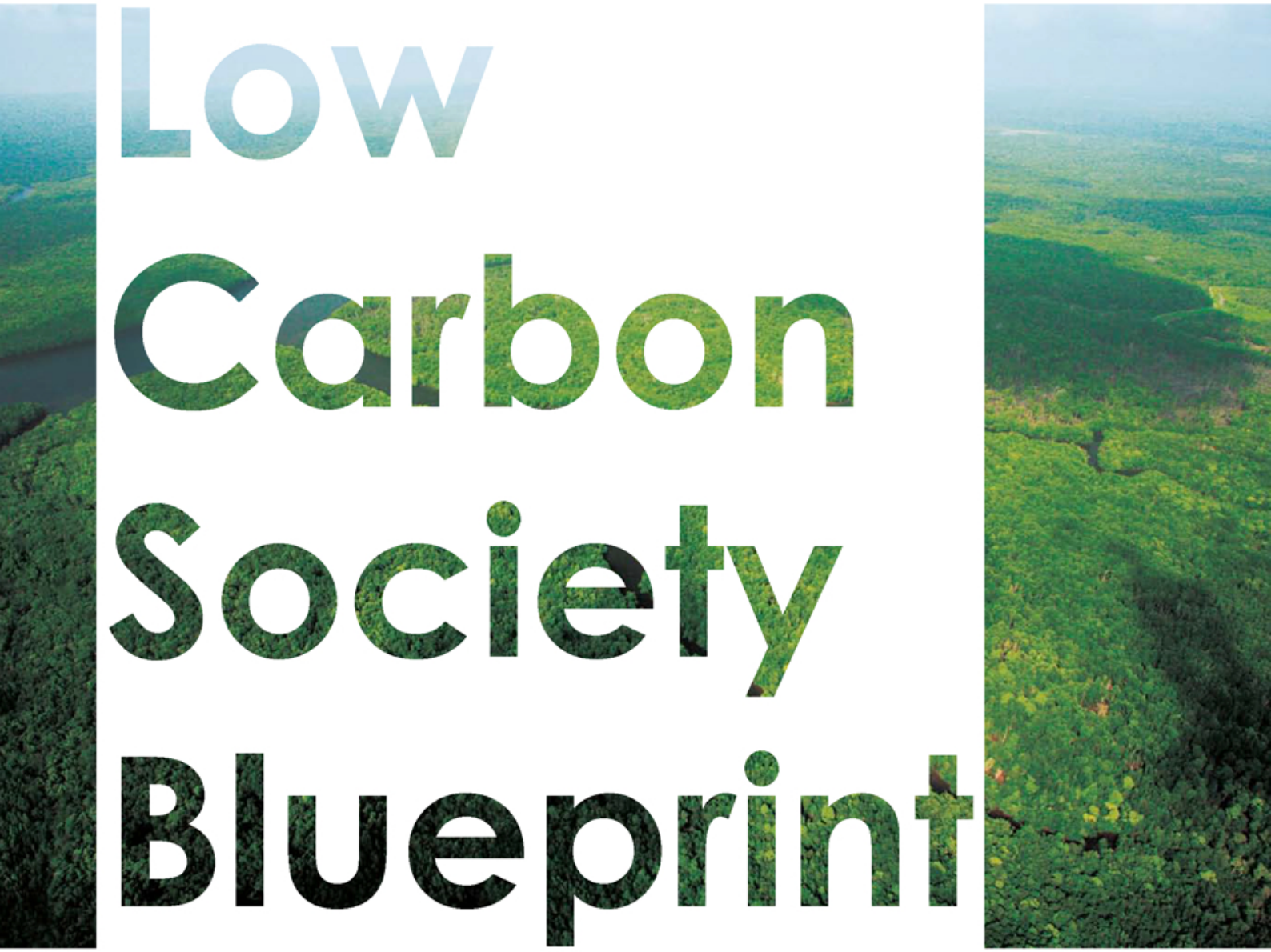
Development of
Low Carbon Society Scenarios for Asian Regions

Full Report



# Low Carbon Society Blueprint

## for Iskandar Malaysia 2025

October 2013

UTM UNIVERSITI TEKNOLOGI MALAYSIA
ISKANDAR MALAYSIA
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OKAYAMA UNIVERSITY
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AIM ASIA-PACIFIC INTEGRATED MODEL

# Low Carbon Society Blueprint

## for Iskandar Malaysia 2025

Full Report | October 2013

Universiti Teknologi Malaysia
Iskandar Regional Development Authority
Kyoto University
Okayama University
National Institute for Environmental Studies

Low Carbon Society Blueprint for Iskandar Malaysia 2025 - Full Report

Published by UTM-Low Carbon Asia Research Center
Room 317, Block B-11, Faculty of Built Environment, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.



Graphic design by Teh Bor Tsong and Nadzirah Jausus

Printed and bound in Malaysia

# Foreword

Y.A.B. Dato' Sri Mohd Najib Tun Abdul Razak
Prime Minister of Malaysia
Co-Chairman of Iskandar Regional Development Authority

The global concern over issues of climate change, global warming and the management of our environment calls for informed and co-ordinated actions by every nation, state and citizen in ensuring that the next generations will inherit a place that is not only fit for human habitation, but conducive for future growth and prosperity.

Therefore, the initiative by Iskandar Regional Development Authority (IRDA) in setting targets for low carbon footprint in the economic development corridor of Iskandar Malaysia in South Johor, Malaysia, as well as the nurturing of a green economy through increased investments in environmental assets and green technology and production, is indeed a commendable one, and should serve as a working model for the development of similar efforts at national, state or regional levels.

# Foreword

Y.A.B. Dato' Seri Mohamed Khaled Nordin
Menteri Besar of Johor
Co-Chairman of Iskandar Regional Development Authority

The issuance of the Low Carbon Society Blueprint for Iskandar Malaysia is indeed an initiative taken by Iskandar Regional Development Authority (IRDA) to meet the world community demands for concrete action and timeframe in protecting and sustaining the environment.

In the State of Johor and Iskandar Malaysia, we understand that astute and careful management of natural resources is the key to sustainable growth and development. This sets the context within which all other factors from land use proposals and development to social engineering, service provision and economic growth potential must be considered. The policies must be sound and substantial, supported by solid research and strong buy-in from the various stakeholders. Therefore, the implementation must be done through collaboration with the local communities, whose knowledge and intimate experiences of their environment are crucial for a well-planned economic region. This will enhance the value proposition of such developments, without sacrificing the future.

# Foreword

Y.Bhg Datuk Ismail Ibrahim
Chief Executive of Iskandar Regional Development Authority

Iskandar Regional Development Authority (IRDA) aims at addressing economic growth, societal well-being and development, as well as environmental preservation and management in Iskandar Malaysia in a holistic manner, and the Low Carbon Society initiative is one of the various mechanisms that have been deployed to achieve these objectives.

Through the Low Carbon Society research project (2011-2015), Malaysian and Japanese research teams have produced substantive research findings that have been translated into workable and bankable development policies and programmes. This Low Carbon Society Blueprint for Iskandar Malaysia, with its 12 Actions and over 300 programmes, will be implemented in a timely and proactive manner, with IRDA performing the leading role.

I wish to thank Universiti Teknologi Malaysia and Japanese researchers from Kyoto University, the National Institute for Environmental Studies (NIES) and Okayama University; and the funders for the project, namely Japan International Co-operation Agency (JICA) and Japan Science and Technology Agency (JST), for their invaluable research efforts, diligence, support and continuing commitment to the growth of Iskandar Malaysia. This is a major contribution towards the realisation of IRDA's vision in making Iskandar Malaysia a strong and sustainable metropolis of international standing.

# Preface

The Malaysian government recognises that climate change and the adverse consequences arising from it are real and has taken positive policy actions to address climate change. A comprehensive ecosystem for an environmentally sustainable framework has been proposed to protect the environmental quality of life and caring for the planet while pursuing economic growth as well as development towards a high income nation status. In order to carry out this agenda, there is a need to increase the awareness of all Malaysians that environmental sustainability is a shared responsibility for attaining a low carbon society.

In addition, as Malaysia is experiencing rapid urbanisation, it is important to develop low carbon, vibrant and liveable cities or conurbation/ economic growth corridors that adopt climate resilient growth strategies. The formulation of a Low carbon society blueprint for regional and local authorities is one of the approaches to develop climate resilient growth strategies to reduce emissions of greenhouse gases (GHGs) at local and regional level.

The Low carbon society blueprint for Iskandar Malaysia not only complements and updates the earlier Low Carbon City 2025 - Sustainable Iskandar Malaysia report (2009) but also embraces the 12 Actions Plan to guide development towards climate resilient urban development for Iskandar Malaysia. This will support the vision of building a strong sustainable metropolis of International Standing.

This blueprint is one of major research outputs of our SATREPS (Science and Technology Research Partnership for Sustainable Development) project on the Development of Low Carbon Society for Asian Regions sponsored by Japan International Cooperation Agency (JICA) and Japan Science and Technology Agency (JST). The main universities involved in this collaboration work are Universiti Teknologi Malaysia (UTM), Kyoto University, National Institute for Environmental Studies (NIES), and Okayama University.

The collaborative research approach in this project is unique because it gathers both international and local experts/scientists to provide scientific findings and quantitative modelling of carbon dioxide emissions to Iskandar Malaysia Development Authority (IRDA) who are the policy makers. The other unique feature is that the blueprint consists of 12 proposed actions which are based on the active participation and consensus building of major stakeholders in Iskandar Malaysia. This will ensure that the detailed proposed measures and programme will be aligned to the local community needs.

In line with the Malaysian Government's effort to achieve a 40% voluntary reduction of $CO_2$ emission intensity by 2020, the implementation of the blueprint will facilitate the low carbon development of Iskandar Malaysia. Being one of the fastest growing regions in Malaysia, this demonstrates the realisation of how a low carbon society can be achieved by decoupling $CO_2$ emissions and economic growth.


Ho Chin Siong
Project Manager

Professor
Universiti Teknologi Malaysia

Yuzuru Matsuoka
Project Leader

Professor
Kyoto University

# Acknowledgements

Economic Planning Unit, Prime Minister's Department, Malaysia
Ministry of Higher Education, Malaysia
Ministry of Science, Innovation and Technology, Malaysia
Ministry of Natural Resources and Environment, Malaysia
Ministry of Energy, Green Technology and Water, Malaysia
Ministry of Housing and Local Government, Malaysia
Department of Town and Country Planning Peninsular Malaysia, Malaysia
Iskandar Regional Development Authority, Malaysia
Johor State Government, Malaysia
Malaysia Green Technology Corporation, Malaysia
Embassy of Japan, Malaysia
Universiti Teknologi Malaysia, Malaysia

Ministry of the Environment, Japan
Japan International Cooperation Agency, Japan
Japan Science and Technology Agency, Japan
Kyoto University, Japan
Okayama University, Japan
National Institute for Environmental Studies, Japan
Institute for Global Environmental Strategies, Japan

We wish to acknowledge and thank to all individuals, departments, agencies and ministries mentioned here in giving their supports on Low Carbon Society Blueprint for Iskandar Malaysia 2025.

# Contents

Introduction

# Low Carbon Society Blueprint for Iskandar Malaysia 2025

Ho Chin Siong, Yuzuru Matsuoka, Chau Loon Wai, Teh Bor Tsong and Kei Gomi

The question that is often asked is:- “How do we define a low carbon society (LCS)?” Following from this, how can LCS in Iskandar Malaysia (IM) be attained with dual objectives of planned social and economic development? A Low car-bon society aims to minimise carbon emission in all sectors, shift to a simpler and quality life and coexistence with nature. This Blueprint contains future society scenarios based on major socioeconomic development variables, quantitative modelling of CO2 emission and “12 major Actions” that come under Triple Bottom Line (TBL) pillars, namely Green Economy, Green Community and Green Environment. The 12 actions are then detailed into specific measures and programs which IRDA and other stakeholders can adopt and implement directly. It covers wide ranging aspects which include urban planning, transportation, industry, building, energy efficiency, renewable energy, lifestyle change, education and awareness, governance, forest conservation, waste management and air environmental quality.

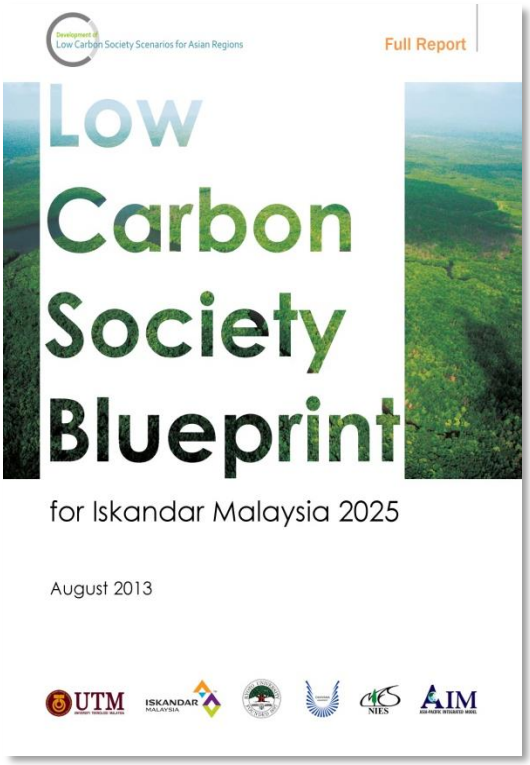
## Introduction

Climate is a global issue with significant implications for Malaysia. Apart from national mitigation and adaption strategies for addressing the impact of climate change, there is a need to also look into regional and local resilient policies to reduce greenhouse gases.

The World Bank (2010) stated that cities all around the world which serve as the center of settlements and economy activities are responsible for consuming two-thirds of the world's energy and generating 70% global emission. Cities with increasing population growth and economic development consuming vast natural resources and generating enormous waste are producing large volume of GHGs. Cities, despite the fact as the main carbon emission contributors, yet experts agreed that cities are possessing greatest opportunity as the forefront in mitigating climate change as well. Cities based climate change policies are proven to be effective and efficient (feasible and easy to deliver) as compare to nationals based climate change policies. Many cities predominantly in developed countries have established action plan and roadmap to tackle climate change issue. However, the challenges are lies on cities in developing and transition nations in Asian regions with including Malaysian cities, whereby the urban population is high; economic growth is rapid and climate change is relatively new for them. There is lack of knowledge to mitigate climate change at cities and regions level.

In line with the Malaysian National and Regional Government's aspiration for green economic growth and greater sustainability, Iskandar Malaysia (IM) is set to be the first region in Malaysia for initiating its' own climate change action plan named '*Low Carbon Society Blueprint for Iskandar Malaysia 2025*'. Optimistically, the low carbon society blueprint does not only benefits to the sustainable pathway of IM solely as the substantial findings will be disseminated towards other cities in Malaysia and across Asian countries.

### About Low Carbon Society Blueprint for Iskandar Malaysia 2025




*Low Carbon Society Blueprint for Iskandar Malaysia 2025* is a written document that presents comprehensive climate change mitigation policies and detail strategies to guide the development of Iskandar Malaysia towards a strong and sustainable metropolis of international standing in year 2025. The Blueprint incorporates various related national policies, and the other 24 Iskandar Malaysia Blueprints and Comprehensive Development Plan for South Johor Economic Region 2006 – 2025 (CDP) in transforming Iskandar Malaysia into a low carbon metropolis (More details on the context of low carbon society blueprint in IM, see Chapter 3). The Blueprint discusses and provides complex technical details of carbon mitigation options (with specific measures and program) for practiced. It is aimed to guide the implementation of twelve (12) low carbon society policy actions in Iskandar Malaysia. *Summary for Policymakers* (SPM) of the Blueprint are available for the readers who are interested to get a straightforward yet sufficient overview of the Blueprint, without the burden of unnecessary scientific and technical jargons.

## Low Carbon Society (LCS)

In view of the fact that, the concept of low carbon society is the fundamental philosophy underpinned of this Blueprint, this section offers readers brief information on the idea of low carbon society. Low carbon society is a new emerging theory with a short history of a decade which many readers may not aware with. It was developed during the Japan – UK joint research project on Low Carbon Society for the first anniversary of Kyoto Protocol back in year 2006. They defined low carbon society as:

"*A society that takes actions that are compatible with the principles of sustainable development, ensuring that the development needs of all groups within society are met*"

"*A society that makes an equitable contribution towards the global effort to stabalise atmospheric concentrations of carbon dioxide and other greenhouse gases (GHGs) at a level that will avoid dangerous climate change through deep cuts in global emissions*"

"*A society that demonstrates high levels of energy efficiency and uses low carbon energy resources and production technologies*"

"*A society that adopts patterns of consumption and behavior that is consistent with low levels of GHGs emission*"

The ideology of low carbon society believes that people as the source and solution of climate change. It highlighted the existing human activities as the main contributors to global GHGs emission and therefore calls for the efforts of current society in all sectors today to shift their mass consumption behavior and lifestyle to a new consumption pattern that less harm to environment. Low carbon society is a new society that consume relatively low amount of resources (raw material, energy and water) in minimizing GHGs emission to avoid adverse effect of climate change. Despite the fact that the concept stress on social reform for better environmental system, yet it does not compromise with robust economy growth for high quality of life.

In realizing low carbon society, various '*soft*' and '*hard*' infrastructure developments/ improvements are needed to encourage communities to change their preferences and behaviors to practice green lifestyle. '*Soft*' infrastructures are the intangible elements that comprise of: awareness, education, governance, institutions, legislation and finance. Meanwhile, 'hard' infrastructure refers to physical elements include technology, transportation, land use, building and utility. Strategies for low carbon society transformation between one city and another are differ with respect to their geography, economic and socio-cultural context.

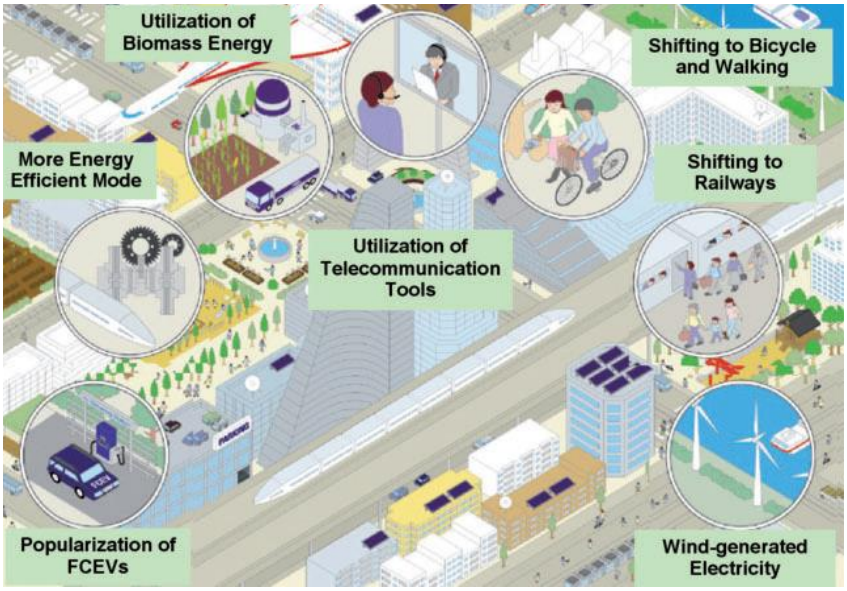



Figure 1.0: The illustration on the low carbon society scenario development in Japan.
(Source: Department for Environment, Food and Rural Affairs, 2008)

## Iskandar Malaysia (IM)

Iskandar Malaysia, previously known as Iskandar Development Region (IDR) and South Johor Economic Region (SJER) is a visionary economic region in Southern Peninsular Malaysia. The region with the size of 221,634 hectares (2,216.3km²) was established in 2006 as one of the catalyst development to spur growth of the Malaysian economy. At the global context, it is strategically located at the southernmost tip of Mainland Asia to tap on a vast market of about 1 billion people within 6 hours flight radius (Figure 1.0). Envision being a strong and sustainable metropolis of international standing and set to become an integrated global node that synergies with growth of Global City State of Singapore and Indonesia. It has been projected that the rapid annual gross domestic product (GDP) growth of 7-8% in Iskandar Malaysia will result on population to double from 1.5 million in 2005 to over 3 million by 2025. Geographically, Iskandar Malaysia covers the entire district of Johor Bahru and several sub-districts of Pontian. The administrative jurisdiction of the region falls under 5 local authorities, namely Johor Bahru City Council (MBJB), Johor Bahru Tengah Municipal Council (MPJBT), Pasir Gudang Municipal Council (MPPG), Kulai Municipal Council (MPKu) and Pontian District Council (MDP).

As shown in Figure 1.0, 5 flagship zones were established as main economic growth centers with their respective niche in Iskandar Malaysia. These flagship zones have been envisaged to both further strengthen existing economic clusters as well as to diversify and develop targeted growth sectors. They are:

**Flagship A: Johor Bahru City Center**
- Financial advisory and consulting
- Cultural and urban tourism

**Flagship B: Nusajaya**
- State administration
- Education and medical tourism
- Entertainment and recreation

**Flagship C: Western Gate Development**
- Logistic
- Oil storage terminal

**Flagship D: Eastern Gate Development**
- Manufacturing (oleo and petrochemical)
- Oil storage terminal

**Flagship E: Senai - Skudai**
- Logistic
- Manufacturing (hi-tech)
- Knowledge center
- Information and communication technology


Figure 1.1: Iskandar Malaysia and the surrounding regions. The region comprises of 5 major urban centers as key focal points for developments namely Flagship A – Johor Bahru City Center, Flagship B – Nusajaya, Flagship C – Western Gate Development, Flagship D – Eastern Gate Development and Flagship E – Senai - Skudai.
(Source: http://www.iskandarmalaysia.com.my/)

## Greenhouse Gases (GHGs) Emission Level in Iskandar Malaysia

The GHGs emission of Iskandar Malaysia is simulated via scientific Extended Snapshot Tool (ExSS), one of the family models of the Asia-Pacific Integrated Model (AIM) which was widely used by the Intergovernmental Panel on Climate Change (IPCC), an international leading body for the assessment of climate change. To quantify the GHGs emission in Iskandar Malaysia, a range of parameters (demography, economic growth, industry structure, energy, technology, transportation and land use) from CDP and other 24 blueprints are considered in the ExSS modelling. Three (3) scenarios are generated from the simulation;

i) *2005* - base year;

ii) *2025 business as usual (BaU)* - upcoming year with the development according to CDP, without any carbon mitigation measures.

iii) *2025 countermeasure (CM)* - upcoming year with the development according to the improvised CDP that adopting carbon mitigation options from low carbon society blueprint.

Based on the simulation result from the ExSS model, the GHGs emission of Iskandar Malaysia in year 2005 is estimated to be 11.4 $MtCO_2eq$ and the value is projected to double into 31.3 $MtCO_2eq$ in year 2025 BaU scenario (Table 1.0). With the introduction of proposed twelve (12) countermeasures from the Blueprint, increment of GHGs emission has been slowed down and it is expected to be 18.9 MtCO2eq for year 2025 CM scenario.

As industry sector is the key component in supporting the fast growing region of Iskandar Malaysia, the industry sector will remain as the highest emission sector with contributing 30% of the total GHGs emission in Iskandar Malaysia for the entire three (3) scenarios - year 2005, 2025 BaU and 2025 CM (Figure 1.2). Thus, a specific countermeasure has been designed in the Blueprint for greening the industry sector (See Action 2: Green Industry).

The result indicates that the complete implementation on the Blueprint would bring 58% reduction of GHG emissions intensity and a 40% emission reduction from 2025 BaU with 2005 as base year (Table 1.0). This achievement is higher than the national commitment for 40% voluntary carbon intensity reduction by 2020.

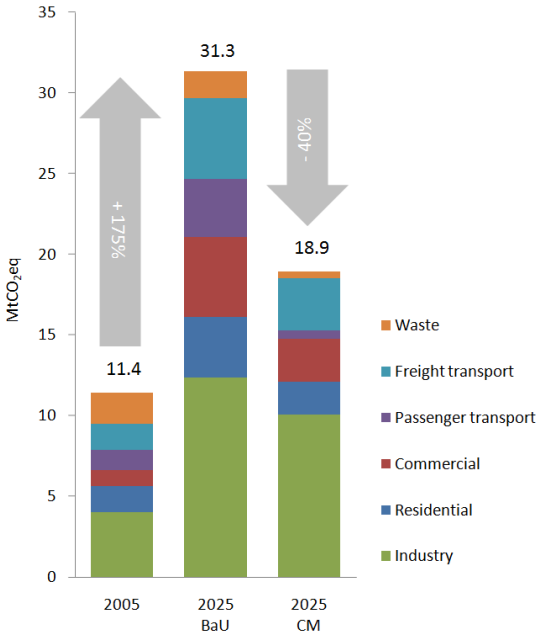



Figure 1.2: GHG emissions by sectors in Iskandar Malaysia.

Table 1.0: Energy demand, GHG emissions and intensity of Iskandar Malaysia

| Unit | 2005 | 2025 BaU | 2025 CM | 2025BaU /2005 | 2025CM /2005 | 2025CM/ 2025BaU |
|---|---|---|---|---|---|---|
| **Final energy demand** (Mtoe) | 2.5 | 7.6 | 5.2 | 3.11 | 2.14 | 0.69 |
| **GHG emissions** ($MtCO_2eq$) | 11.4 | 31.3 | 18.9 | 2.74 | 1.66 | 0.60 |
| **Per capita $CO_2$ emissions** ($tCO_2eq$) | 8.4 | 10.4 | 6.3 | 1.24 | 0.75 | 0.60 |
| **GHG intensity** ($kgCO_2eq$/ mill. RM) | 0.32 | 0.22 | 0.13 | 0.69 | 0.42 | 0.60 |

## Low Carbon Iskandar Malaysia

In transforming the society of Iskandar Malaysia into low carbon society, twelve (12) possible mitigation options have been indentified to lower the carbon emissions of Iskandar Malaysia (Table 1.1). They were formed under the Triple Bottom Pillar (TBL) themes, namely Green Economy, Green Community and Green Environment. In full amount, these 12 policy actions able to provide 12,758 $ktCO_2eq$ direct emissions reduction, accounting for 41% emission cut back from 2025BaU to 2025CM. The Action 5- Green Energy System and Renewable Energy, Action 6- Low Carbon Lifestyle and Action 1- Integrated Green Transportation are the utmost actions with comprise of 57% of total emission reduction. Policymakers should pay more attentions these three (3) actions and highlighting them as the higher priority countermeasures that would helps Iskandar Malaysia to cut carbon emission significantly.

Among the three themes, Green Economy contributes the most with 54% of reduction, followed by Green Environment 25% and Green Community 21%. Action 3- Low Carbon Urban Governance, Action 7- Community Engagement and Consensus Building and Action 12- Clean Air Environment does not have any direct contribution yet they are playing vital role in enabling and promoting the other policy actions for climate resilient Iskandar Malaysia.

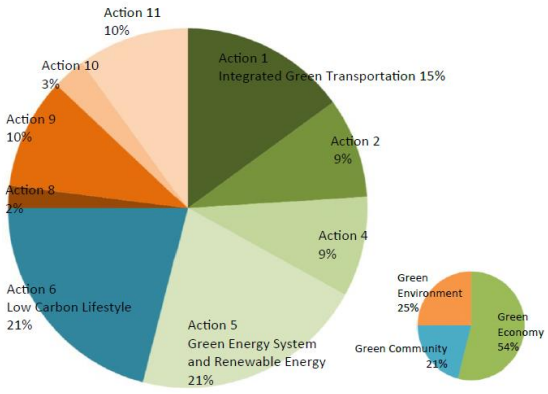



Figure 1.3: 3 main themes and 12 mitigation options for low carbon Iskandar Malaysia.

Table 1.1: Carbon reduction contribution of 12 mitigation options for low carbon Iskandar Malaysia.

| Mitigation Options | Reduction ($ktCO_2eq$) | Percentage (%) |
|---|---|---|
| Green Economy | 6,937 | 54% |
| Action 1 Integrated Green Transportation | 1,916 | 15% |
| Action 2 Green Industry | 1,094 | 9% |
| Action 3 Low Carbon Urban Governance** | - | - |
| Action 4 Green Building and Construction | 1,203 | 9% |
| Action 5 Green Energy System and Renewable Energy | 2,725 | 21% |
| Green Community | 2,727 | 21% |
| Action 6 Low Carbon Lifestyle | 2,727 | 21% |
| Action 7 Community Engagement and Consensus Building** | - | - |
| Green Environment | 3,094 | 25% |
| Action 8 Walkable, Safe and Livable City Design | 263 | 2% |
| Action 9 Smart Urban Growth | 1,214 | 10% |
| Action 10 Green and Blue Infrastructure and Rural Resources | 392 | 3% |
| Action 11 Sustainable Waste Management | 1,224 | 10% |
| Action 12 Clean Air Environment** | - | - |
| Total | 12,758** | 100% |

*Contribution to GHG emission reduction from 2025BaU to 2025CM ** Action 3, 7 and 12 does not have direct emission reduction, but their effect is included in other Actions. *** Since contribution of Action 10 includes carbon sink by forest conservation and urban tree planting, the total of contribution of the 12 Actions is greater than difference of the GHG emissions between 2025BaU and 2025CM.

## The Formulation of Low Carbon Society Blueprint for Iskandar Malaysia 2025

The Blueprint is developed from the unique 'academic-policymaker' partnership, which is rather uncommon. It involves the joint efforts between four (4) research institutions from Malaysia (Unversiti Teknologi Malaysia UTM) and Japan (Kyoto University KU, National Institute for Environmental Studies NIES, and Okayama University OU) and distinctively a regional development authority (Iskandar Regional Development Authority IRDA) that is charged with the duty of coordinating and enabling development in Iskandar Malaysia. The Blueprint is formulated based on scientific evidences with improved policymaker adoption, public acceptance at large, realistic and eventual implementation. Scientifically based and institutional-context sensitive are the important dimension for effective sustainable development policies. The holistic and integrated features of the Blueprint are shaped by the six interconnected multi-disciplinary expert groups from both Malaysia and Japanese counterparts and IRDA officials.

The overall process (Figure 1.4) begins with the usual information gathering, analysis and contextual appraisal of current development, carbon emission and policy scenarios in Iskandar Malaysia. This informs the setting of IM's LCS goals and carbon emission reduction target in 2025. These then feed into an iterative process of formulating policy actions, measures and programs, and testing them via AIM against the achievement of set goals and targets. Stakeholder participation is also built into the process at this stage through a series of Focus Group Discussions (FGDs) where proposed actions, measures and programs are scrutinized and stakeholders opinions are gathered and fed back into the policy formulation process.

A total of five rounds (nine sessions) of FGDs were organised between August 2011 and November 2012 until the final draft of the Blueprint was ready for consideration for approval by the State Planning Committee (SPC) and subsequent mainstreaming into the existing development planning framework for implementation.

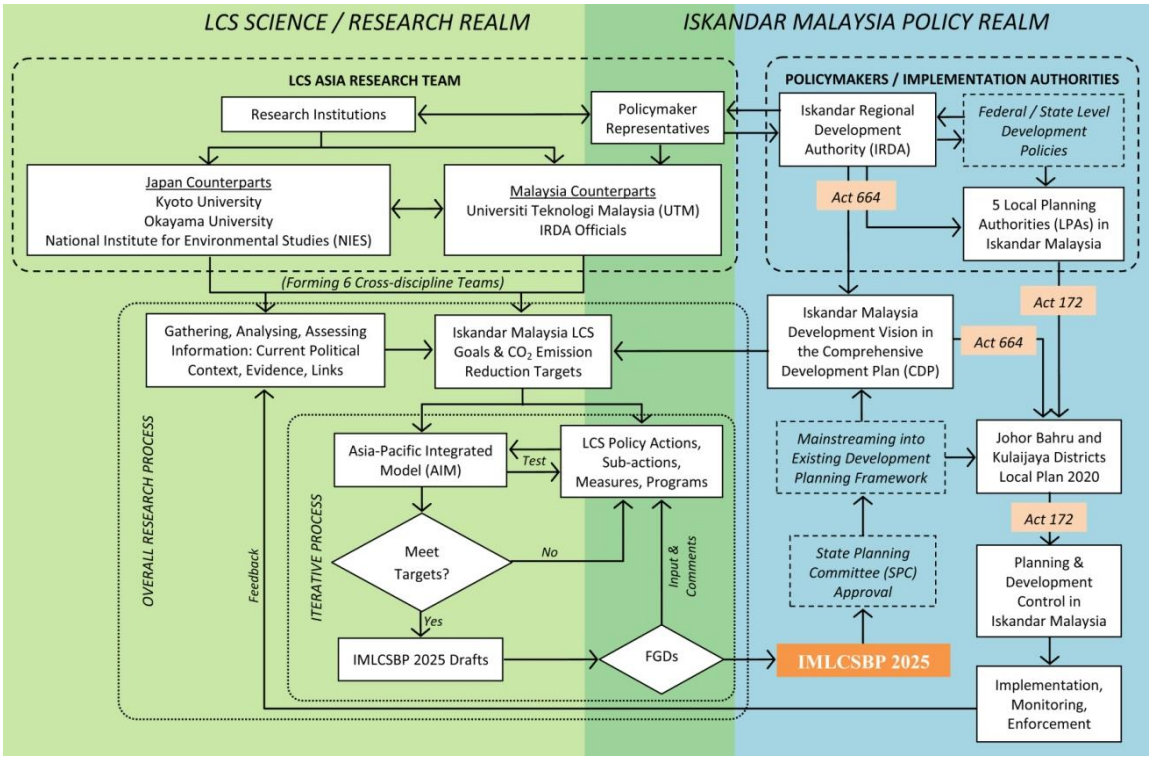



Figure 1.4: The 'science/research – policymaking model that emerged from the formulation of the Low Carbon Society Blueprint for Iskandar Malaysia 2025 and mainstreaming of the Blueprint into the existing development planning institutional framework.

## The Framework of Low Carbon Society Blueprint for Iskandar Malaysia 2025

The blueprint provides a sustainable green growth roadmap with 12 policy actions to move Iskandar Malaysia towards achieving its vision of a 'strong, sustainable metropolis of international standing' by 2025. The integration of two competing goals – 'strong' and 'sustainable' – in a single development vision poses great challenges to IM's growth policies and development planning. On one hand, the urban region needs to develop a prosperous, resilient, robust and globally competitive *economy* (the 'strong' dimension); on the other (the 'sustainability' dimension), it needs to nurture a healthy and knowledgeable *society* that subscribes to low carbon living and at the same time develop a total urban-regional *environment* that enables rapid economic growth but reduces growth's energy demand and carbon emission intensity. This calls for a holistic and integrated approach, involving policies and strategies on *Green Economy*, *Green Community* and *Green Environment*, to decouple rapid growth from carbon emission in IM. Meeting this challenge has been the primary goal and underlying philosophy of the IMLCSBP 2025. Essentially, the Blueprint comprises two principal components:

i) Narrative on growth scenarios, policies, measures and programs to achieve a minimum targeted 50% reduction in carbon emission intensity by 2025 based on the 2005 level. Under the first component, 12 LCS Actions have been identified under the three themes of Green Economy, Green Community and Green Environment. For details of the 12 policy actions, sub-actions, measures and programs (totalling over 400 policy items), readers are referred to the next 12 sections respectively. The Blueprint is comprises of three main parts according to three themes of Green Economy, Green Community and Green Environment. Each part contains several sections that are specifically formulated to the LCS policy actions correspondingly. To provide an effective framework, every section adopts the 'work breakdown structure' (WBS) approach that collapses each of the 12 actions into sub-actions and, in turn, into measures and detailed programs (Figure 1.5).

ii) Scenario-based modelling and projection of carbon emission reductions achievable. Under the second component, a 56% reduction in carbon emission intensity, from 294.12 $tCO_2eq$/MYR1mil in 2005 to 129.42 $tCO_2eq$/MYR1mil in 2025, has been projected.

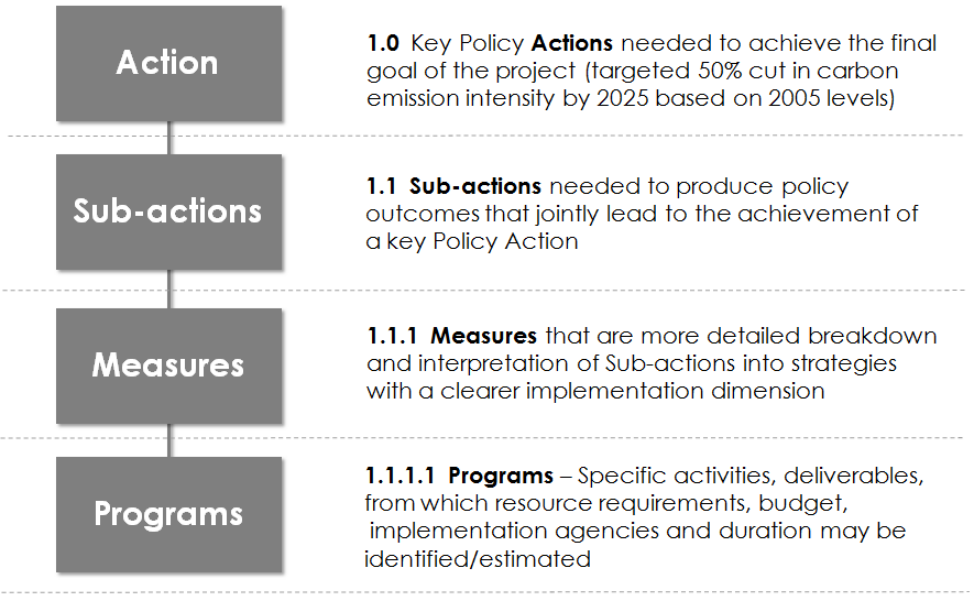



Figure 1.5: Work breakdown structure of Iskandar Malaysia's 12 LCS Actions

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Part I

# Green Economy

**Action 1**
Integrated Green Transportation

**Action 2**
Green Industry

**Action 3**
Low Carbon Urban Governance

**Action 4**
Green Building and Construction

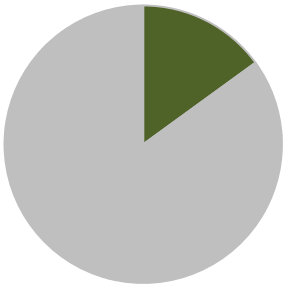
**Action 5**
Green Energy System and Renewable Energy

Action 1

# Integrated Green Transportation

Muhammad Zaly Shah Muhammad Hussein, Gakuji Kurata, Gobi Krishna Sinniah and Nurain Mohd Sith

**GHGs Emission Reduction**



1,916 $ktCO_2eq$

15%

With the targeted strong growth in the economy and population in Iskandar Malaysia, rapid growth in intra- and inter-regional freight and passenger transportation demand is inevitable. If left unchecked, growth in the transportation sector is expected to add to Iskandar Malaysia's carbon emission by 8,584 $ktCO_2$ (27% of total BaU emission) by 2025. In order to mitigate the carbon emission level of the projected increased transportation demand, development of an integrated green transportation system in Iskandar Malaysia is highly essential. This calls for a four-prong strategy of: (1) promoting a shift to more energy efficient passenger and freight transportation modes; (2) enhancing Iskandar Malaysia's intercity connectivity through energy efficient high-speed rail; (3) promoting energy efficiency improvement (EEI) in motorised vehicles; and (4) improving flow and performance conditions in both the passenger and freight transport sectors. Implementation of the relevant sub-actions and measures below is projected to reduce carbon emission in Iskandar Malaysia by 1,916 $ktCO_2eq$ (15% of total emission reduction) in 2025.

## 1.0 Integrated Green Transportation

Under the 10th Malaysian Plan 2011-2015, the Malaysian government has outlined a key national agenda to improve the quality of life of its citizens. The provision of good public transportation, especially in urban areas, is among the initiatives identified by this agenda. Along with this agenda, the Integrated Green Transportation will play a major role in improving the quality of life and achieving a low carbon society in Iskandar Malaysia. The increase in vehicle ownership rate is directly proportional to the increasing number of vehicles on the road, which in turn results in high carbon emissions. Unregulated public transportation services represent a challenge that needs to be overcome as their inefficiencies may lead to continuing dependency on private cars. Therefore, optimization of mobility and accessibility through sustainable transportation systems is needed in order to increase mode shares in public transport.

At present, auto-ownership is expected to grow from 500 cars per 1000 people in the population to more than 800 per 1000 by 2025. Consequently, the public transport mode split is predicted to decline from 15% to 10% by 2030 if nothing is done. This is a challenge to be overcome but it still can be prevented because mode choices in urban areas are not static processes. Mode choice is influenced by several factors, including socio-economic, space, travel, network, behaviour, and so forth. As stated in Iskandar Malaysia's Transportation blueprint (IRDA, 2011), in order to achieve low carbon communities Iskandar Malaysia will need to increase the public transport mode split to 50% by 2030.

Unfortunately, it is impossible to remove motorized vehicles on the road and force commuters to use public transportation. A 2005 survey showed that cars represent 60% of total transportation modes, followed by bus (10%), train (0%) and motorbike (21%). This indicates a very low level of support for the use of public transport. In order for the current modal split to improve, Iskandar Malaysia must increase the adoption of public transportation as the main commuting mode. The use of cars and motorbikes should be reduced to 25% and 10%, respectively. Simultaneously, the use of buses should be increased to 28% and the use of trains up to 28%. These changes will bring Energy Efficiency Improvement (EEI) in motorized vehicles to the forefront as a strategy to reduce carbon emissions in Iskandar Malaysia.

### 1.1 Integrated Public Transportation

The National Physical Plan (NPP) (2005) has underlined the importance of proposing an integrated public transport system for major urban centres as mentioned in NPP 28. In general, integration implies the opportunity to use the entire public transport system across a local or regional area independent of transport modes, tariffs, fares, schedules, tickets and other systems. Integrated public transport systems tend to meet the needs of customers, which ultimately results in the increase of ridership. The integrated public transport system can overcome the problems and inconveniences to customers and authorities that current public transport systems pose. Preferably, only one ticket is needed for a single-trip ride. The customer will also receive transparent tariff systems. Integrated public transport systems improve travel time because the timetables and connections between operators are harmonized.

On the other hand, a non-integrated system will increase competition between the operators and will influence travel costs. Hence, an integrated public transport with seamless transfers between transport modes will encourage people to use public transport as well as increase the efficiency of the services. This is strongly suggested in National Urbanisation Policy (NUP) and in the Johor Bahru Conurbation Transformation Plan, which explained the importance of proposing an integrated, efficient and user-friendly public transportation system.

Figure 1.1: Integrated Public Transportation between LRT and bus in Kuala Lumpur (Source:en.wikipedia.org/wiki/Public_transport_in_Kuala _Lumpur: Sept 2012).

### 1.1.1 Public Transport System Improvement

**I. Route network expansion planning (improve network coverage and connectivity)**

The development of integrated public transport relies on overall system improvement to make it successful. However, the IRDA Transportation Blueprint (IRDA, 2011) identified one of the major issues as a lack of network coverage. Therefore, the improvement of network coverage and connectivity through route network planning and expansion will encourage people—especially commuters from urban fringe areas—to use public transport.

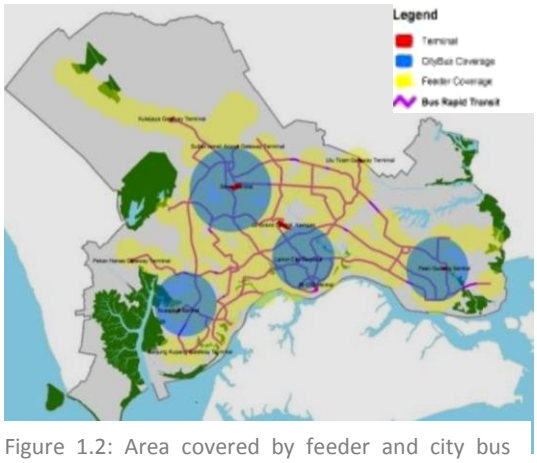



Figure 1.2: Area covered by feeder and city bus network
(Source: Comprehensive development plan (CDP) Review for Iskandar Malaysia)

**II. Increase bus frequency, improve punctuality and reliability**

Parallel to the implementation of an integrated public transport system is an improvement in service quality. This will be accomplished by increasing service frequency and improving the punctuality and reliability of the public transport modes. The upgrading of the bus service system to a more reliable, punctual and frequent service can encourage people to change their modes of travel from private vehicles to buses. When this takes place, such as a significant shift in the mode split towards public buses will result in a significant reduction of carbon emissions.

| Attribute | Factor | |
|---|---|---|
| | 1 | 2 |
| Frequency | | 0.806 |
| Price | | 0.619 |
| Punctuality | | 0.597 |
| Travel Time | | 0.596 |
| On board security | 0.819 | |
| Bus comfort | 0.810 | |
| Staff Behavior | 0.734 | |
| Safe from accident | 0.720 | |
| Info bus stop | 0.717 | |
| Bus stop condition | 0.683 | |
| Cleanliness | 0.629 | |
| Bus stop security | 0.625 | |
| Information | 0.509 | |
| Seat availability | 0.473 | |

Table 1.1: Integrated Public Transportation between LRT and bus in Kuala Lumpur (Source:en.wikipedia.org/wiki/Public_transport_in_Kuala_ Lumpur: Sept 2012).

**III. Real time arrival information**

Like the integration of public buses, real time arrival information also benefits passengers with respect to improved public transport availability and usability. The most prevalent medium used for the distribution of real-time bus arrival information is the electronic sign, also known as the dynamic message sign (DMS), located at bus stations and bus stops.

Generally, the following types of information displayed on electronic signs are the most appropriate:

- Current time and date
- Route number and final destination of vehicle
- Waiting time, either in countdown format or time range
- Service disruptions or other important service messages


Figure 1.3: Example of real time arrival information Terminal Bersepadu Selatan
(Source: www.tbsbts.com.my: May 2013

## IV. Public transport reimaging

The reimaging and rebranding of public transport helps to enhance positive perceptions towards the use of public transport. Reimaging of public transport can be implemented through initiatives such as Bus Rapid Transit system. This reimaging requires some infrastructural changes; these include dedicated public transport lanes, a greater number of stations, and public transport nodes for the feeder systems.

Figure 1.4 is one of the examples of the BRT systems in Paris, France. Current public transport systems should be upgraded with new equipment. In addition, having marketing programs to encourage public transport use is mandatory if knowledge of the benefits of using public transport is to be disseminated. These marketing programs can be further enhanced to highlight the role of public transport in reducing carbon emissions.

Figure 1.4: BRT systems in Paris, France (Source: http://www.streetsblog.org : Sept 2012)

## V. Flat rate tickets and central area free shuttle services

Some cities, like Yate, Canada, have a flat rate per journey policy that has successfully improved the adoption of public transport among the citizens. This policy makes taking a bus within town cheaper and simpler. People will be able to get on the bus knowing exactly how much it will cost them. In the Central Area free shuttle services would provide the best option for attracting more public transport passengers within the town area. The end result will be a city centre with less congestion and pollution which nevertheless provides high mobility. All of these factors will translate into a healthier and cleaner living environment.

## VI. Web-based journey planner

In the highly-integrated public transport system envisioned for Iskandar Malaysia (IRDA, 2011), a web-based journey planner is an important pre-requisite. The web-based journey planner provides important information to the users of public transportation. Ideally, the journey planner application should, at a minimum, provide the following information and functionalities:

- schedule viewing
- bookmarking for favourite schedules
- public transport departure information
- arrival alerts for final destination

- text-to-speech functionality


Figure 1.5: Example of web-based journey planner (Source: http://www.basecreativeagency.com: Sept 2012

### 1.1.2 Introduce Rail-Based And Water-Based Public Transport

Introducing rail-based and water-based public transportation provides more options for people to travel, especially in areas that have limited access to other modes. The efficiency of rail-based and water-based public transport varies greatly but, on average, they have the potential to emit less greenhouse gases per passenger and freight vehicles in the Iskandar Malaysia Region than other motorized modes. Currently Iskandar's rail based system only focuses on the present KTM rail but in the future the implementation of the LRT system will take into consideration other modes of public transport in order to improve the mobility of passengers in the entire Iskandar Malaysia region.

To ensure that rail-based and water-based public transport services will be easily accessible and well-functioning, the following are to be introduced and improved:

**I. Route network planning**

Under Core 3 (Integrated and Efficient Urban Transport System), the National Urbanisation Policy has suggested a more comprehensive road network to improve accessibility and mobility. Indeed, to ensure that the rail and water-based public transportation will be easily accesible and well-functioning in the Iskandar Malaysia Region, route network planning should be implemented to complement other modes of transport. For example, ports and rail stations need to be linked to other modes of transport, including seaports, waterways, inland container depots and major highways inside and outside the Iskandar Malaysia region.

**II. Connectivity and integration with existing public transport modes**

Rail-based and water-based public transport services are yet to be fully developed and are not properly integrated with the predominant road-based services. There is a need to integrate the various transport modes (road, rail, water, and air) and connections must exist between the ports, the rails, the inland waterways, the airports, and the roads.

Figure 1.6: Water-based public trip in Kuching, Sarawak (Source: Rosiella, 2012)

Figure 1.7: Rail-based public transportation in Kuala Lumpur
(Source: mynewshub.my: May 2013)

### 1.1.3 Efficient And Seamless Inter-Modal Transfer (Interchange) Facilities

**I. Integrated ticketing system (across all platforms)**

Integrated ticketing is made possible by using electronic ticketing technologies such as magnetic stripe cards or smart cards. It provides convenient cash-less trips, which improves the riding experience of public transport users. By

making it hassle-free for users to pay for services, public transport will become a serious contender for favoured commuting mode versus private vehicles. When users shift their commuting mode to public transport, reductions in carbon emissions would result.


Figure 1.8: Cashless ticket system for travelling between LRT, monorail networks in Kuala Lumpur will enhance the use of public transportation (Source: http://www.nst.com.my : Sept 2012)

## II. Public transport interchanges as destinations and urban activity nodes

Public transport interchanges provide a place for transfers between motorized and non-motorized transport modes, such as cycling and walking. They should preferably be located near major activities, employment nodes and higher residential areas and integrate into one another in order to increase public transport use and enable easy and convenient passenger transfer between bus, rail and taxi services. Some design principles for creating public transport interchanges which utilize them as destinations and urban activity nodes follows:

- Providing additional services in interchange zones (e.g. shopping facilities). This might even create opportunities for side businesses and generate extra revenues for public transport operators (e.g. renting the premises to shopkeepers)
- Providing consistent and readable signage and information for the orientation of passengers in the public transport system.
- Integrating transit stops and interchanges into the design and layout of the activity centre.
- Providing passenger and operator facilities and security and safety installations such as queue railing, toilets, seating facilities, ticket machines, public telephones, fire-fighting equipment, CCTVs, regulators' offices, etc.

Figure 1.9: Public transportation interchanges in JB Sentral (Source: http://www.nst.com.my : Sept 2012)

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## III. Park and Ride facilities in suburban transit nodes

To encourage the use of public transport in the Iskandar Malaysia region, park and ride schemes and facilities must be provided in the vicinity of public transportation interchanges or in suburban areas. The accessibility of interchange zones and the linkages between modes of transportation should also be improved in order to successfully implement park and ride schemes. Some measures related to building infrastructure for Park and Ride facilities include:

- Park and Ride - the installation of car park facilities with integrated tickets for parking and the use of public transport.

- Bike & Ride - the installation of bicycle stands at stops and bicycle stations at central public transport stations.
- Ride & Walk - luggage lockers at central public transport stations and marketplaces.

Figure 1.10: Example of Park and Ride facility in Penang
(Source: http://penangmonthly.com (Sept 2012)

## 1.2 The Improvement Of Singapore And Johor Bahru-Kuala Lumpur Connectivity

Improving connectivity between JB (Johor Bahru) and Singapore is critical to achieving integrated green passenger transport. Urban integration between JB, Singapore, and KL (Kuala Lumpur) is vital because a large volume of people pass among those cities. Historically, socially, and culturally, the cities are close and share economic advantages. These factors strongly support the cause for Intercity High speed Rail Transit and Mass Rapid Transit.

### 1.2.1 Intercity High-Speed Rail Transit (HSRT)

#### I. Integration of Singapore MRT (SMRT) system with Iskandar Malaysia Light Rail Transit (IMLRT) and bus systems

Intercity High-Speed Rail Transit (HSRT) is introduced with an emphasis on connecting communities and economic centres across the country. Integration of the Singapore MRT (SMRT) system with the Iskandar Malaysia Light Rail Transit (IMLRT) and bus systems will increase the connectivity between JB and Singapore. Business and frequent travellers can avoid cross-border congestion on the causeway with the proposed Rail Transit System (RTS) that will link Johor Bahru to Singapore. Cross-border commuters will have the choice of direct bus services between Iskandar Malaysia flagships and other destinations within the Peninsular. A planned High Speed Rail service will link Johor Bahru to Kuala Lumpur and other important destinations in Peninsular Malaysia.

There are three (3) key objectives of the investment in High-Speed Rail Transit:

1. Building new high-speed rail corridors that fundamentally improve passenger transportation in certain geographic regions;

2. Upgrading existing intercity passenger rail corridors to improve the reliability, speed, and frequency of existing services

3. Laying the groundwork for future high-speed rail services by means of corridor and state planning efforts.

Figure 1.11: Introduction of high-speed trains will result in rapid development of surrounding areas
(Source: http://travel.malaysia.msn.com: Sept 2012)

#### II. Johor Bahru Sentral as HSRT-SMRT-IMLRT Hub

In line with Iskandar Malaysia's Transportation Blueprint (IRDA, 2011), JB Sentral will be positioned as an integrated transportation hub which will provide international and domestic train services. It is connected to the Sultan Iskandar Customs, Immigration, and Quarantine (CIQ) Complex. Consistent with its function as a focal point of people exchange between Malaysia and Singapore, it will fundamentally improve passenger transportation between the regions by designating JB Sentral as HSRT-SMRT-IMLRT hub.

JB Sentral, which has a gross floor area of 89,417 sq-metres, will ease the movement of traffic in the city's commercial centre and act as

a main stop-over for people commuting between Malaysia and Singapore. JB Sentral offers city railway facilities and 6 platforms with a 25,000 persons per day capacity. It also houses taxi stands with coupon counters and a public bus bay area, thus providing ample public transportation facilities.

Figure 1.12: JB Sentral's railway station and public transit station
(Source: http://www.skyscrapercity.com :Sept 2012)

## 1.3 Diffusion of Low Carbon Vehicles

The increase of greenhouse gas emissions from transport creates an incentive to consider the relationship between the process of technological innovation and diffusion of low carbon vehicles. There are many improved technologies introduced recently in today's vehicles that do not change their basic types, general sizes, or performance.

One of the most popular low carbon vehicles used today is the hybrid vehicle. Most of these low carbon vehicles have low gasoline consumption of more than 20-30 km per litre. In addition, the energy efficiency of these low-carbon cars based on BAT (best available technology) is assumed to be only 40% in 2025.

