |
| 1st Weight | : 2,180 (Kg) |
| 2nd Weight | : 2,180 (Kg) |
| Net Weight | : 0 (Kg) |
| Price/Ton (RM) | :0.00 |
| Amount(RM) | :0.00 |

Picture 4-5 Receipt of weighing record at the weigh bridge

iv. Waste treatment and disposal process 2) Transfer Station

Some of the trucks are guided to Transfer Station and dump waste there for tranship, in order to avoid the crowds of waste trucks at the final landfill point and to recover plastic waste. Collected plastics are separated into the following three types and sold: (1) Plastic bottle, (2) White-coloured plastics and (3) Large-sized plastics. Waste separation work is not conducted by SWME but by other company and its profit is attributed to the company.

Picture 4-6 Transfer Station

Picture 4-7 Transhipping waste to the on-site transport vehicle at transfer station

(From left to right, (1) Plastic bottles, (2) White-coloured plastics and (3) Large-sized plastics)

Picture 4-8 Plastics after separated

v. Waste treatment and disposal process 3) Landfilling

Seelong Sanitary Landfill is comprised of 13 cells in total, and landfilling and soil covering is started from cell No.1. When we visited there, cell No.7, newly constructed in May 2022, was being landfilled. Picture 4-9 is a panorama photo that mainly pictures cell No.7.

Picture 4-9 Panorama photo of landfill
(left: landfill point, middle: primary leachate pond)

Picture 4-10 Landfilling work at cell No.7

It was not allowed to see the exact dumping point due to safety reason (frequent vehicle traffic). Instead, SWME gave us a special demonstration of the dumping from 16t compaction truck at Transfer Station. It was observed that there was a lot of water in the compaction truck, and it was supposed that moisture content of the waste is higher than that in Japan. When it comes to material fraction, percentage of kitchen waste/Food waste seemed to be high according to visual check. In addition, most of the collected household waste was packed in plastic bags and the percentage of plastic waste looked to be relatively high.

Picture 4-11 Collected household waste

Picture 4-12 Collected household waste (enlarged photo)

vi. Waste treatment and disposal process 4) Leachate Treatment Plant

Leachate is collected in seven primary ponds in the Landfill site, and then, is transferred to the leachate treatment process by pumps. Leachate treatment plant consists of the

following processes.

Table 4-12 Leachate treatment process

| Process | Treatment description |
|---|---|
| (1) Biological Treatment | Aerobic activated sludge method (for organic matter) |
| (2) Precipitation | Precipitate suspended particulate matter and active sludge |
| (3) Ammonia stripper | Remove ammonia by aeration |
| (4) Chemical Treatment | Remove heavy metals by dosing agent + lamellar separator* |
| (5) Biological Treatment | Remove organic mattar by activated sludge method + lamellar separator* |
| (6) Physical Treatment | Remove turbidity by sand filtration + activated carbon adsorption tower |

*Lamellar separator: Inclined-type precipitation device. Possible to remove solid particulates or suspended solids from liquid in the limited installation space.

Quality of treated water is measured at a laboratory in the landfill site, and after confirming it meets a standard value it is discharged into a river through a final buffer pond in the site. Measurement is conducted every day for internal control, and the result is reported to authorities every week/every month. There are carp in the final buffer pond to demonstrate that the treated water quality is safe enough.

Picture 4-13 (1) Biological Treatment

Picture 4-14 (3) Ammonia stripper


Picture 4-15 (4) Heavy metal removal by Chemical Treatment (Lamellar separator)


Picture 4-16 Laboratory and samples of water quality at each treatment stage

vii. Waste treatment and disposal process 5) Landfill Gas Utilization

SWME employs a gas engine to generate electricity from a pressurized landfill gas (LFG) collected from vertical extraction wells installed in each landfill cell. Methane concentration in LFG generated from this landfill site was 54%. Gas engine they use is made by MWM in Germany and its maximum output is 2MW. When we visited the site, the power output was 0.9MW. There was little fluctuation over the time and the power was generated stably.

Picture 4-17 LFG generation facility

viii. Waste treatment and disposal process 6) Recyclable Waste Segregation

Recyclable waste collected once a week is separated into waste home appliances, cardboards and glass bottles. The profit of the sale is attributed to SWME. Those who want to throw away their recyclable waste can register via app in their mobile phone in advance, put a paper with QR code on the waste, and then, place their waste in front of their house on the designated date of week. After that, SWME come to collect and deliver the waste. As an incentive for citizens, SWME has adopted a system of giving points that can be later exchanged to cash.