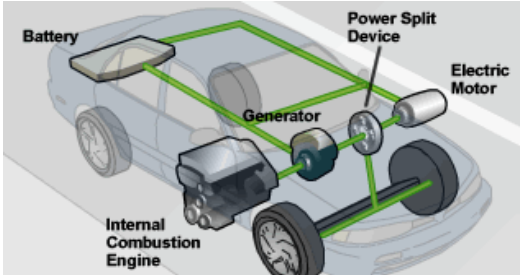


Figure 1.13: Components of Hybrid Car
(Source: http://www.fueleconomy.gov : Sept 2012)

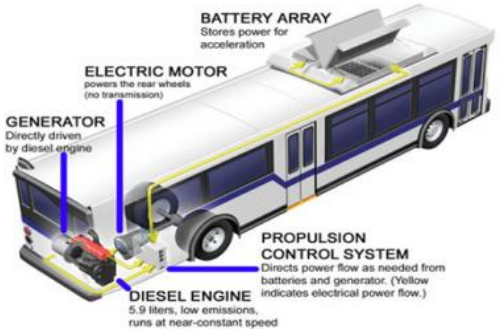


Figure 1.14: Components of Hybrid Bus
(Source: http://www.autoblog.com : Sept 2012)

### 1.3.1 Promoting the Use of Low Carbon Vehicles

**I. Government agencies to use hybrid vehicles/electric vehicles**

The Low Carbon Cities Framework and Assessment System (KeTTHA, 2007) promotes the use of low carbon vehicles and helps to reduce carbon emissions from the transport sector. Hybrid-electric vehicles (HEVs) combine the benefits of gasoline engines and electric motors and can be configured to prioritize different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools. Government agencies are encouraged to use hybrid vehicles or electric vehicles in their fleet and to provide funding or reduce taxes for hybrid vehicle purchases. All these strategies will display green/low carbon leadership and encourage more people to use non-petrol or diesel vehicles in order to reduce carbon emissions.

**II. Tax reduction for hybrid vehicle purchase**

To succeed in promoting the use of low carbon vehicles, related taxes must be reduced for any hybrid vehicle purchases. Based on the figures for Budget 2012, full exemption of import duty and excise duty will be applied only to completely built-up (CBU) hybrid cars and motorcycles. This exemption should be extended to cars, motorcycles, and all hybrid vehicle purchases, including purchases of hybrid buses. Aside from tax exemptions, providing

funding for the research and development (R&D) of Malaysian hybrid vehicles can create incentive for hybrid car purchases.

**III. Gradual phasing out of diesel engine buses**

All diesel engine buses currently operational in Iskandar Malaysia must be gradually phased out as they do not contribute to either a healthier living environment or lower carbon production. As an alternative, Iskandar Malaysia should gradually replace diesel engine buses with buses that run on compressed natural gas. Compressed natural gas is a gaseous fuel that is cheaper , cleaner, and more efficienct than diesel.

**IV. Subsidy for the purchase of hybrid buses**

Hybrid buses are the latest innovations in bus technology, touted as the biggest solution to the heavy diesel and carbon emissions of the existing bus system. The current hybrid vehicles are very expensive. Therefore, a subsidy for the purchase of hybrid buses is recommended to support the promotion of low carbon vehicles and to help the operators reduce their bus maintenance expenses.

## 1.4 Enhancing Traffic Flow Conditions and Performance

Traffic flow consists of the interactions among vehicles, drivers, and infrastructure (including highways, signage, and traffic control devices), with the aim of developing an optimal road network with efficient movement in traffic and minimal traffic congestion. Currently Transportation Demand Management (TDM) is tasked with enhancing traffic flow conditions and performance.

### 1.4.1 Transportation Demand Management (TDM)

**I. Intelligent Transportation System (ITS)**

While many believe that improving a transportation system solely involves building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel but increasingly in IT. ITS applications can be grouped in five broad categories:

- Advanced Traveller Information Systems provide drivers with real-time information and information about delays.
- Advanced Transportation Management Systems include traffic control devices.
- ITS-Enabled Transportation Pricing Systems include systems such as electronic toll collection (ETC), congestion pricing, fee-based express (HOT) lanes, and vehicle miles travelled (VMT) usage-based fee systems.
- Advanced Public Transportation Systems allow trains and buses to report their positions so that passengers can be informed of their real-time status (arrival and departure information).
- Fully integrated intelligent transportation systems, such as vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) systems enable communication among assets in the wider transportation system.

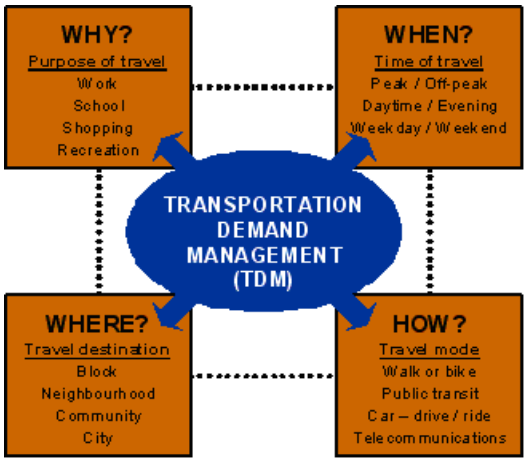


Figure 1.15: Concept of TDM
(Source: http://www.tc.gc.ca/eng/menu.htm: Sept 2012)

**II. Enhancing traffic signal performance**

Enhancing traffic signal efficiency has proven to be an extremely cost-effective way to optimize existing roadway capacity. Common improvements include the installation of computerized traffic signal systems, upgrading the operation of individual traffic signals, and implementing synchronized signal timing.

An important factor in achieving traffic signal efficiency is having access to current traffic flow data to generate effective 24-hour signal timing parameters. To achieve volume and accuracy in data collection, traffic signal design specifications should be modified in the following key areas:

- The size, shape and location of vehicle detector loops
- Controller and cabinet components
- Design drawings and documentation

**III. Enhancing the use of Variable Message Sign (VMS)**

Variable message signs (see Figure 1.7) are the safest means of notifying motorists of changes in traffic patterns and road conditions. This can help traffic users in Iskandar Malaysia make an alternate choice if there are any changes in traffic patterns and road conditions.


Figure 1.16: VMS help to notify traffic. Source: http://www.itsinternational.com: Sept 2012)

**IV. Tidal flow and contra-flow along primary radial routes**

Typically, traffic signals are meant to improve traffic flow during rush hours. Overhead traffic lights and lighted street signs will notify drivers of which lanes are open or closed and of which way to turn. These traffic signals can be applied to major roads, particularly the most congested ones, in Iskandar Malaysia.

**V. Increase in parking charges**

By increasing parking charges, especially in the urban centre of Iskandar Malaysia, a reduction in the use of private vehicles will result. If it is difficult or expensive to park a car, particularly for regular trips such as commuting to work, people will be more willing to consider alternatives. Whether it is for on- or off-street, public or private parking, drivers should pay at least the full market cost of parking because this acts as a disincentive. There are no valid reasons for governments or businesses to subsidise parking and governments can use the resulting revenues for other transport improvements.

## 1.5. Green Transportation in Rural Areas

The most desired future for the Iskandar Malaysia region is a sustainable environment, which only can be gained through environmentally protective measures. Green transportation and development are means of realizing this goal (IRDA, 2011). Green transportation, which encompasses the use of public transportation, can refer to any means of transport with a low impact on the enviroment.


Figure 1.17: Green Transportation Hierarchies (Source: IRDA, 2011)

### 1.5.1 Improving Public Transport Services and Use in Rural Areas

In rural areas, many communities are served with public transport. The improvement of public transport services and use in rural areas improves social and economic connections in those regions. Daily ridership will be expected to increase with the improvement of facilities and infrastructure in rural areas.

**I. Provision of hybrid bus services from rural areas to urban areas**

Buses use a lot of fuel due to their size and constant operation. The exhaust gas emitted by internal combustion in bus engines makes the city environment unpleasant. In the effort to achieve low carbon emissions, it is necessary to provide hybrid bus services from rural areas to urban areas. It is vital to ensure that public transportation services in rural areas in Iskandar Malaysia also support the green transportation concept. This will encourage people from rural areas to commute by using green public transportation.

**II. Provision of school bus services for students in rural areas**

This initiative includes school bus services for students in rural areas because school buses also contribute to high carbon emissions and often circulate near housing areas. The use of school bus services can also reduce the dependency on cars for journeys to and from schools and can help create a lifestyle of using alternative transport, thereby reducing traffic congestion and carbon emissions.

**III. Subsidies for hybrid bus services in rural areas**

It is recommended that hybrid bus services in rural areas should be subsidised to help alleviate the costs of purchasing, maintanence, and so forth. This approach will encourage rural areas to participate in using green transport. Communities in rural areas will indirectly be influenced to change their way of life through the use of green transportation and will be educated on the importance of reducing carbon emissions.

## 1.6. Green Freight Transportation

Government policies should focus on freight transport as much as it focuses on private vehicles and public transport. Whether it is the introduction of cleaner fuels, fuel economy standards, tax incentives, or investments in infrastructure to improve transport, the freight sector is still behind in each of these areas. Some of improvements to freight transport are suggested below:

### 1.6.1 Modal Shift to Greener Freight Transport Modes

A shift to greener freight transport modes should be considered in Iskandar Malaysia. Most of the freight is transported by trucks or lorries, and very few activities are carried out by rail. Based on Malaysian national statistics in 2005, the share of freight transport is 99:1 between trucks and rail. To further improve this modal split, the use of trains should be increased to 5% by 2025, and the use of trucks or lorries to decrease to 95%. Geographical convenience might explain the refusal of business operators to use rail transport.

**I. Modal shift from road-based to rail-based freight transport**

The main disadvantage of rail freight is its lack of flexibility. However, because of the environmental benefits that rail would bring due to its energy-efficiency, the government should encourage more freight business to shift from road to rail transport. For this purpose, integrated railway stations can be implemented so that factories have direct rail access. This means that goods that were shipped through a goods station would be sent by train and unloaded at another goods station for onward delivery to another factory.

**II. Modal shift to ship-freight transport**

Ship transport can be used at any distance over oceans and canals or along rivers. Virtually any materials can be moved using ship transport. However, one weakness is that water transport becomes impractical when the material delivery is highly time-critical. Ship transport can be an alternative for road transport activities when protection of the environment is taken into account. Ship transport should be integrated with rail transport so that goods can be transported to factories at a goods station.

Figure 1.18 Example of ship transport (Source:http://www.seasonmarine.com/services/ffmalaysia.html: Sept 2012).

Figure 1.19 Example of rail transport (Source:http://www.greenlogistics.org/themesandoutputs/wm7/index.htm : May 2013).

The use of green or hybrid freight vehicles helps to reduce carbon emissions from the transport sector. Hybrid-electric vehicles (HEVs) combine the benefits of gasoline engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power. The use of hybrid vehicles is expected to reduce about 40% of CM by 2025 based on BAT.

### 1.6.2 Promote Green/Hybrid Freight Transport

#### I. Tax incentives for freight operators in the acquisition of hybrid freight transport

To be successful in the promotion of green or hybrid freight vehicles, tax incentives should be given to freight operators. To date, the Malaysian government only emphasizes tax incentives given to hybrid car buyers. In order to implement this idea further, the government should consider reducing taxes for any green freight transport purchased by operators. Furthermore, 100% import duty exemptions can also be considered for purchasing hybrid or electric cars.

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Action 2

# Green Industry

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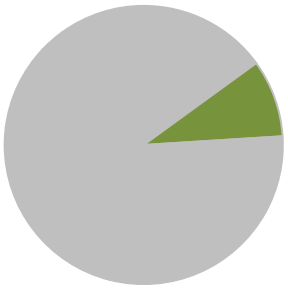
**GHGs Emission Reduction**



1,094 $ktCO_2eq$

9%

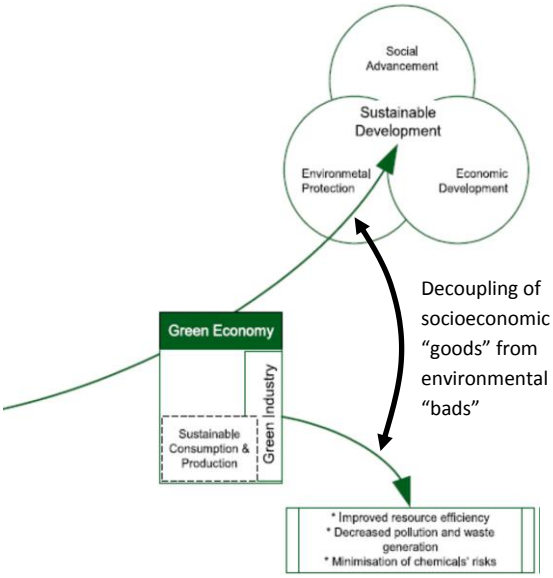
As nations and cities around the world increasingly commit themselves to tackling global climate change, it is expected that there will be a steady surge in demand for green industrial products that are more energy efficient (EE); renewable energy (RE) sources and alternative fuels that are zero-carbon or have low-carbon intensity; and environmental analytical and advisory services that seek to help services continuously monitor, maintain and/or improve their energy and resource efficiency. Such industries' goods or services can reduce GHG emissions of its customers or the society in general, and named "Green Industry" in this blue print. Four main strategies can be introduce for the promotion of green industry: (1) IM as global hub for green industry, (2) decarbonising industries, (3) green employment in existing industries and (4) human capital development in green industry. Implementation of measures and programs under these strategies is projected to reduce carbon emission in Iskandar Malaysia by 1,094 $ktCO_2$ equivalent (9% of total emission reduction) in 2025.

## 2.0 Green Industry

In line with the Iskandar Malaysia vision of becoming "a strong sustainable metropolis of international standing" by 2025, the progression towards a low carbon society must ensure that carbon reduction (sustainable) targets are met without compromising the economic (strong) growth of the region. The industrial sector is expected to remain the key driver of growth in Iskandar Malaysia, but it has also been the main contributor of carbon emissions in the region. Therefore, it makes strategic sense to venture into new types of green high-economic value industries whose growth has high potential to be decoupled from carbon emissions. In other words, rapid industrial growth, which is fundamental to income and job creation, is to be achieved in Iskandar Malaysia without the relative increase in carbon emissions that would be normally expected (see UNIDO, 2011a).

As nations and cities around the world increasingly commit themselves to tackling global climate change, there is expected to be a steady surge in demand for green industrial products that are more energy efficient (EE); for renewable energy (RE) sources and alternative fuels that are zero-carbon or have low-carbon intensity; and for environmental analytical and advisory services that seek to help firms and households continuously monitor, maintain and improve their energy and resource efficiency. Industries that provide such green products and services will become increasingly important to rapidly growing urban regions by helping to reduce the environmental and social impacts of their economic activities. In essence, 'green industry' will become an indispensable component of sustainable growth and the green economy (see Figure 2.1).

It is also anticipated that more and more industries that are not directly related to providing green products and services will seek to infuse some "green" into their usual production and service processes as a matter of market and/or policy necessity. As "green awareness" among consumers rises and




*Source: adapted from UNIDO, 2011b, p.6*

Figure 2.1: Green industry as a potential key pillar in sustainable growth

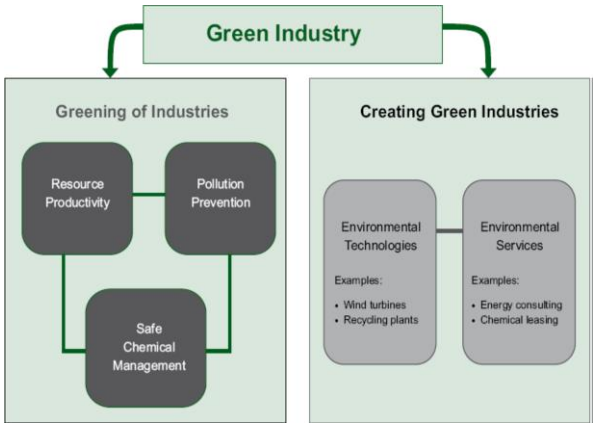
economic growth policies assume stronger ecological tones, industries will have to respond positively by improving resource efficiency and adopting cleaner production (CP) technologies in their production processes. These policies have also been found to be good for business in terms of operational cost savings and improved productivity (UNIDO, 2010a).

In accordance with the above observations, two kinds of 'green industry' are discernible in the context of sustainable development as identified by the United Nations Industrial Development Organisation (UNIDO, 2011a, 2011b). The first is industry with reduced environmental impact or, in the context of this Blueprint, industry with less GHG emissions. The second type is industry whose goods or services lead to a direct reduction in the GHG emissions of its customers or of society in general. The former involves measures and programs for the "greening of existing industries", or "decarbonising industries", while the latter concerns the "creation of new green industries" (Figure 2.2).

In the specific context of Action 2 in this Blueprint, "greening of industries" focuses mainly on the manufacturing and construction

sectors whereas "greening" of other sectors is considered in Action 1 (transport), Action 4 (the commercial sector, offices, and businesses), Action 5 (power supply) and Action 10 (agriculture). On the other hand, industries of the second type – 'green Industries' – have been given special focus due to their potential contribution to overall economic value and employment in IM (Iskandar Malaysia). Green industries are especially strategic to IM because they contribute to carbon emissions reduction through customers and society's use of the green goods and services they provide. They also have high economic value-add potential, which contributes to higher GDP and then further lowers the carbon emissions intensity of GDP.

This action on 'Green Industry' therefore aims to develop IM into a global hub for green industry, decarbonise existing industries, generate new green jobs, and develop the necessary underlying green human capital in IM.




*Source: UNIDO, 2011b, p.8*

Figure 2.2: UNIDO's two-pronged strategy for green industry

## 2.1 Iskandar Malaysia as global hub for green industry

At the global level, green industry has been given much attention, especially after the global financial crisis in 2008. As a strategy to recover from economic debt while reducing the environmental impacts of economic growth, the "Global Green New Deal" was proposed (UNEP, 2009) and many countries implemented their respective initiatives to promote green industries for employment ("green job") generation. Since then, green industry as a sector that supplies low-carbon goods and services has been growing in both developed and developing countries.

In Malaysia, since the promotion of "green economy" and "green technology" initiatives by the government in 2009, industries that aim at improving the environment have emerged, brought about substantial economic output, and contributed to employment. Under the initiative of Green Tech Malaysia, certified green industries have created more than 1,400 jobs in 2012 (Mohamed Azrin, 2012) and contributed RM67 billion of added value to the economy in 2011. The figures are predicted to rise to more than RM120 billion and 50,000 jobs by 2020, according to the Prime Minister's announcement in December 2012 (Borneo Post online, 2012). Hezri Adnan (2013) estimates that currently 2% of GDP in Malaysia is due to "green business" and this proportion will increase to 8% in 2020. To provide a point of comparison, in Japan's case more than 2 million people were employed in environmental industries (pollution control, climate change mitigation, waste management, effective resource use, and nature conservation) that accounted for 3.6% of total jobs in the country in 2012.

In the CDP Review (APUDG, 2013), GDP in IM is expected to grow at an average annual rate of 7.6% between 2013-2025, with 817,500 new jobs created over the same period. Therefore, promoting IM as a global hub for green industry presents great opportunity to contribute significantly to the creation of green jobs and GDP growth in IM. This is in line with the Hon. Prime Minister's call for "green industries to expand and innovate, not just because it is good for the environment, but because it is so plainly good for our economy" (NST Online, 12 October 2012).

The following industries are examples of typical sectors that fall under green industries which can be implemented in IM.

**Renewable energy (RE)**

- Biomass & biogas fuel production/power plant
- Solar cell and PV system manufacturing
- Wind turbine manufacturing.

**Energy efficiency improvement (EEI)**

- Energy efficient home/office appliances manufacturing
- Energy efficient industrial equipment manufacturing
- Energy efficient vehicle manufacturing
- Other energy saving device production
- Energy service companies (ESCOs).

**Smart technology**

- Smart technology devices manufacturing
- Smart control systems engineering
- Smart systems development and operation

**Spatial planning and construction**

- Smart urban growth and compact city design and development for a tropical climate
- Green buildings and green construction

Demand for such goods and services will rise even more in the next few decades as global efforts to mitigate climate change pick up speed and many countries declare their emissions reduction targets for 2020 and beyond. Since Iskandar Malaysia is the primary economic corridor in Malaysia, accumulating such industries is a highly sensible option for the region. Taking into consideration the geographic characteristics and advantages of IM, clusters of industries as shown in Table 2.1 are especially recommended as targeted green industries.

A crucial starting point for IRDA towards effectively developing IM into a global hub for green industries is to put in place a set of Green Economy Guidelines that provides investors with a clear guide to IM's strategic direction; priority sectors; policy frameworks; incentives; institutional requirements; approval processes and procedures; compliance, monitoring and reporting mechanisms, etc. with respect to investing in green industry in IM. The underlying philosophy of a green economy of "[creating] economic opportunities for a growing population while ensuring that economic growth and environmental and social responsibility work together in a mutually reinforcing fashion" (ICC, 2012, p.5) needs to permeate the guidelines in order to place the development of green industry on the appropriate track in the context of IM's sustainable growth vision. In particular, the pivotal position of green industry in IM's progression towards a green economy by 2025 needs to be clearly drawn out and to involve the following phases: green awareness, green infrastructure, green culture, green economy, and sustainable development.

Table 2.1: Potential strategic green industry sectors that have been identified for Iskandar Malaysia

| Potential Strategic GI Sectors | Malaysian Industrial Player | Foreign Investors |
|---|---|---|
| Nanotechnology | Nano Malaysia Bhd | To be identified |
| Bio-fuel | Sime Darby | |
| Biomass | Felda | |
| Smart Community | IBM Malaysia | |
| Electric Vehicles | Proton | |

### 2.1.1 Tax incentives and fiscal measures to attract green industries

Tax incentives and other fiscal measures that will boost the region's relative competitiveness and attractiveness to foreign firms and multi-national companies (MNCs) are essential tools that will attract particular industries to the region. In IM a large portion of investments in new green industries will likely be in the form of foreign direct investments (FDIs). Therefore, it is important that IRDA incentivises FDIs in green industries in IM by providing fixed-term tax exemptions, offering low interest loans, or implementing speedy approval processes that cut down set-up costs and expedite production operation.

In order to promote domestic investments in green industries, IRDA needs to encourage and facilitate qualified Malaysian owned companies that are involved in the production of green technology to invest in IM and apply for the Green Technology Financing Scheme (GTFS), which is backed by GreenTech Malaysia and the Credit Guarantee Corporation Malaysia Berhad (CGC) .

**I. Tax exemption for FDIs in green industry**

A clear framework needs to be laid out at the outset to delineate the terms of the types and quanta of tax exemptions (e.g. Pioneer Status, Investment Tax Allowance (ITA); see KeTTHA, 2009a), as well as their qualifying requirements and conditions with respect to new injections of FDIs in green industries in IM. This needs to build on existing operational frameworks that are already in place. IRDA needs to initiate a comprehensive inventory and analysis of existing FDI-related tax exemption schemes/packages and their underlying legal and institutional frameworks; this will facilitate the process of crafting effective and attractive green industry tax exemption packages tailored to IM's needs. Legislation that is directly relevant include the *Promotion of Investments Act 1986* (Act 327), *Income Tax Act 1967* (Act 53), *Customs Act 1967* (Act 235), *Sales Tax Act 1972* (Act 64), *Excise Act 1976* (Act 176), and *Free Zones Act 1990* (Act 438).

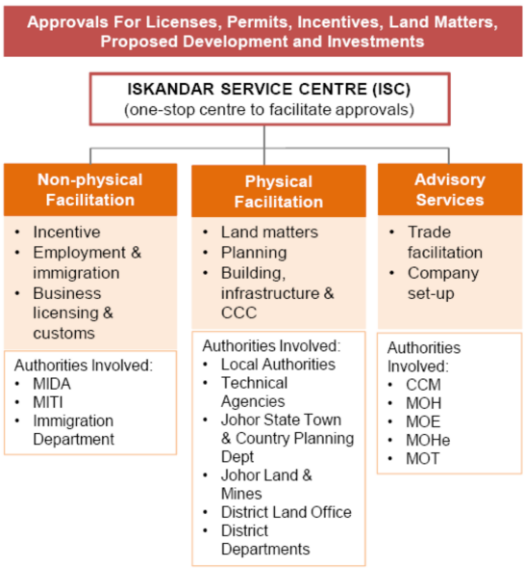
As matters related to taxation and fiscal incentives fall under the purview of the federal government, IRDA (through the Iskandar Incentives Committee (IIC) and the Members of the Authority (MOA)) needs to consult the Prime Minister's Department's Economic Planning Unit (EPU), the Ministry of Finance (MOF), the Ministry of International Trade and Industry (MITI), the Malaysian Investment Development Authority (MIDA) and the Malaysian Green Technology Corporation (GreenTech Malaysia) in order to expedite the implementation of green industry tax incentives in IM. In particular, MIDA's 'Invest in Malaysia' official webpage provides a good base for IM's green industry incentives framework (see: www.mida.gov.my/env3/index.php?page=manufacturing-sector-2).

**II. Working with banks for soft loans with low interest rate packages for new green industries**

IRDA needs to proactively engage with major Malaysian and international banks and other financial institutions to work out attractive yet feasible low-interest investment loan packages to encourage and/or assist in setting up new green industries in IM. IRDA may then provide technical advisory support as necessary to prospective green industry investors, whether foreign or local, for their applications for such loan packages.

**III. Expedite approval process for green technology based FDI**

A "Greenlane Policy" needs to be implemented in IM to enable qualifying FDIs in green technology to undergo speedy approval processes across various administrative levels. This calls for a thorough review of all approval processes relevant to investing in green technology in IM that involve different government entities at the federal, state, and local levels (Figure 2.3). The goal of such a policy would be to eliminate duplication and streamline/integrate related processes, aiming to significantly cut down the overall approval time. To provide certainty and confidence to investors, clear application processes, efficient approval policies, and transparent decision making mechanisms need to be implemented. IRDA's Approval and Implementation Committee (AIC), through the creation of a "one-stop centre", will play an important coordination and facilitation role in installing the "Greenlane Policy" for FDIs in green industry in IM.




*Source: APUDG, 2013, p.82*

Figure 2.3: Various approvals involving different federal, state and local government entities that may be integrated via a single referral centre

### 2.1.2 Promotion of R&D in strategic sectors

Despite its status as a relatively new industrial sector, green industry is developing rapidly in tandem with growth due to demand for new or alternative technologies as well as improvement in existing technologies. Green industry requires continuous innovation and thus 'research and development' (R&D) becomes an indispensable component to such industries so that they will be able to produce innovative and competitive goods and services in the global market. In order to develop IM into a global hub for green industry, it is necessary to create concrete programs that involve setting aside a significant amount of funds to promote R&D activities, particularly for the strategic green industry sectors that were identified earlier (see also Table 2.1). This will create an enabling R&D ecosystem that effectively brings together and synergises industry and academia.

#### I. Industry-university and/or industry-research institution linkages

IM should effectively leverage the presence of Universiti Teknologi Malaysia (UTM); the Johor Technology Park (JTP); Senai Hi-Tech Park and Senai Cargo & Logistic Free Zone in Flagship E; Educity Nusajaya, Southern Industrial and Logistic Clusters (SILC), and Tanjung Pelepas Freezone in Flagships B and C; and Bandar Seri Alam "City of Knowledge" in Flagship D as potential clusters of 'research-industry linkage' for green technology.

IRDA needs to coordinate with the five local planning authorities (LPAs) and the relevant project developers in IM to plan for and create a conducive environment for research-industry collaboration. This may be achieved through enhancing physical and communication linkages; supporting infrastructure and facilities; improving the physical urban environmental quality of the above clusters; and through earmarking new areas with potential for such clustering as needs arise.

In order for IM to become an effective global hub for a globally competitive and strategic industrial sector, providing land for factories and infrastructure alone is insufficient, particularly if attracting top-notch, strategic green industries is the goal. Due to the need for R&D and technological innovation, such industries will form knowledge-based "clusters" and "networks" that yield locational and spatial advantages to "magnetise" further investments in related R&D projects. Quickstart programs for the development of such clusters include:

- Implement a demonstration project for eco-industrial park development in IM that provides a conducive "industrial ecosystem" for green technology innovation and transfer
- Establish the 'IM Global Green Industry Hub' branding to attract top-notch companies of select green industries
- Establish clear "entry criteria" and grant special green industry status for qualified green industry companies in the IM Global Green Industry Hub

IRDA needs to work with the Malaysian Industry-Government Group for High Technology (MIGHT), which falls under the purview of the Prime Minister's Department;

the Ministry of Science, Technology and Innovation (MOSTI); and the Ministry of Education (MOE, specifically the Higher Education Department) towards bringing together policy, funding, and technology to advance high technology interests in IM. This imperative is particularly important in strategic sectors such as advanced material, biomass, solar, and rail, which are potentially related to climate change mitigation. MIGHT is reputed to have the capability to empower industry, government and academia to harness science, technology, and innovation for business and commercial applications.

**II. Attract FDI in production of RE (e.g. BIPV, bio-fuel) and EE (e.g. fuel cell) technologies**

Malaysia is blessed with many indigenous renewable energy (RE) sources, such as palm oil biomass wastes and palm oil mill effluents (POME); mini-hydro; solar power; solid waste; and land-fill gas (KeTTHA, 2009b). RE has been identified as a vital source of mitigation that will help reduce the country's GHG emissions in electricity generation. On the other hand, energy efficiency (EE), which has been recognised as the "low hanging fruit" of the world's energy challenges (UN Foundation, cited in MATRADE, 2011), has been identified as one of the country's top priorities in addressing the rising energy demand that is coupled to rapid economic growth. Aside from the high GHG emissions mitigation potential that results from the utilisation of RE and EE technologies, R&D and production of RE and EE technologies also present Malaysia, and specifically IM, with huge economic opportunities by generating high-skill, high-wage jobs.

Attracting FDIs in the strategic sectors of RE and EE needs to be given priority in IM. In this regard IRDA needs to work closely with MIGHT, GreenTech Malaysia, KeTTHA, the Sustainable Energy Development Authority (SEDA), MITI and MIDA to promote IM as a global hub for green industry with preferential status given to R&D and production of RE and EE technologies. IRDA may proactively take further steps to engage and facilitate the "link-up" between prominent global RE and EE innovators and producers and relevant Malaysian firms to jointly invest in producing RE and EE technologies in IM.

**III. Innovation in green vehicles (hybrid, electric)**

Apart from focusing on RE and EE technologies, the focus on green vehicles, both hybrid and electric, as a strategic sector supports GreenTech Malaysia's target of having 10% electric vehicles (EV) on Malaysian roads by 2020 (GreenTech Malaysia, 2012). Promoting R&D, innovation, and actual production of green vehicles in IM also supports the achievement of *Action 1: Integrated Green Transportation* of this Blueprint. The urban transportation sector normally accounts for between 33-40% of energy use in cities and thus presents tremendous GHG emissions mitigation opportunities if green vehicles progressively became more commonplace.

IRDA needs to formulate and implement strategies and programs that promote IM as a "regional capital" for R&D, innovation, and production of advanced hybrid and electric vehicles, which may range from private motorcars to public transport and commercial vehicles. Related ancillary technologies (e.g. charging stations, battery and energy storage, smart grid etc.) may also be considered. As with attracting foreign investors in RE and EE, IRDA needs to engage and facilitate the "link-up" between established global green vehicle technology innovators and producers and their Malaysian counterparts, which include DRB-HICOM, Proton, Perodua, and GreenTech Malaysia, KeTTHA, among others, in order to promote investing in IM. This will be accomplished wih the implementation of aforementioned taxation and financial incentives as well as the creation of a conducive investment and R&D ecosystem in green technology.

## 2.2 Decarbonising Industries

Decarbonisation of industries is fundamentally about progressive greening of all industries, with a long-term focus on continuously improving their environmental performance regardless of sector, size, or location. It includes commitment to and action on reducing the environmental impact of processes and products by (UNIDO, 2011b, p.9):

- improving production efficiency: using resources more efficiently and optimising the productive use of natural resources
- enhancing environmental performance: minimising environmental impact by reducing the generation of wastes and emissions while conducting environmentally sound management of residual wastes.

Achieving the above presents the added benefit of minimising various health risks that are associated with the direct and indirect environmental emissions that stem from industrial activities. Decarbonising existing industries in IM is crucial, especially when considering the region's industrialisation level at which industries are the main contributors to the region's total energy consumption and GHG emissions levels.

EEI in industrial processes is a particularly important step for Iskandar Malaysia to help it meet its 'high-growth-low-carbon' goal. It is possible to apply many methods for energy conservation to industries. Firstly, the most obvious method is to replace and upgrade existing equipment with equipment that performs better and is more efficient. Other options include implementation of an energy management system for peak shedding and through process integration, which requires the process of the industry to be modified for better performance and energy conservation. Since EE generally requires additional investment and management activities on the industries' behalf, it will be essential to provide incentives, financial assistance, and regulations.

### 2.2.1 Reducing energy intensity of industrial production process

According to UNIDO (2011b), focusing on energy efficiency offers the largest and most cost-efficient GHG emissions reduction in the industrial sector. EEI in industry aims at getting the most value or energy service out of each unit of energy input and can be achieved through a wide range of measures. When applied to the industrial production process, EEI may be achieved at the level of performance improvement of equipment or individual appliances and/or at the level of industrial system optimisation. A wide array of devices and systems are currently available in the industrial production process. This Blueprint projects that an energy efficiency improvement of about 10% on average is potentially achieveable in the industrial sector in IM by 2025 through the combined implementation of the following six programs.

#### I. Purchase of energy efficient equipment

Installation and use of energy efficient equipment is perhaps the quickest way to conserve energy and reduce energy use and carbon emissions in the industry. While installation and operation of energy efficient systems require modification to the current energy system (e.g. application of energy storage for efficient use of energy), application of energy efficient appliances and equipment does not require much modification. Therefore, it is the simplest way to achieve energy conservation and GHG emissions mitigation.

Motor systems account for more than 50% of industrial electricity use worldwide whereas about 40% of fossil fuel consumption in industry is for steam production (UNIDO, 2011b). Optimisation of energy performance of motor, steam, and other systems by upgrading existing motors, boilers, and/or pumps will go a long way to help reduce the energy intensity of existing industrial operations.

There are many types of industries in Iskandar Malaysia and each of these industries possesses different kinds of equipment and systems,

Table 2.2: Available energy efficient devices for industries

| Industrial Devices | General Descriptions |
|---|---|
| Compressed air | Compressed air has a variety of end uses. It is used as a pneumatic tool and for conveying, equipment, instrumentation and so on. Since compressed air is safe and convenient, it is favoured in industries. The cost of compressed air is about 7 to 10 times the cost of electricity. Even though the cost of compressed air is often overlooked, better practices in maintaining the compressed air would benefit the performance of compressed air systems. |
| Cooling towers | Cooling towers act as a heat exchanger; in order to engender the transfer of heat, two fluids are brought into contact. For spray-filled towers, the heat transfer is accomplished by spraying water into a rain. Basically, there are two types of cooling towers, the direct cooling tower and the indirect cooling tower. |
| Electric motors | To provide driven power to equipment such as pumps, compressors and so on, electric motors are used. Electric motors account for 50%-70% of the total electricity used in the industrial sector. Motors are classified into direct current (DC) and alternating current (AC) motors, while AC is further divided into two: synchronous and induction types. AC induction is further classified into single phase or polyphase. |
| Lighting | Lighting functions can be divided into task, ambient, and accent. Task lighting is used to describe lighting that provides enough radiance for tasks to be finished while ambient lighting delivers security, safety, and common brightness for daily activities. Finally, accent lighting lights up the walls to blend more closely with naturally bright areas such as windows and ceilings. |
| Pumps | Pumps are one of the most important pieces of equipment in the industrial sector since most industrial processes involve transportation of fluids. For a pump to be working properly, work has to be initiated on the pump because the pump is unable to transport fluid on its own. Work is generated by an electric motor, a steam turbine, or a diesel engine. These generators all consume energy, whether electrical or fuel-derived. |
| Refrigeration and Air-Conditioning | The process of rejecting heat at relatively higher temperatures and removing heat at lower temperatures is called refrigeration. It is accomplished by means of an absorption system, steam jet refrigeration cycle, vapor compression, or other system. Out of all these systems, absorption systems and vapor compression are the most commonly used. For a complete air conditioning and refrigeration system, fans, pumps, filters, refrigerating equipment and so forth are needed, depending on the process. |
| Boilers | Steam generated from boilers is commonly used as a heating medium. It is widely used mainly due to availability of water and the ability of a boiler to store a large quantity of heat at a temperature that is useful. Depending on fuel availability and costs, various types of fuels can be used for steam generation in boilers. Boilers vary according to the needs of the plant. Depending on the type of fuel used to generate steam, different types of boilers will have different levels of efficiency (see Table 2.3). |
| Furnaces | A furnace is used to provide heat. It can also function as a reactor that generates heat. Furnace design varies according to heating duty, type of fuel, functions, and the method of combustion air being introduced. Even so, most furnaces do share some features. The industrial sector normally uses furnaces as a heater to heat a secondary fluid. They typically operate with special additives. |

A summary of energy efficient technologies and practices is given below. To the typology can be added proper cleaning, operation and maintenance of systems as well as optimization of system operation.

*Space conditioning:*
- Thermal storage
- Sealing and balancing of ducts and pipes
- Improved efficiency of equipment
- Improved building design

*Water heating:*
- Insulation blankets
- Heat pumps
- Flow restrictors
- High-efficiency water heaters

*Building envelope:*
- Insulating glass
- Low-emissivity glass
- Insulation
- Solar shading
- Highly reflective roofs

*Controls:*
- Automated energy management systems

*Motors:*
- Variable speed drives
- Improved motor rewinding
- High-efficiency motors (HEMs)

*Refrigeration*
- Defrost controls
- Multi-stage compressors
- Insulation
- High-efficiency refrigeration cases

*Lighting*
- High-efficiency ballasts and reflector systems
- Lighting controls and occupancy sensors
- Daylight dimmers and switches
- Compact fluorescent lamps (CFLs)
- Efficient fluorescent lamps
- High-intensity discharge lamps

*Process improvements*
- Drying / curing efficiency
- Economizers in recovery in steam systems
- Waste heat recovery
- Good boiler and furnace maintenance
- Air compressor efficiency
- Repairing leaks and insulating tanks and pipes

*Ventilation*
- Improved efficiency
- Variable air volume
- Multi-speed or variable speed motor

***Source:*** *Government of Malaysia, UNDP, GEF, 2008, p.12*

Figure 2.4: Examples of energy efficiency improvements in industry

making it infeasible to provide a full perspective on improving every operating unit in each factory (Meghalaya State Designated Agency, 2012). Therefore, only select devices (which could be found in most factories) are presented as options for EEI for all manufacturing activities (see Tables 2.2 and 2.3; Figure 2.4).

In the quantification of GHG emissions and potential emissions reduction through industrial EEI in IM, energy efficiency improvement rates for select industrial devices according to fuel type (assuming a diffusion rate of 50%) in all manufacturing sectors are as shown in Table 2.4.

Table 2.3: Thermal efficiency levels of different boiler types (Meghalaya State Designated Agency, 2012)

| Boiler type | Variations |
|---|---|
| Manually-fired | 40-60 |
| Stoker-fired | 65-70 |
| Coal-fired | 55-60 |
| Oil and gas – fired up to 20 ton/hour | 70-80 |
| Oil and gas – fired above 20 ton/hour | 80-85 |
| Fluidized-bed combustion (atmospheric) | 75-80 |
| Waste-heat | 55-75 |
| Pulverized-fuel-fired | 80-85 |

Table 2.4: Energy efficiency improvement rate by device type and fuel in 2025 CM scenario in the industrial sector (figures show relative efficiency compared with the base year 2005 assuming a 50% diffusion of efficient devices)

| | Fuel | | | |
|---|---|---|---|---|
| Device | Coal | Oil | Gas | Electricity |
| Furnace | | 1.21 | 1.21 | 1.21 | |
| Boiler | | 1.06 | 1.06 | 1.06 | |
| Motor | | | | | 1.13 |
| Others | | 1.05 | 1.05 | 1.05 | 1.05 |

### II. Investment in energy saving management system: energy saving through system optimisation

Aside from implementing individual energy efficient devices, emissions mitigation based on a systems approach is also available. System optimisation aims at ensuring that energy delivered into the industrial production system is used effectively and may involve reconfiguring processes and redesigning products. While system optimisation may initially require more effort and investment than equipment upgrading, it has been found that systemic approaches eventually lead to higher levels of efficiency and lower GHG emissions in a shorter payback period (UNIDO, 2011b).

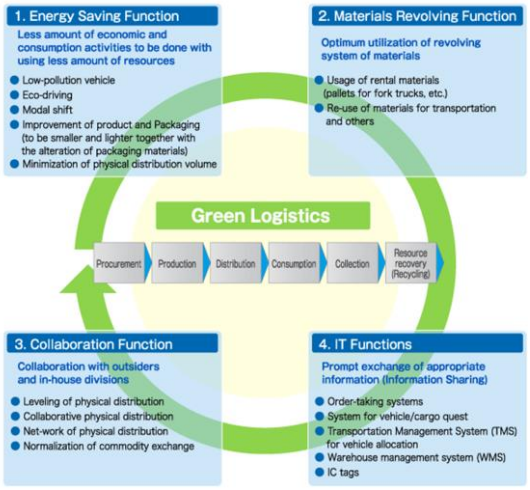
The basic concept of an *energy saving management system* or *energy management system* involves the monitoring and control of energy use by all devices in the system with sensors and networks so that the system achieves minimum energy use while maintaining necessary production levels. This is a newly emergent and rapidly growing area involving the use of new software and system solution vendors. Integrated with the individual devices discussed above, the energy saving management system will achieve greater energy savings. Bigger manufacturing establishments in IM should be encouraged to adopt EEI in their industrial processes at the systemic level.

### III. Introduce intelligent logistic system (ILS) & low-energy warehousing

The energy and carbon emissions intensity of industrial activities in IM can be further reduced through the introduction of the Intelligent Logistic System (ILS). ILS is a technology-based approach to achieving overall energy savings and more efficient logistics through integration of information on transportation; on storage and handling of freight to enable optimal holding; and on discharge, transfer, and subsequent recovery of products and materials (Figure 2.5). ILS therefore helps to save energy and improve the cost efficiency of all activities related to the forward and reverse flows of products and services between the point of production and the point of consumption by capitalising on advanced information and communication technologies (ICTs). ILS can achieve even more energy savings when combined with low-energy warehousing.

The following ILS/green logistics elements may be progressively introduced in IM:

- Alternative transportation modes such as shuttle trains and low-emission/pollution trucks (this is discussed in Action 1, Sub-action 1.6 *Green Freight Transportation*)
- Network planning, which involves introducing a transportation management system (TMS), advanced planning and scheduling, vehicle allocation and routing, and computer aided networking
- Telematic technologies, which include identification and sensor systems, vehicle locating systems, and communication technology and geographic information systems (GIS)
- Intermodal logistic management and control systems, which include low-energy warehousing facilities and warehouse management systems (WMS)




***Source:*** *Otsuka Warehouse Co. Ltd.; available from: [www.otsukawh.co.jp/english/env/target/](www.otsukawh.co.jp/english/env/target/)*

Figure 2.5 Green/intelligent logistics provides a holistic scope for minimising the ecological and climatic impacts of logistic activities of industries in IM

**IV. Tax incentives for EE investment in production processes**

While investment in energy efficient devices and industrial systems is financially justifiable due to savings in energy costs, especially in the long run (e.g. up to 10 years), increasing uncertainty and volatility in the recent business environment may discourage such investment. One way to cut short the payback period of such an investment, say to 3-4 years, is by rewarding tax incentives to qualified industries that adopt EE technologies in their production processes.

As with the earlier program related to *Tax Exemption for FDI in Green Industries*, a comprehensive inventory and analysis of existing tax exemption schemes/packages and their underlying legal and institutional frameworks are essential for crafting effective and attractive tax exemption packages to incentivise EE investment in industries in IM.

Apart from tax incentives, IRDA may encourage legally registered Malaysian industries to utilise green technology in their production processes by facilitating and assisting their application for the Green Technology Financing Scheme ('GT user' category) implemented by GreenTech Malaysia and Credit Guarantee Corporation Malaysia Bhd (CGC). IRDA may also play a similar facilitation role by assisting qualified industries to apply for tax incentives for environmental management under MIDA. These industries may qualify for the incentives by providing 'energy conservation service' and/or undertaking 'conservation of energy for own consumption' (GreenTech Malaysia, 2012).

**V. Soft loans with low interest rates to promote adoption of green technology in industry**

IRDA needs to work out affordable loan packages with the Malaysian Industrial Development Finance Berhad (MIDF), the SME Corporation Malaysia (SME Corp), the Small Medium Enterprise Development Bank Malaysia (SME Bank), and other private financial institutions to encourage and/or assist in the adoption of EE technologies by industries in IM. IRDA may then provide technical and advisory support as necessary to prospective EE/green technology investors in their applications for such loan packages.

**VI. Research and planning for establishment of eco-industrial parks**

In addition to decarbonising measures such as the upgrading of equipment and system optimisation at the scale of individual industrial units, even greater GHG emissions reduction may be achieved through proactive planning for the establishment of eco-industrial parks to accommodate new "non-green-production" industries, which will continue to characterise the industrial landscape in IM.

An eco-industrial park is a cluster of industries that adopt green technologies in their production processes. A key emphasis of the eco-industrial park is spatial and infrastructure planning that creates a regional/local "industrial ecosystem" which supports efficient resource and material flows; effective industrial linkages, synergies and symbiosis; and agglomeration economies of interrelated industries in IM. The eco-industrial park will help to encourage strategic accumulation of specific combinations of factories which jointly enhance resource or energy efficiency in IM. Examples include the co-location of a biomass energy plant that generates steam from burning locally-sourced biomass (renewable fuel) and edible oil/food processing plants that require a steady supply of steam in their production processes.

This Blueprint proposes that IRDA, working with UTM, the local planning authorities, and the industries in IM, initiates research into the planning of such eco-industrial parks in IM. This research should take into account terms of industrial linkages and symbiosis; the spatial, technical and industrial operational requirements underpinning effective industrial linkages and symbiosis; and their economic feasibility. The Menselin Holdings Biomass Energy Plant Project in Pasir Gudang, which was set up in 2007 under the UNFCCC's Clean Development Mechanism (CDM) arrangement,

supplies steam to nearby factories. It is a readily available case study that highlights the planning and eventual establishment of eco-industrial parks in IM.

### 2.2.2 Carbon reduction and environmental standards/rules/regulations

To further enhance the effectiveness and to encourage uptake of EE programs by the industry, a mix of policy instruments that combines economic incentives, information strategies, and flexible regulatory regimes is necessary (UNIDO, 2011a). This may include setting carbon reduction targets and environmental standards; development of indicators, environmental valuation, energy audits, and certification schemes; and putting in place monitoring and reporting systems for environmental management, compliance, and enforcement. These programs will enable industries, government agencies, and the public to "visualise" the results of EE efforts undertaken by industries and be constantly informed of the sector's progression towards the achievement of IM's LCS vision. This will also yield the added benefit of motivating industries to continuously improve their energy performance.

**I. Establish environmental assessment system including carbon emissions for new investment**

An inventory and review of existing management systems and regulatory instruments for environmental assessment related to industry need to be conducted so that energy savings and GHG emissions reduction can be incorporated into the common management portfolio of the industry. It is advisable that IRDA explore the use of instruments to facilitate new industrial establishments that factor energy efficiency and carbon emissions reduction into their development and operations planning. This will enable low-carbon issues to be considered from the beginning of the industrial development. For existing industries, assessment of their energy performance and carbon emissions reduction efforts will initially be on a voluntary basis.

IRDA needs to collaborate with industry (e.g. through the Federation of Malaysian Manufacturers, FMM, which awards the FMM Certificate in Energy Management) on an effective environmental assessment system tailored to the industrial sectors in IM. This system should be based on agreeable targets, indicators, and criteria for assessment of the industry's energy and environmental performance. This should also build on existing regulatory-policy frameworks, which include the *Environmental Quality Act 1974* (Act 127) and its subsidiary regulations and the *Electricity Supply Act 1990* (Act 447) and its subsidiary regulations (e.g. the Efficient Management of Electrical Energy Regulations 2008). To further this purpose, involvement of federal agencies such as GreenTech Malaysia, KeTTHA, MNRE, SIRIM Berhad (previously kown as Standards and Industrial Research Institute of Malaysia), the Energy Commission, and MOSTI will be essential.

**II. ISO 14000 Series Environmental Management System**

In order to support the environmental assessment system that gauges industries' environmental performance, IRDA needs to encourage and facilitate all types of industries in IM to get ISO 14000 Series certifications. ISO 14000 comprises a set of standards related to environmental management that helps organisations minimise the negative environmental impacts of their operations and comply with applicable environmental laws, regulations, and requirements. This is accomplished by designing and implementing an effective environmental management system. ISO 14001 maps out a framework that an industry can follow to set up an environmental management system that contributes to improving resource efficiency, reducing waste, and/or reducing costs. With ISO 14001 certification, an industry has a clear management framework to follow in order to

systematically measure and improve its environmental impact to meet preset environmental performance criteria.

In addition to promoting ISO 14000 certification, IRDA should also encourage and provide technical support to industries to obtain ISO 50000 Series certification to help set up, implement, and improve industries' energy management system. ISO 50000 certification is particularly pertinent to industries in IM as it provides a systematic approach to continuously improve energy-related performance and energy efficiency of industry operations. It also aids in identifying energy reduction opportunities.

### III. Establish energy audit system for industries

In order to effectively implement EEI in the industry sector, it is essential that IRDA puts in place an Iskandar Malaysia Industrial Energy Audit System. An industrial energy audit system generally aims at surveying and analysing energy flows in a production plant, process, and/or system to determine its energy performance. This system would identify energy conservation potential in the plant or system with a view toward reducing the amount of energy input into the plant/system while maintaining or even enhancing its energy output. In addition, the energy audit system may be used as an enforcement tool, as practised in some developed countries, that will obligate large energy consumers to report and disclose their energy use and GHG emissions.

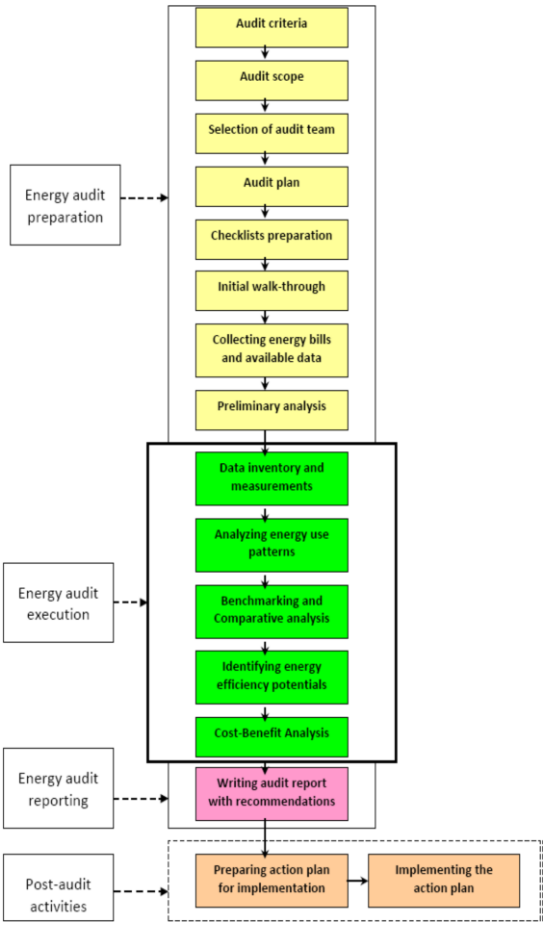
An effective energy audit system contains key elements such as preparing for an energy audit, conducting an inventory, measuring energy use, analysing energy bills, benchmarking, analysing energy use patterns, identifying energy efficiency opportunities, conducting cost-benefit analysis, preparing energy audit reports, and undertaking post-audit activities (Hasanbeigi and Price, 2010). In accordance with this outline, typical steps that need to be built into the energy audit system are (see Figure 2.6):

- preparation and planning
- data collection and review
- plant surveys and system measurements
- observation and review of operating practices
- data documentation and analysis
- reporting of the results and recommendations

Depending on the function, size, and type of the industry; the depth to which the audit is required; and the potential and magnitude of energy savings and cost reductions that are forecast, one of the following audit types may be used (see Hasanbeigi and Price, 2010):

- Preliminary (or Walk-through) Energy Audit
- Detailed (or Diagnostic) Energy Audit
- Investment-grade Audit

As a general guide, an audit should cover




***Source:*** *Hasanbeigi and Price, 2010, p.4*

Figure 2.6: Overview of an industrial energy audit

(though is not limited to) the following systems, technologies, and equipment as are applicable to the industrial plant or facility (Bonneville Power Administration, undated):

- Lighting systems
- Motors, belts, drives
- Fans, pumps
- Compressed air systems
- Steam systems
- Refrigeration systems
- Hydraulic systems
- Material handling systems
- Injection moulding or extrusion
- Veneer dryers
- Kiln drying
- Energy management systems

At the conclusion of the energy audit, an Energy Audit Report should be submitted to the Low Carbon Monitoring Unit of the relevant LPA in IM, which will be set up under this Blueprint's *Sub-action 3.4 Iskandar Malaysia LCS Monitoring and Publication System* and be coordinated by IRDA's Environment Division. Submission of the Energy

Audit Report should be mandatory for large energy consumers in line with the *Efficient Management of Electrical Energy Regulations 2008* under the *Electricity Supply Act 1990* (Act 447), whereas submission by other industries should be on a voluntary basis initially but gradaually become mandatory by the year 2020. The report should include past and present energy sources and their utilisation status; consideration of any future plans for the industrial company or facility; the company or facility's prioritised energy performance improvement measures; the overall EEI concept; the implementation plan; and monitoring and verification strategies.

Past experiences, such as the implementation of an energy audit under the Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP), have shown that industries are generally reluctant to participate in an energy audit. Continuous promotion efforts through seminars, workshops, training courses, demonstration projects, newsletters, websites and direct consultations are crucial to improve participation from industries (Government of Malaysia, UNDP, GEF, 2008). Immediate and long-term economic benefits to be gained by the industries by participating in energy audits need to be clearly communicated to the industrial companies or facilities in IM.

Best practice guides for industrial energy auditing are widely available and include:

- Pusat Tenaga Malaysia (Malaysia Energy Centre, now GreenTech Malaysia) (2007) *Industrial Energy Audit Guidelines: A handbook for energy auditors*
- CIPEC (2009) *Energy Savings Toolbox – An Energy Audit Manual and Tool*
- Hasanbeigi and Price (2010) *Industrial Energy Audit Guidebook: Guidelines for Conducting an Energy Audit in Industrial Facilities*
- Bonneville Power Administration (undated) *A Guidebook for Performing Walk-through Energy Audits of Industrial Facilities*

**IV. Monitoring and enforcement of energy saving actions**

In order to facilitate the establishment and meaningful implementation of the industrial energy audit system in IM, a mechanism for monitoring, reporting, and enforcement of energy savings measures in industries is necessary. It is recommended that IRDA's Environment Division coordinates with the five LPAs (through their respective Low Carbon Monitoring Unit) in IM to maintain a database of all industries' energy audit reports and carry out random inspections to monitor and assess industries' implementation of EEI and energy savings in IM.

In addition, the Division should maintain an up-to-date registry of ISO 14000 and/or ISO 50000 certified industries in IM to enable effective monitoring and reporting of the industries' environmental and energy performance in IM. This will result in continuous improvement in sustainability and GHG emissions reduction.

The above will supplement and form part of the *Iskandar Malaysia LCS Monitoring and Publication System* under *Sub-action 3.4* of this Blueprint.

## 2.3 Green employment in existing industries

Aside from macro-economic and ecological objectives, one important socioeconomic objective of greening existing industries is that of job and income creation, which will benefit the regional and local economies. Greening of existing industries necessitates the creation of green portfolios and green job positions in such industries, since trained and qualified personnel are essential to the proper operation and maintenance of energy efficient industrial equipment. Green jobs may also be generated by the design and running of industrial energy saving management systems; ongoing enhancement of industrial energy efficiency; and compliance with energy and environmental performance requirements.

In this context, the economic viability of greening industry and the concomitant creation of green employment in industry is crucial and needs to be made tangible so that support can be gained from the existing industries in order to achieve the ecological and socioeconomic objectives. Measures and programs are required to quantify the direct and indirect economic benefits – apart from wider ecological and socioeconomic benefits – that will potentially accrue to the industries through the greening of industrial processes. They will also provide services and support to help improve industries' resource and energy efficiency.

### 2.3.1 Promote ecological and economic benefits of greening existing industries

To maximise participation of existing industries in the greening of industrial processes and practices, initial outreach programs by IRDA are essential to promote the economic, ecological, and social benefits of the adoption of technologies to improve industrial energy and environmental performance. Collaboration between IRDA and MNRE's Department of Environment (DoE), MIDA, GreenTech Malaysia, and the Federation of Malaysian Manufacturers (FMM) is necessary in order to effectively disseminate information to and obtain feedback from industries in IM. In particular, information on resource efficient and cleaner production (RECP) technologies; EEI equipment, instruments, and systems; successful cases of greening of industries; cost-benefit analysis (CBA) of adoption of RECP technologies; and institutional support and incentives, among others, needs to be communicated to industries. Afterwards, programs that require industries to adopt cleaner production (CP) technologies and eco-efficiency policies as well as incentives for industries to set up environmental and energy performance units may be implemented.

**I. Progressive requirement for cleaner production (CP) and eco-efficiency policies in industries that aim at improving their environmental performance**

Industry plays a central role in mitigating climate change due to the high resource and energy intensity of its activities. Siginificant mitigation may be achieved through the productive use of natural resources, including energy, water, materials, and chemicals, by means of the Resource Efficient and Cleaner Production (RECP). RECP presents an integrated approach to ensuring that industries align their production processes and practices with climate change mitigation objectives while contributing to business success through operational cost savings and improved productivity (DoE Malaysia, 2007; UNIDO, 2010a). This will strengthen initiatives for decarbonising existing industries in IM.

Industries in IM need to be progressively required to adopt RECP in their production process and practices, as well as formulate and adopt eco-efficiency policies. These should have the following aims (UNIDO, 2010a):

- Reducing material and energy intensity of industrial products
- Minimising consumption of energy, particularly from high-carbon fossil fuel sources
- Minimising emissions of non-energy GHGs

- Maximising growth with low resource consumption and low pollution
- Reducing dependence on water, fossil fuels, and other resources that are likely to become scarcer as a result of climate change

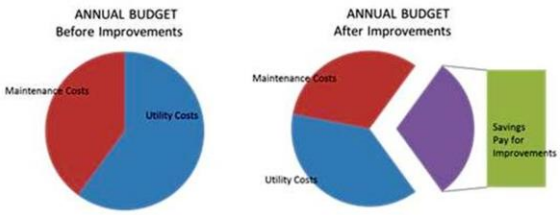
The *Cleaner Production Blueprint for Malaysia* (DoE Malaysia, 2007) provides a good policy framework that may be adapted to guide the implementation of RECP in industries in IM. It highlights the following needs:

- Formulation of institutional strategic action plans for relevant agencies in IM
- Identification of existing legal framework srelated to RECP implementation
- Education and awareness campaigns, including pilot/demonstration RECP projects
- Establishment of IM-RECP networking and mechanisms for dissemination of information
- Capacity building and training of CP project owners and enforcement officials
- Incentives and awards for RECP pioneers

**II. Incentives for industries to set up an environmental and energy performance unit that generates green employment**

In order to effectively implement RECP in existing industries and fulfill the industries' eco-efficiency policies, the establishment of an environmental and energy performance unit in each industrial outfit will be necessary. The unit's purpose will be to audit, report, and improve the industry's environmental and energy performance, which may include the reduction of energy demand and resource use; $CO_2$ emissions; air and water pollution; noise; and waste. The new unit requires the creation of new job positions to be filled by employees qualified or trained in building/industrial energy management, environmental management, and/ or RECP, and thus involves additional financial investment by the industry. Therefore, incentives need to be offered to encourage as many industries in IM to set up such units in order to generate more green employment.

Aside from providing direct financial incentives, IRDA may encourage industries that generate




***Source:*** *http://energy.nv.gov/Programs/Public_Facilities_Retrofit_Grant/*

Figure 2.8 Energy savings pay for overall improvement in industrial processes and operation

green employment related to improving their resource and energy efficiency to apply for prestigious awards of recognition for their contribution to the environment, such as the *Prime Minister's Hibiscus Award* (PMHA). PMHA (Figure 2.7) is Malaysia's premier environmental award, and gives the highest public recognition of business and industry's environmental accomplishment and leadership. It also serves to increase environmental awareness among enterprises that have yet to demonstrate environmental stewardship. The award is endorsed by the Prime Minister's Office and the MNRE's DoE.

### 2.3.2 Promotion of environmental analytical and advisory services in order to improve resource and energy efficiency in existing industries

Environmental services and consulting firms that assist companies in assessing, measuring and managing their environmental impact; that aid in managing the pollution and waste they generate; and that facilitate in waste disposal in an environmentally sound way have grown rapidly. Recent statistics suggest that the industry is worth around USD 300 billion annually in the developed countries alone (UNIDO, 2010b), and presents tremendous growth potential in developing countries.

An example of such firms is the energy service companies (ESCOs) that offer comprehensive

energy solutions to businesses and industries, including the design and implementation of energy saving projects, energy conservation, energy infrastructure outsourcing, power generation, energy supply, and risk management (UNIDO, 2011b). ESCOs will be integral to supporting existing industries in IM that do not have sufficient capacity to carry out the above activities internally, or whose operational requirement and economic scale favour the outsourcing of such activities.

With regard to industries, ESCOs aim at reducing the holistic energy costs of production processes and plant operation. Any energy cost savings that are obtained are partly used to pay a service fee to the ESCO, with the remainder used to pay back the capital investment of the energy savings project or reinvested for further improvement of the industrial operation (Figure 2.8).


***Source:*** *Prime Minister's Hibiscus Award Entry Pack 2012/2013*

Figure 2.7: PMHA – Malaysia's premier environmental award for businesses and industries since 1996

As of publication date, the Malaysia Association of Energy Service Companies (MAESCO) registered a total of 79 ESCOs in Malaysia, with 73 ESCOs registered in the Klang Valley, four in Penang, one in Negeri Sembilan and one in IM (see http://www.maesco.org.my for the latest MAESCO members list). It is expected that more ESCOs will be established, particularly in IM, as industries and businesses begin practicing energy savings in their operation and production processes, which will contribute to green employment and income creation in IM. To that end, it is essential that IRDA collaborates with MAESCO to promote and oversee the establishment of more ESCOs in IM and facilitate industries' engagement of ESCO services.

**I. Progressive requirement for corporate social responsibility reporting (including energy and environmental reporting) by existing industries**

In order to further support the use of ESCOs and the adoption of RECP and EE technologies, industries should be required to formally report the energy and environmental performance of their production processes and operations as part of their corporate social responsibility (CSR). This CSR reporting may be conducted and submitted together with or as part of the industry's Energy Audit Report (see *Section 2.2.2*) to the Low Carbon Monitoring Unit of their respective LPA. The reporting may be conducted by the environmental and energy performance unit that is set up for each industry, as discussed previously (see *Section 2.3.1*), or by an independent ESCO appointed by the industry.

**II. Create "contact point" personnel in existing industries for environmental analytical and advisory services**

For effective, ongoing engagement between existing industries and ESCOs, it is further recommended that "contact point" personnel be appointed in the industries as the reference person(s) for matters related to the industries' environmental and energy performance analysis, management, and improvement. The contact point personnel will be especially necessary for industries that will need to engage an ESCO for the energy and environmental performance audit of their operation. The selected personnel may be the same people who will oversee the industries'

environmental and energy performance units set up under *Section 2.3.1* of this Blueprint.

## 2.4 Human capital development in green industry

Complementary to bringing in green industries to Iskandar Malaysia, a good and reliable supply of competent, "carbon literate" workers that matches the needs of these industries will be necessary. This workforce will be composed of existing and new workers across all levels, such as the highest level management group; middle-level managers; engineers; knowledge and creative workers in specialised fields; and skilled production and operational/technical level workers.

To develop the human capital needed by green industries in IM, a two-pronged strategy is required in order to accomplish the following objectives:

1. Meet the immediate demand of existing industries in Iskandar Malaysia that wish to "go green" as well as the demand of new green industries
2. Ensure a continuous supply of green workers for the long term

The first strategy involves measures and programs to upgrade and retrain the existing pool of professional and semi-professional workers in industrial establishments in Iskandar Malaysia to implement policies on greening industry. The second strategy focuses on the long-term development of new generations of green workers to meet demand for such workers in Iskandar Malaysia and the rest of the burgeoning Asian region.

In order to facilitate effective and timely development of "green" human capital for industries in IM, the potential of ubiquitous ICT and mobile technologies should not be overlooked. IRDA should set up and maintain the "Iskandar Malaysia Green Portal," which serves as an online platform that provides vital information relating to LCS development, green technologies, green jobs, green education, and training resources. These will be readily accessible to the community, government agencies, the private sector, prospective investors, and any interested parties in IM. The Green Portal should be hosted on IRDA's Iskandar Malaysia website: www.iskandarmalaysia.com.my.

Intended to touch upon topics relating to green industry in IM, the portal will allow for easy access at all times to the following:

- Various LCS and green industry related resource materials, such as IRDA's and other government agencies' green policies, blueprints, and guidelines
- Green human capital development programs in IM, including opportunities for education, continuing education, (re)training, scholarships, incentives, and talent spotting
- A green technology, green industry, environmental services and experts directory with links to established websites (e.g. MAESCO at www.maesco.org.my; and Environmental Industry Online at www.environmental-expert.com/companies/keyword-energy-audits-11907/location-malaysia
- Up-to-date information on career opportunities in green industries in IM

### 2.4.1 Upgrading/retraining of exsisting pool of professional and semi-professional workers

Upgrading and retraining of existing workers involve investment in terms of monetary cost and time. To encourage industries to invest in their existing human capital and to have the necessary knowledge of management and operation of RECP processes, equipments and technology, IRDA and various relevant authorities (e.g. Malaysia Industry-Government Group for High Technology, MIGHT; Ministry of Science, Technology and Innovation, MOSTI; Ministry of Energy, Green Technology and Water, KeTTHA; Ministry of Human Resources) need to play enabling and supportive roles in

leading the way through intensive training programs and by providing fiscal incentives to the industries.

**I. Joint government-industry intensive (re)training programs**

Working with academia (UTM and other public and private institutes of higher learning in IM), IRDA and relevant government entities need to collaborate with industry (e.g. through FMM) to implement and offer a series of intensive training and retraining programs. These will be aimed at creating a highly competent, well-trained, knowledgeable, and skilled workforce in the green industrial sector by equipping workers with the latest skills through retraining, up-skilling, reskilling, and cross-skilling programmes.

Systematic planning and implementation of the programs are integral in order to accomplish the following:

- Developing training curricula and content that meet international standards and are tailored to various industries' needs in IM
- Ensuring sufficient numbers of qualified teachers/trainers by introducing well-formulated "train the teachers/trainers" programs
- Ensuring high levels of participation and support from industries
- Rightly prioritising industrial sectors that are in demand for green workers and match the appropriate level of workers
- Including all industries of different types and scales (from large manufacturing enterprises to SMEs)
- Effective monitoring, quality assurance, accreditation, certification and continuous quality improvement (CQI) of the training programs

The (re)training program needs to be marketed to employers as worthy "investments" that will eventually benefit the industries in terms of long-term cost cutting, improved productivity, potential innovation, and market expansion. The program will benefit employees by giving them opportunities to acquire new skills, higher qualifications, lifelong learning, and career advancement.

**II. Fiscal incentives for industries that invest in continuing professional education related to green industry development for current employees**

An inventory of existing fiscal incentives related to human resource development and continuous professional education needs to be conducted to identify the relevant financial assistance, training grants, and tax deductions that can encourage industries to invest in human capital development. IRDA needs to explore the variety of training incentives currently provided under the Human Resource Development Fund (HRDF) set up under the Ministry of Human Resources (see www.hrdf.com.my) and the technical support offered by "SkillsMalaysia" under the Department of Skills Development (see www.skillsmalaysia.gov.my/). This will enable IRDA to facilitate and encourage qualified industries in IM to apply for eligible incentives and programs for (re)training their current and future employees.

### 2.4.2 Regional education hub for green industry

The expected increase in demand for new green workers and "carbon literate" professionals in Iskandar Malaysia as well as the greater Asian region indicates the potential for establishing Iskandar Malaysia as a regional education hub for green industry that will involve joint faculties in the region. In this regard, the availability of qualified academics, researchers, and industrial trainers is crucial. Low carbon society and green industry curricula should be drawn up to target both undergraduate studies and existing professionals in the public and private sectors related to the development of green industries in Iskandar Malaysia. This will ensure a steady stream of development of green professionals to meet potential demands by industries in the Asian region.

**I. Set up joint-regional faculties to meet future green industry human capital demand**

The involvement of various academic faculties from different countries in the Asian region is crucial to drawing up a holistic tertiary-level curriculum in green education and offering academic programs that will be suited to the diverse national, economic, and socio-political contexts in Asia. Developing LCS necessarily calls for a multi-disciplinary approach, in which input from faculties in the relevant fields as well as from government, industry, science, and civil society will be essential. It is recommended that the joint-regional faculties be based at the Low Carbon Asia Research Centre in UTM.

These faculties are integral to establishing undergraduate programs, post-graduate programs (e.g. advanced or post-graduate diploma), and short-term professional courses that target middle-level government managers, ministerial officials, and private sector decision makers. Academics also play a necessary role in building individual and organisational capabilities to develop green industry in the Asian region.

Eventually, the potential of establishing an independent multi-disciplinary graduate school that serves continuing professional education focusing on professional skills and knowledge of the environment needs to be explored. This school would also conduct intensive research on sustainability issues. A mutual-recognition/accreditation framework of environmental academic programs and courses will also need to be developed at the ministerial level among the participating Asian countries.

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Action 3

# Low Carbon Urban Governance

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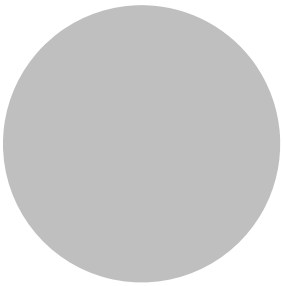
**GHGs Emission Reduction**



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The strategic importance of cities and urban and regional planning in tackling global climate change has been well articulated. Being areas of high concentration of physical assets and geographic epicenters of social and economic functions, cities and urban regions are massive consumers of resources and energy, generators of wastes and emitters of $CO_2$. However, the same asset concentration and functional intensity also mean that any effective LCS measures would go far in mitigating $CO_2$ emissions. Key to this is the cities and regions' overall form and internal structuring. At the local level where decisions about urban form and structure are made, low carbon urban governance is indispensable. Low carbon urban governance measures and programs are essential to the effective implementation of vital $CO_2$ emission reduction measures and programs related to Integrated Green Transportation; Green Building and Construction; Walkable, safe and Livable City Design; Smart Urban Growth; and Green and Blue Infrastructure and Rural Resources.

## 3.0 Low Carbon Urban Governance

As the world continues on a rapidly urbanising pathway, cities and urban regions are increasingly challenged by a multitude of economic, environmental, and social problems that are both internal (local) and external (regional, global) to the affected cities and regions. While holistic urban-regional growth policies, plans, and strategies can be drawn up from time to time to address these increasingly complex and severe issues, even more important, and often missing, is the establishment and operationalisation of a pragmatic and dynamic 'civil-institutional-political' framework. This is a process that facilitates and enables effective implementation of the policies and plans, especially as resources diminish and socioeconomic circumstances change. The central problem that confronts most cities and urban regions in their attempts to resolve the myriad problems facing them is that of 'governance' (Ruble et al, 2002).

Governance is increasingly making its mark in the pursuit of sustainable development that aims at simultaneous achievement of potentially conflicting social, environmental, and economic goals at various geographic and administrative scales in an integrated manner. In the most general sense, governance is about opening up the formal government and institutional processes to include the private sector and civil society in order to collectively chart and better manage the development pathway of a society. Governance entails transparency and accountability; conflict resolution and consensus building; empowerment through equal representation in development policy; and decision making processes and implementation in a world of finite and increasingly contested resources. It is obvious that good governance is indispensable towards developing sustainable, low carbon cities and urban regions.

For Iskandar Malaysia (IM), which aspires to achieve strong economic growth and social development goals while continuously improving its sustainability level, this Blueprint outlines a holistic set of policy actions and programs that will collectively lead to a reduction in the urban region's GHG emissions intensity while maintaining high-level growth. In order to effectively implement relevant actions and programs, good governance at the scale of the urban region is vital. In the context of this Blueprint, 'low carbon urban governance' focuses primarily on the establishment of a formal urban governance structure and process that will enable developments to be planned, regulated, managed, and monitored with carbon emission reduction in mind. These developments will be established within the statutory-functional and operational framework of IRDA and the five local planning authorities (LPAs) in IM. The non-formal, civil community and private sector components of governance networks are covered in various actions and programs under the *Green Community* and *Green Environment* themes.

The scope of 'low carbon urban governance' in this Blueprint covers development planning, planning control, and monitoring mechanisms that are based upon a low-carbon city planning paradigm. It also covers the development of the requisite human capital in relevant State and local government entities for supporting the operation and implementation of the above. While low carbon urban governance measures and programs do not directly lead to carbon emissions reduction in IM, they are fundamental to the effective implementation of vital $CO_2$ emissions reduction measures and programs of most other LCS Actions. These include Integrated Green Transportation; Green Building and Construction; Walkable, Safe and Livable City Design; Smart Urban Growth; Green and Blue Infrastructure; and Rural Resources.

### 3.1 Development Planning For Low Carbon Iskandar Malaysia

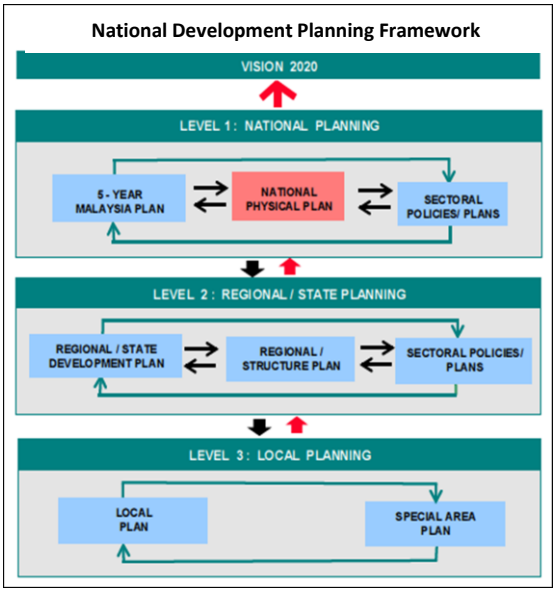
The strategic importance of cities and urban and regional planning in tackling global climate change has been well examined (Condon et al, 2009; Rydin, 2010; American Planning

Association, 2011; UN-Habitat, 2012). As they are areas with high concentrations of physical assets and geographic epicenters of social and economic functions, cities and urban regions are massive consumers of resources and energy, as well as generators of wastes and emitters of $CO_2$. Overall, the built environment has been found to be accountable for approximately 50% of human-induced GHG emissions, due primarily to heating and cooling buildings and transporting people and goods (American Planning Association, 2011).

Nonetheless, the same asset concentration and functional intensity also mean that any effective LCS measures would go far in mitigating $CO_2$ emissions. Key to mitigation is the cities' and regions' overall spatial form and internal structuring. At the local level where decisions about urban form and structure are made, low carbon urban planning and governance are indispensable.

However, urban and regional planning has hitherto been largely "carbon-blind" in that reducing energy intensity and the concomitant carbon emissions growth resulting from urban growth has traditionally not been on the urban and regional planning agenda. Research has shown that an increase in carbon emissions concentration is primarily caused by fossil fuel use and land use change. Therefore, urban planning by means of land development planning and planning control plays a vital role in implementing the idea of a low carbon city (Ho and Fong, 2007). The operationalisation of a low-carbon development planning, control, and monitoring mechanism in IM calls for a fundamental transformation of the overall institutional framework that underlies the entire city-regional development planning process. Such a transformation would encompass the revision of the current development planning, control, and monitoring system and process.

Development planning consists of developing plans that are instrumental in guiding future development. Development plans are also an important tool in translating government policies into action (Mohd Sukuran and Ho, 2008). There are three spatial levels in the Malaysian development planning framework and each level has its corresponding development plan: the National Physical Plan covering Peninsular Malaysia, the Structure Plan (for the State), and the Local Plan or Special Area Plan (for the District of part thereof) (see Figure 3.1). Each higher-level plan provides the planning and policy framework for the lower-level plan, which needs to interpret the higher-level policies and provide more detailed spatial

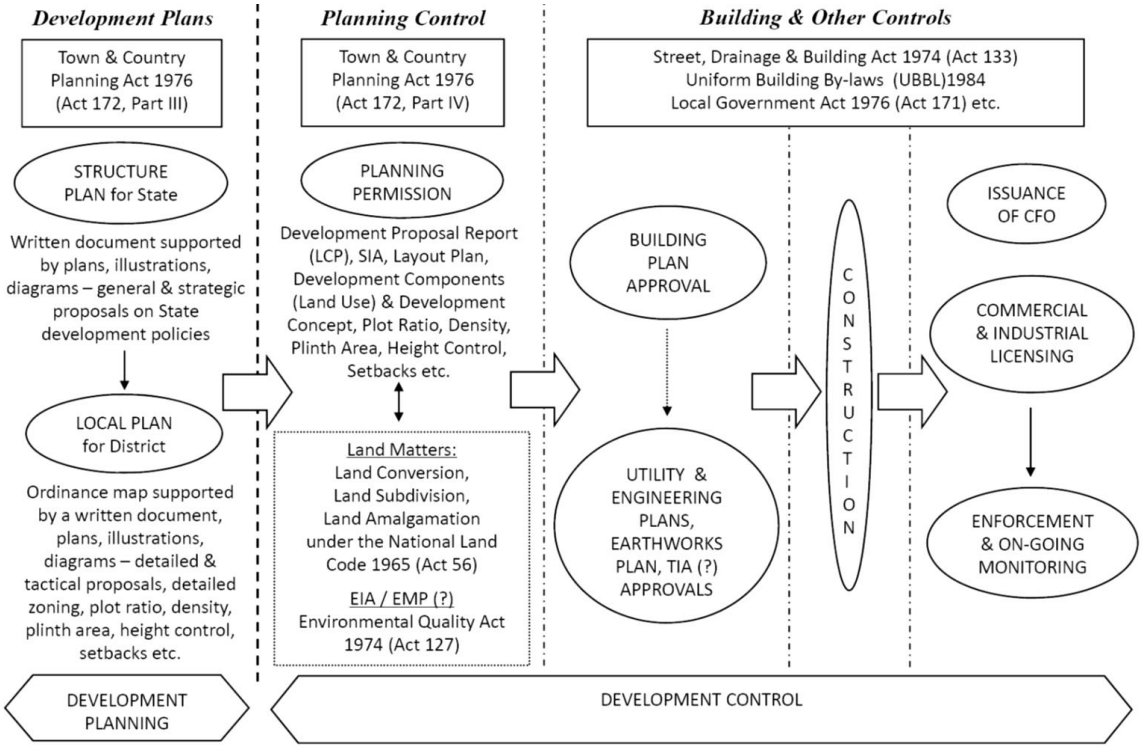



*Source: Federal Department of Town and Country Planning, 2010*

Figure 3.1: National Development Planning Framework

articulation and clearer implementation dimensions for the policies.

Under the Town and Country Planning Act 1976 (Act 172), development plans are statutorily binding and should contain policies and proposals for the principal physical, economic, environmental, and social characteristics, including the principal land uses (The Commissioner of Law Revision Malaysia, 2002). As such, development plans – particularly the local plan – play an important role as tools for regulating the way actual development is carried out through the development control process. This process necessitates that a Planning Permission is to be obtained from the LPA, followed by other necessary approvals




*Source: Chau, 2012, p.7*

Figure 3.2: Overall Development Planning and Development Control Framework in Malaysia

from the relevant authorities, prior to carrying out any development work on the ground (Figure 3.2). In order to obtain a Planning Permission, a key prerequisite is that the proposed development *shall* be in line with the development plan, or the local plan that is in force. Therefore, in order to achieve progressive materialisation of any development vision in a city or region, the first step would be to have the vision institutionalised in the statutory development plans that will be put in force in the city or region. In order to develop IM into a low carbon society, the visions, targets, policies, and programs outlined in this LCS Blueprint need to be 'mainstreamed' (see UN-Habitat 2012) into the Local Plan for the Johor Bahru District and Kulaijaya District (Figure 3.3).

**3.1.1 Institutionalisation of low carbon vision and carbon reduction targets in all statutory plans (Johor Bahru District Local Plan and IM Comprehensive Development Plan)**

In IM, in addition to the Johor State Structure Plan and the Johor Bahru and Kulaijaya Districts Local Plan, there are the South Johor Economic Region Comprehensive Development Plan (SJER -CDP), which is currently under review, and 24 blueprints to guide development in the region. Since its inception in 2006, development in Iskandar Malaysia has been governed by various policies, plans, and guidelines at the national, state, and local levels. In particular, the SJER-CDP is a statutory plan whose preparation is mandatory under the Iskandar Regional Development Authority Act 2007 (Act 664), while the 24 blueprints covering various development aspects of the urban region (see Figure 3.3, column 2) gain statutory status by means of adoption by the Johor State Planning Committee (SPC). The main function of the CDP and the blueprints is to provide a development coordination framework by which all government entities within Iskandar Malaysia are to legally abide.

Iskandar Malaysia is also home to five local planning authorities (LPAs) that hold the

traditional statutory role of planning and regulating development and land use in their administrative areas under the Town and Country Planning Act, 1976 (Act 172). The LPAs fall under the Johor Bahru District and Kulaijaya District Local Plan 2020, which is the statutory plan for guiding and regulating land development in the Johor Bahru and Kulaijaya Districts that jointly cover most of Iskandar Malaysia (Figure 3.3, column 3). The Local Plan is required by law to take cognisance of and provide clear spatial articulation to higher level development policies, including the Johor State Structure Plan 2020, the National Physical Plan-2, as well as other general development policies (Figure 3.3, column 4). Most LPAs also enact their respective development policies and planning guidelines to be in line with the Local Plan. Unfortunately, reducing the energy and carbon emissions intensity of rapid growth has never been an agenda item of the plans and policies.

Since the honourable Prime Minister of Malaysia made the announcement of the conditional voluntary reduction of the country's carbon emissions intensity at COP 15 in 2009, a series of national-level climate change responses and low carbon initiatives have emerged in the form of policies, frameworks, and guidelines (Figure 3.3, column 1). However, these policies and guidelines have yet to find their way into the lower-level development policies, plans, and guidelines that are more effective and detailed in guiding and regulating physical-spatial development.

Due to its status as a premier growth corridor in the country, it is necessary that Iskandar Malaysia lead the way in contributing to meeting Malaysia's voluntary commitment to reduce its carbon emissions intensity by 40% (based on 2005 emissions levels) by 2020. It is in this context that the Low Carbon Society Blueprint for Iskandar Malaysia 2025 is being formulated to provide the crucial policy link

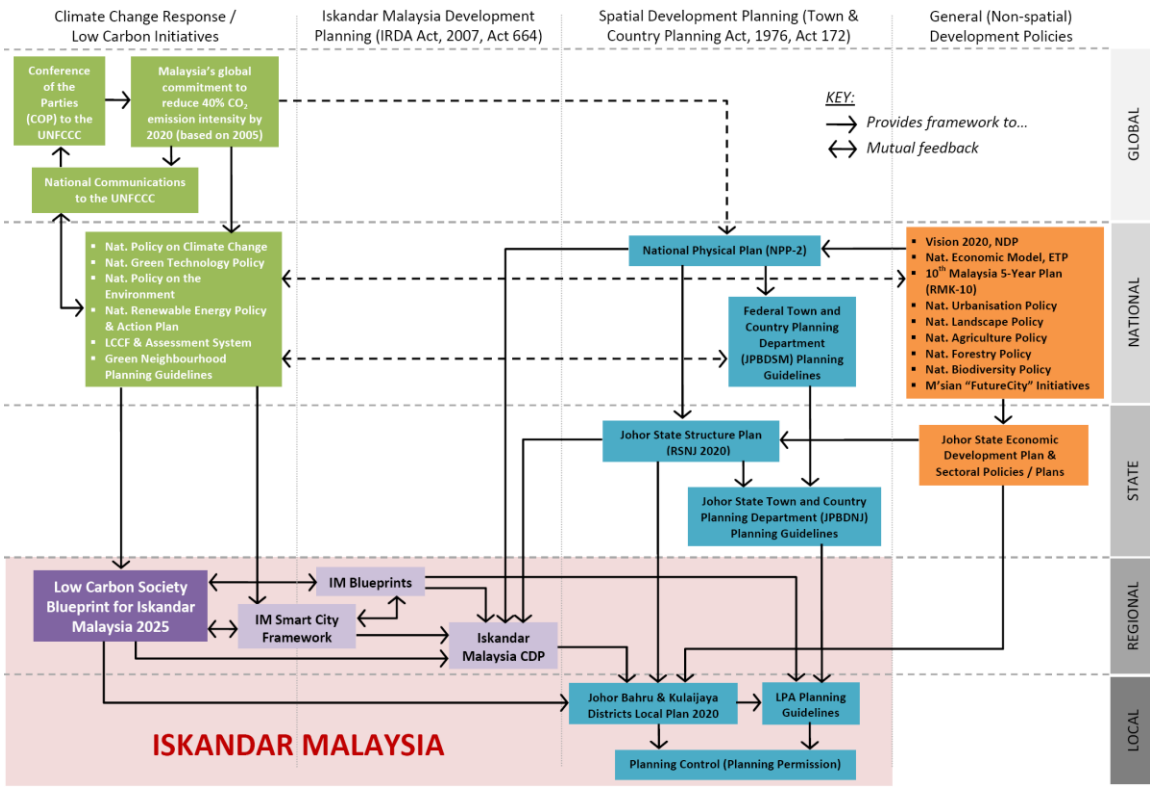



Figure 3.3: Positioning the Low Carbon Society Blueprint for Iskandar Malaysia 2025 within the context of existing national, state, and local development policies and plans; the LCSBP provides a critical link between the global and national low carbon initiative frameworks and policies and local planning policies and guidelines

between the country's global and national climate change responses (Figure 3.3, column 1) and Iskandar Malaysia's regional and local level development plans and policies. The Blueprint also takes cognisance of the recently launched *Iskandar Malaysia Smart City Framework* that sets out the general characteristics of Iskandar Malaysia as a smart city that includes elements of reducing carbon emissions and emphasizes the development of ICT infrastructure.

Furthermore, this Blueprint addresses the potential of a low carbon and smart IM to become the first future city in Malaysia under the Malaysia "FutureCity" Initiative, which is currently being actively explored and pursued by the Federal Department of Town and Country Planning under the Ministry of Urban Wellbeing, Housing, and Local Government. The Malaysia "FutureCity" Initiative will be an adaptation of the prestigious Japan "FutureCity" Initiative (see Regional Revitalization Bureau, Cabinet Secretariat Government of Japan, 2013), under which cities and communities that make outstanding achievements in establishing bottom-up, innovative, and proactive initiatives to address specific sets of social, environmental, and economic issues that they face are given due national recognition as a "FutureCity". These cities create new social, environmental, and economic values and improve the quality of life in the future. If the Malaysia "FutureCity" Initiative is eventually established, IRDA and the five LPAs in IM will need to consider submitting jointly or severally nominations as the first "FutureCity" in Malaysia, since implementation of most LCS programs outlined in this Blueprint will have put IM at an advantage compared to other cities. The "FutureCity" status will potentially enhance and expedite low carbon development planning in IM.

Once adopted by the SPC, the Blueprint shall provide a statutory policy framework for the CDP, which is currently under review, and serve as the "umbrella blueprint" for the existing 24 blueprints which need to be revised to incorporate relevant LCS policies and strategies. As required by Act 664 (ss.24(4)), these policies would then trickle down through the CDP to the Johor Bahru District and Kulaijaya District Local Plan 2020 and LPA Planning Guidelines and take effect through the granting of Planning Permissions to future developments in Iskandar Malaysia (Figure 3.3, bottom-left shaded box).

It can be seen that development planning plays an indispensable role in guiding development on the ground and shaping the urban future, so it is important to ensure that all development plans should prioritize the achievement of a low carbon society (LCS). Once low carbon targets and measures are mainstreamed into the development plans, and the Local Plan in particular, all developments in IM will statutorily need to comply with the plans in order to have the Planning Permission as well as other development approvals granted. This will contribute to ensuring Iskandar Malaysia's continuous growth while steadily progressing towards meeting the region's carbon emissions intensity reduction targets.

**I. Set clear carbon intensity reduction targets for IM up to 2025**

The United Kingdom provides a good reference case in terms of planning at multiple spatial-scales in order to achieve low carbon development; it is the first country that has set a legally binding carbon budget. The UK adopted the Climate Change Act in 2008, with carbon reduction targets set at 34% below the 1990 levels by 2020, and 80 % by 2050. The success of the UK in progressing towards the set carbon reduction targets is in great part attributable to the country's development planning system. The UK adopts a spatially stratified development plan system, on which the Malaysian planning system is based. The national, regional, and local governments in the UK have their own action plans that are directed towards achieving the set carbon reduction targets.

Aside from the aforementioned Climate Change Act 2008, a series of national-level policies have been formulated in the UK to provide clearer operational dimensions to the statutory carbon reduction targets. These include the Energy

White Paper; the Supplement to Planning Policy Statement (PPS) 1 on Planning and Climate Change (2007); the Local Government White Paper; Building a Greener Future (2007); and Code for Sustainable Homes (TCPA & CHPA, 2008). The national policies set a clear direction for the carbon reduction target to be achieved at the national level and also establish a guideline for regional and local action plans.

Using London as an example, under the Greater London Authority Act 2007, the Mayor is statutorily duty-bound to contribute towards the mitigation of, and adaptation to, climate change in the UK (Greater London Authority, 2011a). This responsibility has been effectively translated and reflected in 'The London Plan: Spatial Development Strategy for Greater London.' "Rising to the challenge of climate change is a theme that runs through [the London] Plan, and there are relevant policies in *all* its chapters…." (Greater London Authority, 2011a, p.138; emphasis added)

Iskandar Malaysia and Greater London share somewhat similar geographic-spatial and administrative characteristics in development planning and control. Both the Iskandar Regional Development Authority (IRDA) and the Greater London Authority (GLA) are regional-level statutory bodies established under the parliamentary acts of their respective countries to ensure sustainable growth and oversee spatial development of their respective regions. Both authorities are required by law to prepare spatial development strategies covering their administrative region, with which local-level development documents have to be in general conformity. IRDA prepares the Iskandar Malaysia Comprehensive Development Plan (CDP), while the GLA prepares the London Plan. Iskandar Malaysia is composed of five local planning authorities, which jointly fall under the Johor Bahru District and Kulaijaya District Local Plan, while Greater London encompasses 32 London Boroughs and the Corporation of the City of London, each of which possesses its own Local Development Framework (LDF) and other relevant local development documents. Both the Iskandar Malaysia CDP and the London Plan provide a spatial policy framework for their local level development plans and form part of the statutory development plans that need to be considered when planning decisions are made with respect to any new development. Both IRDA and GLA face similar challenges of needing to ensure economic growth while keeping the environmental impacts of such growth at bay (Khazanah Nasional, 2006; Greater London Authority, 2011a).

In order to contribute to the national 40% carbon emissions intensity reduction target announced by the Prime Minister at COP 15, the Blueprint sets a carbon emissions intensity reduction target of a minimum of 50% in IM by 2025, based on the 2005 emissions level. The target would be achieved by implementing the 12 LCS actions which fall under three main themes: *Green Economy*, *Green Community,* and *Green Environment* in this Blueprint. This minimum 50% reduction target needs to be adopted in the Johor Bahru District and Kulaijaya District Local Plan so that it can be enforced under Act 172.

### II. Formulation of achievable and implementable low carbon transition strategies for 2012-2025 and beyond

The London Plan provides a good reference for the formulation of achievable and implementable low carbon transition strategies that involve a series of temporally stepped-up targets. In order to make real progress in addressing climate change, the London Plan undertakes the following mitigation and adaptation measures (Greater London Authority, 2011a, p.30):

- ***Mitigation***: reducing GHG emissions to minimise future warming and its impacts. Development can be managed to aid this effort—by designing buildings to be energy efficient, by promoting decentralised and renewable energy, and by supporting patterns of development that reduce the need to travel by less environmentally friendly modes of transport

- ***Adaptation***: making sure buildings and the wider urban areas are designed with a changing climate in mind; encouraging urban greening; protecting, enhancing, and expanding the city's stock of green space to help cool parts of the city; continuing to manage and plan for flood risks

While both climate change mitigation and adaptation measures are normally necessary to effectively tackle the issue of climate change, this Blueprint focuses more on mitigating climate change. Mitigation aims to minimise warming and its impacts through the reduction of carbon emissions of IM as it continues to develop rapidly. Low carbon urban governance aims at reducing energy demand and intensity of development and growth activities in IM through the (re)structuring, (re)shaping, and (re)design of its existing and evolving urban structures. This can only be achieved by transforming and strengthening IM's development planning institutional framework.

In this context, formulation of clear and realistic carbon reduction targets that gradually escalate towards an eventual target is vital. As an example, the Mayor of London in 'Delivering London's Energy Future: The Mayor's Climate Change Mitigation and Energy Strategy' (Greater London Authority, 2011b) has set clear interim reduction targets of 20% for 2015, 40% for 2020, and 60% for 2025 based on the 1990 emissions levels (see Figure 3.4). Recognising recent scientific evidence that a global carbon emissions reduction of 80% (based on the 1990 emissions levels) needs to be achieved in order to avoid the catastrophic impacts of global warming by 2050, the Mayor further proposes a minimum 80% reduction target for London by 2050.

| Target year | Target $CO_2$ emissions reduction on 1990 levels |
|---|---|
| 2015 (interim target) | 20 per cent |
| 2020 (interim target) | 40 per cent |
| 2025 | 60 per cent |
| 2050 | At least 80 per cent |

*Source: Greater London Authority, 2011b, p.6*

Figure 3.4: London Mayor's Carbon Reduction Targets

When the above is taken into consideration, it becomes a statutory obligation for the borough councils in London to contribute to achieving the carbon reduction targets. This should be reflected in the Local Development Framework (LDF) and various local level development documents and policies of each borough, which would form part of the material considerations in granting Planning Permissions for new developments.

Barking and Dagenham is a London Borough located in the London Region. The London Borough of Barking and Dagenham have considered the London Plan while producing their own Local Development Framework (LDF) at the local level. There are two policies in the LDF that mention measures and actions to reduce carbon emissions—the Environmental Building Standards and Energy and On-site Renewables (LBBD, 2011).

For IM, this Blueprint proposes that interim emissions intensity reduction targets are set to serve as reference for tracking the progress towards achieving the final reduction targets and as part of material considerations for granting of Planning Permissions. A series of interim targets that increase gradually initially and more rapidly subsequently is achievable and acceptable for IM (Table 3.1).

Table 3.1: Proposed Carbon Emissions Intensity Reduction Targets for IM towards a Minimum 50% Reduction by 2025 (based on 2005 levels)

| Target Year | Target $CO_2$ Emission Intensity Reduction on 2005 levels | Target $CO_2$ Emission Reduction compared to BaU |
|---|---|---|
| **2015** | 10% (interim target) | - |
| **2020** | 25% (interim target) | - |
| **2025** | 50% (minimum) | 40% |
| **2035** | 80% (provisional) | 75% |

**III. Provide policies to "reward" land development projects that contribute to IM's low carbon visions**

In order to encourage landowners' and project developers' initial participation in and subscription to IM's LCS vision and targets, institutional "rewards" that enhance the market prestige and "value" of development projects need to be introduced. General scepticism among land owners, developers, and investors is to be expected, especially concerning the cost implications of the adoption of LCS programs on their projects. It is therefore essential that landowners, developers, and investors realize the value of, and is thence motivated into, investing in LCS programs in their projects.

Rewards that will be introduced should generally fulfill the key criteria of not adding significant financial burden to the awarding agency and costs to the receiving party, while having a high local and global impact in terms of corporate prestige and profile (which may eventually translate into higher sales returns) for the receiving party.

Examples of rewards that meet the above criteria include the GAIA (Green Accord Initiative Award) Framework and the CASBEE (Comprehensive Assessment System for Built Environment Efficiency) Certification, both of which are internationally prominent green certification systems. Both rewards may be considered soft incentives as they do not involve cash-handouts, but greatly impact green awareness of the industry and the public. Both rewards take the form of a certificate and plaque given out by IRDA to worthy development projects that have been designed to fulfill a minimum number of carbon emissions reduction features. Display of the certificate and plaque on the certified premises or development project is permissible for promotional and marketing purposes. IRDA needs to promptly investigate and figure out the details of the rewards' implementation in IM, which may include the need for local adaptation and higher-level endorsement by the relevant agencies.

It is necessary to highlight here that the above proposed certification and assessment systems are to be separate from those presently available in the market, which are mostly private-sector initiated and would normally involve a relatively hefty sum in exchange for conducting an assessment on a development project. The GAIA and CASBEE certifications proposed here are initiated by IRDA; the certification by IRDA is a genuine reward of recognition of a development project's contribution to LCS in IM.

### 3.1.2 Design clear low carbon zoning and urban design codes that promote Iskandar Malaysia's smart growth

In recent years, it has become increasingly clear that urban sustainability and liveability may be associated with some general spatial patterns and structures of urban growth, though there does not exist a "one-size-fits-all" urban spatial model for the sustainable city. Volumes of research and best practice reviews have shown that development approaches such as Smart Growth, compact development, and Transit Oriented Development (TOD), as well as zoning methods such as mixed use development (MXD), high(er) density development (for residential), bonus plot ratio (for commercial), the use of performance-based zoning, and form-based design codes have brought about characteristics of a sustainable low carbon city. These include high quality, liveable, walkable, healthier, safer, and energy efficient urban environments. Therefore, in order to materialise LCS in IM, new developments should be planned and designed according to the above approaches and methods, which are described in detail under *Action 8 Walkable, Safe, Liveable City Design*; *Action 9 Smart Urban Growth;* and *Action 10 Green and Blue Infrastructure and Rural Resources* of this Blueprint.

A quick review of the current zoning, planning standards, and design codes used to guide and evaluate the planning and design of

development projects in IM shows that the zoning, standards, and codes are not capable of guiding new development projects towards the creation of low carbon urban environments as described above. In fact, they have been found to work against the creation of LCS in IM. For instance, the current conventional zoning approach upon which Local Plan zoning is based is not supportive of mixed use development, which is a fundamental aspect of Smart Growth and TOD. The zoning mechanism (e.g. density and plot ratio controls) also tends to be overly rigid and often leads to the establishment of sprawling, single-use urban forms strung along primary highways that are motorcar oriented. In order to enable smart urban growth of IM, a review of the current zoning system, planning standards, guidelines, the design of new zoning, and design codes is essential. This review should apply to all LPA areas within IM.

**I. Coordination of LCS guidelines and standards for all local authorities in IM**

It is vital that the varied planning guidelines and standards used by different LPAs in IM, though adapted to suit the unique socioeconomic, physical, and urban historic contexts of each area, are coordinated in terms of prioritizing the creation of LCS in IM. IRDA needs to take the lead in organizing all the LPAs within IM to review all current guidelines and standards to ensure that they are severally and jointly focused upon helping IM reduce the carbon emissions intensity of development activities in the urban region. Coordination is especially crucial in areas that adjoin neighbouring LPAs to ensure harmony in the design outcomes of adjoining developments in neighbouring LPA areas. Affected areas include interconnecting bicycle lanes, pedestrian links, public transport routes and transit points, networks of blue and green infrastructure, potentially shared public infrastructure and community facilities, etc.

It is crucial that the guidelines and standards review and the coordination exercise commences as soon as possible, as these are the planning tools that will be used to plan, and design, and evaluate new development projects. These tools will ensure that the guidelines contribute to achieving the LCS vision and the targets set in IM's development plans.

**II. Revise and update existing use classes in order to facilitate mixed use development**

As stated earlier, one obstacle to creating a walkable, liveable, transit supportive, low carbon urban environment is that of a zoning system that does not permit mixed use development. As such, it is necessary that the current zoning system that underlies the Local Plan in IM is reviewed and enhanced to enable the incorporation of mixed use development (MXD). The definition of MXD zoning also needs to be refined and streamlined to ensure consistency in various development planning documents, such as between the CDP and the Local Plan. While the CDP provides for Mixed-use zones in IM, it appears that this policy has not been integrated with the Johor Bahru District and Kulaijaya District Local Plan and therefore may not be enforced in the planning control process.

The CDP presently categorises MXD zoning into *Mixed-use 1*, *Mixed-use 2* and *Mixed Use Residential* as follows (CDP Chapter 9, Section 9.3-A):

***Mixed-use 1*** – areas zoned for mixed-use development within the city centre and *transit planning zones*. It is intended to promote a combination of commercial and residential housing on the same site. It allows developments with increased intensity to be centralised, especially with the residential component. This aims to support a strategy to encourage inner city living in the Johor Bahru CBD and to encourage transit-oriented development within *transit planning zones*.

***Mixed-use 2*** – areas zoned for mixed-use development as business and employment centres located within *transit planning zones*.

***Mixed Use Residential*** – mixed-use development in *transit planning zones* in residential districts

Although this summary provides a starting point, these definitions may inadvertently limit the scope of implementation of MXD in IM since MXD seems to be permitted only in transit planning zones. A more elaborate and detailed MXD categorisation is necessary to include neighbourhoods beyond transit planning zones. Furthermore, a clearer range of mix of components needs to be outlined for each category of MXD, including the development intensity expression of density and plot ratio.

Considering there are five LPAs in IM, MXD zoning should also avoid the pitfall of rigidity in conventional zoning, so that some degree of flexibility and the criteria that underline such flexibility are written into it to allow for varied forms of MXD to be permitted and justified across the LPA areas. As with the previous exercise in reviewing and coordinating planning guidelines and standards, the revision and updating of the use classes order to include MXD need to be given priority.

### III. Implementation and enforcement of compact and transit supportive development zoning and design codes

LCS should not be purely focused on mitigating urban growth's $CO_2$ emissions without paying due attention to the quality of the urban living environment. While supporting $CO_2$ emissions reduction, a low carbon city should also offer its inhabitants a high quality, safe, and healthy living environment. This is important because a high quality living environment has been shown to affect how often people walk, cycle, and use public transport in the city. Good urban design has been demonstrated to increase property values, reduce crime, contribute to public health and social wellbeing, and alleviate transport problems (CABE, 2003).

In this context, the formulation of good design codes is essential. According to the UK *Policy Planning Statement 3: Housing (PPS3)*, a design code is "a set of illustrated design rules and requirements which instruct and may advise on the physical development of a site or area." The graphic and written components of the code are detailed and precise; they build upon a design vision such as a "masterplan or other design framework for a site or area" (English Partnerships, 2007).

A design code is composed of two related components (CABE, 2003):

- a three dimensional masterplan of the development area (and probably an area beyond) that shows clearly the intended arrangement of spaces and buildings. Massing, orientation, distribution of uses, densities, building lines, spaces, etc. are also shown.
- A supporting set of written requirements that explain the plan, including dimensions where relevant, and which addresses more detailed issues, such as use of materials, landscaping, and tenancy mix depending on the level of prescription required.

Design codes are increasingly being used to construct high quality places that support compact and transit supportive development in the US, the UK, and Australia. A low carbon IM should lead the way in Malaysia in developing urban design codes that have the goal of creating high quality, low carbon urban environments.

Good reference cases of urban design codes build upon transit supportive development zoning and effectively guide and regulate future urban development towards improved urban sustainability and liveability. The following may be adapted for IM:

- *SmartCode: Version 9.2* (Duany et al, 2012); available from www.smartcodecentral.org/
- *Liveable Neighbourhoods: A Western Australian Government's sustainable cities initiatives* (WAPC, 2007); available from www.planning.wa.gov.au/dop_pub_pdf/ln_text_update_02.pdf

Figure 3.5 depicts a summary of the *SmartCode: Version 9.2* and Figure 3.6 gives an impression of the typical urban structure plan based on the *Liveable Neighbourhoods* design code. Since low carbon zoning and urban design codes form

part of the planning control tool, their early formulation is pivotal to creating an effective low carbon development planning system in IM.

After a development planning system that is built upon a LCS paradigm is established and supported by clear low carbon zoning and design codes, the ensuing planning control system for materialising LCS in IM can be implemented.


| a. ALLOCATION OF ZONES per Pedestrian Shed (applicable to Article 3 only) | | | | | | | (see Table 16) |
|---|---|---|---|---|---|---|---|
| CLD requires | no minimum | 50% min | 10 - 30% | 20 - 40% | not permitted | not permitted | |
| TND requires | no minimum | no minimum | 10 - 30% | 30 - 60 % | 10 - 30% | not permitted | |
| RCD requires | no minimum | no minimum | not permitted | 10 - 30% | 10 - 30% | 40 - 80% | |
| b. BASE RESIDENTIAL DENSITY (see Section 3.4) | | | | | | | |
| By Right | not applicable | 1 unit / 20 ac avg. | 2 units / ac. gross | 4 units / ac. gross | 6 units / ac. gross | 12 units / ac. gross | |
| By TDR | by Variance | by Variance | 6 units / ac. gross | 12 units / ac. gross | 24 units / ac. gross | 96 units / ac. gross | |
| Other Functions | by Variance | by Variance | 10 - 20% | 20 - 30% | 30 - 50% | 50 - 70% | |
| c. BLOCK SIZE | | | | | | | |
| Block Perimeter | no maximum | no maximum | 3000 ft. max | 2400 ft. max | 2000 ft. max | 2000 ft. max * | |
| d. THOROUGHFARES (see Table 3 and Table 4) | | | | | | * 3000 ft. max with parking structures | |
| HW | permitted | permitted | permitted | not permitted | not permitted | not permitted | |
| BV | not permitted | not permitted | permitted | permitted | permitted | permitted | |
| AV | not permitted | not permitted | permitted | permitted | permitted | permitted | |
| CS | not permitted | not permitted | not permitted | not permitted | permitted | permitted | |
| DR | not permitted | not permitted | permitted | permitted | permitted | permitted | |
| ST | not permitted | not permitted | permitted | permitted | permitted | not permitted | |
| RD | permitted | permitted | permitted | not permitted | not permitted | not permitted | |
| Rear Lane | permitted | permitted | permitted | permitted | not permitted | not permitted | |
| Rear Alley | not permitted | not permitted | permitted | required | required | required | |
| Path | permitted | permitted | permitted | permitted | not permitted | not permitted | |
| Passage | not permitted | not permitted | permitted | permitted | permitted | permitted | |
| Bicycle Trail | permitted | permitted | permitted | not permitted * | not permitted | not permitted | |
| Bicycle Lane | permitted | permitted | permitted | permitted | not permitted | not permitted | |
| Bicycle Route | permitted | permitted | permitted | permitted | permitted | permitted | |
| e. CIVIC SPACES (see Table 13) | | | | | | * permitted within Open Spaces | |
| Park | permitted | permitted | permitted | by Warrant | by Warrant | by Warrant | |
| Green | not permitted | not permitted | permitted | permitted | permitted | not permitted | |
| Square | not permitted | not permitted | not permitted | permitted | permitted | permitted | |
| Plaza | not permitted | not permitted | not permitted | not permitted | permitted | permitted | |
| Playground | permitted | permitted | permitted | permitted | permitted | permitted | |
| f. LOT OCCUPATION | | | | | | | DISPOSITION |
| Lot Width | not applicable | by Warrant | 72 ft. min 120 ft. max | 18 ft. min 96 ft. max | 18 ft. min 180 ft. max | 18 ft. min 700 ft. max | |
| Lot Coverage | not applicable | by Warrant | 60% max | 70% max | 80% max | 90% max | |
| g. SETBACKS - PRINCIPAL BUILDING (see Table 15) | | | | | | | |
| (g.1) Front Setback (Principal) | not applicable | 48 ft. min | 24 ft. min | 6 ft. min 18 ft. max | 2 ft. min 12 ft. max | 2 ft. min 12 ft. max | |
| (g.2) Front Setback (Secondary) | not applicable | 48 ft. min | 12 ft. min | 6 ft. min 18 ft. max | 2 ft. min 12 ft. max | 2 ft. min 12 ft. max | |
| (g.3) Side Setback | not applicable | 96 ft. min | 12 ft. min | 0 ft. min | 0 ft. min 24 ft. max | 0 ft. min 24 ft. max | |
| (g.4) Rear Setback | not applicable | 96 ft. min | 12 ft. min | 3 ft. min * | 3 ft. min * | 0 ft. min | |
| Frontage Buildout | not applicable | not applicable | 40% min | 60% min | 80% min | 80% min | |
| h. SETBACKS - OUTBUILDING (see Table 15) | | | | | | | |
| (h.1) Front Setback | not applicable | 20 ft. min +bldg setback | 20 ft. min +bldg setback | 20 ft. min +bldg setback | 40 ft. max from rear prop | not applicable | |
| (h.2) Side Setback | not applicable | 3 ft. or 6 ft. | 3 ft. or 6 ft. | 0 ft. min or 3 ft. | 0 ft min | not applicable | |
| (h.3) Rear Setback | not applicable | 3 ft. min | 3 ft. min | 3 ft. | 3 ft. max | not applicable | |
| i. BUILDING DISPOSITION (see Table 9) | | | | | | | |
| Edgeyard | permitted | permitted | permitted | permitted | not permitted | not permitted | |
| Sideyard | not permitted | not permitted | not permitted | permitted | permitted | not permitted | |
| Rearyard | not permitted | not permitted | not permitted | permitted | permitted | permitted | |
| Courtyard | not permitted | not permitted | not permitted | not permitted | permitted | permitted | |
| j. PRIVATE FRONTAGES (see Table 7) | | | | | | | CONFIGURATION |
| Common Yard | not applicable | permitted | permitted | not permitted | not permitted | not permitted | |
| Porch & Fence | not applicable | not permitted | permitted | permitted | not permitted | not permitted | |
| Terrace or Dooryard | not applicable | not permitted | not permitted | permitted | permitted | not permitted | |
| Forecourt | not applicable | not permitted | not permitted | permitted | permitted | permitted | |
| Stoop | not applicable | not permitted | not permitted | permitted | permitted | permitted | |
| Shopfront & Awning | not applicable | not permitted | not permitted | permitted | permitted | permitted | |
| Gallery | not applicable | not permitted | not permitted | permitted | permitted | permitted | |
| Arcade | not applicable | not permitted | not permitted | not permitted | permitted | permitted | |
| k. BUILDING CONFIGURATION (see Table 8) | | | | | | | |
| Principal Building | not applicable | 2 Stories max | 2 Stories max | 3 Stories max, 2 min | 5 Stories max, 2 min | 8 Stories max, 2 min | |
| Outbuilding | not applicable | 2 Stories max | 2 Stories max | 2 Stories max | 2 Stories max | not applicable | |
| l. BUILDING FUNCTION (see Table 10 &Table 12) | | | | | | | FUNCTION |
| Residential | not applicable | restricted use | restricted use | limited use | open use | open use | |
| Lodging | not applicable | restricted use | restricted use | limited use | open use | open use | |
| Office | not applicable | restricted use | restricted use | limited use | open use | open use | |
| Retail | not applicable | restricted use | restricted use | limited use | open use | open use | |
| ARTICLE 5 | | | | | | | |
| ARTICLE 2, 3, 4 | | | | | | | |

SmartCode Version 9.2 SC45

***Source: Duany et al, 2012***

Figure 3.5: Summary of the SmartCode: Version 9.2

*Source: Morris, undated, p.5*

Figure 3.6: Typical urban structure plans based on the *Liveable Neighbourhood* zoning and design codes

## 3.2 Planning control process, procedures and mechanisms for materialising LCS in Iskandar Malaysia

As shown in Figure 3.2 earlier, various kinds of approvals that fall under several statutes involving different State and local government agencies are required prior to the commencement of construction of a development project. These approvals, which fall under the influence of development control, encompass compliance with land matters, planning control, building control, and engineering (road, drainage and earth works) requirements. They also enable all development projects to be controlled and regulated with respect to the development plans and policies that are in force.