Picture 4-18 Recyclable waste segregation
(panoramic photo on sorting and storage area)

### 4.4.3 Activities for Next Year

The following is a report on the draft plan discussed this year with UTM for a waste quality survey at the Seelong Landfill, which will be carried out jointly with UTM in next year's project.

（1） Waste Survey Plan

Although waste quality data is an essential pre-condition for designing WTE plant, for FY2019~2021 projects, because site investigation was not possible due to Covid-19 travel restrictions, the technical study utilized waste quality data from a published academic article (results of the waste details analysis conducted in 2011 and 2013 by Siti Norbaizura and Professor Takeshi Fujiwara from Okayama University at Seelong Sanitary Landfill Facility in Johor. See Table 4-13) to set the design waste quality to determine plant design which was then used to estimate project costs.

Table 4-13 Design Waste Quality

| Parameter | | Unit | Standard |
|---|---|---|---|
| Calorific value | | kcal/kg | 1,591 |
| Proximate analysis | Moisture | wet% | 56.90 |
| | Ash | wet % | 8.20 |
| | Combustible | wet % | 34.90 |
| Ultimate analysis | Carbon (C) | wet % | 18.90 |
| | Hydrogen (H) | wet % | 2.70 |
| | Oxygen (O) | wet % | 12.67 |
| | Nitrogen (N) | wet % | 0.39 |
| | Sulphur (S) | wet % | 0.05 |
| | Chlorine (Cl) | wet % | 0.19 |

*Source: Norbaizura, Siti, M.R. & Fujiwara, Takeshi (2013). Characterization of Household waste in Iskandar Malaysia and its Suitability for Alternative Waste Handling Methods. Journal of Japan Society of Civil Engineers, Ser. G (Environmental Research), Vol.9, No.5 : I_209-I_216., ultimate analysis results adjusted by NSE.*

In the second year of the three-year project (in the next fiscal year), we plan to analyze waste collected in Iskandar area, where a new WtE plant is planned to be constructed, for the purpose of improving the plant technical specifications and the accuracy of estimation of the business cost. This year, we had discussions with SWME, who operates Seelong Sanitary Landfill for waste composition analysis (reported in the previous section), and with the potential contractor for waste analysis services. The following is a summary of discussion (December 21, 2022) with Uni-Technologies Sdn. Bhd. (Uni-Technology), the potential analysis contractor, and the plan for waste composition analysis.

（２） About Uni-Technology company

Uni-Technology is an entity under UTM, whose main campus is located in Iskandar region. Uni-Technology has carried out waste analysis work for government and private organizations in Kuala Lumpur, Melaka, Labuan, Cameron Highland, Northern Johor, Pontian, Pasir Gudang, Johor Bahru and Kulai in Malaysia. It has more than 30-year experience on waste analysis work. Uni-Technology also has experience working with Japanese companies.

（３） Objectives of this waste quality analysis study

The following is the objectives of waste composition analysis:

1) Understanding of waste generation amount for each waste type in Iskandar region,
2) Obtaining waste fraction data for each of the waste types mentioned above,
3) Obtaining waste analysis data (physical and chemical properties) for each of the waste types mentioned above.

（４） Sampling location and period

Waste sampling will be carried out at Seelong Sanitary Landfill, which is considered to be representative on composition of waste generated in Iskandar area.

On the one hand, the change in water content between wet and dry season is negligible since containers with lids are used for waste collection in Iskandar region. On the other hand, previous UTM studies showed that waste composition varies between the season when the durian harvest is most active (July and November) and the other seasons. Based on this information, it was decided to conduct the sampling campaign in this study in two separate sessions, one in the non-fruiting season (September 2023) and one in the fruiting season (November 2023).

（５） Waste types to be sampled

The following four types of waste will be sampled.

1) Household waste
2) Industrial waste (non-hazardous)
3) Commercial waste
4) Mixed waste

4) Mixed waste is set up for the purpose of ascertaining the average composition of waste

delivered to Seelong Sanitary Landfill. Delivery vehicles will be randomly selected for sampling (for example, one vehicle is selected from every three delivery vehicles for waste sampling), and waste from multiple vehicles are then mixed for analysis.

（6） Items of waste quality analysis

The following analyses will be carried out for four waste samples in each season mentioned in (4) and (5) above (8 samples in total).