Traditionally, these approvals were mostly dealt with separately and sequentially, which created several issues: process duplication, resource inefficiency, delay, and the inability to resolve and reconcile conflicting and well-intended decisions of different technical/approving agencies. This has almost invariably resulted in homogenous development projects that produce largely monotonous and standardised urban environments which fulfill the technical requirements of planning and engineering (especially vehicular traffic requirements) but detract from meeting human needs and the quality of the living environment. This is counterproductive to the creation of sustainable, low carbon cities and regions.

There are two sides to this issue: one involving process and procedures, the other involving substance and contents. The former has been progressively addressed as part of the Government Transformation Program (GTP), which aims at improving the overall public sector delivery mechanism. However, the former has not been given sufficient attention, particularly regarding the need to consider energy and carbon emissions intensity reduction of urban development. So far the latter has not been a key agenda item in the content of urban and regional planning in Malaysia.

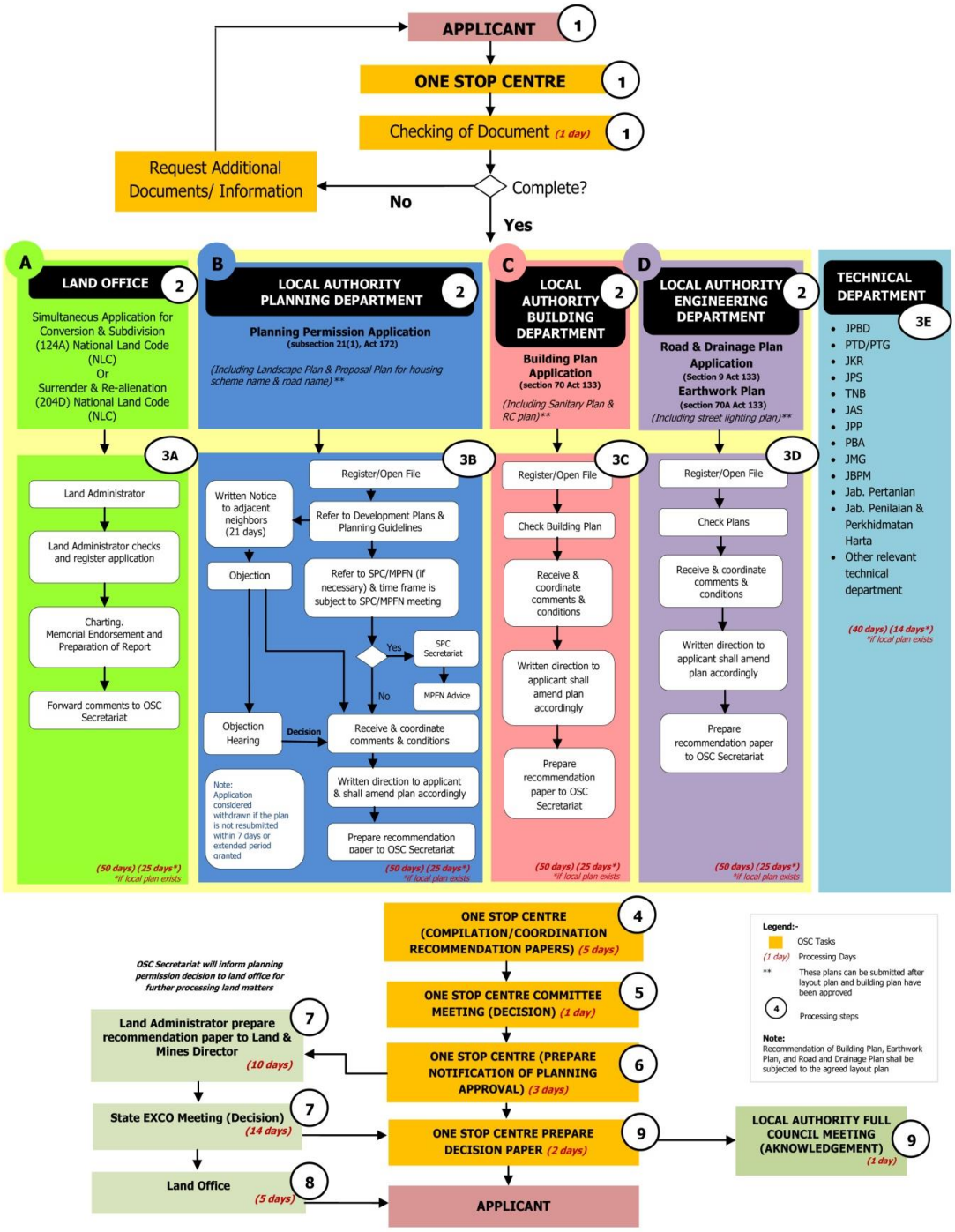
### 3.2.1 Reform and streamline currently fragmented planning approval processes

Recently, the process and procedural aspect has been somewhat addressed with the implementation of the One-stop Centre (OSC) in all Local Authorities (LAs) for processing development applications. The OSC allows for the simultaneous submission of various development applications to the LA and processing of the applications by the agencies concerned (Figure 3.7). Different approvals still undergo different, though parallel, processes that do not facilitate “content cross-cutting” in

the consideration of a development application. The approval processes remain largely fragmented and decisions are not considered in an integrated manner.

With IRDA's increased involvement in IM's planning and development, further consideration needs to be given to IRDA's statutory roles and its power relationship with the other approval agencies. Particular attention should be directed to ensuring the achievement of IM's LCS vision and carbon emissions intensity reduction targets.

For every previous proposed development project in Iskandar Malaysia, the developer




*Source: Rehda Insitute 2012*

Figure 3.7: Flow chart for One Stop Centre (OSC)

needed to apply for Planning Permission as required under Act 172 and for other forms of plan approvals. Now developers can submit their development proposals through the One Stop Centre (OSC) that is set up in all five LPAs in IM. Before the introduction of the OSC, submissions for various approvals were processed separately and sequentially.

With the implementation of the OSC, developers have the option to submit development proposals all at once, which reduces the total length of time of the approval processes. These now consist of four parallel main stages (See Figure 3.7): 1) Application for clearance of land matters; 2) Application for Planning Permission; 3) Application for building plan approval; and 4) Application for earthworks plan and road and drainage plan approvals. For development projects that fall under IRDA's fast track category (whose proposals need to be submitted to IRDA), the approval process may take as short as 21 days (JPBD Johor, 2012).

Each application process has been provided for under the various related legislations, which include: the National Land Code 1965 (NLC, Act 56); the Town and Country Planning Act 1976 (Act 172); and the Street, Drainage, and Building Act 1974 (Act 133). In implementing the process, different departments are responsible for each application. The key parties involved in assessing a development proposal include the Land Office, the Local Authority Planning Department, the Local Authority Building Department, the Local Authority Engineering Department, and various relevant technical departments.

**I. Re-rationalisation of Planning Permission application, processing, and granting procedures**

A review and re-rationalisation of the current Planning Permission application, processing, and granting procedures are needed in order to further reduce waiting time and resource inefficiency. The re-rationalisation process and procedures should enable and facilitate all-time cross-referencing of documents and comments by various agencies by utilising an enhanced online submission platform.

This Blueprint also suggests that IRDA (through the *Environment* and *Planning and Compliance Divisions*) be given a larger role in the approval processes for advisory, coordination, facilitation, and subsequent monitoring purposes. This will ensure that IM's LCS vision and targets, which will have been mainstreamed into the CDP and Local Plan, are heeded (Act 664, s.26) in the approval of development projects. It is necessary to emphasise that the involvement of IRDA in the approval processes must adhere to the spirit of Act 664 (ss.2(2)) of not "reducing or limiting the jurisdiction, powers and functions of the State Authority of Johore in relation to land and local government matters."

**II. Eliminate duplications in currently overly compartmentalised planning approval processes through enhancing the One-stop Centre (OSC) mechanism in IM**

Implementation of the OSC has been found to significantly enhance the planning approval process. It forms a good base on which to further improve the process's efficiency. A critical review of the OSC mechanism needs to be conducted to identify any duplication and overlap in the scope and function of the various approval agencies and technical departments.

The ongoing CDP review (APUDG, 2013) identifies potential duplication and overlap in jurisdictions with respect to project approval in IM since there are the various channels of approval available in IM, viz. the Approval and Implementation Committee (AIC), the OSC and the State Planning Committee (SPC). The specific function, scope, powers, and scale of engagement of the approval committees need to be clearly specified to avoid confusion and unnecessary waste of resources and time.

**III. Integrated decision making processes in planning control at state & local levels**

The current scenario shows that in assessing a development proposal, the departments involved will provide their comments and recommendations for approval based on their respective departmental policies, guidelines, and standards. These are later coordinated by the OSC. As yet, there is no provision for examining carbon emissions reduction as a material consideration for development approval in an integrated, cross-departmental manner, and the overall development approval process is fragmented in terms of the absence of "content cross-cutting". Therefore, it is necessary to reform and streamline the currently fragmented planning approval process in order to allow content cross-cutting across various departments. As tackling climate change and reducing carbon emissions intensity targets becomes the common goal of all statutory development planning documents in IM, achieving the minimum carbon intensity reduction targets as stipulated in the development plans should be the guiding principle adopted by all technical departments in the development approval process. This should yield development forms and patterns that reduce energy demand and improve resource efficiency in IM.

In order for Iskandar Malaysia to become a low carbon urban region by the year 2025, it is important to put in place a horizontally and vertically integrated decision making process in planning control that cuts across the state and local levels.

**IV. Expedite approval process for proposed developments that support achievement of IM's LCS visions**

As an incentive to encourage landowners, developers, and investors to pursue green and low carbon objectives in IM, IRDA should formulate clear policies on expediting the approval processes for proposed development that will contribute to the achievement of IM's LCS vision and targets. Development proposals that explicitly integrate key programs of this Blueprint in their design (e.g. developments proposed around planned public transport nodes; developments that retain existing vegetation; developments that adopt a green construction approach, etc.) should be given "green-lane" approval that is significantly swifter than the approval period needed for conventional projects.

### 3.2.2 Enhance Substantive (Content) Aspects of Development Planning Approval

Often the technical-procedural aspect of approval processes tends to be given priority over the substantive, content-based aspect. While the former is necessary to ensure consistency, objectivity, fairness, and transparency in the approval process, the latter is necessary to support better-informed, judicious, and quality decisions. In order to promote LCS in IM, decisions on whether to grant Planning Permission with respect to a proposed development should not be primarily grounded in the proposal's fulfillment of technical/procedural requirements but should also take into the planning and design merits of the proposal. Particular attention should be given to supporting the achievement of IM's LCS vision and $CO_2$ emissions reduction targets.

**I. Requirement for submission of a 'Low Carbon Statement' in all Planning Permission applications**

In order to help project applicants prepare submissions with clear contents and to help LPA planners evaluate the contents of development proposals, a 'Low Carbon Statement' should be required to accompany all Planning Permission applications. The 'Low Carbon Statement' is an adaptation of the 'Design and Access Statement,' which is required to accompany most planning applications by the Planning Act in the UK (CABE, 2007).

The Design and Access Statement is a tool to help make the planning application system work more smoothly and secure the production of quality built environments. The statement should provide all necessary information about

a proposed development; explain the design of the planning application; describe the likely effects of the proposal; justify what is being applied for; and link to planning decisions by conditions if developers are to be required to follow them (CABE 2007).

In the context of promoting LCS in IM, the Low Carbon Statement would be required to be incorporated into the Development Proposal Report (*Laporan Cadangan Pemajuan, LCP*) that is presently required under Act 172, s.21A to accompany an application for Planning Permission. The Low Carbon Statement should outline the developer's commitment and design approach to reducing the energy demand and carbon emissions intensity of the proposed development. The Statement should also contain clear carbon reduction projections of the proposed development based on established modelling approaches and would form part of the material consideration and planning conditions for granting of Planning Permission with respect to the proposed development by the local planning authority.

**II. Imposition of planning conditions on granting of planning permissions that support LCS actions**

Act 172, ss.12(5) provides that in granting a Planning Permission, the LPA may impose planning conditions that are directly related to the approved development and are, in the LPA's view, necessary for advancing good planning principles and practice. This is a powerful planning tool that IRDA and the LPAs in IM should capitalise upon to achieve the LCS vision and $CO_2$ emissions reduction targets for IM.

Aside from enforcing the standard planning conditions spelled out under ss.12(5) of Act 172, IRDA and the LPAs should explore the practicality and determine the legality of imposing other conditions that are supportive of this Blueprint's various programs. These may include:

- mandatory provision of walkways and cycle lanes in residential neighbourhoods and linking public transport stops
- installation of traffic calming devices on residential and activity centre streets
- provision of public transport facilities within the development project
- installation of EEI equipment and systems in a certain percentage of buildings
- rehabilitation of natural stream systems, etc.

## 3.3 Development of necessary human capital for operationalising and implementing Iskandar Malaysia's Low Carbon Society vision

Human capital development in state and local government departments that are directly and indirectly related to the design and production of the built environment is one of the aspects necessary to achieve low carbon Iskandar Malaysia. It is necessary to ensure that government officials and researchers have sufficient knowledge, appreciation, and technical information of low carbon society and how urban development should be structured and shaped to materialise such a society.

Officers in the national and state planning departments are responsible for formulating planning policies and regulations, while officers in the local departments will implement their national and state governments' policies and regulations. Therefore, officers in the planning departments from the national to the local levels should learn and understand what low carbon is and how to introduce low carbon policies in urban planning. This is important because policy and regulatory responsibility is a powerful catalyst for government action in terms of supporting implementation mechanisms (The Climate Change Group, 2012).

Other professionals related to shaping the built environment, such as architects, engineers, and other related parties, also need to inform themselves of what low carbon society would encompass. LCS is still a relatively new concept in Malaysia and there are professionals who may not be aware of it because the concept was

not covered in the university curriculum until the past few years. Systematic and progressive retraining of existing government officers and professionals in the private sector will be necessary and university curriculums should be updated in order to produce new generations of professionals who are "carbon literate".

### 3.3.1 Progressive retraining of planners, architects, engineers, and other built environment professionals and semi-professionals in state and local planning authorities

Government agencies will be the "frontliners" in the implementation of most programs outlined in this Blueprint, particularly those of low carbon urban governance. This requires planners, architects, engineers, and other built environment professionals and semi-professionals in state and local departments to be well versed in the concepts, approaches, principles, measures, technologies, models, and policies of LCS. Therefore, progressive retraining of in-service state and local authority officials will be an urgent goal of this Blueprint.

**I. Develop a low carbon urban and regional planning retraining curriculum for in-service municipal officials**

IRDA will have to collaborate with higher learning institutions in IM, such as the Universiti Teknologi Malaysia (UTM), which has a long history in urban and regional planning and sustainability research and which has been a pioneer research institution in the region with respect to urban and regional planning to create LCS. This collaboration will involve designing a suitable LCS and low carbon urban and regional planning curriculum for retraining in-service municipal officials and officials in strategic government institutions such as schools, the State Education Department, the State Department of Town and Country Planning, and the State Public Works Department.

In the long run, UTM and IRDA need to extend the retraining program and curriculum to cover government officials for other countries in the Asian region so that IM's experiences may be disseminated and contribute to developing a low carbon Asian region.

**II. Incorporate low carbon society concepts, philosophy, approaches, measures etc. in municipal human capital development programs**

To further strengthen the general governmental institutional framework to support LCS programs in IM, the concepts, philosophy, approaches, principles, and measures of LCS should be incorporated in ongoing human capital development programs in the municipalities and other government agencies in IM. To accomplish this, involvement of key state agencies such as the State Authority, State Economic Planning Unit, and State Department of Town and Country Planning will be necessary.

**III. Systematically prioritise and organise continuous (re)training of officials**

To ensure the sustainability of the implementation of LCS programs in IM, continuous training of new officials and retraining of in-service officials needs to be systematically installed in all government agencies. This will also ensure that officials are kept updated of the latest developments in LCS concepts, principles, measures, and technologies. Strong cooperation will be required from all government agencies in IM to deal with human resource planning and budgeting.

## 3.4 Iskandar Malaysia LCS monitoring and publication system

In order to support the achievement of such goals, an effective monitoring, assessment, and publication system on the progress and achievement of carbon reduction targets and low carbon society is indispensable. Government buildings in Iskandar Malaysia

should set an example by voluntarily submitting monthly environmental and energy performance data to IRDA, which would then compile, collate, and publish such data for public access. The same exercise should then be gradually extended to major commercial buildings and complexes, industrial factories, and individual homes in the Iskandar Malaysia area. They would submit their energy performance data to their respective Local Authority. The data would also be useful for ongoing monitoring of the progression towards and achievement of the set carbon reduction targets and would inform the periodic review of development plans and policies in Iskandar Malaysia.

### 3.4.1 Establishing a Low Carbon Monitoring Unit in All Local Authorities in Iskandar Malaysia

In order to effectively gather, manage, analyse, monitor and publicise LCS data in IM, a Low Carbon Monitoring Unit needs to be established in all Local Authorities in IM. The unit will be responsible for planning and strategising effective collection of data, managing the database, and publicizing the analysed data. The unit will also continuously monitor and analyse trends, progress, and achievement of LCS program implementation to meet the carbon emissions intensity reduction targets set for IM. The results will then be published periodically for "self-reflection" and "self-improvement" in the areas of energy efficiency, resource consumption, and waste generation among all stakeholders involved in advancing the LCS vision of IM.

**I. Ongoing monitoring of energy and carbon emissions performance of development and economic activities in Iskandar Malaysia**

Starting with the voluntary submission of energy performance data of government buildings to IRDA, it is hoped that that action will encourage businesses, industries, the corporate sector, and households in IM to voluntarily submit the same data to their respective LAs. IRDA should explore the progressive automation of collection of such data using network technologies.

**II. Transparent and accountable publishing of energy and carbon emission data in multiple formats that are accessible anytime, anywhere**

Periodically the publication of aggregate trends, progress, and achievement results in carbon emissions reduction in IM is disseminated. However, transparent and accountable publishing of the real time status of energy consumption and carbon emissions in IM is also necessary. IRDA will coordinate the publication of these data with the Low Carbon Monitoring Unit in all LAs in IM. These data should be made easily accessible in multiple formats, such as print media, digital forms, and online to the public anytime, anywhere. This will help increase the public's awareness of the need to consume and live responsibly with the wellbeing of future generations in mind, as well as motivate them to adopt a low carbon lifestyle.

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Action 4

# Green Building and Construction

Mohd Hamdan Haji Ahmad, Malik Tassaduq Abbas and Miho Kamei

**GHGs Emission Reduction**

1,203 $ktCO_2eq$

9%

For IM to materialize its goal of LCS, all the stakeholders in the building industry should work together. Communication amongst the stakeholders, planners, architects, engineers, contractors, developers, manufactures and the local authorities is vital to create common goals. The professional fraternity and the general community must bring about changes in practice and behaviour to lay the foundation and to sustain LCS lifestyle.

Action 4 constitutes designing "Green Building and constructions". It aims to bring the stakeholders in the building industry towards creating a LCS. The five main measures of Green Building and construction are (1) promoting green buildings in new developments, (2) energy efficiency improvement of existing buildings, (3) green Construction, (4) green building design technology, and (5) rural green buildings. This Action is expected to reduce the CO2 emission in 2025 by 1,203 $ktCO_2eq$.

## 4.0 Green Building and Construction

In order for IM to materialize its goal of LCS, all stakeholders in the building industry would need to work together. Communication among the stakeholders, planners, architects, engineers, contractors, developers, manufacturers, and the local authorities is necessary to establish common goals. The professional fraternity and the general community must bring about changes in practice and behaviour to lay the foundation for and to sustain a LCS lifestyle.

Iskandar Malaysia's (IM) vision is to become a strong and sustainable metropolis of International standing". This requires building "green". This involves improving the design and construction standards of buildings according to the specific needs of green criteria so that they last longer, have reduced operational and maintenance costs, and offer healthy indoor and outdoor working environments. Iskandar Malaysia aims to use its catalytic projects to create international living concepts with a good mix of "live, work, learn, and play" components.

To materialise the vision of IM, a development strategy of smart and connected solutions has to be implemented.

Action 4 constitutes designing "Green Buildings and construction". It aims to bring the stakeholders in the building industry together to create a LCS. It is no more a matter of why we need to build green, but rather how we can build green. Building green needs to start now.

### 4.1 Promote Green Buildings in New Construction

#### 4.1.1 Expedite Approval Process for Green Buildings

There are five Local Authorities in IM. These authorities do not have the expertise on green building criteria or green technology features. Most of the local Authorities in IM are not aware of the green building status under their jurisdiction. This is due to the fact that plan approval application processes are not tied to each other. Unfortunately, the developer does not accrue any benefits by declaring the green status of the development to the local authority.

IRDA can play the role of flag bearer for all the local authorities in IM to adapt "IM Green Standard" or green criteria for all new developments. IRDA's responsibilities would include:

- Integrating these standards with regular development, approval, and inspection processes
- Ensuring that compliance to green standards is verified on plans, drawings, and reports as part of regular planning application submissions
- Planning application submissions to be integrated with:
  a) Green Design Assessment
  b) Building performance analysis
  c) Certification by a green tool provider (CASBEE/GBI/others)
  d) Complement "architectural character of Johor"

**I. To impose building rating system**

Rating systems take a systematic approach to evaluating implementation of green building measures to help compare projects on a level playing field. Using a building rating system allows for comparisons and benchmarking of existing buildings and provides a mechanism to track the progress toward designing and operating the green buildings. Rating and certification systems help define green buildings for the market. They indicate how environmentally sound a building is, which provides clarity as to what extent green components have been incorporated and which sustainable principles and practices have been employed.

An example of the buildings rating system is the Leadership in Energy and Environmental Design (LEED), a product of the US Green Building Council, which is the most well-known rating system for commercial buildings. The LEED framework consists of several rating categories that are applicable to different points in a building's lifecycle. For example, LEED NC rates new construction, while LEED EB rates existing buildings. Each category is comparatively rigorous and can add cost to the project, depending on the certification level sought and the experience level of the team.

**II. Plot ratio incentive for platinum rated building**

The aim of this program is to encourage the development of green buildings. Using a neighbouring country as an example, Singapore has implemented a similar program called Green Mark Platinum Rating. All new public sector buildings and existing public sector buildings undergoing major retrofitting works are required to achieve the Green Mark Platinum rating. Large existing government buildings are to achieve at least Green Mark GoldPLUS rating by 2020. From May 2010 onwards, the government will only sell its land in selected key growth areas to developers under the condition that the new developments will be built under Green Mark Platinum or GoldPLUS ratings.

### 4.1.2 Showcase Prototype of Green Building in IM

At the beginning IRDA should take a leading role in developing green building in IM. A prototype of any of the following government buildings—a school, mosque, post office, fire station, police station, sports complex, or an office building—can be constructed as a showcase design.

**I. Pilot demonstration and joint venture project for constructing green offices and commercial and residential buildings in IM**

A pilot and joint venture project between IRDA and any of the private developers can be developed as a demonstration. The project could be a green office, a commercial building, or a residential building in Iskandar Malaysia.n order to In materialise such a joint venture project and to accelerate the development of green buildings in IM, the primary stakeholders, architects, engineers, contractors, the secondary stakeholders, and the developers in IRDA can play a pioneering role. With the developers' initiative, the consultants charge a reduced consultancy fee with the aim of establishing their name as "Green Consultants". The same goes for the contractors. Since IRDA is the leading and coordinating agency, it can encourage the development of a green master plan and green buildings by enacting:

- Fast approvals
- Reduction in contributions during building submissions
- Reduction in infrastructure contributions
- Reduction in plan processing fees
- Exemption in calculation for "Gross Floor Area" for spaces used as "Green Spaces" and associated with green technology

Any green tool provider, such as GBI or CASBEE can play their part by encouraging, giving assistance, and monitoring the pilot project. The tool provider may provide incentives by not charging any fees for the pilot project and reaping the long term benefits instead. In this way, a pilot project can become an actualised joint venture project and all the stakeholders will benefit from it.

## 4.2 Energy Efficiency Improvement of Existing Buildings (Retrofitting)

### 4.2.1 Identify Candidate Buildings (Commercial and Offices) For Retrofitting Demonstration Projects

Almost all of our existing building stock is not designed according to 'green standards'. As a result, these buildings consume a large amount of electricity and are not energy efficient. The

energy efficiency of existing residential, commercial, and office buildings, for the purpose of retrofitting, must be given due consideration. Certain 'high profile' buildings, such as the Sultan Iskandar Building in Johor Bahru, can be retrofitted as a demonstration project. Other office and residential buildings can be identified as well for retrofitting demonstration projects. In order to consolidate the government's system of delivery for property sector, the Ministry of Housing and Local Government (KPKT) has taken a number of steps and initiatives. These include the enforcement of the Cabinet decision for the following item to be made mandatory via the Uniform Building By-Laws, UBBL 1984 (Aminah, 2011).

**I. Subsidies and tax incentives for building owners**

Some of the most effective residential green energy resources are so expensive that their costs serve as a barrier to ownership. Implementing subsidies or tax incentives can help to reduce the burden of the building owners. As an example, the US has a similar federal program called 'Genworth Financial Canada`s Energy Efficiency Housing Program'. Home buyers that purchase an energy efficient home or make energy saving renovations are eligible for savings when Genworth insurance is obtained. Incentives include a 10% refund of the Genworth Mortgage Insurance Premium and a refund of any extended amortization insurance premium surcharges, as well as other things specific to Genworth.

**II. Apply Building Rating System**

As previously mentioned, rating systems take a systematic approach to evaluating the implementation of green building measures to help compare projects on a level playing field. By applying a building rating system, comparisons and benchmarking of existing buildings are enabled. Such a system would also act as a mechanism to track the progress toward designing and operating green buildings.

## 4.3 Green Construction

The building industry will have a major impact on climate change going forward. Greening building stock holds the highest potential for improved efficiency because buildings are responsible for almost 40 percent of all energy use, greenhouse gas emissions, and waste generation.

### Green Building Criteria

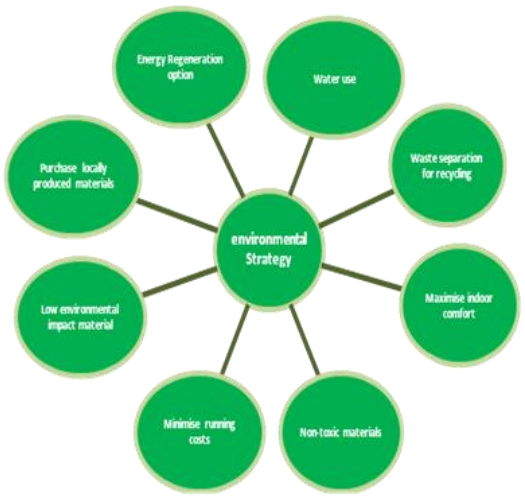


Figure 4.1 Green Building Criteria
(Source : Steve Anthony Lojuntion, Pusat Tenaga Malaysia)

### 4.3.1 Developers to Promote Green Design

In Malaysia, the construction sector is worth RM50 billion a year, which accounts for 3.5% of our GDP and provides employment to over 800,000 workers (Jamilus, 2010). The output of our construction industry has a major impact on our environment. Construction is viewed by the public as destructive to the natural environment. This perception stems from the argument that built environment can only be developed at the expense of destroying the natural environment. It is therefore necessary to seek a path that will provide recovery to the construction sector and take the opportunity to address its climate change effects positively.

**I. All consultants to adopt green design process**

Green building refers to a physical structure that uses a design and planning process that is environmentally responsible and resource-efficient. Green building can be classified as sustainable if it follows the following process throughout a building's life-cycle: planning to design, construction, operation, maintenance, renovation, and demolition. Obtaining consultants (Interior designer/materials consultant) with experience in life-cycle costs involved in the planning process is crucial in order to ensure that green design is achieved.

### 4.3.2 Use of Recyclable and Low Embodied Energy Building Materials

Embodied energy is one part of a building material's overall environmental impact. Embodied energy is the total energy required for the extraction, processing, manufacture, and delivery of building materials to the building site. Energy consumption produces CO2, which contributes to greenhouse gas emissions, so embodied energy is considered an indicator of the overall environmental impact of building materials and systems.

Unlike the life cycle assessment, which evaluates all of the impacts over the entire life of a material or element, embodied energy only considers the front-end of the impact of a building material. It does not take into consideration the operation or disposal of materials.

Energy consumption during manufacturing can give an approximate indication of the environmental impact of the material. For most building materials, the major environmental impacts occur during the initial processes. The total amount of embodied energy may account for 20% of the building's energy use, so reducing embodied energy can significantly reduce the overall environmental impact of the building.

Embodied energy must be evaluated over the lifespan of a building, and in many situations a higher embodied energy building material or system is justified because it would reduce the operating energy requirements of the building. For example, a durable material with a long lifespan such as aluminium may be an appropriate material selection despite its high embodied energy. As the energy efficiency of building increases, reducing its energy consumption, the embodied energy of the building materials will also be reduced.

**I. Encourage production and cost-effective supply chain of green construction materials in industries**

Direct interaction with supply chain partners of green construction materials can enable a company to react more quickly to changes in the market and respond more promptly to customer requests. Essential to supply chain performance is improving the effectiveness of green construction materials management. This can encompass the complete cycle of material flows: from purchasing and internal control of production materials, through planning and controlling work in the process, to warehousing, shipping, and distributing finished products.

## 4.4 Green Building Design and Technology

Design consultants, builders, and developers are all discovering the extraordinary benefits of green buildings. Today, this trend has permeated the worlds of architecture, engineering, construction, and development.

A truly green building can only materialise and sustain itself when all parties are involved in its inception. Figure 4.2 illustrates the integrated approach to achieving green building design and construction.


Figure 4.2: Integrated approach to achieving green building design and construction
(Source: Chen Thiam Leong. IMPAK, Quarterly DOE Update on Environment, Development & Sustainability. Issue 1/2009)

Some of the measures that can be introduced are:

i) Building Energy Management System (BEMS) and Industrialized Building System (IBS)
ii) Technology to conserve resource utilization in a building. This includes rainwater harvesting, solar power, thermal power for heating, etc.

For all new development in IM, the design brief for the design consultants must include the following actions:

i. Maximum north-south orientation
ii. Optimal building depths (9-13m) for maximizing natural lighting
iii. Maximise natural cross ventilation
iv. Integrate green landscaping with building facades
v. Maximise use of day lighting
vi. Insulation and passive shading of west-facing facades

### 4.4.1 Introduce Building Energy Management System (BEMS) and Industrialised Building System (IBS)

**Building Energy Management System (BEMS)**

The evolving capabilities of Building Energy Management Systems (BEMS) offer new opportunities to automate some parts of the commissioning process and can generate benefits over the entire life of a building. The evolving capabilities of BEMS can help circumvent the barriers to commissioning by offering opportunities to automate some parts of the commissioning process. Developing a detailed, systematic, and automated approach will improve the quality assurance process and could even integrate energy audit capabilities to improve the overall performance of buildings.

Monitoring the energy performance of buildings is a growing priority for building owners and operators. A comprehensive energy management plan will ensure that buildings operate at their optimized energy performance levels, while maintaining comfortable conditions for occupants and minimizing energy costs.

To introduce BEMS in IM, the following actions are recommended:

- Temperature control at 24°C. This is to be the air conditioning temperature for government office buildings
- Movement sensors for low occupancy areas
- Movement sensors for elevators and escalators

**Industrialized Buildings Systems (IBS)**

IBS is defined as a construction technique in which components are manufactured in a controlled environment (on or off site), but transported, positioned, and assembled into a structure with minimal additional work on site (IBS Roadmap 2003-2010). IBS has the potential to contribute to green buildings and construction. IBS promotes a controlled production environment, minimization of waste generation, extensive usage of energy efficient building material, effective logistics, and long term economic stability, which can contribute

to better investment in environmental technologies (Kamarul et al 2010).

In 2008 the use of IBS was made mandatory in the construction of public buildings (under Treasury Circular 7/2008). The goal of this policy was to create sufficient momentum for the demand of IBS components (Kamarul et al 2012).

IRDA should take a leading role by demonstrating its commitment to addressing green building and construction issues and meeting its obligations in this regard. IRDA is urged to use innovative construction techniques and to shift from the traditional practice of using brick and mortar to using Industrialized Building System (IBS). IRDA should realise that innovative construction in Iskandar Malaysia holds the key to delivering the solutions that will address the challenges of climate change and the more efficient use of the resources. The close tolerance and high quality control offered by IBS will ensure optimal use of energy and reduced carbon emissions; this would help attain the revised target of converting 30% of all new buildings in Iskandar Malaysia to be green and low carbon by the year 2025.

**I. Temperature Control at 24 0C (air conditioning for government offices)**

Prudent and efficient use of electricity is kinder to the environment and can also save money and generate more profits. Reducing electricity consumption in government offices requires only a minor change. For example, the government officers in sunny Malaysia are typically seen walking around in sweaters, which is a clear sign that the air conditioning is too cold. Raising the temperature settings by 1°C can visibly affect the total electricity bill at the end of the month, and, most importantly, contributes to low GHG emissions.

**II. Movement sensors for low occupancy areas**

There are a few initiatives that we can initiate to save more energy by identifying low occupancy areas:

- In offices where the wall switch is visible from the work space, replace the switch with a passive infrared wall switch sensor. Take advantage of the built-in light level feature to keep lights off when ample sunlight is present.
- Control lighting in restrooms with ultrasonic sensors and eliminate hours of unneeded on-time. Ceiling-mounted ultrasonic sensors can detect motion around restroom stalls for reliable coverage.
- In open or partitioned offices, use ultrasonic or dual technology sensors. Placed on the ceiling, these sensors cover areas in overlapping zones.

**III. Consultants to adopt Industrialized Building System (IBS) in their design processes**

The government of Malaysia has invested much unrealised effort toward starting the implementation of IBS in their construction contract and roadmap for IBS for 2010. Unfortunately, the industry stakeholders are indifferent to this idea and resist moving toward this change, probably due to ignorance (lack of ideas and awareness or lack of effort in understanding the concept) and the costs of a technology transfer. These costs can be initially high in implementation.

### 4.4.2 Climatically Responsive Building Design

During the initial design stages, the design consultants must take into consideration the external environment and climate in the design process. An integrated design process would reduce the cost of green buildings.

The integrated design process typically covers the following steps:

- Analysing green building and green criteria (GBI, CASBEE-or equivalent) related design tasks, with specific assignments for each team member
- Coaching and facilitation by an experienced green building expert
- Modelling of key energy-using systems by the mechanical engineer
- Preparing green specifications for the construction team
- Construction period monitoring to ensure green goals and measures are not compromised
- Commissioning the building to make sure all energy saving measures are functioning according to the design intent
- If aiming for GBI or CASBEE certification, documenting the achievement of specific requirements, which is often done by a specialist green building consultant

**I. Maximise north-south orientation**

Layout and orientation must be considered from the beginning of the design process. Orientation, layout, and location on site will all influence the amount of sunlight a building receives and its year-round temperature and comfort levels Other considerations include access to scenic views and cooling breezes. Orientation and layout will be influenced by topography; wind speed and direction; the site's relationship to the street; the location of shade elements such as trees and neighbouring buildings; and vehicle access and parking.

**II. Optimal building depths (9-13m) for natural lighting**

Lighting is an essential feature of any workplace. It is preferable to provide uniform illumination over the entire building by combining both natural and artificial lighting. Localised lighting may be required in certain cases to cut costs and improve illumination. 47% of the energy used in a home is for the purpose of space conditioning (lighting and temperature control). Natural light produces energy savings by allowing a homeowner to use less heat and less air conditioning while eliminating the need to use artificial light. In some cases, adding natural light to a building resulted in a decrease in energy costs by as much as 75% (Gregory, 2012).

**III. Maximise natural cross ventilation**

Natural ventilation is the process of supplying and removing air through an indoor space without using mechanical systems. It refers to the flow of external air to an indoor space as a result of pressure or temperature differences. Natural ventilation, as an alternative to mechanical ventilation, provides several benefits: low running cost, zero energy consumption, low maintenance, and lower initial cost. Natural ventilation is also regarded as healthier because it results in fewer hygiene problems with ducts and filters. There is also a "naturalness" in the way that it connects with the outdoors.

**IV. Integrate green landscaping with building façades**

Green facades are created by vines and climbing plants that are rooted in soil or containers. They can grow upwards or cascade down. Green facades require a structure to maintain their position, develop growth, and survive through seasonal exposure. Green facades are easily scalable and rely on the adaptable characteristics of a broad range of plant species. A building can heat up when exposed to solar radiation, which leads to an increased demand on cooling systems and the energy they consume. Building façades can help cool the building and bring aesthetic value, heightened indoor air quality, and increased energy savings.

**V. Maximise use of day lighting**

Day lighting is the practice of placing windows or other openings and reflective surfaces so that natural light provides effective internal lighting during the day. Particular attention is

given to day lighting while designing a building when the goal is to maximize visual comfort or to reduce energy use. Energy savings can be achieved either from the reduced use of artificial (electric) lighting or from passive solar heating or cooling. The energy use of artificial lighting can be reduced by simply installing fewer electric lights since daylight is present in the space, or by installing dimming switches for electric lights. These automatically dim lights in response to the presence of daylight, a process known as daylight harvesting.

### 4.4.3 "Build to Last" Buildings-Longer Building Lifespan

A growing global population is straining the finite resources available on the planet. Sustainability seeks to balance the economic, social, and environmental impacts of population growth, while acknowledging that it will continue. The consideration of sustainable development brings this evaluation to the design and construction industries, which have significant potential to reduce the negative impact of human activities on the environment.

All buildings have specific purposes and functions to fulfill. Some buildings are designed to have a shorter life span than others. The building's "needs" or requirements may change with the passage of time. Therefore, buildings that can accommodate changing needs may "last" longer and any design and construction of a building should be "built to last" rather than "built to the need".

Any building design and construction must consider the following factors:

i. Enhancement of building durability
ii. Maximum space adaptability

**I. Enhance building durability**

The durability performance of construction materials is important and must be considered both in terms of its benefits to society and in terms of the environmental impact associated with its use in construction. Production of Portland cement (PC), in particular, is energy intensive and generates a significant amount of carbon dioxide. Cement is, however, only a relatively small component of concrete and overall the material is resource efficient; it has moderate embodied energy and a moderate carbon dioxide footprint. Concrete is widely used due to its low cost, ease of use, good track record, versatility, local availability, thermal benefits, acoustic dampening, and durability.

**II. Maximise space adaptability**

To fully realise the goal of developing spaces that can reach maximum adaptability, careful and practical assessment of existing building conditions, building suitability and type, available space, built form, environmental sustainability, furniture, equipment, and technological infrastructure is needed. When developing the Master Plan, it is necessary to consider the physical environment surrounding the space, which may contain adjacent parish and community facilities, landscaped and outdoor areas, and places of interest. Community connection to the space is important, and the consideration of internal and external environmental elements is paramount. Planning for these features should occur at the beginning of the facility planning process. Spaces should:

- Have excellent natural cross-ventilation
- Have extensive natural lighting
- Include sustainable heating and cooling where necessary
- Be suitably orientated to maximise environmental benefits
- Be heavily insulated to ensure building efficiency
- Incorporate sophisticated "green" building systems where possible
- Incorporate energy efficient lighting
- Recycle and reuse water wherever possible
- Use efficient water fixtures

## 4.5 Rural Green Buildings

Vernacular architecture is an area of architectural theory that studies the structures constructed by empirical builders without the intervention of professional architects.

### 4.5.1 Conservation and Promotion of Vernacular and Climatically Adapted Architecture in Rural Areas

In the context of architecture and urban design, sustainable architecture can be achieved if cultural and ecological aspects are synergized as two connected entities. Cultural context implies a sound respect for the traditional knowledge of place, technology, and local materials. Ecological context implies the recycling of energy, either by the use of passive energy or by the use of renewable energy.

Malay houses are nearly a perfect solution which allows control of climate, multifunctional use of space, and flexibility in design. They are a sophisticated prefabricated system which can extend with the growing needs of the family (Figure 4.4: Yuan, 1987). The Malay house is designed with deep understanding and respect for nature. Traditional Malay houses in rural villages are usually surrounded by many tall trees and grass covers the surrounding areas.

The Malay house has benefitted from the cooler outdoor micro climate and shade from trees to improve its passive cooling (Doris et al); the tree shade forms first layer of defence against the tropical sun. It is important to design better microclimates in urban areas to achieve indoor thermal comfort in modern Malaysian houses.

One important source of energy consumption is the built environment. Architectural design vastly contributes to alleviating this issue. Many vernacular technologies, resources, and forms are suitable, sustainable, and low carbon. The traditional Malay house has been designed to suit the local climatic requirements by the installation of various ventilation and solar control devices, as well as by using low thermal capacity building materials (M.M. Tahir et al).

The conservation and promotion of vernacular, climatically adapted architecture in rural areas must be encouraged by the following:

1. Subsidies for conservation of vernacular structures such as traditional timber houses, mosques, schools, community centres, clinics, shops, and holiday cottages
2. To promote reinterpretation and adaption of vernacular construction principles and methods in new construction

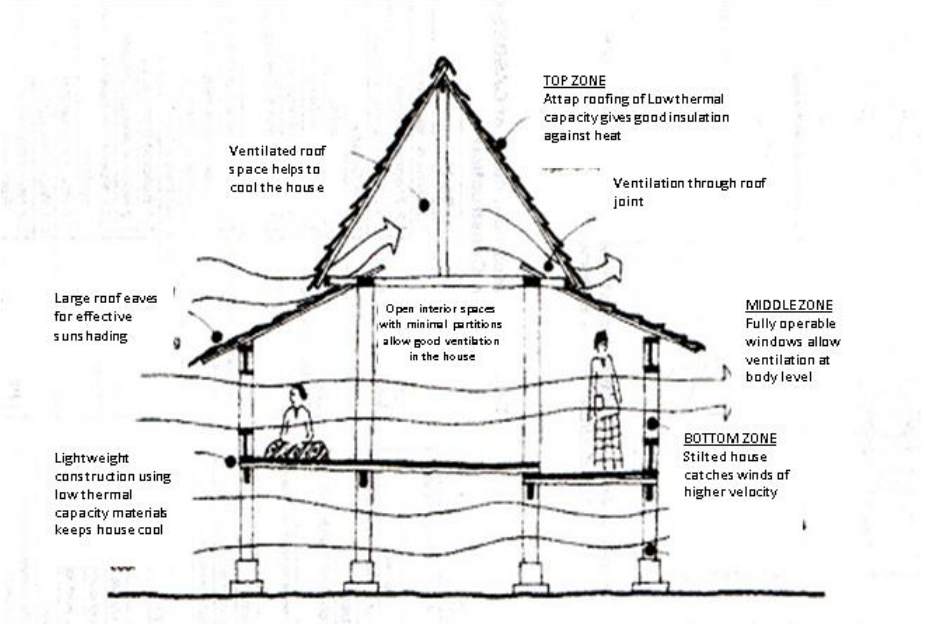


Figure 4.3: Environmental Details of Malay House

(Source : Lim Jee Yuan: The Malay House: Rediscovering Malaysia`s Indigeneous Shelter System, Institute Masyarakat, 1981.)

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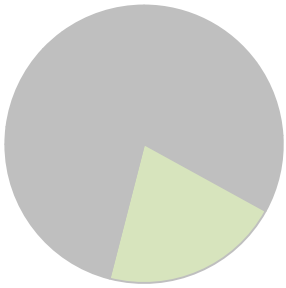
Action 5

# Green Energy System and Renewable Energy

Haslenda Hashim, Suichi Ashina, Diego Silva Herran, Lim Jeng Shiun, Ho Wai Shin and Siti Aktar Ishak

**GHGs Emission Reduction**



2,725 $ktCO_2eq$

21%

Energy supply is the main driver of development as well as the largest emitter of greenhouse gases (GHG). In Iskandar Malaysia, increasing energy demand and carbon emission over the years is inevitable due to the rapid growth in economic. Hence, low carbonisation of the energy supply is therefore one of the key factors toward the realisation of Low Carbon Society in Iskandar Malaysia. Three strategies are therefore presented: (1) promotion of renewable and alternative energy utilisation such as solar energy, biomass, biogas, waste, hydrogen, etc.; (2) establishment of advance energy system such as smart grid and decentralised electricity generation which incorporate both the supply and demand side for a more sustainable, cleaner, reliable, se-cure, robust and efficient system; (3) provision of incentives and subsidies and derivation of tariff rate to promote the utilisation renewable and alternative energy. Through this action, it is expected, up to 2,725 $ktCO_2eq$ of GHG will be reduced by 2025 (21% of the total emission reduction).

# 5.0 Green Energy System and Renewable Energy

Renewable energy (RE) has been designated a primary option to overcome the dependence on fossil fuels and also as a solution towards energy crisis and global warming. Even so, due to the intermittency of renewable resources, smooth operation of renewable energy systems cannot be achieved without detailed planning and control. For that reason, the green energy system, built on the concept of renewability and efficiency, has been introduced as the key factor for achieving sustainability in the energy sector.

Action 5 (Green Energy System and Renewable Energy) thus focuses on providing guidelines to achieve a low carbon energy supply system in Iskandar Malaysia through the implementation of actions for RE and energy efficiency (EE). Action 5 consists of three sub actions:

- Promotion of Renewable/Alternative Energy
- Establishment of Advances Energy System i.e. Smart Grid, Decentralized Electricity Generation System
- Provision of Incentives and Subsidies and Derivation of Tariff Rate

There are three strategies for the development of green energy system in Iskandar Malaysia. The three strategies include implementation of renewable energy (RE), improvement of energy system by incorporating advance energy system and promotion of their development through incentives, and subsides and political assistance.

Implementation of these three strategies can be further broken down. RE/Alternative energy implementation can be broken down to different RE and/or alternative energy in Iskandar Malaysia such as solar, biomass, SW, and hydrogen. There are also many other advance energy systems, including hybrid systems, that can enhance better energy utilisation, such as distributed energy system with incorporation of energy storage and eco-industrial park (EIP). Lastly, political assistance may be given through direct subsidy to purchase of facilities, feed-in-tariff and creating an energy market.

Nevertheless, implementation of these strategies must be introduced gradually over the development period of Iskandar Malaysia, mainly to ensure smooth development and to allow gradual modification to the current energy system. Among these options, some of the options are still in development and could pose as a better option in the future, for instance solar energy. On the contrary, there are also technologies which would require tremendous modification to the existing energy system and therefore not suitable for large-scale implementation at the moment, but they are still important options for future implementation.

Due to these scenarios, it is important to identify the appropriate option to be implemented for the short term and long term planning. From the three main strategies, RE/Alternative energy and advance energy systems should be developed hand-in-hand, and incentives and subsidiary schemes should be established in line with development of said strategies.

## 5.1 Promotion of Renewable / Alternative Energy

RE resources availability depend on geographic locations. The potential RE sources in Iskandar Malaysia include solar, biomass (from palm oil mill), biogas (palm oil mill effluent (POME) and sludge), municipal solid waste (MSW), and hydrogen.

### 5.1.1 Harnessing Solar Energy

Energy from the sun can be directly harnessed as electricity through a solar photovoltaic (PV) system or as heat through a solar thermal system. Since Iskandar Malaysia is located in a tropical climate, it receives up to an average of 1575 kWh/$m^2$ of solar radiation annually (RE and EE Blueprint of Iskandar Malaysia, 2010). Assuming that all energy is utilised, the sun can provide more or less about 3000 TWh of power

annually. Harnessing just 1% of the total energy is in fact, more than sufficient to fully supply the energy needs of Iskandar Malaysia.

Solar thermal system functions mainly through focusing sunlight to generate heat and the system could contribute to reducing $CO_2$ from generating hot water. In general, the heat source is usually utilised for water heating in houses. For that reason, solar thermal system might only be suitable in certain conditions and applications. In industries, solar thermal can be applied also as a power generator for on-site application or a cooling or heating device to produce chill or hot water (Weiss, 2006). In the residential and commercial sector, solar thermal systems mainly function as a heating device for hot water production (Clean Power Solar Thermal Website).

While solar PV system produces electricity directly by converting solar radiation, solar thermal system works by using heat from the radiation to produce high pressured steam to operate a turbine to generate electricity (Becker et al., 2000).

Although solar energy appears to be a promising source of energy, the implementation of solar technologies for solar energy exploitation requires vast areas. The identification of a suitable location and site are important to prevent wastage of useful land space. On the contrary, operation of solar systems is pollutant-free, and therefore is one of the most suitable technologies for low carbon developments. In order to analyse potential energy generation from solar systems in Iskandar Malaysia, Table 5.3 shows the available land areas for solar installation and its corresponding energy potential. Noted, that the calculation is based on the average solar radiation of 1575 kWh/m$^2$ with an average solar system efficiency of 15%.

Table 5.1: Available Area for Solar Energy Systems (Source: Comprehensive Development Plan, 2006)

| | **Available Area (hectares)** | **Energy Potential (GWh/yr)** |
|---|---|---|
| **Solar Farms** | | |
| Vacant Land | 17381.85 | 41064.62 |
| **Solar for residential use[1]** | | |
| Villages | 2952.92 | 1395.25 |
| Planned Housing Area | 6771.93 | 3199.74 |
| **Solar for commercial and public use[1]** | | |
| Commercial | 1213.23 | 573.25 |
| Public Amenities | 78.18 | 36.94 |
| Government Use | 266.83 | 126.08 |
| Religious Reserve | 157.10 | 74.23 |
| Education Reserve | 2251.30 | 1063.74 |
| Security and Emergency Facilities | 147.48 | 69.68 |
| Health Facilities | 354.91 | 167.69 |
| **Totals** | **31575.73** | **47771.23** |

[1] The energy potential for residential, commercial and public is calculated based on an assumption that only 20% of the total area is suitable for solar PV installation.

Despite having sufficient land areas and abundant of solar energy waiting to be harnessed, implementation of solar energy systems is still under research and development. This is mainly due to the low efficiency of the system, leading to a high installation cost. Reports indicate that the installation cost for solar energy systems, may they be for electricity or heat generation, is still higher than those of other existing technologies, such as thermal power generator for electricity or gas or electric water heater for heat (Ali et al., 2009).

However, as the operational cost of these systems are relatively low (free solar energy compare to fossil fuels), long term economic gains are certain. The average payback for solar systems is presumed to be about 20 years (Haris, 2010). In addition, studies also show that installing solar energy systems in existing households results in an increase of their resale value taken from the overall cost of the system.

The entire investment might be able to be recovered when reselling the home (Hoen et al., 2011).

**I. Encouraging Solar PV as PV roofing, PV farm and PV on public infrastructure**

There are several technological options for diffusing PV system in IM. Most popular technology is solar PV panels. Solar PV panels convert solar radiation directly into direct current (DC) electricity, usually required to be converted to alternating current (AC), before it can be injected to the grid or utilised by electrical equipment and appliances.

Strategies for solar PV implementation usually involve a large scale project with a large area of land space allocated for the installation of arrays of solar PV panels, also known as a solar farm (Figure 5.1) to generate large amount of power (up to several megawatt (MW) or higher) or a smaller scale project where the solar PV panels are installed on the roofs of existing buildings and infrastructure, such as residential houses, commercial buildings (shopping centres, offices, and so on), street lamps, bus stops, and many more.

In Iskandar Malaysia, there are many available land areas for the construction of solar farms, making them a potentially useful choice for sustainable energy production. While the cost of the system may be a barrier at the moment, it will definitely become an important source of energy in the near future.

Figure 5.1: Solar farm (Source: Bendygo Website)

**II. Promotion of Solar Thermal for PowerGeneration**

Solar PV in building could be accelerated through building-integrated PV (BIPV), in which PV materials are used to replace conventional building materials in parts of the buildings such as the roofs, skylights, or cover-ups. The advantage of integrating solar PV in existing buildings is that besides being used to produce electricity, the panel could also function as roofs, building façades and shading devices (Sopian et al., 2005). The most important benefits of BIPV systems come from the ability to employ PV systems without excessive land-use, since they become a part of the building structure. Generally, as long as there is sufficient sunlight throughout the day on the specific part of a building, solar PV can be potentially used to exploit solar energy.

Figure 5.2: PV roofing (Source: Suntappers Website)

PV systems can be incorporated into Non-Building Structures (NBS) such as bus shelters, information signs, traffic and street lights, and sound barriers (Andersson and Romero, 2001).As a mean of power storage for on-site use at night or cloudy weather, batteries may be used. PV panels, however, may run the risk of getting vandalised or stolen. Planners need to find a solution as to prevent any kind of damage of the PV panels (Berry, 2011)

### 5.1.2 Utilisation of Energy from Waste

In recent years, waste to wealth has been a hot topic discussed globally. Instead of disposing of

waste, it could in fact be utilised for other beneficial purposes, such as energy.

In Iskandar Malaysia, the top three potential resources for waste to energy, based on long term availability and abundance, are agriculture wastes (palm oil biomass), municipal solid waste, and sewage sludge.

Conversion of waste resources to energy can be generalised into two different categories: conversion for solid waste and conversion for gaseous waste.

**I. Applying waste treatment technologies for energy generation from municipal solid waste (MSW), agricultural waste and sewage sludge**

In Iskandar Malaysia, the potential waste that can be converted into energy includes municipal waste (MSW), industry waste (IW), sludge and agricultural waste (AW). Table 5.4 shows the amount of available waste resource under three different scenarios of years, i.e.: i) a baseline (BL) case for year 2005, ii) business as usual case (BAU) for year 2025, iii) carbon emission management (CM) case for year 2025. In general, the MSW, IW and sludge are forecasted to be markedly increased over the years, due to the continual development of Iskandar Malaysia as an economic hub, increase of population and economic growth. On the other hand, the availability of AW should be reduced, due to the conversion of agricultural land into commercial land or industrial land.

Table 5.2: Production of biomass in Iskandar Malaysia (tons/year)

| | 2005 (BL) | 2025 (BAU) | 2025 (CM) |
|---|---|---|---|
| **MSW** | 467,253 | 1,577,403 | 1,498,533 |
| **IW** | 296,023 | 1,089,885 | 790,260 |
| **Sludge** | 32,290 | 71,197 | 71,197 |
| **AW** | | | |
| **EFB** | 511,464 | 306,878 | 409,171 |
| **MF** | 307,848 | 184,709 | 246,278 |
| **PKS** | 269,064 | 161,438 | 215,251 |
| **POME** | 1,454,400 | 872,640 | 1,163,520 |
| **OPF** | 2,908,800 | 1,745,280 | 2,327,040 |
| **OPT** | 484,800 | 290,880 | 387,840 |
| **GW** | 16,182 | 24,406 | 24,406 |
| **Total AW** | 5,952,558 | 3,586,232 | 4,773,507 |
| **Total** | 6,748,124 | 6,324,717 | 7,133,497 |

[1] BL = baseline, [2] BAU = business as usual, [3]CM = carbon emission management

The agricultural waste (AW) is mainly available from the palm oil industry in the form of empty fruit bunches (EFB), palm kernel shells (PKS), mesocarp-fibres (MF) and palm oil mill effluent (POME) which is a source for biogas, along with oil palm front (OPF) and oil palm trunk (OPT). There are also some minor quantities of green waste (GW).With a plantation area of about 101,585 hectares (of Table 11.10; pg 11-14), the abundant biomass will be collected in palm oil mills in and around Iskandar Malaysia. With an estimated production of 20.2 tonne per year per hectare of fresh fruit bunches (FFB), the total collectable FFB is up to 2,052,016 tonne (Evald, 2005). As of year 2005, the total availability of AW is 5,952,558 tonne per year. This is expected to be reduced to 3,586,232 tonne, under the scenario of BAU in 2025. However, with the in place of carbon emission reduction activities, such as land reserving, the availability of AW should be able to maintain at 4,773,507 tonne.

In Iskandar Malaysia, most of the wastes generated are dumped into open landfills. All this open landfill should be upgraded into sanitary landfill to capture the methane gas a source of green energy.

Currently, there are only three waste sites in Iskandar Malaysia which have the potential for energy tapping; Tanjung Langsat, Seelong and Pekan Nenas. Among the three waste sites, Pekan Nenas landfill has already ceased operation and a new landfill in Ulu Choh, Pontian will be replacing it in the near future. As of current, the total waste produced in Iskandar Malaysia is about 700,000 tonne per year and is expected to increase in the near future. The estimated lower heating value of the waste is Iskandar Malaysia is about 14.77 GJ/tonne and provides up to an energy

potential of 10,339 TJ (RE and EE Blueprint of Iskandar Malaysia, 2010).

Iskandar Malaysia has about 190 locations of sludge sources. The total amount of sludge collectable in a year totals to about 693,060 $m^3$ (499,696 tonne at density of 0.721 tonne/$m^3$) and could yield up to about 262,340,400 $m^3$of biogas. Out of this sludge, the potential that can be utilised for energy production is 32,290 tonnes.

The potential electricity to be generated from various renewable energy resources in IM is shown in Table 5.3.

Table 5.3: RE Development in Iskandar Malaysia

| Power Generation (kWh) | | | |
|---|---|---|---|
| **-** | **2005** | **2025 (BAU)** | **2025 (CM)** |
| **MSW (MW)** | 41.77 | 141.02 | 1,339,024 |
| **IW** | 12.75 | 40.54 | 17.82 |
| **Sludge** | 4.24 | 9.31 | 402,730 |
| **CW** | 0.39 | 0.78 | 0.47 |
| **AW** | 1,028,199 | 616,921 | 3,335,649 |
| **Total** | 1,028,258 | 617,113 | 5,077,421 |

Solid wastes (biomass and MSW) can be converted through direct incineration in a thermal power plant utilising a steam turbine which applies the Rankine cycle (Kiameh, 2003).

Another option to convert the solid fuels is through a more advance technology such as gasification and pyrolysis. Through gasification or pyrolysis, fuel which is originally in solid form is converted to fluids and which can be utilised similarly to biogases or landfill gases which will be discussed later. Even though these advanced technologies are proven to have higher efficiency, they are more costly compared to direct incineration.

For solid biomass, one of the interesting facts is that it can be modified to have similar properties such as coal, making it possible to replace coal with fuel in a coal power plant. In such a situation, either partial replacement or full replacement are both possible.

As for MSW, as it comprises of many different materials, the efficiency for direct combustion is rather low, mainly due to the existence of non-combustible (glass metal) and high humidity (food waste) materials. This is especially true in Iskandar Malaysia, where segregation of waste is rarely practiced. Nevertheless, with proper segregation systems, the prospect of utilising MSW as a fuel source for power production could be enhanced. On the other hand, organic or food waste could also be digested by anaerobics to produce biogas or dried to increase the overall performance. This of course requires organic or food waste to firstly be segregated. Apart from the above sewage sludge can also be dried and apply as solid fuel.

For gaseous waste, once the biogas or landfill gas is captured, conversion to energy could be done through a thermal power plant utilising a gas turbine applying the Brayton cycle (Kiameh, 2003) or combined cycle system (U.S. Energy Information Administration, 2010). Additionally, sewage sludge can be dried to be used as a solid fuel and subsequently generate electricity using a steam turbine.

POME is a major waste stream in the crude palm oil production plant with high emission rate of GHG. Upon discharge from the mill, POME is in the form of thick dark brownish colloidal slurry with water, oil and fine cellulosic materials. Freshly-produced POME contains 96% of water, 0.6-0.7% of oil and comprises solid in the form of suspended and dissolve solid (Zakaria, 2000). For every tons of crude palm oil (CPO) produced, about 2.5 tonnes of POME will be generated from sterilisation, crude oil clarification and cracked mixture separation operation (Ma, 2002).

Anaerobic decomposition of POME can reduce the BOD content for up to 95% of its original BOD (Hassan *et. al.,* 2000). It involves the breakdown of organic waste to primarily methane (65%) and carbon dioxide gas (35%) in the absence of oxygen where methane can also be harnessed for heat and electricity generation. It is particularly suited for the treatment of high temperature and high

strength wastewater. The process will produce a significant quantity of biogas that can be converted into electricity.

In addition, a thermal plant can be designed as a co-generation or tri-generation plant to produce hot and chill water thus increasing the overall efficiency of the system.

In general, these systems share a similar configuration, as the raw resources have to be processed before they can actually be used. For that reason, the cost for each specific system is different. The list of selected technologies including the estimated overnight capital cost, fixed operating and maintenance (O&M) cost, and variable O&M cost are as listed in Table 5.4 (U.S. Energy Information Administration, 2010).

Table 5.4: Cost of Technology
(Source: U.S. Energy Information Administration, 2010)

| List of technology | Overnight Capital Cost[2] (RM/kW) | Fixed O&M Cost (RM/kW) | Variable O&M Cost (RM/MWh) |
|---|---|---|---|
| **Solid Fuel Gasification** | 24594 | 1050 | 51.58 |
| **Solid Fuel Incineration** | 11966 | 312 | 15.50 |
| **Gas Capturing** | 25519 | 1159 | 25.82 |

[1] Noted that the cost estimation for solid fuel gasification and incineration are based on biomass resources and gas capturing is based on landfill gas capture.

[2] The cost is based on U.S. Energy Information Administration, but it is converted to Ringgit Malaysia (RM) with a conversion rate of RM 3.10 to 1 USD

Table 5.5 and Table 5.6 show the usage of waste in different technologies, including landfill (LF), incinerator (INC), anaerobic digester (AD) and biomass thermal plant (BTP). The potential power generated from these technologies is shown in Table 5.7, Table 5.8 and Table 5.9, based on the waste utilisation in three different scenarios. Finally, Table 5.11 shows a summary of total power generated from different waste. In the case of year 2025 (CM), the total power generated from waste is 5,077,421 MWh, resulting in a reduction in carbon emission that amounts at 3.2 million tonnes/year.

Table 5.5: Utilisation of waste in different technology

| | 2005 (BL[1]) | 2025 (BAU[2]) | 2025 (CM[3]) | | |
|---|---|---|---|---|---|
| | LF[4] | LF[4] | LF[4] | INC[5] | AD[6] |
| **MSW** | 95% | 95% | 80% | 14% | 0% |
| **IW** | 97% | 91% | 50% | 10% | 0% |
| **Sludge** | 100% | 100% | 1% | 16% | 80% |
| **CW** | 100% | 100% | 100% | 0% | 0% |

[1] BL = baseline, [2] BAU = business as usual, [3]CM = carbon emission management, [4]LF = landfill,[5] INC = Incineration, [6]AD = Anaerobic digestion

Table 5.6: Utilisation of agriculture waste in different technology

| | 2005 (BL[1]) /2025 (BAU[2]) | | | 2025 (CM[3]) | | |
|---|---|---|---|---|---|---|
| | LF[4] | BTP[5] | AD[6] | LF[4] | BTP[5] | AD[6] |
| **EFB** | 30% | 15% | 0% | 0% | 60% | 0% |
| **MF** | 0% | 20% | 0% | 0% | 80% | 0% |
| **PKS** | 0% | 20% | 0% | 0% | 80% | 0% |
| **POME** | 70% | 0% | 30% | 0% | 0% | 90% |
| **OPF** | 30% | 0% | 0% | 30% | 0% | 0% |
| **OPT** | 30% | 0% | 0% | 30% | 0% | 0% |
| **GW** | 30% | 0% | 0% | 20% | 50% | 0% |

[1] BL = baseline, [2] BAU = business as usual, [3]CM = carbon emission management, [4]LF = landfill, [5] BTP = Incineration, [6] AD = Anaerobic digestion

Table 5.7: Power (kWh) generated by waste in different technology (2005)

| | LF[1] | BTP[2] | AD[3] | Total |
|---|---|---|---|---|
| **MSW** | 41,772 | - | - | 41,772 |
| **IW** | 12,752 | - | - | 12,752 |
| **Sludge** | 4,237 | - | - | 4,237 |
| **CW** | 391 | - | - | 391 |
| **AW** | | | | |
| **EFB** | 52,944 | 401,949,328 | - | 402,002,272 |
| **MF** | - | 325,650,850 | - | 325,650,850 |
| **PKS** | - | 300,005,015 | - | 300,005,015 |
| **POME** | 131,737 | - | 56,459 | 188,196 |
| **OPF** | 301,110 | - | - | 301,110 |
| **OPT** | 50,186 | - | - | 50,186 |
| **GW** | 1,704 | - | - | 1,704 |
| **Total AW** | 537,680 | 1,027,605,193 | 56,459 | 1,028,199,332 |
| **Total** | 596.832 | 1,027,605,193 | 56,459 | 1,028,258,484 |

[1] LF = landfill, [2] BTP = Biomass thermal plant, [3] AD = Anaerobic digestion

Table 5.8: Power (kWh) generated by waste in different technology (2025 BAU)

| | LF | BTP | AD | Total |
|---|---|---|---|---|
| **MSW** | 141,021 | - | - | 141,021 |
| **IW** | 40,539 | - | - | 40,539 |
| **Sludge** | 9,305 | - | - | 9,305 |
| **CW** | 784 | - | - | 784 |
| **AW** | | | | |
| **EFB** | 31,766 | 241,169,597 | - | 241,201,363 |
| **MF** | - | 195,390,510 | - | 195,390,510 |
| **PKS** | - | 180,003,009 | - | 180,003,009 |
| **POME** | 79,153 | - | 34,014 | 113,166 |
| **OPF** | 180,668 | - | - | 180,668 |
| **OPT** | 30,111 | - | - | 30,111 |
| **GW** | 2,528 | - | - | 2,528 |
| **Total AW** | 324,225 | 616,563,116 | 34,014 | 616,921,355 |
| **Total** | 515,875 | 616,563,116 | 34,014 | 617,113,004 |

[1] LF = landfill, [2] BTP = Biomass thermal plant, [3] AD = Anaerobic digestion

Table 5.9: Power (kWh) generated by waste in different technology (2025 CM)

| | LF | INC | AD | BTW |
|---|---|---|---|---|
| **MSW** | 9,871 | 1,339,014,028 | - | - |
| **IW** | 17,820 | - | - | - |
| **Sludge** | 92 | 39,198,220 | 363,531,882 | - |
| **CW** | 470 | - | - | - |
| **AW** | | | | |
| **EFB** | - | - | | 1,286,237,851 |
| **MF** | - | - | | 1,042,082,719 |
| **PKS** | - | - | | 960,016,047 |
| **POME** | - | - | 135,501 | - |
| **OPF** | 90,334 | - | | - |
| **OPT** | 15,056 | - | | - |
| **GW** | 630 | - | | 47,070,793 |
| **Total AW** | 106,020 | - | 135,501 | 3,335,407,410 |
| **Total** | 134,274 | 1,378,212,248 | 363,667,383 | 3,335,407,410 |

[1] LF = landfill, [2] INC = Incinerator, [3]AD = Anaerobic digestion, [4] BTP = Biomass thermal plant

Table 5.10: Power (MWh) generated by waste

| | 2005 | 2025 (BAU) | 2025 (CM) |
|---|---|---|---|
| **MSW** | 41.77 | 141.02 | 1,339,024 |
| **IW** | 12.75 | 40.54 | 17.82 |
| **Sludge** | 4.24 | 9.31 | 402,730 |
| **CW** | 0.39 | 0.78 | 0.47 |
| **AW** | 1,028,199 | 616,921 | 3,335,649 |
| **Total** | 1,028,258 | 617,113 | 5,077,421 |

### 5.1.3 Hydrogen Utilisation

Hydrogen is a secondary energy source which is clean and does not damage the environment when consumed. In Iskandar Malaysia, hydrogen can be produced from thermal conversion of natural gas and biomass and from electrolysis of electricity and can be delivered by pipeline and/or tank. The source of electricity, on the other hand, can be from solar PV system or from the grid. The usage of electricity from the grid is for storage purposes however, and will be discussed in later section.

#### I. Research and development of hydrogen technologies

As mentioned, hydrogen is produced from primary resources (natural gas, biomass and solar). For that reason, rather than using these primary resources directly for electricity production or as a fuel source for transportation, additional cost and lower overall efficiency can be expected from the implementation of hydrogen technologies (Winter, 2009). Despite that obvious disadvantage, hydrogen systems and technologies may actually be very beneficial as a solution to the current issues faced by fossil fuel systems and renewable energy systems.

In order to show the advantage of hydrogen system, a comparison between the use of the respective primary resources for hydrogen production and direct usage of the primary resources is shown here.

First is the comparison between hydrogen and natural gas. The benefit of hydrogen compared to natural gas is mainly in the transportation sector. Currently, many vehicles use natural gas as a fuel and during combustion, greenhouse gases are emitted. These gases contribute to global warming and hinder the planning of a low carbon city which Iskandar Malaysia is envisioned to be. The retention of these gases as a solution to reduce carbon dioxide emission however is impossible as it is spread throughout the city.

However, if the natural gas is converted to hydrogen before it is used as a fuel in vehicles, the greenhouse gases can be captured and stored through carbon capture and storage (CCS) technology used during the conversion process. Utilisation of hydrogen as fuel for vehicles through fuel cell conversion or hydrogen combustion engine does not produce any greenhouse gases. Simply by this advantage alone, hydrogen fuel can be said to be the most appropriate fuel for a truly clean and green community.

Next are hydrogen and biomass. Similar to natural gas, the main advantage of hydrogen over biomass is the production of a cleaner fuel for vehicles, where through CCS technology the carbon emitted during the conversion can be captured and stored.

Last is a comparison between hydrogen and solar. Production of hydrogen through electrolysis from electricity produced by solar PV system solves the intermittency of solar energy. In this configuration, all electricity produced by the solar PV system is converted to hydrogen before it is again converted back to electricity constantly through a fuel cell (Kazmerski and Broussard, 2004). By doing so, the stability and reliability of the system are thus guaranteed and back-up system for stability and reliability assurance of solar PV system can be abided.

Further research and development need to be carried out to improve the economic feasibility of adopting these hydrogen technologies.

**II. Establishing Infrastructure for hydrogen supply**

The readiness of the society of accepting the use of hydrogen fuelled vehicles is the key to establish a hydrogen supply infrastructure. Also, the establishment of hydrogen transport infrastructure can be built up gradually, through demonstration projects in urban areas around the country, before eventually being linked together in a national network. IM would be an ideal candidate to be the showcase of such a hydrogen network.

**III. Producing and promoting utilisation of hydrogen**

Although hydrogen can be proved to be more advantageous than the primary resources in terms of environmental conservation of the technologies, it is economically incomparable to the conventional fossil fuel technologies and renewable energy technologies as it is much more costly, making it unattractive for investment and implementation. However, regarding the progressing development of hydrogen technology, it should always be kept as an option for future use once the technologies are economically competitive.

## 5.2 Establishment of the Advanced Energy System

The advanced energy system is comprehensive system for energy supply which is decentralised and has several key technologies such as distributed energy generation, energy storage, demand response technology and load management system with IT technologies.

In the current energy system, electricity is produced from several centralised power plants and then transmitted and subsequently distributed to the end users. However, due to several pressing issues related to the current system, there is a call for a more advanced system based on the renewable energy. The smart grid that contribute to the current scenario include the constraints on the construction of new transmission lines (for centralised system), increased customer demand for highly reliable electricity, electricity market liberalisation and mitigation of global warming.

### 5.2.1 Employing Distributed Energy System

The distributed energy system emphasise on utilising the local resources to fulfil the energy demand. It can be further categorised into distributed (or decentralised) energy generation (DEG) and district heating and cooling (DHC).

**I. Starting pilot project for installation of distributed energy generation system for power generation, district heating and cooling.**

DEG systems are systems that produce and distribute electricity within the distribution network without being injected to the transmission network. ADEG system does not necessarily consist of only renewable energy. The natural gas power plants which operate in the same manner are too considered in the DEG system. Generally, a DEG system consists of a cluster of small to medium size (1-50 MW) power generators (solar, biomass, natural gas, etc.) and energy storage devices which are optional that compliments one another for optimal operation (CIGRE, 2012). Figure 5.6 shows the conceptual design of DEG system.

The benefits from DEG can be categorised into three categories, which are (1) Combined technical and economic benefits, (2) Solely for technical benefits, and (3) Solely for economic benefits.

**1) Combined technical and economic benefits (based on Abou El-Ela et al., 2010)**

- Standby/peak use capacity: standby/peak use capacity will provide energy during peak hours (also known as peak shaving) leads to lower operating costs. In addition, it also reduces reserve requirements and associated costs to serve loads during events of unexpected failure power generation units.
- Power quality, reliability and security: DEG provides voltage supports which enhance the quality, reliability and security of the electric power supply.

**2) Technical Benefits**

- Environmental and health benefits: DEG which improves the environmental quality of the surrounding area, leading to a healthier lifestyle, will reduce health care costs (Honton, 2011).
- Grid support: DEG can aid in stabilising a dropping frequency caused by a sudden under capacity or due to excessive demand
- DEG operating within the distribution network avoids losses during transmission.

**3) Economic Benefits**

- Enhancement in DEG technologies: DEG technologies can reduce O&M costs of the power generators
- DEG reduces electricity transmission costs (Gulli, 2006).

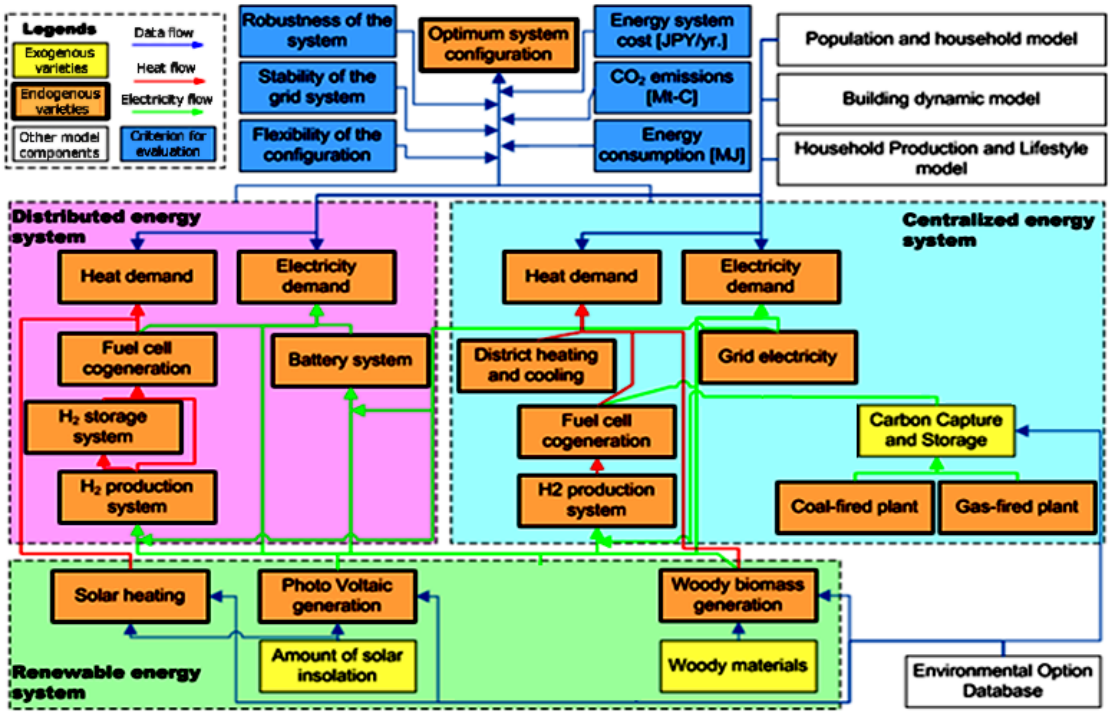



Figure 5.3: Conceptual design of DEG system

DHC is a centralised heating or cooling system where the produced heat or cold is distribute to the individual consumer via the pipelines. Fuel, heat or cooling sources are being utilised in an efficient manner to provide a cheap and reliable energy solution to local distribution network, such as circulating water from the plant to the consumer in a district energy network. In district heating, the water is heated and supplied as the steam to the consumer, and recirculate to the plant to be re-heated. In the case of district cooling, chilled water is used instead of steam, to be supplied as the cooling sources.

Comparing to the individual heating or cooling system, the DHC hold several advantages, in terms of energy efficiency and long term economic performance. The DHC usually have higher energy efficiency due to the simultaneous generation of power and thermal energy by using a cogeneration system. For district cooling, the generated thermal energy will be utilised to run the absorption refrigerators, which in turn will greatly reduce the electricity load. In terms of economic performance, the DHC benefits the local community due to the avoided cost for energy and individual equipment to generate those energy demands.

Nevertheless, the incorporation of DHC requires an extensive amount of investment and thus, in requires a long-term financial commitment. Thus, a detailed study needs to be carried out to examine the economic feasibility of installing DHC in Iskandar Malaysia.

### II. Establishing evaluation methods for selecting candidate place to incorporate distributed energy system

A renewable energy based DEG system such as biomass based power plant or MSW harvests the source of energy in the vicinity of the power plant to fulfil the energy demand for the localized energy system. Thus the location of the power generator is a critical factor to be determined, to ensure the power plant has sufficient supply of biomass plant and to reduce the transportation cost of biomass from the source to the location of power benefits such as the reduction in GHG emission. Therefore it is vital to establish an evaluation method to select the optimal location of DEG system.

### 5.2.2 Widespread Use of Energy Storage

Generally, by storing extra energy at times of light loading and supply energy at times of heavy loading, energy storage systems can provide the required energy when the generation and loads do not match (Suryanarayanan et al., 2010). Energy storage can be performed at the power plant, in support of the transmission system, at various points in the distribution system and on particular appliances and equipment on the customer's side of the metre (Grid 2030, 2003). Additionally, energy storage systems with an adequate power electronics (PE) interface can provide frequency and voltage regulation, power quality enhancement, power factor correction, and instantaneous power compensation for load transients (Peng et al., 2009).

Energy storage can be defined as the conversion of electrical energy from a power network into a form in which it can be stored until it is converted back to the electrical energy (Status of Electrical Energy Storage System, 2004).

**I. Evaluating the suitability of energy storage technologies to IM**

Many different technologies for energy storage with different application are as listed below (Makansi and Abboud, 2002) (Ibrahim et al., 2007):

- Battery Storage - Battery energy storage systems correspond to series/parallel arrangements of individual batteries. Batteries provide fast response for both charge and discharge, and behave as a constant DC voltage source. Capacity: Lead-acid – tens of MW, Nickel-Cadmium – multiple MW, Sodium-Sulphur – multiple MW, and Lithium-Ion – tens of kW.
- Pumped-Hydro Storage – Pumped-hydro storage operates using the potential energy of stored water. During off-peak hours, water is pumped from the lower to the upper reservoir, where it is stored. To generate electricity, water is then released back into the lower reservoir, passing through hydraulic turbines and generating electrical power. Capacity: Up to 1000MW.
- Compressed Air Energy Storage (CAES) – CAES systems use off-peak power to pressurise air into an underground reservoir which is then released during peak daytime hours to power a turbine/generator for power production. Capacity: Above 100 MW in single unit sizes.
- Flywheel Storage - A flywheel energy storage system stores energy through accelerating a rotor up to a high rate of speed and maintaining the energy in the system as inertial energy. The flywheel releases the energy by reversing the process and using the motor as a generator. Capacity: From 150 kW to 1 MW.
- Ultracapacitor - Energy storage in super-capacitors is done in the form of an electric field between two electrodes. The energy/volume obtained is superior to that of capacitors (up to 15 Wh/kg). Super-capacitors generally are very durable, that is to say 8–10 years, 95% efficiency and 5% per day self-discharge, which means that the stored energy must be used quickly. Capacity: Up to 100 kW for a short period of time (Carrasco, 2006).
- Superconducting Magnetic Energy Storage - stored energy in the magnetic field created by the flow of direct current in a coil of cryogenically cooled, superconducting material. Due to the construction, it has a high operating cost and is therefore best suited to provide constant, deep discharges and constant activity. The fast response time (under 100 ms) of these systems makes them ideal for regulating network stability (load levelling). It is generally applied at manufacturing facilities requiring ultra-clean power. Capacity: Up to 3 MW per unit
- Regenerative Fuel Cell – The system operates via a reversible electrochemical reaction between two electrolytes. Electric from the grid is converted into potential chemical energy and stored. Release of the

potential energy occurs within an electrochemical cell, with a separate compartment for each electrolyte-physically separated by an ion-exchange membrane. Capacity: Two facilities exist with a capacity of 15MW, 120 MWh, and 12MW, 120MWh.

**II. Establishing evaluation method for appropriate capacity for Energy Storage which will be installed**

Apart from the type of Energy Storage technology, capacity is also an important aspect that must be determined prior to the installation of energy storage technology in IM. In general, the capital cost of power generators and energy storage system are two key cost of advance energy system. In order to prevent the over-sizing of energy storage system, the designer must determine the optimal capacity of energy storage in the energy system. At such, an evaluation method needs to be established to identify the optimal capacity of energy storage system, subject to the hourly electricity consumption pattern and the source of power supply, for instance, grid electricity, solar and biomass power generators.

### 5.2.3 Diffusion of Demand Response Initiatives

Demand Response is an initiative that involves electricity consumption change at the demand side in responds to the requirement of utility company during critical periods, i.e., high price and peak hour. The energy saving capacity is then served as the virtual power plant that supplies electricity to the peak demand load.

**I. Evaluating the impacts of Demand Response technologies on curtailment of peak loads in IM**

In general, the incorporation of Demand Respond technologies will reduce the peak loads, yet the extent of reduction will be subjected to the localised data. Thus given the supply and demand profile in IM, it is important to evaluate the impacts of Demand Response technologies on the curtailment of peak loads.

**II. Evaluating the economic impacts of Demand Response technologies on the power supplier and participants in IM**

Demand Response presents mutual economic benefits for both supply and demand side of electricity system. At the supply side, the cost of constructing additional power plant capacity to fulfil the peak demand can be avoided. At the demand side, participant will get pay for reducing the energy consumption; that is, the energy that they don't use. Therefore, it is vital to evaluate the economic impacts of Demand Response technologies on the power supplier and participants in IM.

### 5.2.4 Incorporation of Power Management System (IT Technologies)

A power management system refers to a computer-aided tool for monitoring, controlling and optimisation purposes. The advantage of the system is such that it allows the plant to keep track of their energy utilisation for further analysis. In terms of control and optimisation, the system aids the plant through scheduling which will then shave energy peaks leading to lower cost of electricity. While in terms of total energy consumption the system does not reduce and in fact might increase the overall electricity consumption, if energy storage is implemented for peak shaving purposes. Although consumption may increase, with a constant or flat consumption of electricity, the cost of electricity will generally reduce.

In the case of Demand Respond, power management system acts as an agent to dispatch the demand respond event. On the participant side, along with the installed metering device, the power management system shall monitor the energy reduction of participant during such events, which will then determine the payment received by the participants.

**I. Conducting Research and Development of power management system with IT technologies for enabling self-healing system features, ensuring cyber-security and physical security and allowing system transparency within the grid**

There exists a need to develop a power management system to address the challenges of ageing infrastructure, continued growth in demand, the integration of increasing numbers of variable renewable energy sources and electric vehicles, the need to improve the security of supply and the need to lower carbon emissions. Therefore it is important to conducting researches relevant to the power management with IT technologies.

**II. Promoting the installation of power management system**

Energy management system is crucial to ensure smooth operation of the future energy system which may consist of various types of power generator. Thus it is important to promote the installation of power management system as the platform of integrating various power sources.

## 5.3 Provision of Incentives and Subsidies and Derivation of Tariff Rate

At the moment, renewable energy cannot be compared to fossil fuel in term of profitability. Mainly due to that reason alone, incentives and subsidies are a must to ensure progressing development and implementation of renewable energy. In general, incentives and rebates consist of tax rebate, Feed-in-Tariff (FiT), capital and soft loan. Next sub-section discusses the existing incentives in Malaysia and other possible incentives.

### 5.3.1. Incentives for Green Energy Initiatives

In Malaysia, the federal government has been developing key policies and strategies for over 30 years to support the development of green energy system. As of that, the incentives and subsidies related to the energy sector as taken from Sustainable Energy Development Authority (SEDA) have been quoted directly in this blueprint for easy referencing (KeTTHA, 2009).

**I. Evaluating and proposing suitable incentives schemes in the form of tax rebate, feed-in tariff, capital subsidies and soft loan to promote the installation of RE and alternative energy at house-hold, commercial and industry level**

**a) Incentives for Energy Efficiency**

Conservation of energy is a promoted activity under the Promotion of Investments Act 1986 and companies can be considered for the Pioneer Status (PS) or the Investment Tax Allowance (ITA). These incentives are applicable for applications received until 31 December 2015 and the companies are required to implement the projects within one (1) year from the date of approval of the incentives.

The PS provides an exemption from income tax (25% from 2009 onwards) on 100% of statutory income for 10 years. Accumulated losses and unabsorbed capital allowances incurred during the pioneer period can be carried forward and deducted against post pioneer income of the company. The exemption commences from the date the company makes its first sales or the date of first invoice of company.

Under the ITA, 100% of qualifying capital expenditure incurred within a period of 5 years can be utilised against 100% of the statutory income for each year of assessment. Unutilised allowances can be carried forward to subsequent years until they are fully utilised. Qualifying capital expenditure means capital expenditure incurred on buildings, plant and machinery used for the purpose of EE activities.

Under the incentive, companies intending to undertake the performance contracting service activities to conserve usage of energy are eligible to apply for PS with tax exemption of 100% of statutory income for 10 years; or ITA of 100% of qualifying capital expenditure incurred

(on building, plant and machinery used for the purpose of EC/EE activities) within a period of 5 years. Companies intending to incur capital expenditure for conserving energy for their own consumption are eligible for ITA of 100% of the qualifying capital expenditure incurred within a period of 5 years.

Companies providing EE services or adopting EE initiatives can also apply for import duty and sales tax exemption on imported machinery, equipment, materials, spare parts and consumables used directly in the generation process and that are not produced locally. For locally purchased machinery, equipment, materials, spare parts and consumables, full exemption is given on sales tax. This incentive has been extended under Budget 2015 to grant exemption of import duty and/or sales tax to "Third Party Distributors (TPD)" of the relevant products as applicable for EE products and appliances, provided they satisfy specific criteria. The criteria include certification as "Authorised Agents" of the product suppliers (principals) or as manufacturers of the products locally as well as appropriate evidence of the EE performance of products. The "Authorised Agents" must be registered with the ST for the products concerned to be granted the exemption. Exemption is given for a period of one year, commencing from the date the application is received by MIDA.

**b) Incentives for Renewable**

Commercial and industrial business entities which undertake generation of energy using renewable energy resources such as biomass, biogas, hydropower and solar power, whether for generation of electric power to sell to local utility providers through the distribution grid system or for their own consumption, are eligible to apply for fiscal incentives.

Businesses that choose to generate RE can apply for incentives, irrespective of whether their utilisation is in a grid connected or stand-alone form. For example: i) Palm oil millers or timber industry owners who convert their processed wastes into electricity for their own use and to sell the surplus to the local utility providers, and dispose of their recurring wastes. ii) Prospective RE plant developers, using solar, biomass, biogas or municipal waste, whether to generate electricity or thermal energy (heating or cooling) for sale to the local utility providers or for their own use. iii) Businesses that use thermal energy, normally derived from fossil fuels can benefit from fuel substitution to save on energy costs in the presently prevailing high fossil fuel price environment. iv) commercial and industrial electricity users who wish to install grid connected BIPV systems using RE for power generation or for thermal energy use (heating or cooling) for their own use.

Note that under the current incentive system, companies that provide electricity to the national distribution grid system must obtain approval from the Ministry of Energy, Green Technology and Water (MEGTW) under the Small Renewable Energy Programme (SREP). They must also obtain a power generating licence from the ST. The maximum capacity that can be sold to the distribution grid system under this programme is 10 MW.

This incentive has been extended under Budget 2015 to grant exemption of import duty and/or sales tax to "Third Party Distributors (TPD)" of the relevant products as applicable for Solar (PV or thermal) Systems, provided they satisfy specific criteria. The criteria include certification as "Authorised Agents" of the product suppliers (principals) or as manufacturers of the products locally. The "Authorised Agents" must be "registered" with the ST for the products concerned.

FiT has been proven to be the most effective mechanism and is a cost-effective way to foster renewable energy compared with other policy mechanisms such as quotas, direct incentives or voluntary goals. It has been successfully implemented in over 40 countries in the world such as Germany, Spain, Italy, and Thailand, to name a few. FiT provides a guarantee of payments in dollars per kilowatt hour ($/kWh) for the full output of the system for a guaranteed period of time (typically 15-20

years). FiTs are payments for the utilisation of electricity generated by RE in kilowatt-hour (kWh). The FiT proposed launched in 2011 covers renewable energy such as solar PV, biomass, biogas, and mini-hydro (SEDA, 2011). Nevertheless, Table 5.11 shows only the proposed FiT applicable for Iskandar Malaysia without mini-hydro.

With the introduction of feed-in tariff in Malaysia, it is anticipated that not more than 30 MW of renewable energy facilities will be built in Iskandar Malaysia. For that reason, it can be concluded that many small to medium size facilities will exist around the 5 flagships in Iskandar Malaysia by 2025 and that the existence of many power generation facilities will surely pose an issue to the operation of the energy system. Due to that reason, an advanced energy system should be developed hand-in-hand with RE to ensure that the system is able operate optimally.

With various available RE in Malaysia, a quota system is also set up under the RE Act 2011 to ensure a smooth implementation of the system and fair development of RE. The overall allocation until 2030 is as shown in Table 5.6. The FiT system also allocates generation below or equal to 1 MW from solar PV for the domestic sector. The FiT system allocated an accumulated amount of 227.5 MW from solar PV. Taking an average of 5 kW of solar PV per house, the system could support up to a total of 45,500 houses by 2030. Allocation for solar PV for the domestic sector is as shown in Table 5.12.

Table 5.11: Proposed FiT in Malaysia (Source: SEDA, 2011)

| Renewable Resource | Installed Capacity and Qualifying Bonuses[1] | Feed-in Tariff Rate (RM/kWh) | Effective Period (yr)[2] | Annual Digression Rate (%)[3,4] |
|---|---|---|---|---|
| **Biogas** | ≤ 4 MW | 0.32 | 16 | 0.5 |
| | > 4 MW ≤ 10 MW | 0.30 | 16 | 0.5 |
| | > 10 MW ≤ 30 MW | 0.28 | 16 | 0.5 |
| **Biogas – Bonus** | Use of gas engine > 40% efficiency | +0.02 | 16 | 0.5 |
| | Use of locally manufactured or assembled gas engine | +0.01 | 16 | 0.5 |
| | Use of landfill or sewage gas as fuel source | +0.08 | 16 | 1.8 |
| **Biomass** | ≤ 10 MW | 0.31 | 16 | 0.5 |
| | > 10 MW ≤ 20 MW | 0.29 | 16 | 0.5 |
| | > 20 MW ≤ 30 MW | 0.27 | 16 | 0.5 |
| **Biomass - Bonus** | Use of Gasification Technology | +0.02 | 16 | 0.5 |
| | Use of steam based technology with > 14% efficiency | +0.01 | 16 | 0.5 |
| | Use of locally manufactured or assembled gasification technology | +0.01 | 16 | 0.5 |
| | Use of MSW as fuel source | +0.10 | 16 | 1.8 |
| **Solar Photovoltaic** | ≤ 4 kW | 1.23 | 21 | 8 |
| | > 4 kW ≤ 24 kW | 1.20 | 21 | 8 |
| | > 24 kW ≤ 72 kW | 1.18 | 21 | 8 |
| | > 72 kW ≤ 1 MW | 1.14 | 21 | 8 |

| | | | | |
|---|---|---|---|---|
| | > 1 MW ≤ 10 MW | 0.95 | 21 | 8 |
| | > 10 MW ≤ 30 MW | 0.85 | 21 | 8 |
| | Used as installation in building or building structure | 0.26 | 21 | 8 |
| | Used as building materials | 0.25 | 21 | 8 |
| | Use of locally manufactured or assembled solar PV modules | 0.03 | 21 | 8 |
| | Use of locally manufactured or assembled solar inverters | 0.01 | 21 | 8 |

[1] Install capacity of RE technologies is set at a limit of 30 MW otherwise approved by the Minister

[2] Commencing from the FiT commencement date

[3] FiT rates are reduced progressively each year based on applicable digression rate commencing on the 1st of January every year while subjected to revision every three years

[4] FIAH benefits from the fixed rate approved during the year of commencement until the end of the applicable period

Table 5.12: Annual RE quota for FiT (Source: Haris, 2011)

| Year | Biogas | Biogas (Sewage/ Landfill) | Biomass | MSW | Mini-hydro | Solar PV ⩽ 1 MW | Solar PP > 1 MW | Total Quota (MW/yr) |
|---|---|---|---|---|---|---|---|---|
| **2011** | 10 | 5 | 70 | 10 | 30 | 9 | 20 | 154 |
| **2012** | 20 | 10 | 60 | 20 | 60 | 11 | 35 | 216 |
| **2013** | 20 | 10 | 70 | 30 | 80 | 13 | 50 | 273 |
| **2014** | 25 | 10 | 60 | 40 | 60 | 15 | 80 | 290 |
| **2015** | 25 | 10 | 70 | 50 | 60 | 17 | 110 | 342 |
| **2016** | 25 | 10 | 80 | 35 | 60 | 19 | 130 | 359 |
| **2017** | 30 | 10 | 90 | 30 | 50 | 21 | 145 | 376 |
| **2018** | 30 | 10 | 100 | 20 | 40 | 24 | 155 | 379 |
| **2019** | 30 | 10 | 100 | 20 | 30 | 28 | 165 | 383 |
| **2020** | 25 | 10 | 100 | 10 | 20 | 33 | 170 | 368 |
| **2021** | 25 | - | 90 | 6 | - | 37 | 30 | 188 |
| **2022** | 25 | - | 90 | 5 | - | 41 | 80 | 241 |
| **2023** | 20 | 4 | 80 | - | - | 47 | 130 | 281 |
| **2024** | 20 | 3 | 70 | - | - | 60 | 250 | 403 |
| **2025** | 20 | - | 60 | - | - | 80 | 250 | 410 |
| **2026** | 20 | - | 50 | - | - | 105 | 250 | 425 |
| **2027** | 20 | - | 50 | - | - | 135 | 250 | 455 |
| **2028** | 20 | - | 50 | - | - | 175 | 250 | 495 |
| **2029** | - | - | - | - | - | 220 | 250 | 470 |
| **2030** | - | - | - | - | - | 280 | 300 | 580 |

Table 5.13: Opportunity for households (Source: Haris, 2011)

| Year | Solar Quota for Residential (MW) | No. of New Homes per Annum (e.g. 5 kW/home) |
|---|---|---|
| **2011** | 4.5 | 900 |
| **2012** | 5.5 | 1100 |
| **2013** | 6.5 | 1300 |
| **2014** | 7.5 | 1500 |
| **2015** | 8.5 | 1700 |

| | | |
|---|---|---|
| **2016** | 9.5 | 1900 |
| **2017** | 10.5 | 2100 |
| **2018** | 12 | 2400 |
| **2019** | 14 | 2800 |
| **2020** | 16.5 | 3300 |
| **2021** | 18.5 | 3700 |
| **2022** | 20.5 | 4100 |
| **2023** | 23.5 | 4700 |
| **2024** | 30 | 6000 |
| **2025** | 40 | 8000 |

While allocation of RE has been made, RE Fund is set up in order to provide sufficient funding to support the FIT system (SEDA, 2011). The RE Fund is administered by SEDA under KeTTHA (Lim et al., 2006).

As the main distribution licensee in Peninsular Malaysia, Tenaga National Berhad (TNB) is responsible for providing 1% of their electricity sales revenue to the funding though it is expected that the electricity tariff to increase by 11% by 2012, with additional 1% increment corresponding to the FIT system. Thus, the total increment of electricity tariff by 2012 is 12% (Haris, 2011).

As stated in the RE Act 2011, TNB may only withdraw an amount equivalent to the difference between the FiT paid by TNB to Feed-in Approval Holder (FIAH) and the prevailing displaced cost to cover for FiT remuneration (Haris, 2011). Other than that, the RE Fund also covers for the administration fees of TNB and SEDA for implementing and administrating the FiT system (SEDA, 2011).

Referring to the flowchart of RE Fund as shown in Figure 5.4, all money withdrawn from the Fund must first be administered by SEDA before releasing to TNB. Out of the required FiT payment, additional 5% of the FiT payment would have to be recovered to pay for the administration fees of SEDA (3%) and TNB (2%). Upon receiving the fund, TNB would then include the displaced cost and pay the total sum to FIAH (Haris, 2011).

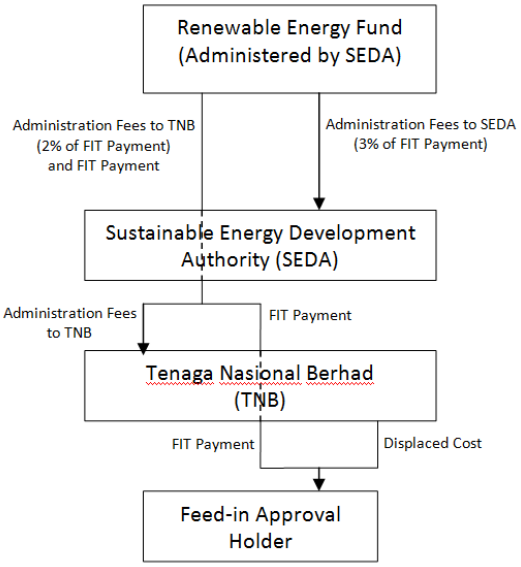



Figure5.4: Flowchart of RE Fund

**c) Incentive for Power Quality**

Good Power Quality is an essential need for some manufacturing facilities whose manufacturing processes require stringent controls. PQ initiatives can be implemented by the supply utilities or the power users themselves, or by Energy services companies (ESCOs). The ESCOs would undertake PQ improvement projects on behalf of clients, including financing, on the basis of energy performance contracting (EPC) services which include design and tendering, procurement, construction supervision and commissioning of the project.

Only ACA (Accelerated Capital Allowance) is available for those who wish to implement PQ improvement projects. This incentive is applicable for applications received until 31 December 2015 and the applicants are

required to implement the projects within one (1) year from the date of approval of the incentives.

**II. Establishing incentives schemes for accelerating of demand response (load management)**

Despite its potential economic benefits to both power generators and consumers, demand respond is still a relevant new technology in Malaysia. Attractive incentive schemes stimulate the transfer the "know-how" from expert countries, such as Japan. Ultimately, the incentives shall encourage the adoption of demand response technologies in IM.

**III. Allocating research fund for R&D on green initiatives**

To drive the implementation of proposed green initiatives, corresponding flagship programs should be crafted and funded by the stake-holders. The flagship programs should cover different stages of implementation, including R&D activities, installation and maintenance.

R&D activities are a key component in promoting and supporting the development of renewable energy. A typical flagship research project covers the feasibility study, product development and impact assessment. Prior to the implementation of green initiatives at a large scale, a pilot scale green program should be financed and constructed. A detailed feasibility study is needed to evaluate the technical feasibility, economic performance and environment impact. Tools and products will be developed along the pipeline to assist the planners and stake-holder to determine the feasibility of implementing such green initiatives.

Also, stake-holder funded flagship program should be made available to support the construction and operation of green technologies related project; for instance, the construction of decentralised power plant, a district heating and cooling plant that powered by biomass, or solar energy incorporated with energy storage system. During the operation stage, the impact of these green initiatives should be assessed to benchmark and monitor the performance.

Apart from the execution of flagship program at the large scale, to promote the installation of RE technologies at individual commercial building and household level, a well-planned maintenance program needs to be in place. For example, in the case of solar panel, a major concern for a typical building and house owner to participate in such program would be the maintenance issue. The maintenance program for solar panel usually covers washing solar panel, inspection of inverter, racking and wiring. A well maintenance solar panel will yield higher solar energy, compared to those unkempt panels. Thus, a well-planned maintenance program is required to ensure the owner can yield the maximum solar energy from the panel.

### 5.3.2. Tariff for Future Grid

On the FiT, the existing FiT system only caters to on-grid power generation, in which the off-grid power generation has been overlooked. In general, an off-grid power generation system such as distributed energy generation is more energy efficient than the on-grid power supply, as less transmission loss is incurred over the long transmission distance of electricity. However, the unit cost for constructing such an off -grid power plant is typically higher than the on-grid power plant due to its smaller capacity. Thus, a revised FiT for distributed energy generation is required to offset the additional cost.

**I. Evaluating current tariff scheme to propose new tariff scheme, i.e., on and off-peak tariff scheme for household**

The current tariff rate at Peninsular Malaysia is derived by TNB. At domestic level, there is only one tariff package, and the tariff rates are solely determined by the amount of electricity being consumed. By contrast, the commercial and industry sector can opt for an alternative tariff package that consists of different tariff

rates throughout different periods of a day, i.e., peak and off-peak period for electricity consumption. For domestic level, the tariff rates difference during different period of time could motivate the household owner to reduce the electricity consumption during peak demand. This will subsequently reduce the standby power capacity requirement of power plant to cater the intensive electricity demand during peak period. With this consideration in mind, a detailed study should be carried out to examine and propose a suitable tariff rate for the future grid.

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Part II

# Green Community

**Action 6**
Low Carbon Lifestyle

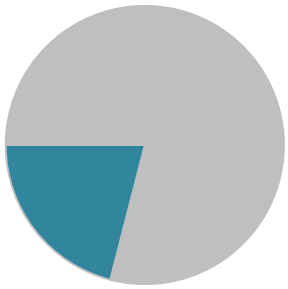
**Action 7**
Community Engagement and Consensus Building

Action 6

# Low Carbon Lifestyle

Fatin Aliah Phang, Junichi Fujino, Maiko Suda, Wong Wai Yoke, Azilah Mohamed Akil and Anis Syahira Zulkifli

**GHGs Emission Reduction**



2,727 $ktCO_2eq$

21%

Low carbon lifestyle refers to living and working in a sustainable way of life. This means that having a living pattern that reduces carbon foot print per person. Low carbon life-style promotes low energy consumption through using appliances with higher energy efficiency and adopting energy saving practices, opting for lower energy transportation mode and switching to a healthier lifestyle. Low carbon lifestyle calls for involvement from individuals of all levels, communities, government offices and private businesses to support low carbon development in Iskandar Malaysia, giving a minimum impact to the environment without com-promising the quality of life. The low carbon lifestyle action is the third largest contributor towards the emission reduction in Iskandar Malaysia. It contributes about 2,727 $ktCO_2eq$ in total emission reduction.

## 6.0 Low Carbon Lifestyle

The low carbon lifestyle refers to living and working in a sustainable way of life. This means that having a living pattern that reduces carbon foot print per person. Low carbon lifestyle promotes low energy consumption through using appliances with higher energy efficiency and adopting energy saving practices, opting for lower energy transportation mode and switching to a healthier lifestyle. The low carbon lifestyle calls for involvement from individuals of all levels, communities, government offices and private businesses to support low carbon development in Iskandar Malaysia, having a minimum impact to the environment without compromising quality of life.

The low carbon lifestyle action is the third largest contributor for emissions reduction in Iskandar Malaysia. It contributes about 2,727ktCO2eq in total emissions reduction.

### 6.1. Awareness Through Education

Green education or environmental education is a learning process that increases knowledge and awareness about the environment and associated challenges; develops the necessary skills and expertise to address the challenges; and fosters attitudes, motivations, and commitments to make informed decisions and take responsible actions.

Education is not limited to educational institutions such as schools and universities, but includes raising awareness among general public.

The significance of environment educaction in Malaysia is highlighted in the National Policy on the Environment. The first area addressed in the Green Strategies (the policy contains a total of seven key areas) is 'Education and Awareness' (Ministry of Science, Technology and the Environment, Malaysia, 2002). Among the strategies for "Education and Awareness" aimed at raising public awareness are:

> *"1.1 Comprehensive formal and informal environmental education and training strategies and information dissemination programs will be devised and introduced*
>
> *1.2 Environment and development will be integrated into educational activities, from school to tertiary institutions. Towards this end, relevant methods and materials will be developed for environment education programs*
>
> *1.4 Education curricula at all levels will be reviewed to ensure a multidisciplinary approach with environment and development issues*
>
> *1.5 Non-formal education activities will be promoted at local and national levels. These activities will include direct involvement of social support groups and recognize the important role of the family unit inculcating positive environmental attitudes*
>
> *1.6 Public information services on environment and development will be made available and those may include information technology, multi-media and other audio-visual methods, Public and academic forums to discuss environmental and development issues will be encouraged."*
>
> (p. 8 and 9)

These strategies are in line with Agenda 21, which dedicated Chapter 36 to Promoting Education, Public Awareness & Training, where "Increasing Public Awareness" is one of the three program areas explicitly discussed in the chapter (United Nations, 1992).

The National Policy on Climate Change (Ministry of Natural Resources and Environment Malaysia, 2009) has also outlined the Principle "P4: Effective Participation" to "*improve participation of stakeholders and major groups for effective implementation of climate change response*" (p. 5), and two Strategic Thrusts (ST8 and ST9) and several Key Actions have been drawn to support the principle.

Key Actions (KA) include strengthening collaboration among stakeholders, from public and private sectors, to adopt formal and informal education and awareness raising programs.

### 6.1.1 Enhancing general public awareness

The population in Iskandar Malaysia is projected to reach 3 million by year 2025 wih 4.1% growth (Khazanah National, 2006). As such, public awareness and support is important to gain LCS in Iskandar Malaysia. Actions can be taken in a variety of areas to increase environmental awareness.

Governmental agencies (Federal, State, and local authorities), Non-governmental Organizations (NGOs), schools and local communities should involve in developing and delivering public awareness campaigns in Iskandar Malaysia.

Education programs for the public should continue throughout the LCS program operation to support the development of a Low Carbon Society in Iskandar Malaysia and also to sustain it. A significant part of the overall project budget may be needed. There are several programs to be carried out such as the following:

**I. Freely available green education catalogue in shopping centres**

A green education catalogue is a means to disseminate low carbon information to the public. It should include knowledge and awareness of current issues on carbon emission and waste managment, to promote intention to act on the issues and as a manual to practise low carbon and proper waste management behaviour.

These catalogues should be published by the municipal councils in collaboration with private corporate and / or NGOs:

- with waste-collecting company(ies). This is mainly due the differences in collection facilities provided in each district, information on types of recyclables collected by respective waste collecting companies and the requirements on how to pack or bundle household waste.
- with other private corporate and other organizations. A joint effort in producing catalogues, with their respective company logos or brand name printed on the catalogues shows commitment in low carbon initiatives or as a part of their Corporate Social Responsibility (CSR).

The content should be prepared in at least four major commonly used languages in Malaysia namely Bahasa Melayu, English, Mandarin and Tamil languages for the diverse population in IM. The content should be in simple terms with respective illustrations to ease the understanding.

Green education catalogues offered to the public are of high priority and should be implemented immediately.

Studies indicate that specific knowledge about recycling (what to recycle and how to recycle) is a strong factor influencing the behaviour (Vining & Ebreo, 1990; Oom Do Valle et al., 2005). As such, rather than projecting issues we are facing and the need to act on it, catalogues should include practical guidelines or best practices. Figure 6.1 provides an example of such catalogues.
However, it should be noted that supporting infrastructure must made available to the public to facilitate lifestyle change (such as recycling facilities) must be in place to support recycling habits.

There are more than 25 shopping complexes and hypermarkets within Iskandar Malaysia (iProperty, 2010; Zazali Musa, 2009). The location of these malls are in the heart of urban area making them the centre of attraction to public. To target the increasing urban population, it would be best to make available

printed information (catalogues) at these centres .


Figure 6.1: Catalogue for separating household waste (showing only two out of the total four pages)
(Source: Okayama City Council http://www.city.okayama.jp/contents/000105177.pdf)

Facilities on waste separation are proposed to cover 100% of the households in IM by 2025 (see Table 6.1) and the recycling rate is projected to reach 31% by year 2025, based on the proposed facilities (see Table 6.2). Green education catalogues are intended to prepare the public for future implementation of mandatory waste separation requirement, and to realise the projected recycling rate.

Based on the proposed source separation scheme (MMSB Consult Sdn Bhd, 2010) and projected housing units in IM (Table 6.3), the number of printed brochures and distribution points are proposed in Table 6.1.

Table 6.1: Summary of Source Separation and Recycling Scheme from 2010 to 2025

| | **Immediate Term (2010-2014)** | **Medium Term (2015-2020)** | **Long Term (2020-2025)** |
|---|---|---|---|
| Drop-off points proposed across IM | 300 drop-off points | 300 drop-off points | 300 drop-off points |
| Household source separation schemes (ie. two bin system, weekly door-to-door collection) | - | percentage of household coverage:<br>- 30% (by 2015)<br>- 100% (by 2020) | percentage of household coverage:<br>100% |
| Proposed brochure distribution points | • at the 300 drop off points<br>• shopping centres<br>• municipal council building<br>• e-brochures downloadable online from municipal council official websites | • at the 300 drop off points<br>• shopping centres<br>• municipal council building<br>• e-brochures downloadable online from municipal council official websites | • No printed brochures<br>• e-brochures downloadable online from municipal council official websites |
| Number of brochures needed | 135,565 brochures for 30% housing units (2015 projection) | 384,016 brochures for 70% housing units (2020 projection) | - |

(Source: IM Integrated Solid Waste Management Blueprint, March 2010, MMSB Consult Sdn Bhd; page 3-30, Table 3-12)

Table 6.2: Projected recycling rate based on proposed source separation schemes in IM Integrated Solid waste Blueprint

| Year | Projectedrecycling rate |
|---|---|
| 2010 | 2% |
| 2015 | 11% |
| 2020 | 22% |
| 2025 | 31% |

(Source: IM Integrated Solid Waste Management Blueprint, page 3-24)

Table 6.3: Projected residential units

| Year | Projected residential units |
|---|---|
| 2010 | 372,232 |
| 2015 | 451,884 |
| 2020 | 548,594 |
| 2025 | 666,024 |

(Source: IM Integrated Land Use Blueprint, 2010, page 2-19)

II. **Awareness programs for community**

Other than providing guideline on low carbon lifestyle and information on latest carbon reduction facilities and technology to the public to encourage low carbon lifestyle, programs which are needed to raise awareness among communities include:

- campaigns
- competitions
- volunteer programs to encourage citizen participation

It is important to note that the programs are well-planned and sustainable in terms of funding and human resources. Campaigns are necessarily to be launched regularly over a period of time (eg. annually) to serve as a reminder for the citizens.

The following example shows a national campaign in Japan to conserve energy during summer:

**Example: Super Cool Biz campaign in Japan**

Figure 6.2 Super Cool Biz national campaign

The Ministry of the Environment Japan launched "Cool Biz" national campign in year 2005 and the consecutive years. In year 2011, an evolution of the original campaign, Super Cool Biz was launched, aiming to raise awareness and encourage energy saving practices among general public during summer.

The general idea includes wearing casual wear (at work), setting air-conditioner temperature at a comfortable level (not too hot and not too cold) and to share cool places.

It encompasses several sub-concepts, they are:

- Cool fashion
- Cool work
- Cool house
- Cool idea
- Cool share

Citizens are 'reminded' of this campaign through publicity annually, before summer arrives. It serves as a cue for the geneal public to adopt these practices to save energy).