1) Material fraction analysis
2) Proximate analysis
3) Ultimate analysis
4) Ash elemental analysis

*1) Waste fraction Analysis*

In order to obtain accurate material fraction data, the collected 200 kg of waste sample will be sorted into the following 16-material fractions. It is also possible to make comparisons with existing Japanese waste composition data by reclassifying the 16-material fraction data into the 7-material fraction data which is commonly used in Japan (*).

(*) 7-material fractions: 1) paper, 2) textiles, 3) synthetic resins/rubber/leather, 4) wood/bamboo/grass/straw, 5) kitchen waste, 6) non-combustible materials, and 7) others (miscellaneous materials).

Table 4-14 Classification in Material Fraction Analysis

| Analysis items | | Unit |
|---|---|---|
| Material fraction | | - |
| | Food Waste | wt%, wet |
| | Fruit Husk | wt%, wet |
| | Yard Waste | wt%, wet |
| | Paper | wt%, wet |
| | Tetra Pak | wt%, wet |
| | Plastic | wt%, wet |
| | Dry Wood | wt%, wet |
| | Textile | wt%, wet |
| | Rubber and Leather | wt%, wet |
| | Metal | wt%, wet |
| | Glass | wt%, wet |
| | Nappies | wt%, wet |
| | Face Mask | wt%, wet |
| | Haradous Waste releted to Covid-19 | wt%, wet |
| | Other Hazardous Waste | wt%, wet |
| | Others | wt%, wet |

### *2) Proximate analysis*

The analysis items are listed in Table 4-15 below.

Table 4-15 Items of proximate analysis

| Analysis items | | Unit |
|---|---|---|
| Proximate analysis | | - |
| | Moisture Content | wt%, wet |
| | Combustibles | wt%, wet |
| | Volatile Matter | wt%, wet |
| | Fixed Carbon | wt%, wet |
| | Ash Content | wt%, wet |
| | Lower Heating Value (LHV) | kJ/kg |
| | Bulk Density | $kg/m^3$ |

### *3) Ultimate analysis*

The analysis items are listed in Table 4-16 below.

Table 4-16 Items of ultimate analysis

| Analysis items | | Unit |
|---|---|---|
| Elemental analysis (Combustibles) | | - |
| | C | wt%, dry |
| | H | wt%, dry |
| | N | wt%, dry |
| | O | wt%, dry |
| | S | wt%, dry |
| | Cl | wt%, dry |

*4) Ash Elemental Analysis*

The analysis items are listed in Table 4-17 below.

Table 4-17 Items of ash elemental analysis

| Analysis items | | Unit |
|---|---|---|
| Elemental analysis (Ash) | | - |
| | Ca | wt%, dry |
| | Si | wt%, dry |
| | Al | wt%, dry |
| | Mg | wt%, dry |
| | Pb | wt%, dry |
| | Zn | wt%, dry |
| | Na | wt%, dry |
| | K | wt%, dry |
| | Cu | wt%, dry |
| | Cd | wt%, dry |
| | F | wt%, dry |
| | Hg | wt%, dry |
| | Fe | wt%, dry |

（7） Sampling Method

Sampling method was planned to obtain representative data as much as possible, based on the method published by the Japanese Ministry of Environment (Notice No.95).

Samples of at least 10 kg of waste will be taken from each of several delivery vehicles, for a total of 200 kg per sample. When sampling from each delivery vehicle, the waste shall be sampled and mixed from three locations: the front, centre, and rear of the waste loading area, to ensure that the waste is representative of each delivery vehicle as much as possible. (Figure 4-12)

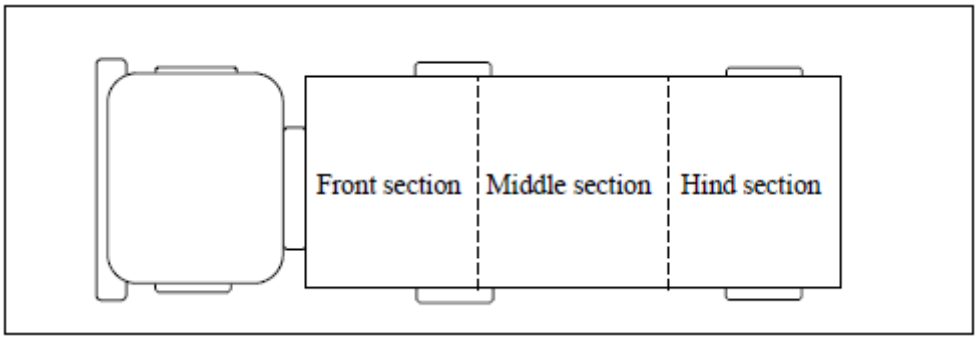


Figure 4-12 Sampling locations from each delivery vehicle

The flow of waste sampling and analysis is shown in Figure 4-13. Material fraction analysis and unit volume weight (waste bulk density) measurements will be performed on-site at the landfill site using a 200 kg waste sample collected. Based on the results of the material fraction analysis obtained, a 2 kg mixed waste sample is prepared and brought back to the lab. Then, proximate analysis, ultimate analysis, and ash elemental analysis will be performed.