(Detailed information about the campaign in Japan can be found in http://www.challenge25.go.jp/practice/coolbiz/coolbiz2012/about.html )

### 6.1.2 Enhancing School Children Awareness

In total, there are 89 secondary schools and 198 primary schools in IM. The total number of secondary school students are about 110,968 while the primary school students number about 184,009. In all, the number of teachers in IM is 16,167 (as of 2011, source from ICT Unit, JPNJ).

According to the population projection by age group, 27.26% of IM's population (in 2010) was made up of children and teenagers between age 5 to 19 (AJM Planning & Urban Design Group Sdn. Bhd., 2010). The population of this age group is projected at 22.79%, a slight decrease by 2025. The detail breakdown is shown in Table 6.4.

Table 6.4: Projected population by age group

| Age group | 2010 Number | % | 2025 Number | % |
|---|---|---|---|---|
| 5-9 | 150,900 | 9.81% | 226,500 | 7.55% |
| 10-14 | 139,600 | 9.07% | 226,400 | 7.55% |
| 15-19 | 129,000 | 8.38% | 230,700 | 7.69% |

(Source: IM Integrated Land Use Blueprint, 2010, page 2-10)

This age group consists of children from pre-school level up to teenagers from secondary school level. The projection shows that school students take up one fourth of the total population in IM, making them a significant target group for low carbon (green) education.

Furthermore, it is quite important to ensure that the younger generation who will be replacing the older generation continue to promote and practise LCS in their daily life. Moreover, they play the vital role of educating and showing examples to generations to come.

Raising school children's awareness can be systematically achieved because of the educational system which is centralised and authorised by the Johor State Education Department (*Jabatan Pelajaran Negeri* Johor, JPNJ) through directive orders.

Awareness among school students can be fostered through the following:

- formal curriculum (i.e. school syllabus and subjects taught)
- co-curriculum programs (i.e. school club activities, campaigns, competitions)

NGOs play an active role in supporting school programs especially in co-curriculum activities.

**I. LCS education across curriculum**

The education system is centralized in Malaysia where formal curriculum for primary and secondary schools is developed by the Curriculum Development Centre (CDC) of the Ministry of Education, Malaysia. Syllabuses for all subjects taught in schools are standardized for the whole country, including textbooks. Making changes to the curriculum is a long process involving meticulous evaluation and careful examination by national level authorities.

Environmental Education in Malaysia is not taught as a single subject but across all subjects, depending very much on teachers' discretion whether to include environmental or low carbon elements in their teachings. As these elements are not assessed in national standardized examination, they are often neglected by teachers who have low awareness on the issues. As such, education through curriculum in this section mainly focuses on developing LCS modules for both teachers and students, and an emphasis on teacher training.

Although environmental education is a compulsory subject in pre-service teacher education programmes such as The Malaysian Teaching Diploma (DPM) and the Post Graduate Diploma in teaching (KPLI) courses (Pudin, 2006), the is no specific focus on concept of Low Carbon Society.

Low carbon modules for teachers and students should be developed by relevant government agencies (such as the Department of Environment, Department of Solid Waste Management, Solid Waste Management and Public Cleansing Corporation) and NGOs (such as MNS, WWF-Malaysia) in collaboration with State Education Department or the Ministry of Education.

LCS should be included in teacher training (part of the current environmental education modelu), or in the form of in-service training, offered by the State Education Department in a regular and consistent manner. Up-to-date low carbon or environmental education knowledge (modules and education kit) should be provided and teachers should be trained to incorporate them into the subjects they are teaching. Table 6.5 shows the number of teachers in primary and secondary schools in IM, according to the District Education Office (PPD).

Table 6.5: Number of teachers in IM according to District Education Office (PPD) and school level

| *Pejabat Pelajaran Daerah, PPD* | Primary school | Secondary School | Total |
|---|---|---|---|
| Johor Bahru | 4181 | 3172 | 7353 |
| Pasir Gudang | 3422 | 2182 | 5604 |
| Kulai | 1809 | 1126 | 2935 |
| Pontian | | 275 | 275 |
| Total | 9412 | 6755 | 16167 |

(Source: ICT Unit, JPNJ, data as of year 2011)

Teacher training (for LCS) should be introduced in a staggered manner, targeting schools under a same district education office (PPD) at a time, until all teachers are equipped with LCS knowledge and pedagogical skills. A session of training can be provided to 300 teachers every week; a proposed schedule for teacher training is shown in Table 6.6.

Table 6.6 Proposed EE training schedule for teachers in-service

| Month | Johor Bahru | Pasir Gudang | Kulai | Pontian |
|---|---|---|---|---|
| Total teachers | 7353 | 5604 | 2935 | 275 |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |

Note: Calculation is based on 300 teachers/ week for 54 weeks (equivalent to 12.5 months)

In tertiary education, only specific programs offered include environmental issues in their courses such as Environmental Science, Environmental Engineering, Marine Science, and so on.

As a Low Carbon Society includes each individual in society, especially the future workforce, it is proposed to include low carbon, sustainability or environmental-related studies as one of the core and compulsory course or subject for all programs offered in higher education institutes. This is to ensure the graduates from these insitutes will possess the awareness on environmental issues and be able to connect their profession to the environment, thus be able to make ore low-carbon choices in their career.

The following example shows an example of UNESCO Associated School program bes practices in Japan which can be implemented in schools in IM.

**Example: UNESCO Associated Schools in Japan**

Figure 6.3 Logo of UNESCO Associated Schools

Founded in 1953, the UNESCO Associated Schools Project Network (ASPnet), commonly referred to as UNESCO Associated Schools, is a global network of more than 9,000 educational institutions in 180 countries. In Japan, 459 schools are certified as UNESCO school by UNESCO. There are four main study themes under this project:-

- ASPNet and UN priorities (such as peace, poverty, hunger, HIV & AIDS, illiteracy, climate change etc.)
- education for sustainable development
- peace and human rights
- intercultural learning

Some schools in Tama-city and Kesennuma-city are certified UNESCO schools and are actively engaged in this program.

(Detailed information about the project in Japan can be found in http://www.unesco-school.jp/index.php?action=pages_view_main&page_id=505
More about UNESCO Associated Schools in http://www.unesco.org/new/en/education/networks/global-networks/aspnet/)

One pilot school will take up the initiative to achieve the UNESCO school status in 2013. This can be widen to other schools in IM in the following years where by 2025, at least 30 UNESCO schools will be established in IM. Coporate companies are encouraged to support

the green initiatives at schools through CSR programmes.

UNESCO Schools can serve as a base for promoting Education for Sustainable Development (ESD), which is vital for achieving sustainability (environment, society and economy) (Japanese National Commission for UNESCO, 2012)

**II. School clubs for LCS & 3R programs**

Nearly all the schools in IM have a Nature Club (*Kelab Alam Sekitar*) which is usually coordinated by the Co-Curricular (*Ko-Kurikulum*) Teacher (*Guru Ko-ko*) or a Geography teacher. The club is further coordinated by the Johor State Education Department, JPNJ at the state level. Among the activities of this club are environmental campaign at school, partcipating or organising competitions, visits, assisting the school projects and so on.
Several programs can be conducted through these clubs:

- Organising activities, campaigns and competitions
- Identifying champions among students
- Disseminating LCS and 3R information
- Raising funds for future activities

Some possible activities are as follows:

- production of fertiliser from food waste
- bio-diesel products from used cooking oil
- rain water harvesting for watering plants
- mangrove tree and forest tree planting activities

Through directive order from the State Education Department, it is projected that 80% of the schools in IM will conduct LCS or 3R programs in the first year of implementation. However the percentage is forecast to decrease over the years and sustain at 20% from the 4$^{th}$ year of implementation without follow-up activities to keep encouraging schools to continue with the LCS or 3R programs at schools. Active participation of 20% of the schools in IM is the best target if EE (specifically LCS and 3R) cannot formally be implemented in schools.

**III. Children's Eco-life Challenge project**

Children's Eco-life Challenge project is a student version of eco-household accounting. Eco-household accounting includes recording and evaluating household energy usage such as electricity, water and gas (Utaka et al., 2009). This aims at raising awareness of energy efficiency among students, promoting sensitivity towards energy usage and its conservation, and inculcating energy savings behaviour from young.

Chidlren's Eco-Life Challenge project should be included as a supplement to the existing formal curriculum as it is a form of contextual learning and promotes students thinking skills through its activities. It can be conducted at the end of the school year (after school examination and before the year-end school holidays). The project cut across several subjects in formal curriculum and students will be able to apply knowledge and skills learned during the year in real-life context (as required by the project). Through this project, students will be able to monitor their own behaviour patterns to move towards a low carbon lifestyle.

Other than energy consumption, petrol consumption, traveling pattern and waste generation and management can also be incorporated in the project, to increase awareness level on other low carbon aspects.

The following demonstrates a successful case study from Japan:

**Example: Eco Life Challenge supported by NGO**

Figure 6.4 Member of KIKO Network (NGO) conducting preliminary learning session with students

Since 2005, KIKO Network in Kyoto-city provides an environmental program "Eco Life Challenge" for the students of 4th grade to 6th grade in primary school (see Figure 6.4). All primary schools in Kyoto (173 schools) use this tool now (see Figure 6.5). The success factors are:-

- study program such as study/ action/ feedback
- planning and management by partnership
- participation from diversified bodies

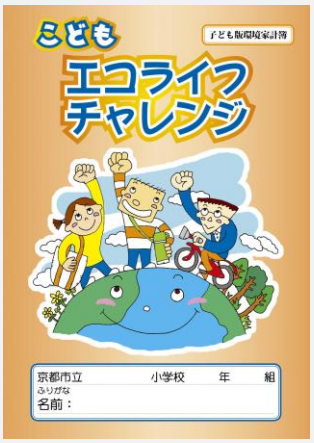



Figure 6.5 Toolkit used in "Eco Life Challenge" environmental program in Kyoto schools

(More information about the project can be found in http://www.kikonet.org/ )
* "KIKO" means "climate" in Japanese language

Eco-Life Challenge project can be introduced to one school respectively under each District Education Office (PPD). Successful schools will become model for other schools. This project calls for a strong collaboration among schools (principals and teachers), NGOs/ NPOs (providing experts) and private sector (providing experts or funds). Partnership between various sectors will be discussed in 'Program VII: Collaboration with relevant government agencies & non-governmental organizations (NGOs)'.

This project can be implemented in the form of competition. The following example is a competition among school students held in Singapore named "Singapore Project Carbon Zero".

**Example: Singapore Project Carbon Zero**

It is an energy saving competition organized by National Environment Agency (NEA) and the Singapore Environment Council (SEC open to all primary (started from 2008), secondary schools and junior colleges students (started from 2009).

It challenges participants to reduce at least 10% of their household electricity consumption during the competition period (4 months). It helps students to realize that the 10% reduction targetis achievable by adopting simple energy saving habits.

Similarly, a project on energy efficiency among secondary school students was held in Kuala Lumpur.

**Example: Secondary School Energy Efficiency Action Project (SSEEAP) in Kuala Lumpur**

SEEAP is a study on school energy efficienty by CETDEM (Centre for Environment, Technology and Development Malaysia) in year 2009, involving five secondary schools in Kuala Lumpur.

The overall aim is to encourage secondary school students to reduce their energy consumption (thus GHG emission) by taking measures to conserve energy and increase energy efficiency in their schools.

The project was carried out as a co-curricular activity in the form of inter-school competition. Energy efficiency activities were proposed by the students and their teacher-in-charge, and implemented at their schools. Energy audit was performed by the students to monitor their progress and results.

Based on the feedback from teachers and students, they are more aware about energy usage and their knowledge on energy conservation has increased. Energy saving practices are being implemented at schools.

(Source: SSEEAP - working with schools in Kuala Lumpur on Energy Efficiency: A CETDEM study on energy efficiency 2009, published by CETDEM)

## IV. Interschool 3R project competitions

From the response of a Focus Group Discussion (FGD) with school administrators and teachers in December 2011, schools are very supportive in encouraging students to join competitions related to LCS and 3R awareness. Students are quite excited when they are involved in competitions, more so if the prizes are what they desire, such as iPads, iPods, PSPs and so on.

However, current programs (survey results from the FGD) are not standardized among schools, mostly are on an *ad hoc* basis and do not have plans to sustain them. An interschool 3R project will act as an umbrella program that covers schools in IM area. This will help to turn existing ad hoc 3R programs into regular, periodical programs serving as a motivation to sustain the program in long term basis.

Some exsting competitions include:

- collecting recyclable items
- 3R or environmental essay competitions
- 3R or environmental quizzes

Ideas from school teachers gathered during the FGD includes:

- competition through social networks
- competition through websites (eg. blogs)
- waste collection competition

The Department of Environment (*Jabatan Alam Sekitar,* JAS) has funded schools to promote Green and Sustainable School (*Sekolah Lestari*). Each school receives RM1,000.00 a year to conduct green projects at schools.This fund could be pooled together by several schools at a time to co-organise an intershool recycling competition. A rotation of organising schools can help sustaining the interschool competition in terms of funding.

## V. 3R measures at schools

Among the 3R measures agreed and discussed among the school administrators at an FGD in December 2011 are as tabulated in Table 6.7. These are 3R measures considered to be practical in schools:

Table 6.7: 3R measures agreed by school administrators

| A | **REDUCE** |
|---|---|
| 1 | Eating to be restricted in canteen area (to reduce the need for packing / take away) |
| 2 | No plastic bag/ polystyrene policy in canteen |
| 3 | Encourage 2-sided printing (set the printers to 2-sided) |
| 4 | Prepare purchasing plan before buying |
| 5 | Buy according to needs |
| 6 | Buy & use refills (ink, cartridge) for printing |
| 7 | Use internet system to circulate information rather than mails. |
| **B** | **REUSE** |
| 1 | Do not prepare polystyrene / paper cups at water-cooler (encourage staffs to refill using their own bottles) |
| 2 | Reuse banner by leaving the year or date or time blank for annual events (eg., welcoming banner, banners for recurrent programs) |
| 3 | Reuse one-side printed paper for notes / |

| | |
|---|---|
| | drafts |
| 4 | Encourage the usage of old / unused exercise books (lined notebooks) from previous academic year |
| 5 | Encouraging school leavers to donate their references book to school for students use in future |
| 6 | Art teachers should teach school students to make items from recyclable materials (e.g. baskets from paper) |
| 7 | Reuse of students record files |
| 8 | Reuse of binding rings after the documents are taken out |
| **C** | **RECYCLE** |
| 1 | Prepare recycling bins (3-coloured bins) in each school block (building) |
| 2 | Provide the recycle boxes in each class for recycled paper |
| 3 | Competition among classes on waste segregation and collecting recyclables |
| 4 | Recycling day in school (encourage students and staffs to bring recyclable goods to school, arrange schedule pick-ups from recycling centre) |
| 5 | Creating a group of students whose role is to monitor the activities of recycling in schools (such as an Environmental Club) |

## VI. LCS measures at schools

Among the LCS measures agreed and discussed among the school administrators at an FGD in December 2011 are as tabulated in Table 6.8. These are 3R measures considered to be practical in schools:

Table 6.8: LCS measures agreed by school administrators

| | |
|---|---|
| 1 | Only switch on fans / lights during school time |
| 2 | Switch off all computers when not in use |
| 3 | Install separated (individual) switches for fans and lights |
| 4 | Set air conditioner temperature at 24C in administration buildings |
| 5 | Use eco-friendly air conditioners in vehicles transporting students to schools |
| 6 | Increase outdoor activities to reduce the use of electricity in classrooms |
| 7 | Install ventilation / exhaust fans on the roof of school buildings |
| 8 | Install wind turbines on school roof (generate electricity) |
| 9 | Students living nearby should walk to school |
| 10 | Use public transport to schools |
| 11 | Separate food waste at canteens to make bio-fertilizer to be used in school compound) |
| 12 | Plant trees / landscape in school compound |
| 13 | Use clay flower pots for plants |
| 14 | Plant trees for shading |
| 15 | Create herb garden (plant lemongrass, tumeric, ginger, roselle etc.) |
| 16 | Use organic fertilizer |
| 17 | Create landscape with water elements |

A preliminary survey conducted in a FGD with school administrators and teachers (33 schools located in IM) has provided us with data on school electricity consumption. It could be used as a measure to gauge the effectiveness of programs at school in terms of electricity saving.

With an assumption of 20% of electricity consumption reduction, schools in IM would be able to save up to 400 thousand kW-h in each month. Figure 6.6 shows 20% reduction of electricity usage according to the size of school (based on number of students per school).

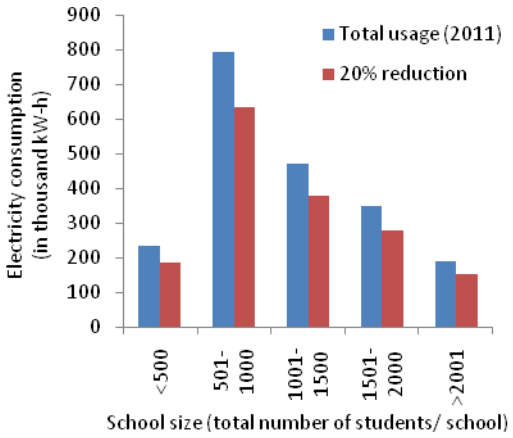



Figure 6.6: School electricity consumption and projected 20% reduction according to school size.
*Data were collected in terms of electricity bill in Ringgit Malaysia (RM) and converted to kilowatt-hour using electricity Tariff B - Low Voltage Commercial Tariff: RM0.43/ kWh according to Tenaga Nasional Berhad tariff as at 1-Jun-2011.

## VII. Collaboration with relevant government agencies & NGOs

Government agencies have authority to formulate policies and enforce regulations. They are also able to reach out to the larger

community through their extended agency offices and services. Non-governmental organizations (NGOs), on the other hand, usually comprise an education division within the organization, mainly to promote public awareness and education on their respective area of focus. They are usually made up of a group of experts (in their related fields of focus) and committed individuals.

As such, government agencies and NGOs need to create a platform for sharing their knowledge, skills and experiences. Such collaboration will reduce cost and eliminate overlapping (duplicate) efforts, which will be a waste of resources, and thus be able to sustain the activities into long term programs.

The following examples show several programs co-organized by government agencies and NGOs, showing the interdependence of both communities.

**Example:*Kelab Pencinta Alam*(School Nature Club)**

- Founded by Malaysian Nature Society, MNS and supported by the Ministry of Education Malaysia, MOE, with collaboration from State Education Departments.
- More than 400 primary and secondary schools from all over Malaysia participated
- Workshops for teacher (national level), workshops for students (national level), camps, KPA Awards and several themed projects.
- Aims to promote knowledge about the environment and further promote eco-friendly attitude among school students

**Example:*Projek Wira Alam* (literally translated as Environment Hero Project)**

- Initiated by the Department of Environment (Jabatan Alam Sekitar, JAS) in collaboration with MOE and MNS.
- Promoted through Kelab Pencinta Alam, KPA at schools
- Aims to motivate and provide opportunities forstudents tocontribute to theconservation of the environment

**Example: Schools' Green Audit program**

Singapore Environmental Council (SEC), an NGO in Singapore has conducted a **Schools' Green Audit program** where schools are audited biennially (once every two years) for their environmental effort and plans for improvement

Partnership between government agencies and NGOs is a key success in green education initiatives, as both top-down and bottom-up approaches strengthen the effectiveness of the initiative.

**Example: Eco Life Challenge Project: Partnership among governmental agencies and NGO**

- Introduced in 'Program III: Children's Eco Life Challenges project', the project is an initiative by an NGO and recognised and supported by Kyoto City Government.
- Figure 6.7 shows the Planning and Management through partnership among various sectors in this project
- With strong collaboration between government agencies and NGO, within 5 years of implementation, the project is conducted in all primary schools in Kyoto City. The project has spread to Okayama Prefecture, Kurashiki City, Ikoma City and currently is being piloted in Osaka, Japan.

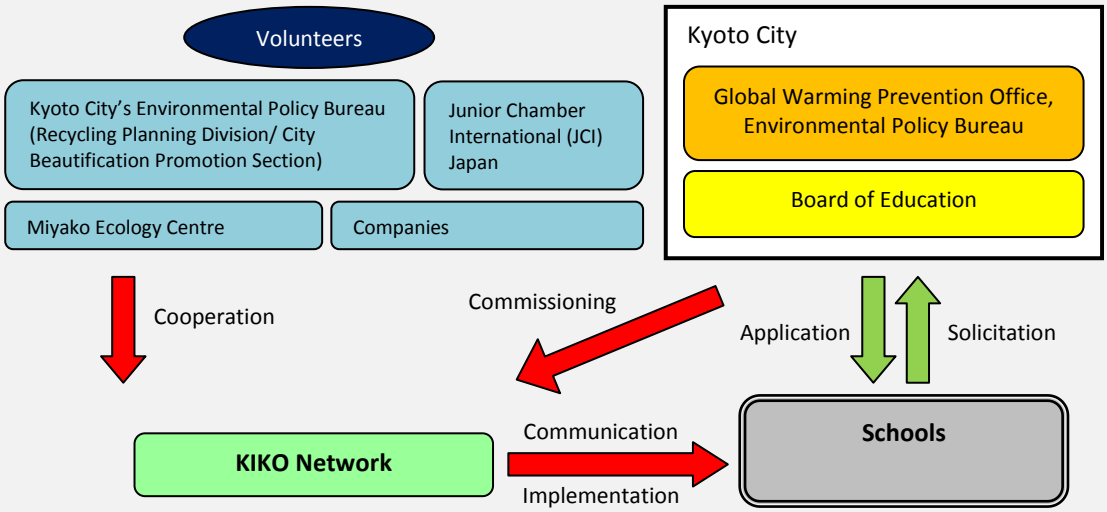



Figure 6.7: Children's Eco-Life Challenge project - Planning and Management through partnership
(Source: Presentation by Mr Yosuke Toyota on Children's Eco-life Challenge)

Figure 6.7 shows the partnership among several sectors especially government agencies and NGOs in making an education program a success.

### VIII. Students to collect reusable and recyclable wastes from home and neighbourhood

A significant number of programs currently in place at schools are related to recycling, implying that the initiating 3R programs will not face much resistance from school students, teachers and administrators alike.

The habit of sorting-at-source should be cultivated from young as children will be the future residents and home owners in IM.

Peers are a major influence on personal and social development by reinforcing acceptable behaviours (in this case, 3R practices). Peers affect each other by communicating attitudes and values (Moreno, 2010). By conducting recyclable waste collection at schools, students will be able to learn the correct practices of waste separation through cooperative learning among themselves (and guidance by teachers).

Other than targeting students, it has a significant effect on students' parents participation. However, aim(s) / objective(s) of program(s) must be explicitly communicated to parents in order to achieve a larger impact on changing behaviour (Ballantyne et al., 2001).

Waste collected in recycling programs will be used to generate funds for future programs and activities at schools.

The following example shows a successful project of fund raising through recyclables collection at schools with sponsorship from the corporate sector and collaboration with local authorities.

**Example: Green for Hope (GfH) @ Primary School (in Singapore)**

- Launched in year 2008 by CapitaLand
- For every 1kg recycling waste collected, CapitaLand will donate SGD2 (2 Singapore Dollars) to the underprivileged students through the five Community Development Councils (CDCs) in Singapore
- In 2010, fund raised was close to SGD900,000
- In 2011, all 179 primary schools in Singapore participated

## 6.2 Smart Working Style

Smart working style is about finding good practices on more flexible arrangement and alternative working style. Sharing knowledge about how to reduce working hours can save energy, lead to a good life and reduce CO2 emissions in a cost-effective way up to 20% of current levels. The measures and programs are as follows:

### 6.2.1 Work from home

From Ministry of Human Resources (2011), 'work-from-home' is referring to "the works offered by the company either directly or through the third party by the individual or group in the specific premises which used as a working operation". There are three programmes introduced to the work-from-home scheme as well as the 'Work-from-home' pilot project for the government, SOHO and teleworking to develop the lifestyle towards a low carbon society.

**I. 'Work-from-home' pilot project for government agencies**

'Work-from-home' is a relatively new concept in Malaysia and was implemented by Public Works Department of Malaysia (Man Power Inc., 2010). This concept is a pilot project to plan for draughtsmen to work from home. The objectives of this programme are to reduce costs, save time and increase productivity as well as give the opportunity for staff to spend time with their families. In this programme, staff only come to the office once a week for discussion or meeting with their supervisors.

The pilot project has shown a positive development which involved 35 staff. The period was originally set in three months but since it was a success, it was extended to six months. Therefore, it can be used as a model to be carried out in Iskandar Malaysia. In other countries, including the United Kingdom, United State of America and a few countries in Europe, they also have successfully implemented this program.

There are benefits of Work From Home, which are less traffic congestion, less pressure to expand infrastructure capacity, fewer traffic accidents, conservation of energy and reduction of green house gas emissions and reduce air pollution from vehicles.

**II. Promote private SOHO development in IM**

SOHO, "Small Office / Home Office", refers to a category of business that operates in small office space and with low number of employees, normally fewer than 10 people. A home office is a good choice for professionals who operate their own service-based small business such as legal service, real estate and internet-based business including e-mail marketing service..

Nowadays, home office becomes a popular choice of working environment because advance telecommunication technologies (telephone, facsimile, internet) allow individuals to work from home using e-mail, tele- or web conference and remote access software to communicate with their business partners, employer, co-workers, customers and suppliers. The rationale of working from home is to save commuting time and expenses, while reducing the cost of starting the business, including the hassle of finding suitable business premises, paying some advance rental and getting the right workers to man the office.

It is attractive to promote SOHO in Iskandar Malaysia, provision of technology such as the

latest tools and technology advances should be in place to connect, communicate, and collaborate with customers, clients and co-workers. Developers should plan an appropriate design for working space at home in the housing market. This is important in the future to encourage a culture of working from home. Indirectly, this lifestyle can contribute to reducing traffic and carbon dioxide emissions.

**III. Encourage tele-working telecommuting among private sectors employees**

Teleworking or telecommuting refers to employees working from home or location other than the central office. Telework may be "regular" or "occasional." Regular teleworkers work from an alternate location such as a home office on a regular schedule (most often, 2 or 3 days per week). There are some employees who telework full- time only visit the office for occasional meetings or events. Employees do not always work outside the office. For occasional tele-workers, they do not have regular schedules for tele-working; they work from home, a client's office, or other remote locations as needed.

A telework normally comprises a centre as an office facility, located in the suburban area of a major metropolitan area. The workers can go to work there instead of making the long commute into the city center. Telework centres typically host workers and irregularly, individuals may choose to work from a telework centre on their own that is set up by public agencies or public or private partnerships (Telework Pilot Project, 2009).

### 6.2.2 Staggered Working Hours

Staggered working hours is a system of working in which employees do not all arrive and leave at the same time (Anderson & Ungemah, 1999). Staggered working hours can reduce traffic congestion during peak hours. Staggered working hours differs from flexible working hours, in which the employees can choose the staggered start times. For example, the staff is given the choice to start work between 8:00 a.m. to 8:30 a.m. and finish work at the adjusted given time accordingly.

**Example: Staggered working hours in Johor government office**

Such program has been implemented In Malaysia since year 2007, particularly in Johor. The gap for each hours staggered is 30 minutes (Table 6.9).

Table 6.9: The Examples Staggered Hours Are Applied In Malaysia Government Offices

| Stag-gered Hours | Days | Working Hour | Break | Working Hour |
|---|---|---|---|---|
| WP1 | Mon-Thu | 7.30 to 1.00 | 1 to 2 | 2 to 4.30 |
| | Friday | 7.30 to 12.15 | 12.15 to 2.45 | 2.45 to 4.30 |
| WP2 | Mon-Thu | 8 to 1 | 1 to 2 | 2 to 5 |
| | Friday | 8 to 12.15 | 12.15 to 2.45 | 2.45 to 5 |
| WP3 | Mon-Thu | 8.30 to 1 | 1 to 2 | 2 to 5.30 |
| | Friday | 8.30 to 12.15 | 12.15 to 2.45 | 2.45 to 5.30 |

Source : Pekeliling Perkhidmatan Bilangan 2 Tahun 2007 (Service Circular Number 2 of Year 2007)

**I. Promote adoption of flexible working hours in suitable sectors**

Flexible working arrangement are about people having the opportunity to make changes to the hours they work over a day, a week or over the year, the time they work or where they work. It also concerns about how careers are organized, how transitions in and out of work are managed, and how flexible work is managed in the workplace in order to give benefits to the employees and business .

In a flexitime programme, employees work five eight-hour days each week, but they are allowed to choose their work arrival and departure times, as well as the length of their lunch break. Flexitime programmes generally require employees to be present during a specified core time when meetings or other company-wide events are scheduled. This program can be apply for certain category of jobs for example online marketing, insurance

consultancy, data entry, softwate designing, website designing and tourism.

## 6.3 Promote Energy Efficiency

This idea of energy efficiency practice is to promote spending less, consuming less and emitting less $CO_2$ which will eventually lead the society towards adopting a low carbon lifestyle. The government should promote energy saving consumption and practices among community. With these efforts, it is expected that at least 20% of the total households in Iskandar Malaysia will be committed to sustainable living practices by year 2025.

### 6.3.1 Promote Sales And Use Of Energy Efficient Appliances

Emphasizing the links between changes in consumption patterns and environment would help to better understanding of different driving forces and policy instrument that interrelate and affect the environmental sustainability of consumption. The government should provide a basic guideline for monitoring policy effectiveness and progress in moving towards consumption patterns.

**I. Set up Eco Point system in local stores**

Eco-point system is a concept of providing rewards for the consumers after they purchase low-carbon products. The concept of eco-point system has been practised successfully in countries such as Japan and Italy. Having the successful models around the world, several suggestions for the establishment of an eco-point system as low carbon lifestyle in Iskandar Malaysia are drafted.

Discounts for the consumers who purchase products with low carbon labels such as energy-efficient home electrical appliance with 5-star reted refrigerator, air conditioner, hot-water dispenser, TV, LED, furthermore less packaging product, and recycled product. Some private companies in Malaysia have taken initiatives to promote green purchase and frugal consumption. For public understanding, energy supply operator provides periodic information on energy use.

### 6.3.2 Promote Energy Saving Practices

Apart from providing subsidies and rewards for selling and purchasing low-carbon products, it is important to promote actions that can be conducted by the people (public) for making a choice of eco lifestyle, buying energy saving device, using renewable energy, choosing energy-saving office building and house and participating in local climate change actions.

**I. Promote the 'Cool Biz'$_3$ concept**

Malaysia's climate is hot and humid all year round. As such, most of the electricity consumption during daytime (working hours) are for air-conditioning. For saving energy in government and private offices, the concept of "Cool Biz" can be adopted. For example, wearing casual wear instead of formal, thick clothing such as suits (see Figure 6.8), set air conditioning to a comfortable room temperature (not too cold) and drinking more water. At offices, window blind, thermal barrier coating, green curtain can be installed. Air-conditioned room is recommended to be shared among co-workers (at office) or family members (at home) instead of using the air-conditioned room alone. The campaign will be more effective with control lighting (movement sensitive), water saving practices and "Smart Move" (discussed in Sub action 6.4).

Figure 6.8: Promoting to wear casual wear like 'Kariyushi' or polo shirts in a Japanese central government office in SUPER COOLBIZ campaign 2012.

**II. Promote the engagement of Energy Saving Advisors (Environmental Concierge)**

Energy saving advisors (or Home energy advisors) are individuals who provide energy advice and information to residents within a living area such as in IM on the following matters:-

- Ways to save money, energy, water and the environment
- Grants and energy assistance packages
- Waste management for household (waste separation and selective waste collection)
- Rationalization of public transport
- Environmentally responsible purchasing and eco-consumption (RES Compass, 2009; Scottish Border Council, 2011 )

Local councils should encourage residents in IM to engage energy savings advisors to assess, evaluate and give suggestions on ways to increase their home energy efficiency as well as ways to save energy.

Energy advisors may be employed by local energy bodies, consumer associations or local authorities (RES Compass, 2009).

**III. Real time energy monitoring system for low carbon lifestyle**

Electricity Audit Calculator also can be promoted to households. Its function is to track real time and monthly energy consumption of appliances in home and display energy consumption in kWh and cost (Figure 6.9). This energy monitor can provide data of electricity consumption at home. Residents will be more sensitive to their energy usage with such real time feedback from the device. Reducing the usage of high energy consuming appliances also can change people's lifestyle to consume less energy.


Figure 6.9 : Energy Monitor
(Source:http://www.lowcarbonsg.com/2009/05/08/monitor-your-electricity-consumption-at-home/)

### 6.3.3 Incentives For Green Energy Initiatives

**i. Subsidies for energy efficient appliances in residential**

Apart from the retail discounts, a reduction of the government tax for frugal consumers that purchase low carbon products will also encourage a low carbon lifestyle.

## 6.4 Promote "Smart Travel Choices"

In line with the Programs and Measures in 1. Integrated Green Transportation and 8. Walkable, Safe, Liaveble City Design which induce voluntary modal shift in travelling options by the residents, promoting "Smart Move" focuses on the user end, by providing information about low carbon options and its benefits to individuals. "Smart Move" consists of several actions by individuals, such as travelling on foot, riding bicycle, using public transport, car-pooling, as well as practising eco-driving.

Local government plays a key role in encouraging and enabling people to walk. Others agencies can collaborate with State and Federal Governments, NGOs, and community groups to increase walking lifestyle.

### 6.4.1 Public Information On "Smart Move"

Promotion of public information on "Smart Move" is associated with long-term changes in

behavior. The walking lifestyle will build support for the creation of more walk able places, reduce air pollution and traffic congestion, and to improve physical health. Informing residents about the co-benefits of "Smart Move" will greater encourage people to walk more often and use public transportation. The development of walk-friendly environments can be promoted in the community.

**I. "Burn more calories, burn less carbon" campaign**

Smart move is good for the body. Obesity rates and BMI for car users are 40-50% higher than commuters using other forms of transportation (bus, train, bicycle or foot). For example, if a person use train or bus instead of car for a week, the burning of calories (kcal) is one-fold. Using public transport system, riding a bicycle, traveling on foot are alternatives to private car and can be adopted according to individual's work or life style. For awareness raising, promoting to participate local climate change actions about smart move is important.

To encourage more prople to use public transport, the services of travel information should be provided clearly. This is to provide up-to-date and accurate information on services that run within the neighbourhood (discussed further in Action 1 "Integrated Green Transportation".

Figure 6.10: Bus Iskandar Malaysia

**II. Guideline for eco-driving practices**

To reduce CO2 from cars, eco-driving by drivers is very important. The actions regarding eco-driving are car pooling, community cycling, promoting to change to eco-friendly driving and rebuying eco-car. Before promoting these actions, the guideline should be prepared by government.

Car pooling consists of two or more persons driving together in a privately owned vehicle. This programme involves the use of a person's private or company vehicle to carry one or more fellow passengers, either by using one car or rotating cars. Employers should encourage their employees to car pool. The employers may introduce car pool incentive, such as a reduced cost or free parking, preferred parking or reward. The program also can be implemented for school or college pool program.

**Example: Carpool incentive programme in San Mateo County, San Bruno, California**

in San Mateo County, San Bruno, a carpool incentive programme has been implemented. The organizer distributes $20 to $25 gas cards as incentives for drivers who transport at least two children from two different households to one school, a minimum of two days per week to college or, a minimum of two days per week in a consecutive four-week period .

(Source: San Mateo County Carpool incentive programme http://www.commute.org/programs/carpool-incentive-program)

The practice of car pooling with more than three persons could reduce 66% from the total amount of cars (Jayagandi, 2008). Car pooling not only reduces traffic congestion, but also results in reductions in gas emissions, parking needs and improved environment.


Figure 6.11: An example of how to show benefits of carpooling to encourge people.
(Source: www.smartcommute.ca)

## 6.5 Stoke-Taking For Low Carbon Lifestyle

Stock-taking for low carbon lifestyle is made available by calculating CO2 emission from residents and communities. Sharing these information (CO2 emission) with stakeholders is important. Government agencies should lead and implement the following measures and programs:

### 6.5.1 Promote Self Management Of Lifestyle To Monitor $CO_2$ Emission Expenditure In Residential And Community

**I. Development of environmental report system at community level**

The International Council for Local Environmental Initiatives (ICLEI) has developed carbon Cities Climate Registry (cCCR) which is a global mechanism that encourages local governments to regularly and publicly report their greenhouse gas reduction commitments, GHG emissions inventories and climate mitigation/adaptation actions. The cCCR was developed by local governments for local governments.

The cCCR enables cities and local governments to publicly register their greenhouse gas reduction commitments, report performance and showcase actions.

This reporting system should be referred to community level in IM for reducing GHG and setting the goals.


Figure 6.12: Carbon registry project by ICLEI Japan (Source: http://citiesclimateregistry.org/)

**II. Establish Eco-life check tool for household**

It is important to promote frugal consumption and energy saving in the household as it signifies the carbon emission in low carbon lifestyle. Guidelines for energy saving for household are shown in Table 6.10:

Table 6.10: Energy saving tips for household

| |
|---|
| • Turn off unnecessary electrical devices when you are away from the room such as lights, TVs, entertainment systems, computers and monitors. |
| • Unplug home electronic devices, such as TVs and DVD players. Turn off the power strips when equipment is not in use—TVs and DVDs in standby mode still use several watts of power. |
| • Take short showers instead of baths and use low-flow showerheads for additional energy saving. |
| • Ensure that the windows and doors were tightly closed when using cooling system in your home. |
| • Drive sensibly; aggressive driving such as speeding, and rapid acceleration and braking, wastes fuel. |
| • Look for the ENERGY STAR® label on light bulbs, home appliances, electronics, and other products. |

Catalogues with guidelines on household energy accounting, household waste accounting and household carbon footprint calculators can be produced.

Figure 6.13 shows a leaflet of CO2 reduction checklist for household. Reduction quantity and savings (monetary) is stated for the respective daily action. As such, household members would be able to connect their daily actions to CO2 emission, thus understanding their

contribution to reduction (both CO2 and expenditure) through daily choices they make.


Figure 6.13: CO2 Reduction checklist (household version)

(Source: Shinjuku Eco Team Recruitment Sheet – Household version http://www.shinjuku-ecocenter/)

Local authorities should develop a website, which is devoted for carbon foot prints to encourage households to keep a regular record of meter readings. There are free online tools where residents can keep their records, monitor their energy use over time, and even compare their results with others within their community and beyond. A reward or incentive can be provided to those who have achieved excellent results in their carbon footprint.


Figure 6.14 :The examples carbon footprint online reporting

(Source: http://footprint.wwf.org.uk/)

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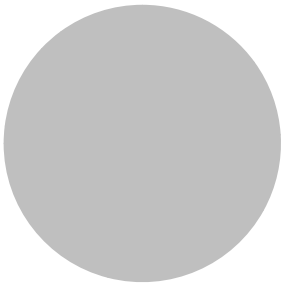
Action 7

# Community Engagement and Consensus Building

Fatin Aliah Phang Abdullah, Ibrahim Ngah, Junichi Fujino, Maiko Suda, Wong Wai Yoke, Azilah Mohamed Akil and Anis Syahira Zulkifli

**GHGs Emission Reduction**



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A society is built from various communities. Apart from developing the environment to create direct impact inducing change in lifestyle among people, strong connection among people or communities forms an indirect support for those impact. This is vital in promoting and sustaining all initial efforts in LCS development.

This action engages with the community through consensus building to develop LCS for IM. The process of moving to-wards LCS involves various stakeholders in Iskandar Malaysia. Strong collaborations among these stakeholders are needed to work as a whole. Community engagement aims at building an on-going and strong partnership among stakeholders or communities in Iskandar Malaysia moving towards LCS. The formation of relationship is for the benefits of the communities involved. Consensus building is to create mutual agreement to meet the interests of all stakeholders and to raise awareness among all parties who are relevant in creating LCS. It is a process to help mediate conflict between stakeholders, remove misunderstanding, clarify interests and establish common grounds between concerned parties based on negotiations.

# 7.0 Community Engagement and Consensus Building

This action engages with the community through consensus building to develop LCS for IM. The process of moving towards Low Carbon Society (LCS) involves various stakeholders in Iskandar Malaysia. Strong collaboration among these stakeholders is needed to work as a whole.

Community engagement aims at building a strong on-going partnership among stakeholders or communities in Iskandar Malaysia moving towards LCS. The formation of relationship is for the benefits of the communities involved. Consensus building creates mutual agreement to meet the interests of all stakeholders and to raise awareness among the parties who are relevant in creating LCS. It is a process to help mediate conflict between stakeholders, remove misunderstanding, clarify interests and establish common grounds between concerned parties based on negotiations.

Both community engagement and consensus building are long-term processes and on-going efforts from related parties, supporting low carbon development in IM. Action 7 constitutes bringing different communities into the path towards creating LCS. The first section 7.1 lays out the structure for engaging stakeholders in two-way communication to bring about mutual agreement through understanding of each others' interests. Working jointly, all sectors can contribute to carbon emission reduction while pursuing their own interests.

Section 7.2 focuses on disseminating public information on low carbon progress to target groups. It involves engaging them in programs aiming at promoting higher participation level in low carbon activities. Active participation from the residents of Iskandar Malaysia will be the key to success in carbon reduction.

Section 7.3 outlines the methodology used to engage community in producing action plans and roadmaps in developing a low carbon community, based on experiences in the pioneer project at Felda Taib Andak.

Section 7.4 focuses on appointing individuals who have keen interest and strong motivation to lead and promote green initiatives as green ambassadors or champions in community, organization as well as schools.

## 7.1 Share LCS Information and Gather Opinion Through Stakeholder Engagement

Stakeholders are commonly defined as those people who have an interest in a particular decision, either as individuals or representatives of a group. They are people who influence decisions, or can influence it, as well as those affected by it (Commonwealth of Australia, 2006). Potential stakeholders include local communities, government agencies, non-governmental organizations (NGOs), public (residents, communities), private sectors (corporates, industries) and researchers (scientists) who play their role individually or collectively in the development of a certain area (refer to Table 7.1).

Stakeholders are also empowered to make decisions based on common ground and implement them (to move towards LCS). Through workshops and discussions, related stakeholders have an opportunity to build new connections in order to share expertise, pool resources and prevent counterproductive competition. Thus greater effectiveness can be achieved with the collaboration among them.

The Integrated Solid Waste Management Blueprint for Iskandar Malaysia also highlights the role of stakeholders, particularly in strategy 7.1, Roles and Responsibilities of Agencies for Recycling Education. This strategy proposes roles of all stakeholders for promotion and source reduction of recycling (IRDA, 2010a; page 7-83).

Table 7.1: Stakeholders and responsibilities

| Stakeholder | Possible responsibilities |
|---|---|
| Government agencies (Ministry, Local Authorities, IRDA) | • Taking a leadership role to prepare strategies, set policies and legislation<br>• create opportunities for carbon mitigation (LCS) activities<br>• establish ways to communicate with the public<br>• encourage involvement of NGOs and private sector |
| NGOs (WWF, MNS) | • Contribute knowledge, skills and experience<br>• Design programmes<br>• Mobilize existing resources and connections |
| Private sector/ business community | • Incorporate low carbon concept (designs) in products and services<br>• Initiate low carbon practices and providing resources (through CSR and expertise sharing) to support low carbon activities at community level (such as local communities and schools) |
| Public/ communities | • Implement immediate low carbon measures with lifestyle change<br>• Participate actively in programmes |
| Researchers / Scientists (scientific community) | • Perform objective analysis on issues and provide scientific-based opinion and suggestion<br>• Share/ make accessible up-to-date data/ technical information to support low carbon activities<br>• Provide latest low carbon technology<br>• Open up possibilities of international cooperation/ collaboration through existing networks |

(Source : Low Carbon Society Project, 2012)

### 7.1.1 Periodic LCS Workshops and FGD With Stakeholders In IM

Workshop is one of the channels to engage discussion among stakeholders on related issues. Assembling related stakeholders for open conversation, their concerns can be discussed and negotiated in person. The more engaged stakeholders are, the more they will participate and contribute to decision making and implementing programs.

For more specific issues, focus group discussion (FGD) would be more effective compared to workshop as it forms smaller groups of stakeholders to focus on certain topics in a more detailed manner. FGD allows stakeholders who have similar interest, expertise, available time or dedication to work through a problem more thoroughly. This is in line with the Thrust 5: Promotion and Public Awareness of Renewable Energy and Energy Efficiency Blueprint For Iskandar Malaysia. One of the actions in Strategy 5.3 is "to have regular workshops or focus groups with associations and stakeholder groups to get feedback on public opinions" (IRDA, 2010b; page 80).

Community engagement requires sustained opportunities for discussion; as such, periodic workshops and Focus Group Discussion with stakeholders need to be held to maintain the information flow, particularly at the initial stage of forming strong relationships among them (see Figure 7.1).

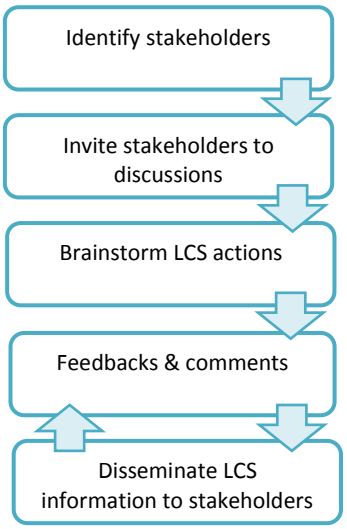


Figure 7.1: Programs for engaging stakeholders and building consensus through communication

#### I. Maintain updated list of stakeholders

Identification and selection of the potential community stakeholders will improve the effectiveness of project outcomes. Therefore, it is important to update the list of stakeholders according to their research topic.

Apart from committed and active stakeholders, it should include and keep track of passive stakeholders, those who only participate in meetings, receiving information but not actively involved in giving input or implementing programmes. By engaging a wider range of stakeholders, decisions can be made while taking into account various considerations.

**II. Invite all key stakeholders to IM CDP & blueprints processes**

The involvement of stakeholders with different interests who are willingly to participate in the planning and implementation of programs and activities is essential. Their participation will increase understanding of issue from different viewpoints and helps to address issues in a more holistic manner.

While engaging in the blueprint processes, stakeholders can help define how they can participate and open up new opportunities for collaboration among them, thus encouraging formation of new network.

**III. Brainstorming about LCS actions in IM with expert and local knowledge**

Brainstorming sessions during workshops are an opportunity for a broad and diverse group of stakeholders to come to discuss their ideas and interests. It allows all involved parties to meet face-to-face, to explore the issues or problem and consider a wide range of possible solutions.

Such sessions are used prior to planning in order to gather preliminary information from stakeholders, to identify issues raised during the planning process, to refine initial plans by suggesting potential solutions or to review existing plans for modifications.

**IV. Disclose ongoing feedbacks and comments on LCS actions**

The information received and conclusions reached during FGDs and workshops will not act as a fixed plan but it will be a guideline for stakeholders to work with. The guidelines act as a springboard to spur further discussion based on the actual scenario alongside the development timeline. Stakeholder input will from time to time be used for on-going improvement. This ongoing feedback is in the line to the strategy in Integrated Solid Waste Management Blueprint for Iskandar Malaysia, under Strategy 7.5. stated the government will work with all stakeholders to ensure that good practice is shared and unnecessary duplication.

### 7.1.2 Ongoing Feedback and Comments On LCS Actions

Feedback is a form of communication that gives information, as well as a strategy for building belief and strengthening relationships. It is fundamentally managing information flow in order to work effectively towards the low carbon society (Sebastian, Skelton, & West, 2000). Ongoing feedback and comments from stakeholders brings benefits such as gain valuable information from the perspective of stakeholders, can alert to difficulties or problems that we are not aware and improve program effectiveness and interventions. Ongoing feedback from stakeholders can be gathered through the following programs:

**I. Feedback and comments during LCS workshops and FGDs**

During focus group discussions, stakeholder feedback can be obtained through questionnaires or feedback forms. Contents of questionnaire might include low carbon society set up, current low carbon development issues, programs to be implemented and recommendations for improvement.

**II. Feedback and comments through website**

Actions to be taken are to provide feedback and comments through the website low carbon society will take the form of online forums or questionnaires, and so on. This mechanism should be user friendly and easily accessible. They should also provide constant response.

## 7.2 Public Information On LCS Progress

Public information serves as a medium to introduce LCS to the society. The purpose of public information is to explain the current issues or phenomena that are happening in Iskandar Malaysia. This section is an elaboration on how to disseminate information of LCS in Iskandar Malaysia. By addressing issues using all possibilities, the greatest impact can be achieved.

According to several strategies in Renewable Energy and Energy Efficiency Blueprint For Iskandar Malaysia, Strategy 5.2 states that effective involvement of media, non-governmental organizations and individual stakeholders in promoting renewable energy (RE), energy efficiency (EE) and Green Technology is essential. These programs may include creating online portal for public information, comprehensive media plan and to organize period energy efficiency campaigns (IRDA, 2010b; page 80).

### 7.2.1 LCS Progress Through Mass Media

Updates for IM LCS need to be disseminated to the public to provide opportunities for them to engage and paticipate in the building of LCS in their community. These can be done through the following programmes.

**I. LCS project updates**

For the general public to engage with the progress of IM LCS, the progress needs to be disseminated among the public. This progress should be updated at regular basis (quarterly, half-yearly, and annually). This can be achieved by providing the latest updates of the LCS project in the public through various mediums in order for them to be aware of LCS and participate in any project in IM. The target groups for this medium include investors, consultants, researchers and government agencies. Sustainable Iskandar Portal is an online gateway which can serve as a platform to distribute the project updates (Figure 7.2).

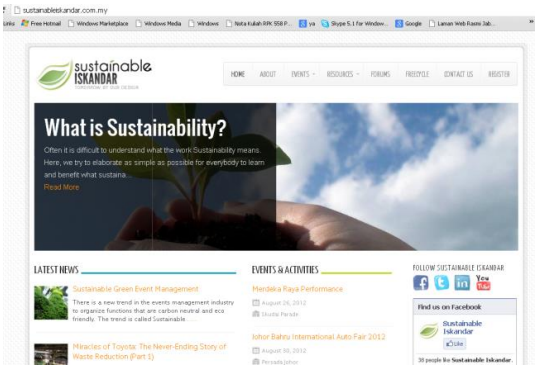


Figure 7.2: Sustainable Iskandar is an online portal established by IRDA to promote sustainable Iskandar Malaysia communities
(Source: http://sustainableiskandar.com.my/)

**II. LCS events announcements**

LCS event announcements should be given out to the public through various mediums and locations such as at shopping complexes, the use of banners, portals and flyers. This will bring in participation from the public to LCS events.

**III. Web-based newsletters**

LCS can be slotted in into the Sustainable Iskandar Portal and can be used to complement the information and service available through the use of public hotlines. These portals can also generate feedback from the public either on issues or complaints about certain activities.

Technology can lower the cost for collecting quantitative data. Web hosting services can record the number of visits to the site and other data. This enables the communication with publics through emails. Singapore has been using such websites to engage with the public (see Figure 7.3).


Figure 7.3: Examples of web-based newsletters in Singapore
(Source:http://www.lowcarbonsg.com/;
http://www.greenfuture.sg/)

**IV. Distribution of the printed newsletter (printed on recycled paper)**

For those who do not have digital devices to access the internet, the use of printed newsletters may be more effective, although it is less cost effective and less environmentally friendly. However, target groups may include those who may not afford to own digital devices or internet subscription such as certain households which do not have internet coverage.


Figure 7.4: Iskandar Insight - The Official Newsletter of Iskandar Malaysia
(Source: Iskandar Insight, Issue 1, 2 and 3)

Newsletter features should preferably be in color, with attractive graphics to support the contents for easier understanding such as Iskandar Insight Newsletter (Figure 7.4). Several versions with different languages should be produced, as residents of IM have diverse ethnicities. The distribution can be performed through several means, such as:

- Placing stacks of newsletters in public areas where anyone can pick it up, such as in kiosks, schools, offices, community centers, hospitals, banks, hotels and information desks (passive distribution)
- Hand delivery or postal mail to target audience (active distribution)
- Inserting printed newsletter into a local newspapers for delivery

**V. Dissemination of progress updates / events announcement via billboards, banners, newspaper, radio, television, web, live streaming, DVD etc.**

The dissemination of the progress updates or event announcements towards LCS can be addressed through billboards, banners, and mass media such as electronic media (television and radio, web, live streaming) and printed media (newspaper). For instance, LCS activities can be slotted into The Iskandarian, the official monthly community newspaper (Figure 7.5).

Figure 7.5: The Iskandarian - The Free Official Community Newspaper of Iskandar Malaysia
(Source: Sustainable Iskandar Malaysia Portal)


With the rising popularity of the internet among younger generations, announcements also can be made through social networks such as Facebook (Iskandar Malaysia Facebook), Twitter, and blogs.

### 7.2.2 Mobile LCS Media Center

There should be mobile centers to disseminate information and awareness of LCS such as mobile showrooms, exhibitions, info-kiosks, and so on.

**I. LCS mobile showroom / exhibition (hybrid vehicle) periodic visit to neighborhoods**

A mobile showroom will serve as a medium to bring information about LCS awareness to the residential areas and rural areas to encourage them to take on LCS lifestyle. LCS information can be slotted into this medium and may include information about LCS lifestyle, 3R awareness, sustainable transport, and energy saving tips. During the visits, various activities can be organized for the public and children to attract their attention. These events can be coordinated with the local authorities.

Figure 7.5: Examples of mobile showroom bus by Centre for Education, Training and Research in Renewable Energy and Energy Efficiency, Universiti Sains Malaysia
(Source: http://www.uniscience.net/usm)

As there are now a few types of hybrid cars being imported and distributed in Malaysia, such as Toyota Prius, Honda Jazz Hybrid, Honda Insight and so on, these cars should be given the opportunity to be displayed and promoted at shopping complexes and exhibition to let the public understand the hybrid cars which can reduce the carbon emission. The cars can also be placed into a mobile showroom to promote LCS around IM.

**II. IM LCS info-kiosks in shopping centers**

If a mobile showroom is too costly, a simple IM LCS info-kiosk can be set up in shopping centers where many people may come. The kiosks can be set up at different shopping centres for a certain period of time (2 weeks). Info-kiosks location should be easy to access, including at the information counters and corridors at each level of the shopping centers. The information can be distributed to urban residents.

**III. IM LCS info-kiosks in community centers (multi-purpose hall, places of worship)**

A community centre is a place where people gather in events held by various organizers. it is similar to IM LCS info-kiosks to set up at community centers such as the multi-purpose hall at residential areas, places of worship such as mosques, prayer rooms (*surau*), churchs, temples, or activities centres of various NGOs.

## 7.3 Developing Model Low Carbon Communities

A model of low carbon community is one of the effective strategies for building up practical solutions that could set the communities on a journey to low carbon living. By creating this model, it can help to reduce the carbon emission caused by the current lifestyle as well as being a role model to other residential areas.

This initiative involves developing a few pioneer low carbon community models of villages and residential neighbourhoods in IM. It aims to establish the appropriate methodology for producing roadmap in developing low carbon communities. Low carbon community model incorporates the application of low carbon mitigation measures which include the practices of energy saving, 3Rs (reduce, reuse and recycle), production of green goods and reducing the use of private transportation. It focuses on the formulation of community action plan and community participation to inculcate low carbon behaviours among local communities. These strategies are in line with

National Urbanization Policy, which dedicated Thrust 6 on Effective Urban Governance, where the involvement or participation of the community is being discussed (Federal Department of Town and Country Planning Peninsular Malaysia, 2006).