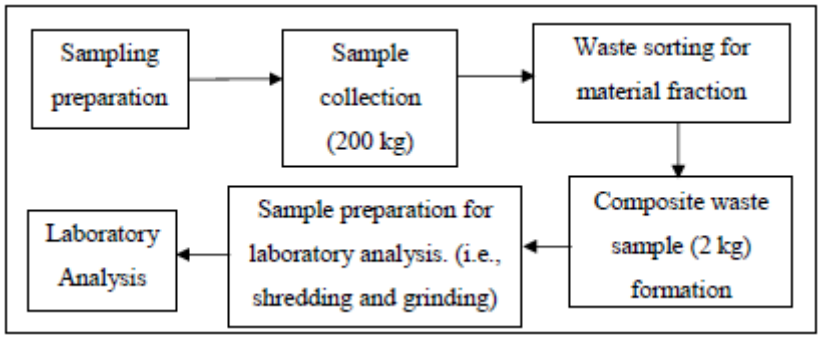


Figure 4-13 Flow of waste sampling and analysis

## （8） Schedule of waste sampling and analysis

Table 4-18 Schedule of waste sampling and analysis

| | | 2023 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | August | | | | September | | | | | October | | | | November | | | | December | | | |
| | | W1 | W2 | W3 | W4 | W1 | W2 | W3 | W4 | W5 | W1 | W2 | W3 | W4 | W1 | W2 | W3 | W4 | W1 | W2 | W3 | W4 |
| Sampling for Non-fruit season | Site entry approval | | ■ | | | | | | | | | | | | | | | | | | | |
| | Sampling preparation | | | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| | Waste sampling & waste sorting | | | | | | ■ | | | | | | | | | | | | | | | |
| | Sample preparation for lab analysis | | | | | | ■ | ■ | | | | | | | | | | | | | | |
| | Lab analysis | | | | | | | ■ | ■ | ■ | | | | | | | | | | | | |
| | Data analysis | | | | | | ■ | ■ | ■ | ■ | ■ | | | | | | | | | | | |
| | Report preparation & submission | | | | | | | | | | ■ | ■ | | | | | | | | | | |
| Sampling for Fruit season | Site entry approval | | | | | | | | | | | ■ | | | | | | | | | | |
| | Sampling preparation | | | | | | | | | | | | ■ | ■ | | | | | | | | |
| | Waste sampling & waste sorting | | | | | | | | | | | | | | ■ | | | | | | | |
| | Sample preparation for lab analysis | | | | | | | | | | | | | | ■ | ■ | | | | | | |
| | Lab analysis | | | | | | | | | | | | | | | ■ | ■ | ■ | | | | |
| | Data analysis | | | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | | | |
| | Report preparation & submission | | | | | | | | | | | | | | | | | | ■ | ■ | | |

## 4.5 Future directions

This year, it was a major achievement to be able to conduct a field survey at the Seelong Landfill located in the Iskandar region, on the premise that the entry restriction measures to Malaysia in response to the global spread of COVID-19 has eased, which allowed the field survey to be conducted. As a result of on-site interviews with SWM Environment Sdn. Bhd. the local waste management company operating the Seelong Landfill, it was found that the Seelong Landfill had not conducted sufficient waste quality surveys on its own and did not have data on the composition and properties of the waste it received. Therefore, in order to conduct a waste quality survey, discussions on the survey plan were held remotely with a research team from Universiti Teknologi Malaysia.

In the second year of the three-year project next year, waste quality analysis of waste collected in the Iskandar region, where the WTE facility is planned to be built, and delivered to the landfill, will be carried out with the aim of improving the technical specifications of the facility and the accuracy of the estimated project cost.

In addition, a survey of the legal system applicable to facility design was carried out this year as part of a survey of information on the premises for facility planning. In the coming year, it is envisaged that the research on institutional design will be deepened and the progress of the Bukit Payong project will be followed, and the legal systems and issues related to the implementation of the project will be sorted out with reference to conditions and other factors.

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