**Policy: NUP 29**
The involvement of society shall be encouraged in urban planning and governance.
**Measures**

i. Implement the Local Agenda 21 programs in the formulation of policy, strategy and action plan for sustainable development.
ii. Establish a division at local authorities to coordinate and manage programs to increase local community participation.
iii. Ensure all local authorities establish a public relations unit.
iv. Ensure federal and state governments prepare the allocation of funds to manage Community Participation Programs.
v. Facilitate public in obtaining information relating to urban planning and governance.
vi. Increase public awareness on planning aspects and culture of maintenance.
vii. Promote community, private and NGO participation in development planning and the management of urban environment.
viii. Activate JKKK and encourage the establishment of resident association and Neighborhood Watch.

This program has also been implemented elsewhere such as in the project of rehabilitation of Oakleigh village in Melbourne, where conversations with the community, traders and public transport stakeholders about Oakleigh's future were being done (Nilsen, 2010). Community engagement is centered on communicating the vision and developing a consensus around the aspirations of the local community for the future of Oakleigh and what they value about the place.

IM, as the pioneer project for the implementation of low carbon community, will be selected according to the flagship zones. The target for 2015 is one showcase project for each flagship zone. The target projects until 2025 is shown in the Table 7.2.

Table 7.2: No. of villages to be developed as LCS villages 2015, 2020, 2025

| Target Year | No. of villages |
|---|---|
| 2015 | 5 |
| 2020 | 10 |
| 2025 | 20 |

### 7.3.1 Choose, Plan & Implement LCS Initiatives

There are several programs that should be carried out such as the following:

**I. Build consensus with related authorities**

Community and stakeholder reference groups need to be established in order to ensure the project will be successfully implemented. Felda Taib Andak in Kulai, Johor is the first village that has been chosen as a pioneer project after consultation with Felda Regional Office and management of Felda Taib Andak in October 2011.

A good consensus with various parties such as Felda officers, the heads of villages, representatives of Felda settlers, imam of the mosques and members of a women's' group is also important as to clearly inform them about the idea and how it could benefit the community.

For urban neighborhoods, consensus and cooperation with respective local authorities, representatives of residents associations and other interest groups need to be established at the initial stage.

**II. Produce action plans & road maps (through FGDs)**

The methodology for formulation of action plan and roadmap adapted from the technique used by Japan's Shiga Prefecture (see Figure 7.6) is recommended based on experience from a pioneer project in FELDA Taib Andak. The action plan and roadmap are formulated through detailed discussions with the villagers through a series of focus group discussion (FGD) (see

examples in Figures 7.7 and 7.8). This will ensure that all steps in developing model of low carbon community are participated by the residents/community and obtain concensus on the outcome.

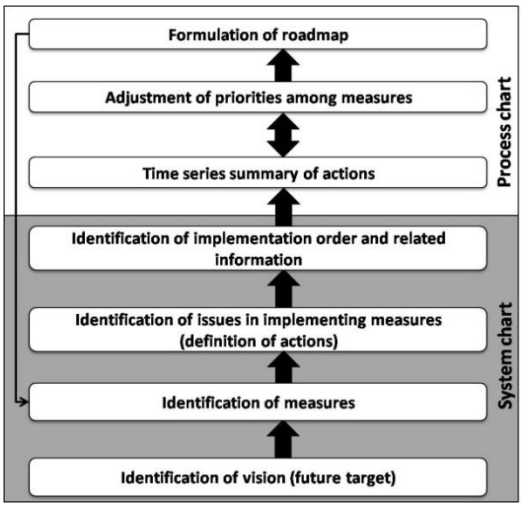


Figure 7.6: Methodology for formulation of action plan and roadmap

Some of the examples of initiatives need to be given in promoting low carbon community are low carbon awareness programs, the practice of 3R, zero open burning, use of bicycle and organic farming.

Figure 7.7: First FGD in Felda Taib Andak on 30th October 2011

Figure 7.8: Second FGD in Felda Taib Andak on 11th December 2011

### III. Formation of implementation committees

The implementation committee need to be formed as the main decision making body for the implementation. It functions to facilitate, coordinate the implementation and assist in fundraising.

As in Felda Taib Andak, the implementation committee is chaired by the Head of the village, and the members consist of representatives of various groups in the community (such as mosque, Felda officer, youth, women group) and related government agencies (including UTM). Figure 7.9 shows the example of how the meeting was carried out in Felda Taib Andak.

Figure 7.9: Low carbon eco-village committee meeting

### IV. Continuous community level monitoring of implementation

The monitoring units need to be set up from among the IRDA members which consists of representatives of the local authorities, FELDA, District Office and UTM. Continuous monitoring is important in order to keep up with the progresses that have been done by the villagers. In the pioneer project of Taib Andak, the research team visit the village once a month to observe any progress or to help the village in overcoming any related issues.

For instance, monitoring through meetings, discussions and visits from the researchers from time to time is essential to create interest and commitment among the villagers. This is also to ensure that the villagers are always in a right

track in implementing the low carbon eco-village.

## 7.4 Green Ambassadors / Champions

Green ambassadors or champions are individuals in a community or organization who have a keen interest and strong motivation to lead and promote green initiatives. Under this Sub action 7.4, Green ambassadors or champions in the public community (neighbourhood, company, organization) and schools are discussed in the following measures respectively:-

### 7.4.1 Appoint individuals as Neighborhood, Company, Organization Green Ambassadors / Champions

Green ambassadors or champions in public communities are discussed in four programs under Measure 7.4.1 which are appointing community level leaders, organising green initiatives (various activities and programs), monitoring the progress of these initiatives, the development of these leaders and their role in developing human resources for the future to ensure sustainability.

**I. Ongoing monitoring of neighborhood, company, organization green initiatives**

Green ambassadors or champions not only initiate green programmes, but also follow-up them through:

- close monitoring to maintain the momentum, and
- assessment and evaluation of the effectiveness of programme for further improvement

**II. Annual green neighborhood, company, organization competitions**

Competition acts as reinforcement for strengthening the practices of low carbon activities. At the same time, competitions are suitable to attract members of society to join the green initiatives. It also serves as a platform to pool resources (ideas and skills) and to share information on low carbon lifestyles.

However, it is vital to have consistent and regular competitions instead of ad hoc campaigns which are not sustainable for building low carbon habits among the community.

**III. Appoint community level leadership**

Leaders at the community level are individuals in communities (neighbourhood, company or organisation) who support low carbon-related initiatives.

Identifying and training community level leaders to lead and maintain the operation of LCS programs is one of the key factors to sustain LCS initiatives at grass root level. Several existing community leaders would be the best key person(s) to direct community effort including:

- Village Development and Security Committee (*Jawatankuasa Kemajuan dan Keselamatan Kampung*, JKKK)
- Religious leaders such as mosque chairmen (*pengerusi masjid/ surau*)
- Committee members of community and local organizations (societies/ clubs) such as *Rukun Tetangga*(neighborhood association)

JKKK develops and implements programs together with government departments and NGOs by acting as a liaison between village folks and government departments / NGOs. The committee organizes meetings at least once a month, making them appropriate to sustain any programs introduced. The following example shows a program currently conducted to engage rural community.

**Example: Kawan Iskandar Malaysia, KIM (literally means Friends of Iskandar Malaysia)**

Kawan Iskandar Malaysia (KIM) is a network of *ketua kampung* (head of village) for villages within Iskandar Malaysia area., initiated by IRDA. Currently there are 109 members in this network.
Programs conducted for KIM include:

- regular meetings to discuss issues or problems related to the village
- regular gathering session among KIM community

It serves an effective platform to spread environmental awareness or plans to rural community through these village leaders.

On the other hand, the religious community has established a firm platform and strong network within the community and with other related communities, enabling them to sustain program (in long term) and able to reach out to many community members. Training should be provided to these leaders by regular discussion, information sharing and support by the authorities. The following show an example of recycling activity conducted by a local branch of an international organization, Buddhist Tzu-Chi Merits Society Malaysia:

**Example: Recycling activity by Buddhist Tzu-Chi Merits Society Malaysia (Tzu-Chi)**

Figure 7.10: Tzu-Chi logo

Tzu Chi is an international organization with established local community network in almost all states in Malaysia including Johor. It's activity includes charity, medicine, education, humanity and environmental protection.

One of the regular activity under environmental protection is recycling. Recycling collection points are set up at various location in Iskandar Malaysia, with regular volunteers forming recycling groups conducting door-to-door recyclables collection and also sorting of collected recyclables. The volunteers lead by example influencing the community to join the recycling efforts.

The effort is recognized through several awards given to branches in Malaysia by both local and federal authorities.
(Detailed information about the organization (Malaysia branch) can be found in http://eng.tzuchi.my/index.php?option=com_content&view=article&id=410&Itemid=397)

For companies or corporate organisation, key personnels in the Administration or Human Resource department can be the leaders for LCS initiatives. They can promote green initiatives both within the organisation and with other communities:

- Within the organisation - to initiate low carbon practices such as energy saving practices and green purchasing policy (such as adopting the government policy to set office air-conditioning at minimum of 24°C)
- With other communities - support schools or neighbourhood activities and programmes through company's corporate social responsibilty (CSR) and also expertise sharing with school students (such as giving talks and experience sharing)

**IV. Human resource development for community leaders**

Apart from leading initiatives, Green ambassadors or champions help train potential volunteers among the general public through activities and programs to become green community leaders. This is to ensure that green initiatives are spread horizontally (to more people or communities) and sustained vertically (a continuous stream of successors).

The following example shows how community leaders are appointed and trained through a volunteer program in Miyako Ecology Centre, Kyoto, Japan:

**Example: Policy of human resource development in Miyako Ecology Center**


Figure 7.11: Miyako Ecology Center

Miyako Ecology Center was built to commemorate the event of Kyoto hosting COP 3, where the Kyoto Protocol was adopted and acknowledged. The building itself is a display of passive building design that saves and conserves energy. It provides facilities for eco-friendly initiatives and a platform to promote partnership of study and action.

Miyako Ecology Center's operation relies on the efforts of large number of volunteer staff. Volunteers come from various backgrounds, and mainly are citizens of the city. The activities at the ecology center are sustained through a continuous recruitment and training of these volunteers.

The term of service for volunteer staffs is limited to three years, where they learn and contribute at the ecology centre. After completion of the three-year service, these volunteers (now leaders) will spread environmental activities to other communities (eg. at work place or higher education institution in another city)

It is emphasized that the main factor for success in training human capital is communication. Training is given on communication skills, and volunteers gain experience by communicating with visitors to the ecology centre.

(Source: Presentation by Mr Hiroshi Iwamatsu on Policy of human resource development in September 2012)
(Detailed information about Miyako Ecology Centre can be found in http://www.miyako-eco.jp/ )

### 7.4.2 Appoint Ambassadors/ Champions In Schools

Leaders in schools are discussed in two levels in this Measure 7.4.2. They consist of students (future citizens and leaders) and school management level (including administrative staff and teachers).

**I. Green ambassadors in school (students)**

Students who are actively involved in LCS or 3R programs and exhibit high awareness and positive attitude towards LCS and 3R can be identified in Nature Club members as Green Ambassadors or Champions.

Training can be given to these Champions through workshops, seminars and activities by government agencies (e.g., The Department of Environment (*Jabatan Alam Sekita* or JAS)) and NGOs alike.

These student leaders serve as a change agent in the school by championing the low carbon cause. Peer influence and examples are more likely to create and sustain a green environment.

Moreover, interschool competitions will open up possible interactions with Champions from other schools to exchange ideas and experience, building a network of young people

who will eventually lead the future generations.

### II. Champions in school (school management team)

Another group of Champions in schools may come from the school administrators. School administrators and teachers play a vital role in promoting activities and encouraging students to participate, thus sustaining the Green campaign. School administrators or teachers would be able to monitor the program and to report the schools' achievement (including fund raised) in school assembly.

The following example shows a successful project at a local school initiated and sustained by encouragement of a champion (teacher).

**Example: Effective microorganism (EM) fertilizer @SMK Engku Tun Aminah, Johor Bahru**

- School produces EM fertilizer from food waste
- Sustained over a few years (still on-going) through active encouragement from *Guru Ko-ko* (Co-curriculum teacher)
- Fund raised from the sale of fertilizer to teachers and students' parents

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Sustainable Iskandar Portal http://sustainableiskandar.com.my/downloads/

Low Carbon Singapore Portal http://www.lowcarbonsg.com/

Part III

# Green Environment

**Action 8**
Walkable, Safe and Livable City Design

**Action 9**
Smart Urban Growth

**Action 10**
Green and Blue Infrastructure and Rural Resources

**Action 11**
Sustainable Waste Management

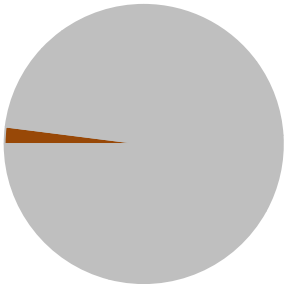
**Action 12**
Clean Air Environment

Action 8

# Walkable, Safe and Livable City Design

Muhammad Zaly Shah Muhammad Hussein, Gakuji Kurata, Chau Loon Wai, Gobi Krishna Sinniah and Nurain Mohd Sith

**GHGs Emission Reduction**



263 $ktCO_2eq$

2%

A low carbon city should offer its inhabitants a high quality, healthy and safe living environment while contributing to mitigating $CO_2$ emission. Designing walkable and livable cities is therefore an important facet of a low carbon society. Its main purpose with respect to Iskandar Malaysia is to induce a voluntary modal shift from motorised vehicles to walking and cycling for short- to medium-distance trips while creating world-class environments to live, work, learn and play in. Specifically, the targets are to increase walking from 7% of all trips in 2005 to 20% by 2025 and cycling from 3% of all trips in 2005 to 5% by 2025 in Iskandar Malaysia, yielding a total reduction of 263 $ktCO_2$ equivalent. While this amounts to just 2% of total $CO_2$ emission reduction, walkable and livable city design is crucial to ensure that Iskandar Malaysia continues to be the choice location to invest, live and work in. This calls for the following interrelated sub-actions and measures to be implemented.

# 8.0 Walkable, Safe and Liveable City Design

Liveability of a city is generally understood to encompass those elements of home, neighbourhood, and metropolitan area that contribute to safety, economic opportunities and welfare, health, convenience, mobility, and recreation. The Comprehensive Development Plan (CDP 2006-2025) for Iskandar Malaysia identified the importance of creating liveable communities with the objective to enhance the city living environment. Human-oriented and environmentally friendly design, with features to make it attractive, convenient, safe, and pleasant make up the main characteristics of this concept. It must be economically viable and efficient as well as socially driven, without social, economic or ethnic barriers to eventually create a sense of togetherness and pride in the city and region.

In the design of new communities, the transportation system is often an after-thought, with "bigger is better" as the modus operandi. One goal of these actions is to encourage local residents to come together, reinforce community and minimizing car used. Therefore, the most important things to be considered to meet this action are to design movement framework on walking distances from facilities and eventually, the quality of the routes with the elements of safe city must take into consideration on achieving liveable city concept.


Figure 8.1: Some of the campaign to promote walkable activities
(Source: News Straits Times, 2011)

## 8.1 Designing Walkable City Centres and Neighbourhood

Creating a walkable city design is a new challenge for city. However, this can be achieved by focusing on creating the pedestrian environment applying the 'Five C' principles, namely, connections, convenience, convivial, comfortable and conspicuousness. A safe, attractive and well cared for public realm are the elements that will encourage people to walk. One of the key considerations is that footpaths should lead to where people want to go. Current prediction based on 2005 shows 10% of travellers walking and this is expected to increase approximately to 20% in 2025. Increasing walking activities, however, is hugely dependent on several factors described as follows:

### 8.1.1 Providing Comfortable Walkways

The implementation of comfortable pedestrian walkways should be emphasized in Iskandar Malaysia as stated in the Road Layout Design Blueprint (2011) for IM and also CDP on Liveable Communities. These include intensive efforts to upgrade existing pedestrian walkways in various iconic places, residential areas, as well as within the cities and nearby public transportation stations.

**I. Street tree planting for shades**

In a tropical climate such as Iskandar Malaysia, weather is often cited as the main reason people refuse to walk. Thus, providing shade along walkways is an important element to encourage residents to walk as recommended in Sustainable Neighbourhood Designs of the Comprehensive Development Plan (2006).

Planting trees is a great way to offset $CO_2$ emissions and eventually enhance the natural of the existing landscape. Some that are widely used in Malaysia are *Andira inermis, Filicium decipiens* or *Fern Tree, Rain Tree* and *Sterculia Oblongata.*,

Figure 8.2: Rain Tree at Wetland Park, Putrajaya, (Source: www.agrobiosolution.com)

Trees provide natural shades while at the same time increasing the aesthetic value of the surrounding. Although continuous maintenance is required at the initial planting stage, mature trees, require very minimal care other than pruning. Through periodical pruning, tree branches are used to form natural canopy that will shade pedestrians from sunshine and protect from rain.

To achieve the proper shading effect, correct selection of trees must be emphasized. Trees providing good shades are trees with large canopy that hangs relatively low but high enough not to endanger the safety of the pedestrians. Species like *Pterocarpusindicus* (*Angsana* in Malay) provides better shading quality and are very commonly planted in tropical countries like Malaysia and Singapore to provide shades. Meanwhile the selection of Palm tree, another popular choice in this region, is not suitable as it only increase aesthetic value and has little function to provide shade for pedestrians.


Figure 8.3: Palm trees providing little shading effect (Source: Mutiara Rini Town Park, Johor Bahru)

Apart from serving as shades, tree planting along walkways offers the following benefits:

1. Helps define the walking path, thus serving as natural guidance for pedestrians
2. Creates natural physical barrier separating vehicular traffic and pedestrians
3. Serves as natural healer of the environment by consuming $CO_2$ through photosynthesis, thus lowering $CO_2$ level in the surrounding environment.

Figure 8.4: Trees defining walking path

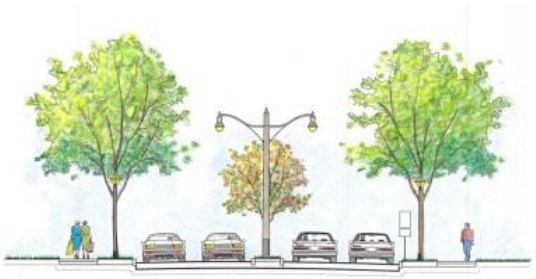


Figure 8.5: Trees as natural physical barrier

**II. Appropriate street furniture**

Pedestrians often require guidance to reach their destinations. Guidance in the form of street name signs helps pedestrians identify locations. The ability to correctly determine locations and streets is beneficial not only for locals but especially so for visitors as well as emergency workers. Street name signs are just one example of street furniture that benefits pedestrians and increase their utility of walking. As Iskandar Malaysia aims to attract more visitors and tourists to the region, the importance of providing adequate and properly placed street name signs must not be overlooked.


Figure 8.6: Street signs in Singapore
(Source : Muhammad Zaly Shah)

Other important street furniture that can increase pedestrians' comfort and safety are listed below:

1. Benches along walkways to serve as a place for people to rest and admire the surrounding view. Arm rests may be provided to discourage lying down.

2. Bollards at crossings to prevent illegal entrance into or movement along the walkways by motorised vehicles, especially motorcycles.

3. Streetlamps provide illumination to the surrounding area at night. The illumination creates a sense of safety to pedestrians and discourages criminal activities.

Figure 8.7: Streetlights illuminating walkways

4. Waste containers or litter bins in properly placed locations help to promote street cleanliness as well as recycling activities.

Figure 8.8: Waste containers along streets
(Source: Muhammad Zaly Shah)

Although street furniture creates a more comfortable and safe walkways, improperly placed street furniture, on the other hand, may present hazards to pedestrians especially the disabled and physically-challenged. Hence, it is important that the placement of this street furniture is given due considerations and proper planning.

### III. Continuous covered pedestrian walkways

Sometimes, street tree planting is not possible in certain areas, and man-made covered walkways is a feasible and logical alternative. Man-made covered walkways can serve as both shelters from the weather elements as well as linkages between buildings. These linkages when properly planned create external corridors that group buildings together.

When planning for covered pedestrian walkways, continuity of these covered walkways is critical, as it may defeat the purpose of the walkway itself. When continuity is broken, the pedestrian may be exposed at certain locations or may break planned external corridors.

Figure 8.9: Covered walkways creating external corridors

Figure 8.10: Covered walkway in Kuala Lumpur
(Source: Muhammad Zaly Shah)

**IV. Apply universal and include design concepts**

The idea behind universal design in to ensure that walkways are accessible, barrier-free and usable to all people – with or without disabilities, regardless of age and social status.

Applying the universal design concept requires deep understanding of the needs and physical abilities of different groups of people. The application of universal design concept to walkways design may include the following elements or components:

- Walkway surfaces that are stable, firm, and slip resistant
- Auditory output with information on visual street displays
- Ramp access to pedestrian walkways
- Street signs with light-on-dark visual contrast

### 8.1.2 Interconnected Pedestrian Network

**I. Create permeable street layouts**

When using public transportation, trip makers must at some point of time walk to reach their final destination. A highly interconnected network of walkways will ensure the walking experience is a pleasant, comfortable and a safe one. This improved walking experience will encourage people to reduce dependencies on private vehicles and rely more on public transportation to make their trips.

To achieve an effective Low Carbon Society, planners in Iskandar Malaysia must design a street network that provides selectively high degree of pedestrian network connectivity and permeability; but decreasingly permeable for motorised vehicles (see Figure 8.10). Achieving this will force some streets to be only accessible by walking and not driving.

Permeability and connectivity must be designed with walking comfort in mind. Thus, maximum street block dimensions of 70m - 90m are encouraged to achieve both permeability and comfort.

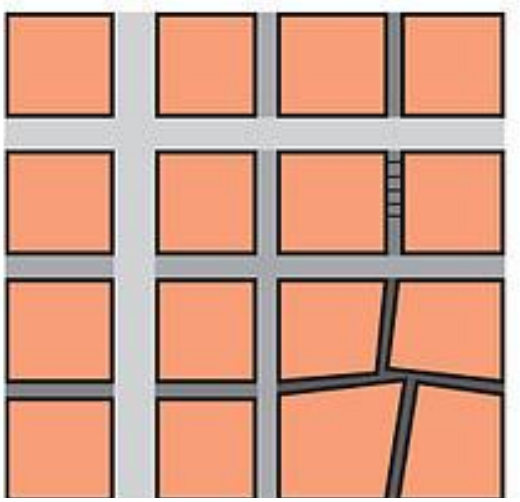


Figure 8.11: Connectivity vs. Permeability - where darker streets representing narrower streets ensure pedestrian connectivity but restrict access (reduced permeability) to selected motorised vehicles e.g. trucks and lorries
(Source: Marshall, 2005)

### II. Identify gaps/disconnections in existing street network

When there are disconnected pedestrian networks, permeability and connectivity could not be achieved. Pedestrian network analysis must be performed to identify gaps in the pedestrian network (see Figure 8.11).

Gaps identified in the existing street network indicate discontinuity in the pedestrian network. Based on the identified gaps, mitigation measures could be planned to improve permeability of the network. Once permeability is improved, the walking experience will also be improved, thus encouraging more people to walk to their destinations or adopt travelling via public transportation.

### III. Identify potential new pedestrian connection

A pedestrian destination analysis could identify potential new walkways between a set of origins and destinations. Destinations frequented by pedestrians but are not connected with walkways indicate discontinuity and represent future walkways development.

The destination analysis could also include forecasting future demand for walking based on proposed or committed new development in the study area. Combining both current and future demands, a more sustainable pedestrian planning and development could be implemented. See examples of analysis to identify pedestrian connection below.

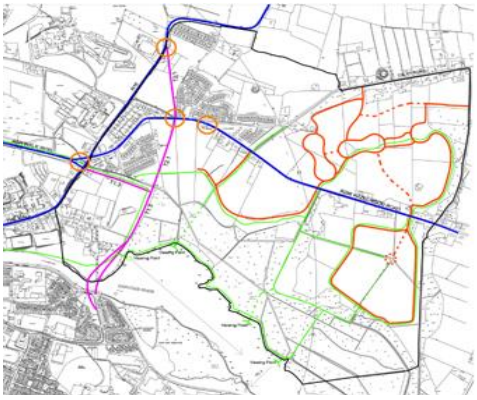


Figure 8.12: Pedestrian connectivity analysis map

Figure 8.13: Pedestrian destination analysis to identify potential walkway

### IV. Create continuous active street frontages

Businesses and retail outlets that face walkways create a street frontage that encourages active participation from the people. Active street frontages encourage economic/business activities as well as provide a sense of life, security and safety.

Figure 8.14: Active street frontage
(Source: http://lacartujita.com/gallery.html)

### V. Provide safe walking routes to school

School children are our future. The success of a Low Carbon Society depends on our children's adoption of a low carbon lifestyle. Yet, school children are among the most vulnerable group of pedestrians. Lack of understanding and appreciation for road safety may lead to accidents.

A study by the University of Michigan (2008) found that the number of school children who walk to school has decreased significantly due to their concerns about road safety. The study also concluded that the concern is particularly related to the physical environment between home and school. Thus, it is imperative that planners provide active measures, such as segregation between pedestrian walkways and road, fences along the pedestrian walkways, and shelter for pedestrians to protect our school children. With improved confidence in safety, more parents will allow their children to walk to school, thus lowering carbon emission associated with home-to-school trips.

## 8.2 Designing the Cyclist-Friendly City

### I.2.1 Providing Safe And Comfortable Cycling Network

Cycling has attracted a lot of interest lately due to major campaigns in Malaysia to promote it as a healthy way of travelling compared to driving. In some major cities, including Johor Bahru, campaigns to promote cycling undertaken during major holidays, such as National Day (see Figure 8.15).

The increased interest in cycling has also resulted in the formation of informal neighbourhood cycling clubs that group residents with similar interest in cycling. Web sites and blogs dedicated to cycling in Johor Bahru have gained huge popularity among cycling enthusiasts. This phenomenon should be encouraged to create awareness on the positive effects cycling has on the environment especially in lowering carbon emission. As the authority in Iskandar Malaysia, IRDA should take the lead in promoting cycling as well as play a more active role in ensuring safety for cyclists.

When cycling is actively promoted, cycling activity in Iskandar Malaysia is estimated to be increased to 5% in 2025 from 3% in 2005 due to high potential and support lately by people who started to cycle quite often, even though for recreational purposes. This can be expands by giving some priorities in terms of development of infrastructure and facilities to encourage people to use bicycle to replace cars or motorbikes as transportation modes.

Figure 8.15: Cycling campaign in Taman Daya, Johor on National Holiday
(Source: The Star, 2011)

**I. Provide dedicated cycle tracks along major roads**

Based on Road Layout Design Blueprint (2011), various bicycle facilities will be provided along the road by providing cycle track to encourage the using of bicycle in Iskandar Malaysia. Cycle track is reserved only for bicyclist, combined with pedestrian walkway, separated by the making and separator and shall not combine with motor vehicle lanes (see Figure 8.16). Besides that, as bicycles travel faster than pedestrians, bicycles may present physical hazard to pedestrians just like motorized vehicles do. Hence, if bicycle traffic is heavy, a dedicated cycle track should be provided because it may be hampered as the cyclists need to consistently avoid pedestrians.

Figure 8.16: Dedicated cycle track in Montreal, Canada
(Source :
http://www.flickr.com/photos/7995989@N03/4931846917/

### II. Priority signals for bicycles at major junctions

Traffic signals that are timed specifically for automobiles are not suitable for bike riders. In most situations, when priority bike signals are not available, bicyclists will choose to beat the red light to cross a junction. A priority signals for bicycles can avoid this problem.

Nonetheless, priority signals for bicycles may not be suitable for all areas. Instead, the option to provide bicycle priority signals should be weighed against the impact they have on other road users including pedestrian. In most situations, a street with high bicycle traffic is a good candidate to implement the priority signal.

### III. Provide sufficient and secure bicycle parking facilities

To encourage cycling and to improve management of bicycles, a proper parking facility (see Figure 8.17) should be provided at major destination points such as transit stations, educational institutions, retail outlets, and so on. Additionally, the parking facility provides a secure facility for riders to leave their bicycles unattended just like automobile parking lots do to drivers.

Figure 8.17: Bicycle parking facility at Tampines MRT Station, Singapore
(Source : Muhammad Zaly Shah)

#### iv. Provide safe cycling routes to school

When schools are located slightly further away from home, cycling is a better choice than walking. In such a situation, if cycling routes are not provided, school children who cycle will have to compete for the same road space with other road users particularly motorised vehicles.

The competition for the same road space plus different handling characteristics between bicycles and cars will often results in conflicts leading to accident. Thus, to prevent this, dedicated cycling routes to school should be provided. The provision of the dedicated cycling routes will undoubtedly increase the safety confidence of parents to allow their children to cycle to school.

#### v. Promote bicycle rental services

In order to promote cycling activities, rental services can be useful for some people, especially in the city center. This idea will be significant especially for tourist or local people to ride bike and embrace a healthier and greener lifestyle. This idea have been introduced in city like Georgetown, where by the operators, which is Metro Bike, incorporated with Tourism Malaysia, hoteliers and other private company are promoting this idea to visitors in their respective places.


Figure 8.18: Example of bicycle rent by Metro Bike
(Source: www.metrobike.com.my)

## 8.3 Designing Safe City (From Crime)

Since 1990, the safe city initiatives have rested on crime prevention through environmental design, an approach involving the practical elements of designing a safe community and the need to address the root causes of violence in our community. Despite seeing street crime

and the overall index crime drop by 35 percent and 15 percent respectively in 2010, efforts are still ongoing to ensure that crime prevention initiatives under the Government Transformation Programme (GTP)'s National Key Results Area (NKRA) are on track and sustainable (www.pemandu.gov.my).

### 8.3.1 Crime Prevention Through Environmental Design (CPTED)

#### I. Installing CCTVs at strategic locations

Close Circuit Television (CCTV) cameras, when placed at strategic locations, provide additional set of eyes for law enforcement agency to prevent crimes or to respond to criminal activities. They can be used to monitor and record images of what happened at a specific place.

Figure 8.19: Improper walkway planning may not protect pedestrians from criminal activities

Installing CCTV in Iskandar Malaysia can create a sense of security thus encouraging healthy social activities among its residents including encouraging residents to walk and cycle.

Planning-wise, CCTV helps to mitigate issues created from poor street or walkway design that may not deter criminal activities (see Figure 8.18).

When used strategically, the CCTV provides the following positive effects:

- Deter people from committing crimes in the area in which it is used
- Signify that the area with CCTV is a safe place and crime is less likely to happen
- Remind people to take other security measures such as locking their car

#### II. Increase resident's natural surveillance

Natural surveillance relates to the ability to see into and out of an area. It involves the placement of physical features, activities and people in ways that maximize the ability to see what is ocurring in a given space and optimize the potential to spot suspicious persons or activities. Generally, criminals do not want to operate in an area that they can be easily seen. An increase in natural surveillance techniques will improve the security of the area whereby the visibility for witness will increased by making it easier for people to naturally see into an area during normal day-to-day activities. This will create an increased risk of detection for potential criminals.

Figure 8.20: Landscaping example: Good line of sight from property to street (Source: Ewing, 1996)

Some ways to increase resident's natural surveillance includes;

- Pruning shrubs down to a height of 3 feet and trimming tress up to about 6 feet high to provide a clear, unobstructed view and to prevent someone from hiding on your property, doors and windows.
- Making sure that the front door is at least partially visible from the street, to allow neighbours and passers-by to see unknown people near their neighbor's house.

- Choose open type fencing such as chain-link and metal ornamental/security style fencing. Open fencing does not obstruct visibility, is harder to climb and is less susceptible to graffiti.
- Placing cafes and kiosks in parks to increase natural surveillance by park users.

### III. Identify & eliminate blind spots & gap spaces

Blind spot or corners make people feel uneasy and unsafe. Not knowing what is around the next corner can discourage genuine users of a space to use and maximise it. Avoiding blind spots or conrners in pathways, stairwells and car parks can reduce crime activities as well as increase sense of safety among people. This can be achieved by redesigning the urban areas that have the potential to be crime spots as follows:

- Pathways should be direct. All barriers along pathways should be permeable (see through) including landscaping, fencing, etc.
- Consider the installation of mirrors to allow users to see ahead of them and around corners
- Install glass panels in stairwells where appropriate.

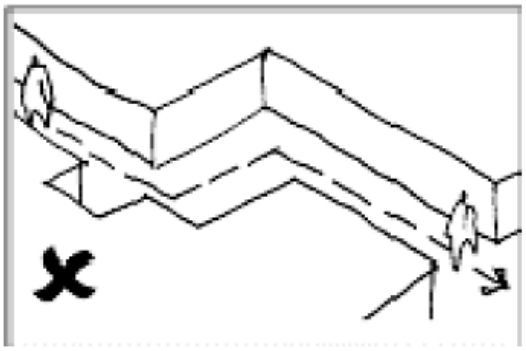


Figure 8.21: Example of Blind spot/corner
(Source: Ewing, 1996)

### IV. Community patroling as recreation

Community patroling ideas is another options to reduce crime rate in the areas. It is mainly organized by local community in colaboration with the police to monitor an area that has a high rate of crime. Many places in the world have implemented the idea, and it is essential for IRDA to promote this idea. The patroling groups can consists of a group of youth and/or also senior citizens, that are retired police or army.

### V. GIS database on crime occurrences

GIS database is essential to identify and spotted places that have high crime rate and/or potential areas to have high crime rate. This is important for monitoring purposes and also for continuous evaluation and analysis on crime rates. GIS aids crime analysis, among others, by:

- Identifying and highlighting suspicious incidents and events that may require further investigation
- Supporting pattern and trend analysis across multiple jurisdictions
- Educating the public with visual information to clarify crime concerns and enlist community action
- Providing tools and techniques to capture crime series and forecast future crime that might happen.

GIS can help police and community to understand events and dynamics in a neighbourhood, including persons, events and crime hazards. It also can develop plans for special crime abatement teams to address regional or seasonal hot spot locations.

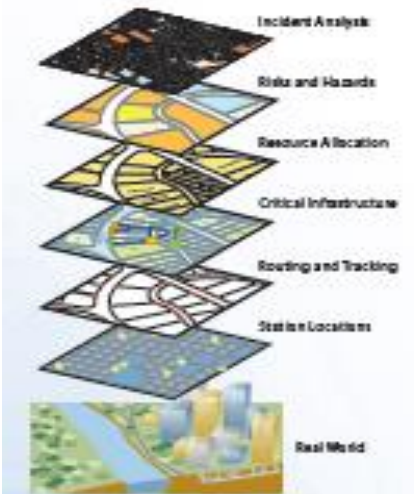



Figure 8.22: Among the information required to identify crime locations using a GIS application

### I.2.2 Increase Police Presence

**I. Set up community police beats at strategic locations**

IRDA has played a leading role in ensuring public safety and security in Iskandar Malaysia by providing Community Police Post (CPP) to the Police Department to enable the police to be closer to the community (see Figure 8.22).

The CPP, together with the Community Police Beat (CPB), have been successful in bringing down the crime statistics in Johor. Statistics show that street crime cases for Jan-Feb 2012 decreased by 53.6% from 6690 to 3104 over the same period in 2009 (see Figure 8.23). The active participation by IRDA in Iskandar Malaysia to reduce crime by cooperating with the Police Department should continue and further be strengthened to bring the crime statistics down further.


Figure 8.23: The opening of a new police beat base in Johor Bahru
(Source: http://www.kccdev.com.my)

Police patrolling provide the confidence to residents that everything is under control and the police has the upper hand in crime fighting. The presence of police will also boost investors' confidence especially in the issues of expatriates living in Iskandar Malaysia.

Located next to Singapore, Iskandar Malaysia is consistently benchmarked against Singapore, a nation with one of theworld's lowest crime rate. Thus, it is imperative that IRDA and law enforcement agencies work closely to increase public confidence in the region's security and safety to be at par with Singapore. Increasing police patrolling is definitely a step in the right direction towards achieving this objective.

Police patrolling not will safeguard the community but it will also protect the public and private infrastructure, such as street furnitures, ornamental street lights, CCTV, and so on. This will result in a higher Return-on-Investment (ROI) on this infrastructure.

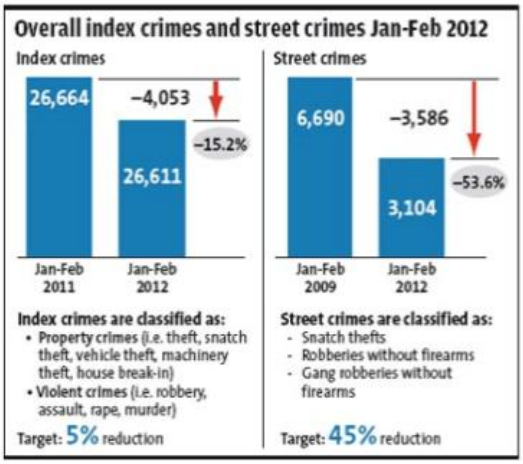



Figure 8.24: A significant reduction in street crimes due to active cooperation between IRDA and the Police Department

**III. Community cycling patrol with police**

The role of protecting neighbourhoods should not be the responsibility of the police alone. Citizens should also play an active role in contributing towards community safety and security. Through community cycling patrol with police, the burden of ensuring safety and security is shared between the residents and the police.

To effectively achieve this, IRDA could promote the concept of community cycling patrol through campaigns, together with the police and eventually would be a safer Iskandar Malaysia where people can perform social and economic activities without obstacles.

## 8.4 Designing Civilized and Liveable Streets through Traffic Calming

The "liveability" of streets decline as the traffic volumes and speeds increased. Residents are

more satisfied with the street environment when traffic volumes and speeds are low-to-moderate. In line with the Road Layout Design (2011), Iskandar Malaysia will be emphasized on ensuring safety for all road users by introducing 'traffic calming'. Traffic calming is accomplished through measures that control the volume of traffic, the speed of traffic, or both. Speed humps is one of the example commonly used to reduce speed of vehicles. For speed control, traffic calming must be designed into a community. The maximum speed recommended is approximately 30km/h, which cities like Amsterdam and Barcelona have been using for many years.


Figure 8.25: Examples of speed limit used in Barcelona

### 8.4.1 Reduce Vehicle Speed

#### I. Enforcing 30km/h zones

Speed kills! Vehicles travelling at speeds above 35 km/h are capable of seriously injuring pedestrians. Thus, to reduce serious accidents and make streets safer for pedestrians, it is important to enforce lower travelling speeds from the current 35 km/h in sensitive areas like schools to 30 km/h.

Nonetheless, having lower speed limit is ineffective without strict enforcement. Reckless drivers who violated the speed limit must be punished either through fines or suspension of driving license for a specified duration. Repeated traffic speed offenders may have their driving license revoked temporarily until the offenders have undergone certain remedial or behaviour alteration processes.

#### II. Installing speed humps

While voluntary speed reduction through observation of speed limit is more desirable, sometimes there is a need to force drivers to reduce traveling speed via physical means such as speed humps.

Figure 8.26: Flat-top speed hump doubling as pedestrian crossing at Bandar Tasek Selatan LRT station, Kuala Lumpur
(Source: Muhammad Zaly Shah)

#### III. Carriageway deflection (chicanes & chokers)

Apart from introducing stop signs, speed limits and legal penalties, traffic calming can be implemented by changing the driving conditions on roadways in such a way that traffic speeds and driver behaviour are self-enforced. This is accomplished through incorporating design elements into the roadway, such as using chicanes and chokers. This can reduce erratic or aggressive driving behaviour and enhance the livability of neighborhoods and business districts through attractive street design.

Figure 8.27: The use of chicanes in Kyoto to reduce vehicles speed (Source: Muhammad Zaly Shah)

**IV. Reduce junction turning radii**

When streets intersect at an obtuse angle or have a large curb radius, motorist can make turns at relatively high speeds. By contrast, 90-degree intersections and corners with tight curb radii tend to slow motorists down. The ideas to reduce junction turning radii are based on several possible place or routes, such as those used by school children or the elderly, in neighbourhood shopping areas with high pedestrian volumes or intersections identified by the neighbourhood as having safety problems. Some of the guidelines may need to be considered for are:

- A curb radius of 3 to 4.5m (10 feet to 15 feet) is recommended where residential streets intersect other residential streets and arterial streets.
- A curb radius of 6 m (20 feet) is recommended at intersections of arterial streets that are not bus or truck routes.
- A curb radius of 7.5 to 9m (25 feet to 30 feet) is recommended at intersections of arterial streets that are bus or truck routes.

Figure 8.28: Obtuse intersection allowed motorists to make high-speed turns

**IV. Reduce junction turning radii**

Most of existing turning radius do not comply with the requirement guideline as mentioned in Iskandar Malaysia Road Design Blueprint. Radii through junctions should generally allow cyclists to maintain progress without interruption when they have priority. A minimum external radius of 4m should be used on cycle facilities, with a larger radius wherever possible.

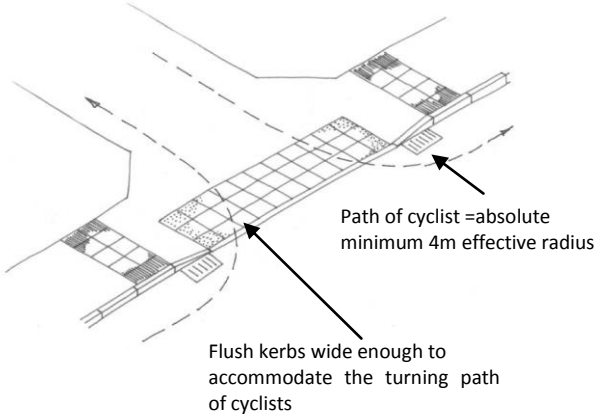



Figure 8.29: Example of design of junction turning radii
(Source :www.cycling-embassy.org.uk)

**8.4.2 Street Environmental Enhancement**

**I. Home zones**

Home zones are residential streets in which the road space is shared between drivers of motor vehicles and other road users, with the wider needs of residents in mind. Changes to the layout of the streets should emphasise this change of use, so that motorists perceive that they should give informal priority to other road users. The design of the home zone should make motorists feel that they are a “guest” in the street and must make it difficult for them to travel at speeds between 10-30 km/h.

**II. Gateway design into traffic calmed areas**

The entrance to a traffic calmed area requires special attention to make it clear to drivers that the area they are entering has speed restrictions and conditions very different from the surrounding network. Some measures used to achieve this effect include:

- Different surface materials
- Road narrowing
- Traffic island / ghost island
- 20-30km/h signs if appropriate

Figure 8.30: Road narrowing design to calm traffic (Source: http://en.wikipedia.org/wiki/File:Traffic_calming.jpg)

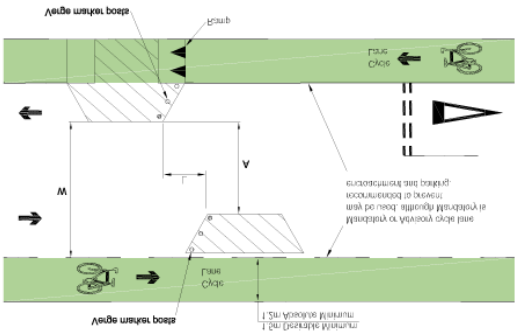


Figure 8.31: Example of chicane stagger length and motor vehicles speeds

#### III. Community landscaping program

The community landscape concept is intended to provide identity and character to the various residential business areas and cities. It can be realized through cooperation between the local community and the local authorities to have landscaping plans for their respective areas. The purpose for landscaping programs is to enhance the visual quality and aesthetic characteristics of the community, promote a consistent character of development and community identity and enhance the open space or natural resource areas of the site.

### 8.4.3 Reclaiming Pedestrians Space

#### I. Carriageway narrowing

Carriageway narrowing is a gateway feature to help to slow down the speed of vehicles. Although the road is narrowed slightly, the remaining width should be adequate to pass cyclist safely. Chicane consists of two or more build-outs on alternate sides of the carriageway, permitting only one vehicle to pass at a time. They are designed to force vehicles to move out of and then back in to the left side of the carriageway first and to give way to oncoming vehicles where required.

#### II. Pavement widening

Should people to be encouraged to walk, providing a network for them as good as for motorists are essential. Sidewalks are an absolute necessity along all through-streets serving developed areas. Most of current pedestians paths are provided from 3 feet or less, especially at the roadside. To encourage more people to walk, this should be extended for their convenience and at the same time reduce crime activities such as snatching.

#### III. Kerb extension at junctions

A kerb extension is an extension of the footpath on the roadway for a short distance. They normally reinforce the existence and prominence of signalised pedestrian crossings, reinforce the presence of pedestrains, reduce the width of the road that pedestrains have to cross and improve visibility between motorists and pedestrians.

#### IV. Humped pedestrian crossings

Road humps that do not have signs or marking for pedestrian crossings but rather coincide with pedestrians desire lines are confusing to both motorists and pedestrians. Pedestrians perceive these devices as crossings on which they have priority over vehicles. Some of the motorists consider road humps to be pedestrian priority devices and stop to give way to pedestrians. Signs have been erected at some humps that have neither pedestrian crossing signs nor pavement markings to make it clear for both pedestrians and motorists.

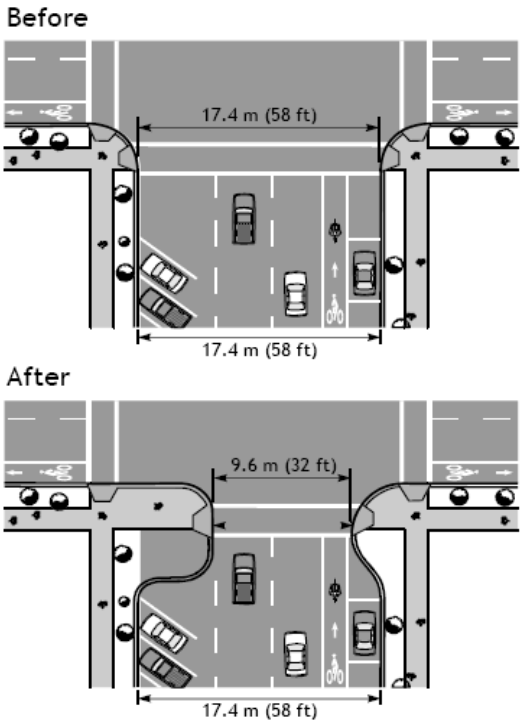



Figure 8.32: Example of hump flush with kerb

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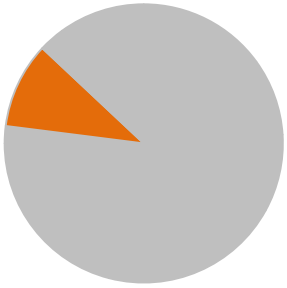
Action 9

# Smart Urban Growth

Mohammad Rafee Majid, Chau Loon Wai, Ho Chin Siong, Muhamad Azahar Zikri Zahari and Teh Bor Tsong

**GHGs Emission Reduction**



1,214 $ktCO_2eq$

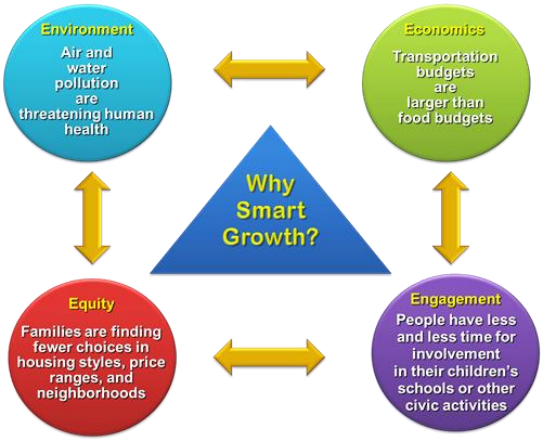
10%

As the population in Iskandar Malaysia will more than double from to 3 million and GDP almost quadruple to RM141.4 billion in 2025, supporting and managing rapid growth while keeping energy demand and $CO_2$ emissions at bay becomes a critical issue. Key to this is the way in which Iskandar Malaysia's spatial growth is managed through 'smart urban growth' strategies. Smart urban growth aims to reduce average number of trips, trip distance and vehicle mile travel (VMT) and at the same time increase the use of public transport in Iskandar Malaysia by providing a spatial framework for sustainable growth, specifically in: (1) promoting a polycentric growth pattern; (2) promoting com-pact urban development; (3) promoting transit supportive land use planning; and (4) developing the 'Smart Digital City'. These are achieved while quality of life and the natural environment in Iskandar Malaysia are preserved and enhanced. Measures and programs related to the above strategies are expected to reduce Iskandar Malaysia's $CO_2$ emission by 1,214 ktCO2 equivalent (10% of total emission reduction) by 2025.

## 9.0 Smart Urban Growth

Iskandar Malaysia, which is a rapid growth metropolitan area like many other megacities of the world, is likely to face a dispersed urban expansion pattern across its landscape. This phenomenon is also known as urban sprawl. Low density suburban developments are increasing and the urban functions have been decentralized over the entire area of the dispersed region. Limitless urban expansion without any clear directions over the fringe of metropolitan areas will consume vast amounts of agricultural land and forest and require an overwhelming majority of community members to prefer automobiles over other long-distance modes of transportation. This has been identified as a climatic threat, manifested in greenhouse gas emission due to the higher automobile dependency, excessive energy use and loss of agricultural and forest land for carbon sinks.

To combat the above scenario, Smart Growth development concept will be introduced to Iskandar Malaysia to guide urban development growth in a sustainable pattern. The Smart Growth development concept is a spatial planning strategy reaching beyond conventional practice in urban expansion management. It attempts to overcome the sprawl through the promotion of polycentric growth patterns, compact urban structure, and integration of land use and transportation




"Smart urban growth" is a collection of land use and development principles that aim to enhance our quality of life, preserve the natural environment, and save money over time. Smart growth principles ensure that growth is not only fiscally, environmentally and socially responsible but also recognizes the connections between development and quality of life. Smart growth enhances and completes communities by making infill, redevelopment, and densification strategies a priority.


### 9.1 Promotion of Polycentric Growth Pattern in Iskandar Malaysia

The urban form of traditional city is monocentric, with only a city center, usually containing a high density commercial core surrounded by residential suburban. This structure provides a clear focal point with centralized functions and strong support for radial transportation network. Yet, when the city grows, suburbanization occurs. Many low density residential suburbs are established and expand outwards. This tends to increase travel distance, automobile ownership, heavy congestion and encroachment on the natural landscape. To overcome the monocentric model, polycentric development should be

encouraged in decentralizing the functions of the current city center to the other sub-centers. With the formation of sub-centers, public transport is increasingly feasible and favoured. Besides, a polycentric spatial organization is likely to provide a chance of shrinking the sprawl and green spaces can be re-established. Nonetheless, the polycentric urban development needs to be in a clear hierarchical distribution of urban functions over the various sub-centers of the region. This is quite vital to prevent either city centers or sub-centers from becoming dysfunctional.

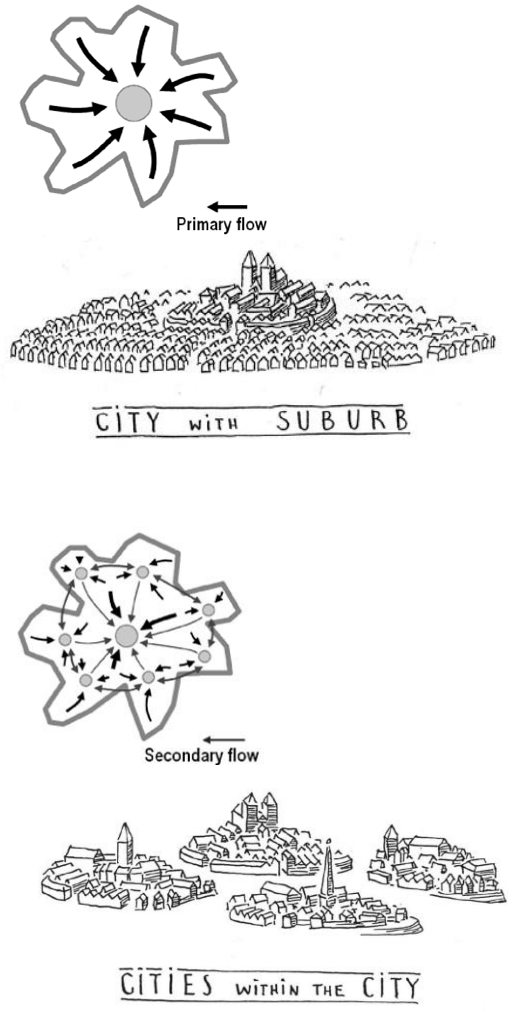



Figure 9.2: Monocentric and polycentric Cities
(Source: A. Bertaud 2001, L. Krier 1998)

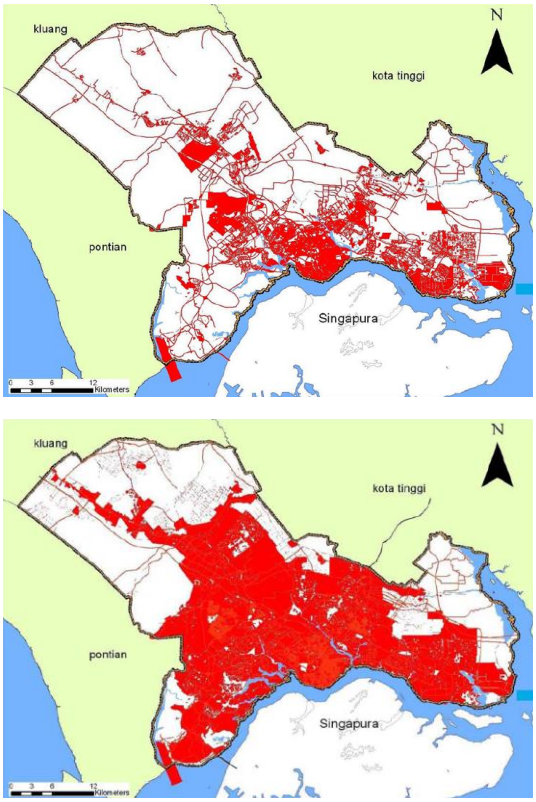
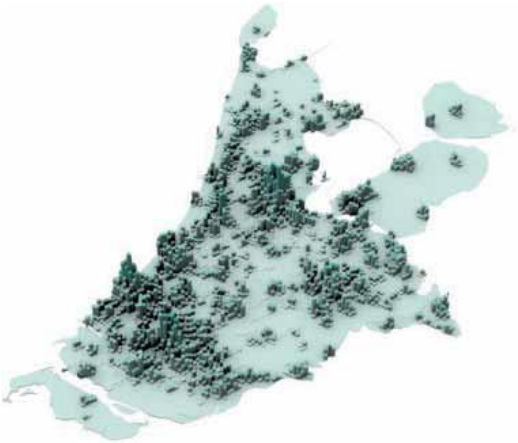



Figure 9.1: Urban morphology of Iskandar Malaysia in 2003 and 2025 (simulated)
(Source: S. Soheil and Y. Ahris, 2008)

### 9.1.1 Gradual Urban Function Reconcentration In Polycentric Nodes Connected By Public Transport

Green neighbourhood design is often linked to the polycentric nodes. Having many nodes in a region is sometimes an important action in balancing between land use and environmental planning. Polycentricity can either refer to an intermediate pattern of urban population clustering and economic activity, such as Los Angeles, London, or Paris, or a pattern between cities, such as Randstad, Holland with the area of Padua-Venice-Treviso in Northern Italy. Apart from those cities in the European Union (EU), southern California urban region in the United States and Kansai in Japan may be seen as the latter form of polycentricity (Batten, 1995). An example of the differences between monocentricity and polycentricity can be seen clearly by comparing Randstad, Holland and Greater London (Figure 9.3).

Residential densities of central London (Monocentric).



Residential densities of Randstad Holland

Figure 9.3: Comparison of urban function between monocentric and polycentric urban form.
(Source: London School of Economics and Political Science)

Findings from this study show that Iskandar Malaysia is a polycentric urban form but with inequivalent urban activities. This fact has been indicated by the urban population, which is highly concentrated within suburban areas (Figure 9.4).

Even though there are other centers or subcenters in the region, apart from Johor Bahru, still the urban function of those centers are competitive. Therefore, policy makers and the monitoring agencies should be aware that smart growth is not as simple as merging the polycenters, but also to gradually concentrate urban function into those centers.

**I. Identify and reinforce functions of existing urban centers as polycentric nodes.**

There are five nodes in Iskandar Malaysia that have been identified. These nodes represent different urban functions but are very useful to ensure that the urban function pattern of the nodes gradually grows (Figure 9.5).

***Flagship A***- The city of Johor Bahru is Malaysia's 'Southern Gateway', receiving sixty percent of foreign tourists who visit Malaysia. It is a major holiday and shopping destination for

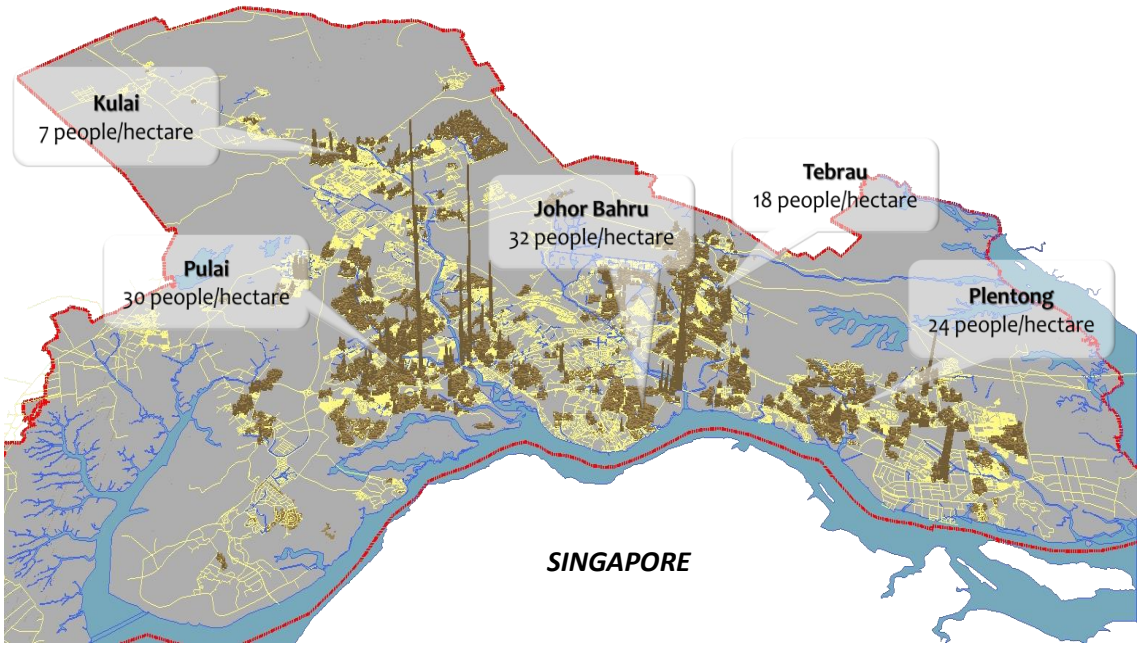



Figure 9.4: Current pattern of residential densities in Iskandar Malaysia.

neighbouring Singaporeans due to the comparatively lower cost of goods and services. The City of Johor Bahru is the Central Business District and the State Capital of Johor. It is also the main gateway into and out of Singapore (via the Causeway). The current key economic activities in Flagship A are financial services, commerce and retail, arts and culture, hospitality, urban tourism, plastic manufacturing, electrical and electronics (E&E), and food processing.

***Flagship B*** - Nusajaya, a key component of Iskandar Malaysia with 24,000 acres of contiguous development-ready land, is one of the largest property development in South East Asia. Flagship B will be a major new growth center of Iskandar Malaysia, as most of the catalyst projects will be developed within the area. The projected population size for this area by 2025 is 500,000. Current key economic activities in Flagship B are focused on mixed property development, state and federal administration and logistics. Going forward, Flagship B would be the hub for creative arts and entertainment, medical facilities, educational institutions, tourism, biotechnology, and high-tech manufacturing.

***Flagship C*** - The key economic activities in Flagship C are port and marine services, warehousing, logistics, engineering, high-tech manufacturing, food production, petrochemical industry, and entreport trade. Flagship C boasts a logistics center, regional distribution centers, regional procurement centers and utilities such as power.

***Flagship D*** - As one of the key components of Iskandar Malaysia, the industrial and manufacturing hub in the southern region of Peninsular Malaysia encompasses 31,132 ha of the Pasir Gudang area. Flagship D covers Pasir Gudang Port, Pasir Gudang Industrial Park, Tanjung Langsat Port and Tanjung Langsat Industrial Complex. Current key economic activities in Flagship D focus on heavy industries and logistics, including electrical and electronics (E&E), chemical, oleochemical, food and engineering-based industries as well as ports and logistics and warehousing. Flagship D has the largest concentration of palm oil refining industries and downstream activities in the world. The main economic activities in Key Economic Zone D are focused on heavy industries and logistical services.

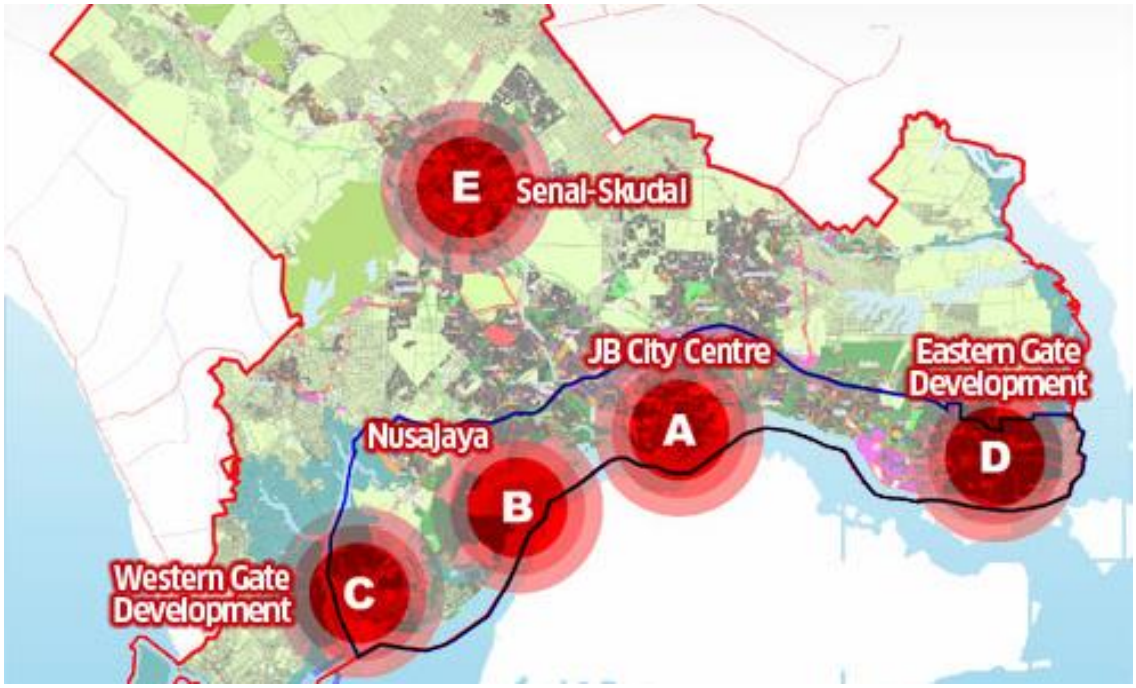



Figure 9.5: Polycentric nodes of Iskandar Malaysia
(Source: Iskandar Regional Development Authority)

***Flagship E*** -Current key economic activities in Flagship E are airport services, engineering, electrical and electronics (E&E) and education. Going forward, Flagship E would also be the hub for agro and food processing, ICT and retail tourism.

**II. Expand public transport service coverage (new development area within UGB).**

Iskandar Malaysia boasts of an extensive road system. Beyond that, several major road networks have also been proposed and some have been developed, for example, the Eastern Dispersal Link (EDL), Johor Bahru Coastal Road and the Johor Bahru Middle Ring Road. In addition, pertinent road upgrades and improvement programmes have been recommended for many of the roads in areas where economic activities are envisioned to increase. Major highways are being upgraded to enable the dispersion of traffic flow from congested areas as well as providing connecting routes to drive development in other areas (Figure 9.6). In the short to medium term, public bus services will be upgraded and continue to play the role of backbone for Iskandar Malaysia's public transportation until the mass-oriented urban rail system takes hold. In the long term, public bus services will be oriented to act as a feeder services to the rail-based transport system.

The multi-modal transportation system will consist of different modal transportation networks which, by themselves, allow a traveller to move from one location to another. Inter-modal connection provides the ability to transfer from one modal network to another. A local transit terminal is proposed to be located within the CBD of Johor Bahru. The existing bus terminal at Jalan Trus has been proposed to be upgraded to accommodate a local transit terminal and create a dedicated pedestrian route connection between the Johor Bahru Sentral I and the Transit Terminal located at the existing Johor Bahru KTM terminal (Figure 9.7). To cater for regional linkages, a Regional Transit Terminal known as Johor Bahru Sentral II at Senai is proposed. This terminal will function as a regional transit terminal for the Johor Bahru District transit system. It will consist of facilities for High Speed Rail system, LRT, and KTM Komuter Services.


Figure 9.6: Current major highways in Iskandar Malaysia
(Source: Iskandar Regional Development Authority)

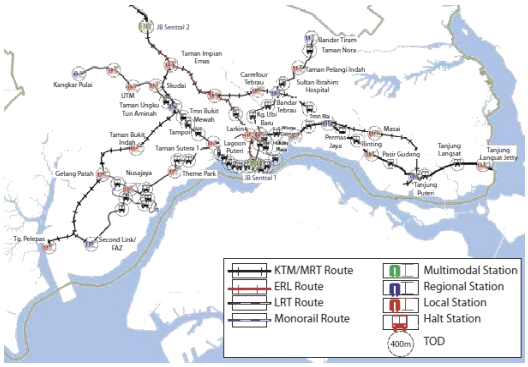



Figure 9.7: Proposed Integrated Transportation System in Iskandar Malaysia
(Source: Iskandar Regional Development Authority

**III. Coordination of spatial growth strategies across administrative boundaries of local authorities.**

The Iskandar Regional Development Authority (IRDA) is a Malaysian Federal Government statutory body tasked with the objective of regulating and driving various stakeholders in both public and private sector for realizing the vision of developing Iskandar Malaysia into a strong and sustainable metropolis of international standing. IRDA works closely with five local authorities inside Iskandar Malaysia (Figure 9.8) including Majlis Bandaraya Johor Bahru (Johor Bahru City Council), Majlis Perbandaran Johor Bahru Tengah (Johor Bahru

Tengah Municipal Council), Majlis Perbandaran Pasir Gudang (Pasir Gudang Municipal Council), Majlis Perbandaran Kulai (Kulai Municipal Council), and Majlis Daerah Pontian (Pontian District Council).

### 9.1.2 Gradual extension and reconnection of forests and regional green spines

Based on the comparison, it is seen that each node in the city have leftover spaces resulting from major development. This allows the provision of green spaces as a crucial element in the low carbon society. These efforts can emerging the green linkages within those nodes. For example, the city of London created a green belt (Figure 9.9) while the Randstad Holland also established a major primary green field (Figure 9.10). Those effort were purposed to achieve a public realm for those cities.

Iskandar Malaysia green linkages can be best developed using the Green Infrastructure approach. The Green Infrastructure approach analyses the natural environment in a way that highlights its function and subsequently seeks to put in place, through regulatory or planning policy, mechanisms that safeguard critical natural areas. Where life support functions are found to be lacking, layout plans must propose how these can be put in place through landscaped or engineered improvements. The term "green infrastructure" is sometimes expanded to "multifunctional" green infrastructure. In this context, multifunctionality refers to the integration and interaction of different functions or activities on the same piece of land. This is key to the efficient and sustainable use of land, especially in a compact and bustling country such as England, where pressures on land is particularly acute. Examples might include an urban edge river floodplain which provides a repository for flood waters, acts as a nature reserve, provides a recreational green space and could also be productively farmed, perhapse through grazing. There is growing evidence that the natural environment also has a positive effect on human health.

Figure 9.9: The green belt of London
(Source: London School of Economics and Political Science)

Figure 9.10: The primary green field of Randstad Holland
(Source: London School of Economics and Political Science)

**III. Minimize development on greenfield sites.**

Every urbanization has always given a bad impact to greenfield. The building footprint is a good indicator to show the water and green permeability for Iskandar Malaysia (Figure 9.10). This means that all development should not touch the green linkages which have been gazeted. This role should have taken by all of the municipal in Iskandar Malaysia and coordinated by Iskandar Region Development Authority (IRDA). The sprawl of building

footprints should not spill out to the green linkages of Iskandar Malaysia.

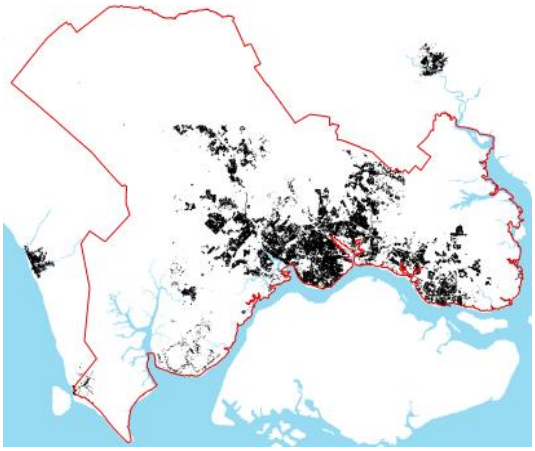


Figure 9.10: Building footprint of Iskandar Malaysia

**II. Identify and gradually establish interconnected regional green wedges.**

By using the green infrastructure approach, several landuses have been identified to be integrate as the green linkages of Iskandar Malaysia (Figure 9.11). These multipurpose landuses that had been identified are open spaces, electrical utility lines, water bodies, vacant land, road network buffer, wet land, forestry, bare earth and recreational space.

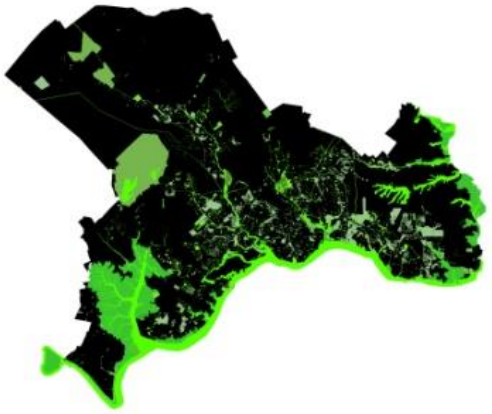


Figure 9.11: The green linkages of Iskandar Malaysia

## 9.2 Promote Compact Urban Development

The compact urban development model is a good practice for Iskandar Malaysia. The growth concept stems from the compact urban development model, ensuring that 'most future growth is within the existing urban area where environmental, accessibility and community principles can be met. Furthermore, within the existing built-up area, most urban growth is focused around centers of major passenger transport routes, such as polysentric nodes in Iskandar Malaysia's passenger transport corridors. This includes a reduced, emphasis on the generally unpopular suburban infill, and a much greater focus on the redevelopment and intensification of particular areas which have the infrastructure to support such growth. By intensifying development primarily along high-frequency bus routes at the polycentric nodes in Iskandar Malaysia, reliance on their vehicles as a primary method of transportation could be reduced. This would decrease traffic congestion, as well as encourage other 'indirect' improvements in quality of life for residents, such as lowered air pollution and related respiratory health problems.

### 9.2.1 Urban Growth Boundary (UGB) for Iskandar Malaysia

An urban growth boundary is an officially adopted and mapped line that separates an urban area from its surrounding greenbelt ie; open lands, farms, watersheds and parks (Figure 9.12). There are a number of reasons to implement an urban growth boundary. The two most fundamental purposes are to promote compact and contiguous development patterns to be more effectively served by public services, and to preserve open space, agricultural land, and environmentally sensitive areas that are not currently suited for urban development.

Urban growth boundary programs should have provisions for revising the boundary over time, but should have limitations on how often the boundary can be modified. Additionally, growth within the boundary should be subject to contiguity requirements for annexation purposes and should be sized for efficient development within the planning period.

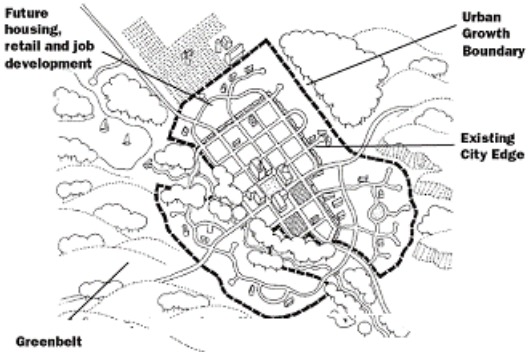



Figure 9.12: Urban growth boundary
(Source: Greenbelt Alliance)

**I. Setting spatial growth limit of Iskandar Malaysia and enforcing urban growth boundary.**

Iskandar Malaysia's urban growth boundary, with some exceptions, reflects the existing edge of urban development together with a number of known commitments that are consistent with other development plan. An open and transparent process has been developed to deal with any anomalies or transitional cases. Generally, the Iskandar Malaysia urban growth boundary will be permanent. Once it has been settled, only designated growth areas will undergo periodic changes. In these locations, the urban growth boundary may be revised occasionally after regular assessments are made of land supply, and the availability of infrastructure and service provision at metropolitan and regional level. This may lead to the revision of development plans for these areas.

Land within Iskandar Malaysia urban growth boundary will be available for a range of urban uses, including open space. Rural activities will be encouraged until land is required for urban purposes. Land outside the Iskandar Malaysia urban growth boundary will remain predominantly rural in use and character. Metropolitan green wedges will be planned and managed to protect their individual resources, values and characteristics.

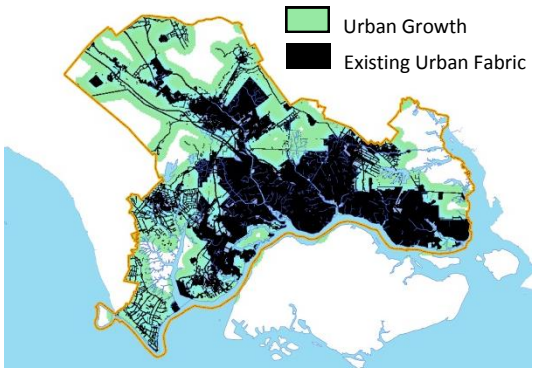



Figure 9.13: Urban growth boundary for Iskandar Malaysia

**II. Encourage infill development within existing build up areas (on brown field and greyfield).**

Closely related to the principle of smart growth, infill development involves building and developing in vacant areas in city centers or urban settings. This promotes the betterment of these city centers and leaves rural areas and open spaces undeveloped. Advocates claim that infill development can reduce traffic congestion, save open space, and create more liveable communities.

All growth increases traffic, but infill can alleviate congestion by reducing trips and encouraging alternative transportation. Good infill projects are sometimes "mixed-use," placing residences and businesses in close proximity. Bringing homes and jobs together, along with services like shopping, schools and recreation, shortens trips and makes walking and bicycling more appealing. Only higher housing densities can support transit like light rail. A major study found that in a neighbourhood with 15 homes per acre, one-third fewer auto trips occur compared with a suburban tract.

**III. Preserve urban fringe primary agricultural areas.**

Urban fringes are recognised as valuable assets which can provide a high quality environment in an urban setting, creating vital areas for the

health and well-being of local communities (Figure 9.13).

Conservation is a must because competition for land in these areas increased significantly during the 2000s. Agricultural and is much cheaper than land nearer the city center, and many factories that were once in inner-city locations have moved to these areas as their previous locations lacked space for expansion. As well as industrial estates and residential zones, these areas attract shopping centers, business parks and recreation facilities such as golf courses.

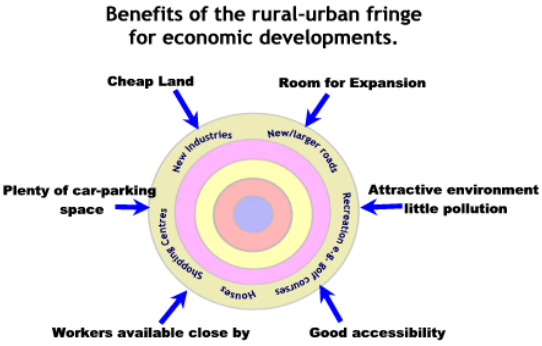



Figure 9.14: Primary agricultural urban fringe (Source: R Chambers)

### 9.2.2 High Density Mixed Use Development

Imperatives driving the promotion of mixed-use and high density residential and employment land-use, referred to as densification, derive from core aspects of the urban sustainability agenda. These include the demand for additional housing arising from increased population, inward migration and social change and limits to supply due to current density levels and land-use, and development control on the green linkages. Secondary is the need to reduce car and other vehicular use in order to reduce carbon emissions and pollution. Solutions include the increased use of brownfield sites as well as the re-use of non-residential buildings for housing and services employment and facilities, and the development of higher density, mixed-use buildings for housing, retail, commercial and amenities thus encouraging local employment and consequently reducing work commutes and travel time for routine activities.

Iskandar Malaysia's mixed-use, higher density development and compact city hierarchies now underpin sustainable communities and housing growth plans, these basic concepts are neither reflected in legislation or in guidance to inform the design, location and impact assessment of mixed-use. One of the most fundamental variables in cities, especially when considered as complex systems, is their degree of diversity.

Diversity has been determined to be an essential factor for liveability, economic growth, and the general attractiveness of cities. Its importance in urban debate has since steadily grown and diversity has been put forward. In addition, the importance of diversity in attractiveness for retail facilities and in marketing studies is paramount. Iskandar Malaysia can promote the high density mixed use through diversity index. For example, one of the neighbourhoods in Iskandar Malaysia has been measured through the diversity index (Figure 9.14) to indicate whether the concept basis are high density mixed use or not.

**I. City center and inner city area repopulation.**

As Johor Bahru population is growing in monocentricity, redistribution of the city center and inner city population to the other polycentric nodes are needed. This effort is important in assuring that the growth will not affect the green neighbourhood design. One of the examples of repopulation is transferring the administrative center of Johor to Nusajaya. Repopulation will supposedly follow the polycentric nodes and urban functions.

**II. Mixed residential development (including affordable homes).**

Homes located within walking distance of amenities such as schools, parks and shopping are not only more convenient for their owners, they are often also worth more than homes in neighbourhoods where driving is the rule, according to a new study. Much of this compact residential design in Iskandar Malaysia is important for developing a low carbon society.

This design will led to sustainability as indicated by low vehicle miles travel (Figure 9.15).

### III. Promote locally self-sufficient land use mix distinct urban neighbourhoods.

A mixed landuse in an urban neighbourhood alone cannot cause the neighbourhood to be deemed green. Additional gradual proximity index and connectivity of street design for those neighbourhoods was a surplus in assuring a green design for social pattern in Iskandar Malaysia. Some of the residential areas in Iskandar Malaysia lack in measuring the proximity between the type of landuse, especially commercial and residential. Some of the residential figures did not sustain a transition to low carbon society (Figure 9.16). The connectivity of the street design is also poor (Figure 9.17).


Simpson Diversity = 0.1
Shannon Diversity = 0.23

Figure 9.14: Diversity Index of residential area in Iskandar Malaysia

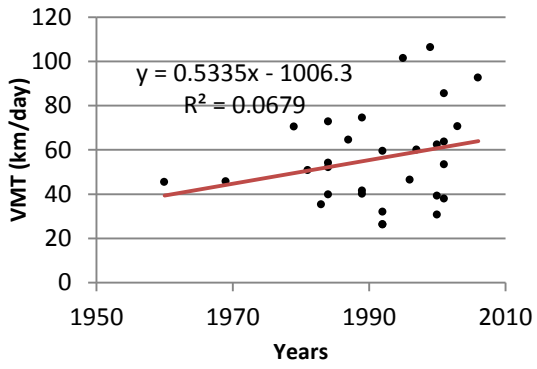



Figure 9.15: Vehicle mile travel trend of Iskandar Malaysia

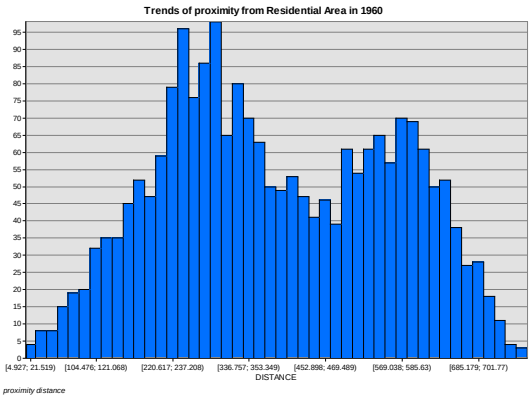



Figure 9.16: Proximity trend of Taman Abad, Iskandar Malaysia

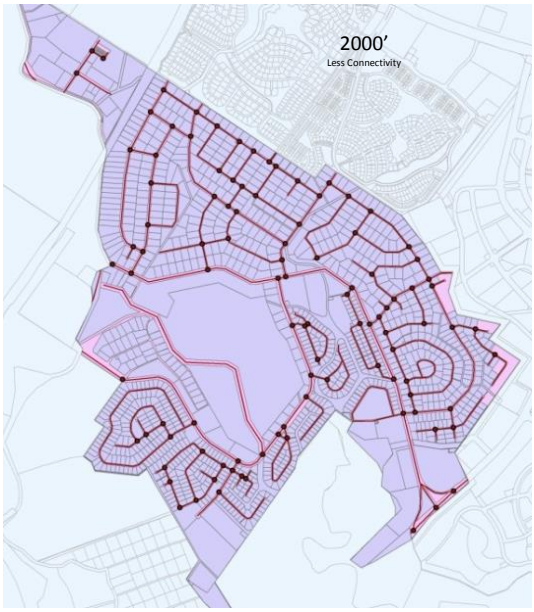



Figure 9.15: Less connectivity street design of residential area in Iskandar Malaysia

### IV. Design high quality public realms that encourage higher density urban living.

The public realm is the spaces around and between buildings including streets, squares and parks, which has a major part to play in the character, attractiveness and success of any town. It is also important for encouraging sustainable modes of travel such as walking, cycling and public transport. Providing a high quality public realm will attract members of society to become involved and occupied with the compact city.

Figure 9.18: High quality of public realm design (Source: W. Christopher)

**Low Carbon Quantifier: Ten Percent More Smart Growth as an Achievement for Twenty Percent less Driving**.

Due to the current situation of Iskandar Malaysia, smart growth is one of the key components for achieve the low carbon society and environment. Several indicator of smart growth had been used as the quantifiers for Iskandar Malaysia. Quantifiers which have been used are connectivity index, intersection density, diversity index, proximity index and housing density (Figure 9.15).

**Diversity Index**

Variety of uses in mix land uses.

Calculation formula:

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Diversity of neighbourhood = 1-D

n : Number of unit for each land use
N : The sum of n for every neighbourhood
D : Simpson's Index

**Proximity Index**

The proximity between residential and commercial area within neighbourhood
Calculation formula:

$$P = \frac{\text{Euclidean Distances}}{\text{Manhattan Distances}}$$

1 = perfect
<1 = less connectivity
>1 = impossible

**Connectivity Index**

The degree of street interconnectedness
Calculation formula:

$$C = \frac{\text{Total link}}{\text{Total intersection}}$$

C = Interconnectedness of street

**Intersection Density**

The number of intersection in the neighbourhood
Calculation formula:

$$I = \frac{\text{Total intersection}}{\text{Total Neighbourhood Area}}$$

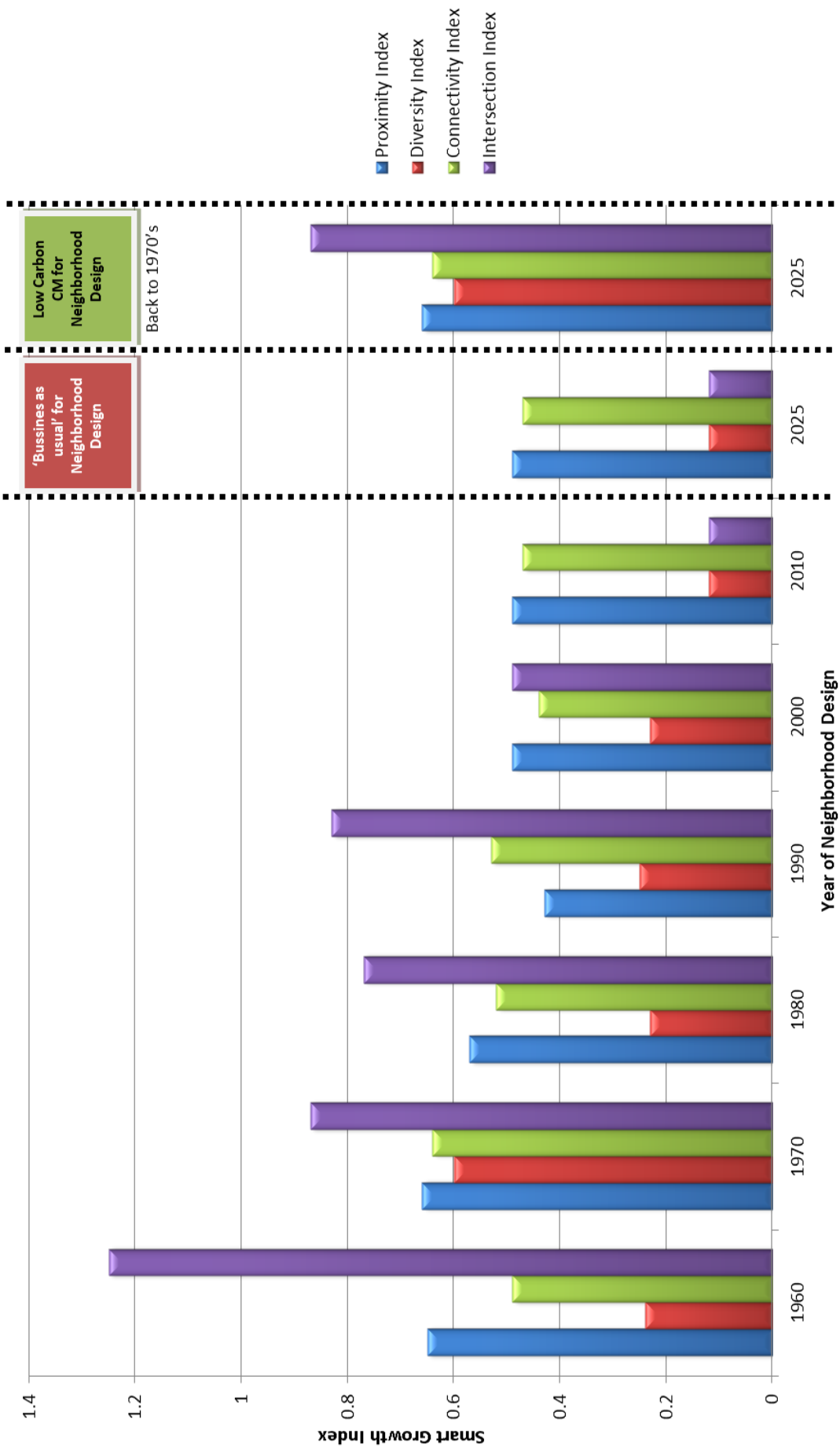



Figure 9.15: Ten percent addition to the smart growth indexes target in achieved the low carbon society

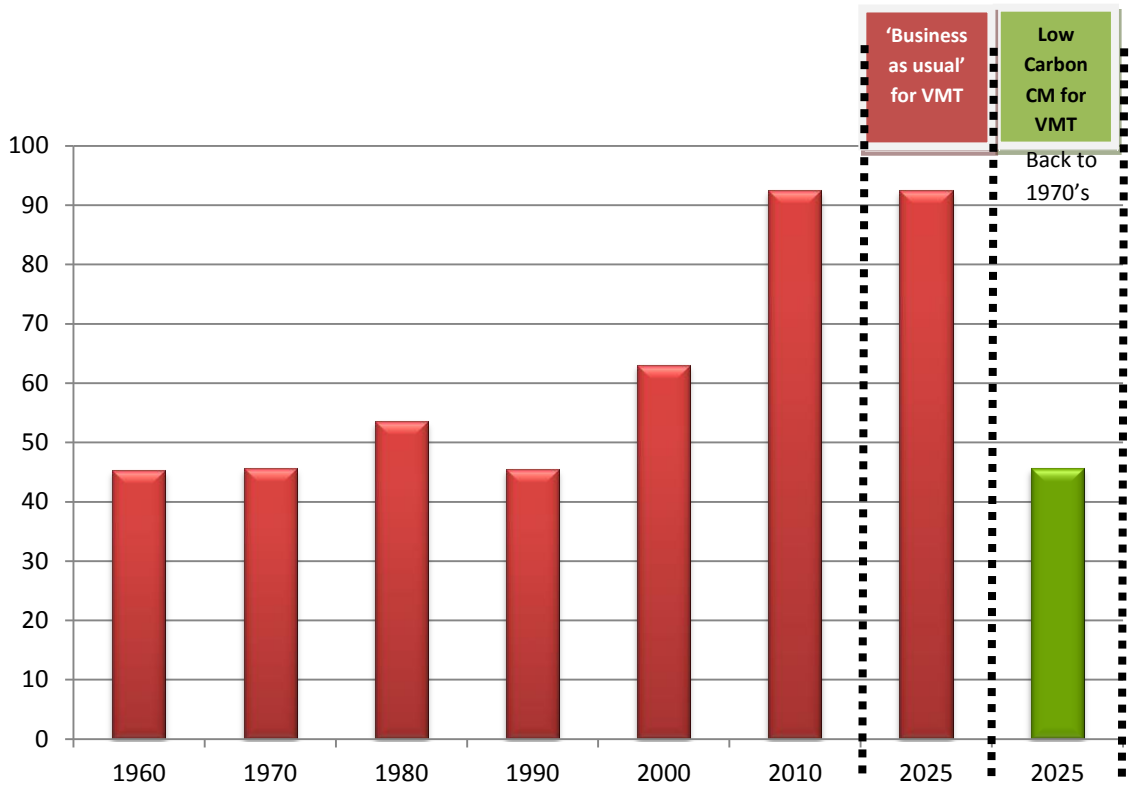



Figure 9.16: Twenty percent deduction target for vehicle miles travel trend

The vehicle miles travel for Iskandar Malaysia had been plotted in (Figure 9.16) by year of the neighbourhood established. The vehicle miles travel seems to be increased for every year the neighbourhood has been established. From the analysis, every smart growth quantifier was highly correlated to the vehicle miles travel. It is therefore important to increase the smart growth index to cut down the vehicle miles travel. Increase another ten percent of smart growth index will cut down another twenty percent of driving behaviour, (Angie Schmit, 2012). Decreasing driving behaviour will cause the carbon emission decrease. So, smart growth indexes are a good quantifier for cutting down carbon emissions.

In order to develop a smart growth neighborhood design, the local authority should stick to the index in the approval process. It will be good tools to control the neighbourhood element to fulfil the principal of smart growth.

## 9.3 Promote Transit Supportive Land Use Planning

Transit oriented developments (TODs) are not arbitrary nodes represented by 400m-radius circles drawn around public transport stops or stations, as one tends to observe in many development plans purported to supporting public transport use in the city, unfortunately including the SJER Comprehensive Development Plan 2006-2025 (see Khazanah Nasional, 2006, Chapter 16). TOD and development around station areas have clear land use structures which are closely related to the energy demand and carbon emission levels of the urban area (see Figure 9.19).


Figure 9.19: Example of neighbourhood-scale station area development (Fruitvale, Oakland)
(Source: Reconnecting America, 2007, p.10)

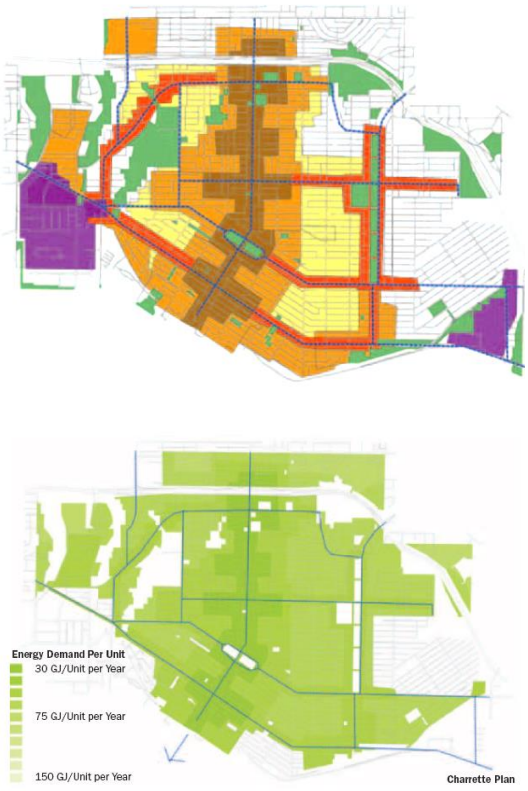



Figure 9.20: TOD has clear land use structure which is closely related to the urban area's energy demand, hence its carbon emission level
(Source: Condon, et al, 2009, pp.39, 41)

In order to ensure an urban transit system work effectively, planning aspects of the transit stations, particularly on how the stations better relate to their surrounding developments, are vital. Transit stations should be planned to effectively increase the quality of a place by creating a vibrant mix of activities relating to its urban contexts (Trip, 2007, cited in Cheng, 2011, pp.3-4). Through effective station area planning (SAP), successful station areas may be built upon a rich mix of efficient land uses which can bring a diversity of people, choices and opportunities that are essential for a vital station area, neighbourhood, and transportation system (see Figure 9.20) (Denver Community Planning & Development, 2008, 2009).

The new perspective on transit stations in urban areas is that they should not only be transit points for moving *through* to get to a final destination, but that they should be destinations, or places that people living and working in the surrounding area of the transit station would go *to*, for shopping, work meetings, social gathering, leisure, and even cultural purposes. This will bring liveliness and vibrancy to the station and its surrounding area, contributing to improving the sense of security of the area, making the whole area more inviting and pleasant to get to, and may eventually lead to an increase in public transport ridership in the area.

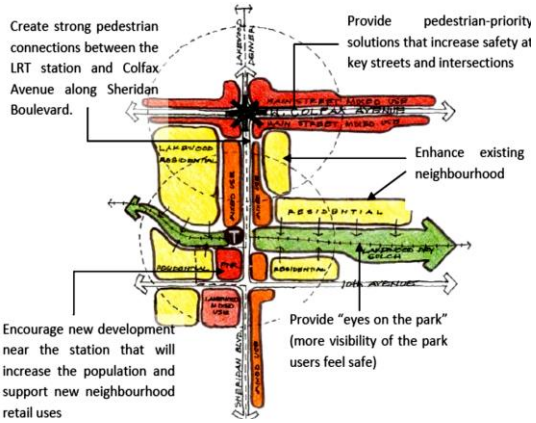



Figure 9.21: Illustrative concept of station area development for Sheridan Station Area Plan
(Source: Cheng, 2011, p.33)

Key principles of station area planning may include the following (see Figure 9.21):

- Establish a land use plan and policy framework that will guide redevelopment and future development within the area toward land uses that will support transit ridership and create a recreation-related destination;
- Improve motorized, non-motorized and transit connectivity between the station site and existing surrounding land uses;
- Develop and implement urban design standards that promote walkable and liveable environments within the station area;
- Provide a variety of commercial and mixed-use development opportunities, ranging from large-scale corporate or institutional sites to increase infill development zones;
- Create a compact and quality pedestrian environment with excellent connectivity to downtown destinations and transit;
- Expand station to create a well-integrated center of architectural and functional significance; and
- Enhance the existing residential neighbourhood and promote high density mixed-use development.

Towards promoting effective smart growth in Iskandar Malaysia, the implementation of TOD and SAP is a crucial component.

### 9.3.1 Transit Oriented Development (TOD) and Station Area Planning (SAP)

1. Identify existing and potential public transport/transit nodes.
2. Integrate pedestrian network with transit nodes.
3. Orientate and provide direct walking routes from homes to transit stops.
4. Permit higher densities and plot ratios within 800m of transit nodes.
5. Incentives to developers for reduced parking requirements.

## 9.4 Develop the 'Smart Digital City'

Nowadays, smart urban areas all over the world have been converted to the digital cities. Digital cities create public spaces for people living in the cities which concerted attainable and real-time urban information. Since 1994, more than a hundred European local organizations have started to talk about digital cities. The topics are telematics applications, car-free cities and so on.

Japan long ago launched the Digital City Kyoto Project, while the United States launched American Online (AOL) Digital City to create a social information infrastructure towards the 21st century. In regards to this issue, Iskandar Malaysia should improve and virtually convert the urban activities and businesses. Policy makers should realize that the internet has triggered global businesses, and at the same time, it enables them to create rich information spaces. Digital cities will concert everyday life and business virtually and physically on the internet using a city metaphor. Digital cities of Iskandar Malaysia should provide infrastructure for networking local communities.


Figure 9.19 Illustrative images for Smart Digital City of Iskandar Malaysia.

### 9.4.1 Build up a Digital Infrastructure Platform

Making Iskandar Malaysia's Smart Digital City real requires creating a strong virtual connection to the physicality of Iskandar Malaysia. The digital city is not only an imaginary city that exists in cyberspace but a complement to the corresponding physical city, providing an information center for actual urban activities and businesses. Secondly, to make the digital city live, the authority should dynamically integrate WEB archives and real-time sensory information created in the city. The authority should provide a tool for viewing and reorganizing vivid regional information created by people in the city. The system architecture of digital cities proposed as Figure 9.20. This 'Smart Digital City' will encourage people to interact virtually and will save a lot of time, money and especially carbon consumption through transportation.

### 9.4.2 Connect the Online World to the Real World (Citizen Engagement)

It should be obvious by now that the basic concept of connecting the real world to the online can be a powerful technique to build a digital city is facilitating this degree of interpersonal contact between the users. Connections in a smart digital city will create social presence or a degree of interpersonal contact. The challenge in smart individuals participating in smart digital city are separated by physical or geographic location and sometimes are working in isolated conditions, the ability to establish interpersonal contact with others greatly diminishes because all contact is electronic. The overall goal for creating social presence in this digital city, whether online or face-to-face, is to create a level of comfort in which people feel at ease around the activities and businesses. Without achieving this goal, the virtualization process may become unfulfilling for the smart digital city.

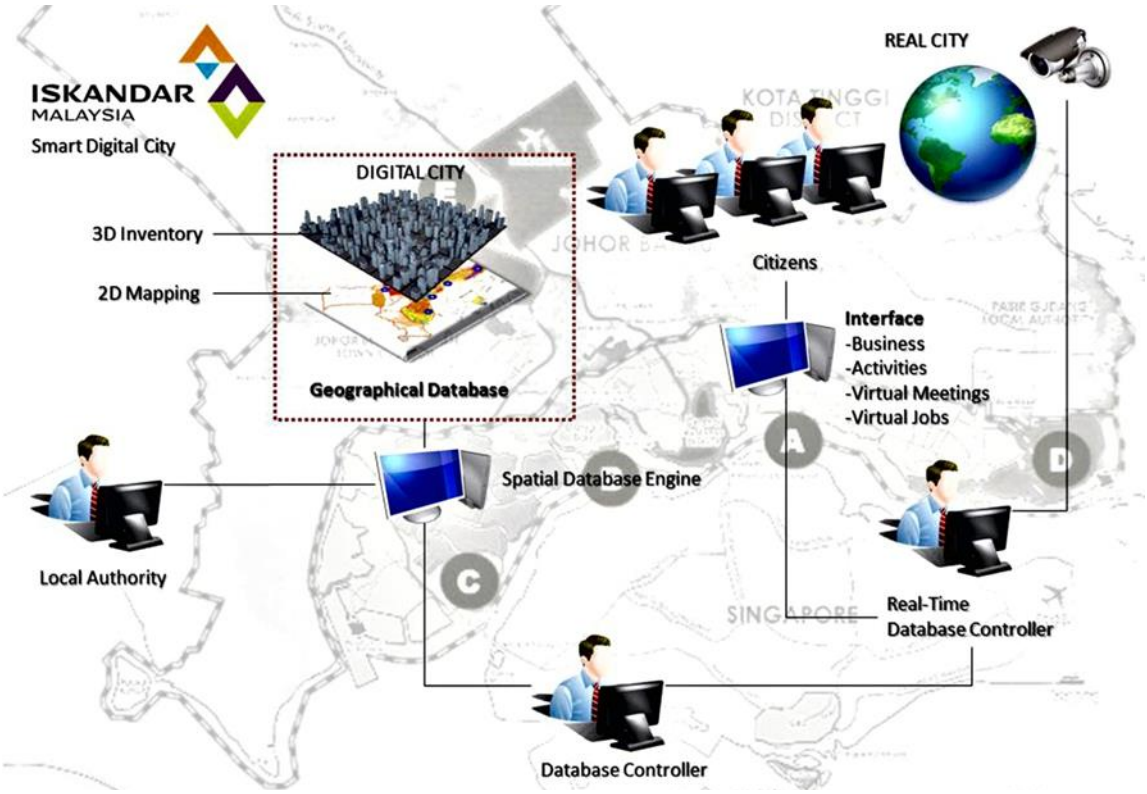



Figure 9.20: Basic System Architecture for Smart Digital City of Iskandar Malaysia

### 9.4.3 Digital Jobs for Digital Citizens

Digital jobs are created through the application of information and communications technologies (ICT) to a new or existing activity or process. Digital jobs generally include performing information-based tasks that build the individual's capacity for future work. A digital job can be distinguished from other jobs such as manufacturing because the core product produced by a digital jobs worker (sometimes termed "information worker" or "knowledge worker") is information or knowledge, as opposed to physical objects or services such as a haircut or a meal. The core tools for digital jobs are ICTs, such as computers, databases, smart phones and the internet, which they use to manipulate and manage information. Physical objects are made of atoms, which are difficult to replicate and expensive to transport, whereas bits can be copied freely and sent around the world through global communication networks at extremely low cost. The ability to inexpensively transport perfect copies of information, all over the world, opens up an opportunity for people across the globe to work in digital jobs. Today, digital jobs exist in almost every sector of the economy, including healthcare, agriculture, education, finance, media, manufacturing, retail, telecommunications, manufacturing, and public services provided by the government.

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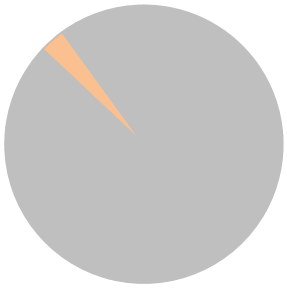
Action 10

# Green and Blue Infrastructure and Rural Resources

Kasturi Devi Kanniah, Ibrahim Ngah, Abdul Rahim Ramli, Kang Chuen Siang and Anis Syahira Zulkifli

**GHGs Emission Reduction**



392 $ktCO_2eq$

3%

Green and blue infrastructure includes the natural environmental components and green and blue spaces that lie within and between our cities and towns. Among the ser-vices provided by them include sequestrating and storing excessive $CO_2$ from the atmosphere (acting as a regional carbon sink), moderation high temperature in the cities (large trees, lakes and water courses) and reducing GHG emissions by conserving energy used for space cooling. Existing green infrastructure should be better managed for the range of services it provides. Green infrastructure actions, which include safeguarding, creating, enhancing, maintaining and promoting, are an attractive approach to combating climate change. This action reduces IM's GHG emissions by 392 $ktCO_2eq$ or 3% of total GHG emission reductions.

## 10.0 Green and Blue Infrastructure and Rural Resources

Development of cities nowadays is aimed only at fulfilling the needs of increasing population without considering the environmental effects. This has led to various environmental problems, including increased air temperature, air pollution, and global climate change. Appropriate measures need to be undertaken in order to make the cities as a livable environment. This can be achieved partly by integrating the green and blue infrastructure into the planning and development of new cities in Malaysia such as the Iskandar Malaysia (IM) in the southern region of Malaysia. This is important for IM because of aspirations to become an economic growth center to be developed as an integrated global node of Singapore and Indonesia (Ho and Fong, 2007).

Green and blue infrastructure includes the natural environmental components and green and blue spaces that lie within and between our cities and towns (Community Forests Northwest for the Northwest Climate Change Partnership, 2011). Types of green and blue infrastructure include agricultural land, allotment, community gardens and urban farms, cemeteries/burial grounds, coastal habitats, derelict land, general amenity spaces, grasslands, heathlands, and shrublands, green roofs, institutional grounds, orchards, outdoor sports facilities, p 234234 parks and public gardens, private domestic gardens, street trees, water bodies and courses, wetlands, and woodlands (modified from Community Forests Northwest for the Northwest Climate Change Partnership, 2011).

These elements of green and blue infrastructure are just as critical as other infrastructure such as roads or waste disposal. Thus, they must be protected over long term because they provide a number of services which help to combat climate change. Among the services provided by them include sequestrating and storing excessive $CO_2$ from the atmosphere (acting as a regional carbon sink), moderating high temperature in the cities (large trees, lakes and water courses) and reducing GHG emissions by conserving energy used for space heating and cooling (Figure 10.1).

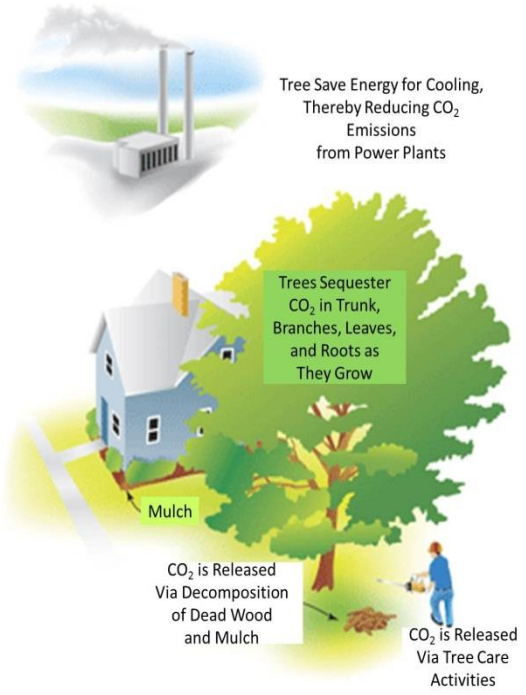



Figure 10.1: Illustration showing the role of trees as (i) sequester of atmospheric $CO_2$ as they grow and (ii) reduce green house gas emissions from power plants through energy conservation *(adopted from McPherson, et al., 2008).*

Various actions can be undertaken to develop IM as a green city. For that, it is essential to exploit the multi-functionality of green infrastructure. Existing green infrastructure should be better managed for the range of services it provides. Green infrastructure actions, which include safeguarding, creating, enhancing, maintaining and promoting it, are an attractive approach to combating climate change (Community Forests Northwest for the Northwest Climate Change Partnership, 2011). Collectively green and blue infrastructure can reduce IM's GHG emissions by 620 ktCO2eq, or 3.1% of total GHG emission reductions. In addition, various innovative plans should be promoted on local elements in urban and rural areas.

The following sections describe various sub-actions, measures and programs that can be

taken under the main action of green/blue infrastructure and preservation of the rural resources by low carbon farming and eco-tourism and rural-cultural tourism activities to achieve sustainable development in IM.

## 10.1 Regional Green Corridor Network

### 10.1.1 Acquisition of Land for Forest Connections

**I. Identify potential linking corridors between existing forested areas for future land acquisition**

Under this measure, efforts will be undertaken to identify potential land areas to be used as forested areas. Large areas of presently non-forested lands can be used for reforestation, planting trees and agro forestry. In the tropics, carbon sequestering rates tend to be high and vast areas of lands are degraded and in need of reforestation. It is estimated that the total carbon sequestration of tropical forest (for trees more than 20 years old) is approximately 4.5 t C ha per year (IPCC, 2006). For IM, the total forested area (both primary and secondary) is estimated as 7,000 ha. Thus, the forested area in IM is capable of assimilating about 4060 $ktCO_2e$. This amount is equal to 203 $ktCO_2eq$ per year. Suitable lands for forests can be identified using GIS (Geographical Information System) and existing spatial data. The following criteria can be used to identify suitable areas: slopes (for example less than 60%), surface waters and wetlands (should be a buffer of about 20 meters), and non-private and public ownerships as well.

### 10.1.2 Protect Existing Forests

**I. Gradually gazette presently ungazetted primary & secondary forests as protected forests**

Ungazetted primary and secondary forests in IM will be identified and subsequently these forests will be gazetted as protected forests. This can ensure the forests are not cleared for other purposes.

## 10.2 Conservation of Mangrove Forests

The mangrove forest is an important habitat for aquatic and terrestrial fauna. It is also a natural defense against strong wind, waves and tsunamis, protector of soil erosion, play a role in flood mitigation and sequestration of $CO_2$ (Azian and Mubaraq, 2012). A recent study revealed that mangroves have higher levels of primary productivity (carbon) than most other forests (Daniel et al., 2011). Another recent study in Malaysia (unpublished data by FRIM) has identified mangroves of over 20 years age can sequester about 4.1 t C ha per year. In IM, the total mangrove areas are estimated at 25,000 hectare, therefore assimilating 5650 $ktCO_2e$, equal to 282 $ktCO_2e$ per year.

However, it is sad to see that mangroves are disappearing due to land-use change and deforestation, leading to lower capacity of carbon sequestration and increasing global greenhouse gases (GHG) emissions. In Peninsular Malaysia, mangrove area has declined about 19% between 1990 and 2010 and Johor has lost approximately 20% of its mangrove areas (Hamdan, 2012). Many people do not realize the value of mangroves and their efficiency in sequestrating $CO_2$.

### 10.2.1 Reinforce Protection of Existing Mangrove Areas

**I. Gazette all mangrove areas as protected forests**

Existing mangrove areas and trees in the IM (Figure 10.2) should be protected under Act 172 (part VA- Trees preservation order). Under this Act, all existing mangroves in Johor (25,000 hectare) will be gazetted as protected forests.

**II. Strict enforcement against illegal mangrove clearing**

In addition, strict rules must be enforced under the Act to curb illegal logging of mangrove trees in the region. This is because they have high potential to sequester $CO_2$ from the atmosphere (282kt $CO_2$e year$^{-1}$).

**III. Ongoing mangrove species audit**

Moreover, an audit of mangrove species should be conducted. This is in line with the National Policy on the Environment (under green strategies) that will maintain and regularly update a national inventory and audit of environment and natural resources with particular emphasis on depletion and renewability to serve as a guide to policy formulation and decision making (item 2.1 under section 2). The purpose of the mangrove audit is to identify if any types of species are undergoing extinction. Information on mangrove species is important because some species such as bakau kurap (*Rhizophara Mucronata*), bakau minyak (*Rhizophora Apiculata*), rhu (*Casuarinaequisetifolia*) are identified as important environmental protectors (Azian and Mobaraq, 2012). Studies will be conducted in mangroves areas such as Kukup Island, Tanjung Piai and Sungai Pulai in IM.

### 10.2.2 Mangrove Area Regeneration

Since mangrove areas are declining in Malaysia (Hamdan, 2012), it is necessary to plant more mangrove trees to obtain various benefits that they provide. A National Task Force Committee of Planting Mangroves and Other Suitable Species Operation in Shorelines of the country were formed on 7 February 2005 by the Ministry of Natural Resources and Environment (Barizan, 2012). This effort should be continued in IM by planting mangrove tree species such as bakau kurap (*Rhizophara Mucronata*), akau minyak (*Rhizophora Apiculata*), rhu (*Casuarina equisetifolia*), bintangor (*Calophyllum pulchicherrimum*) and bebaru (*Hibiscus tiliaceus*). Such planting activities may be carried out as follows:

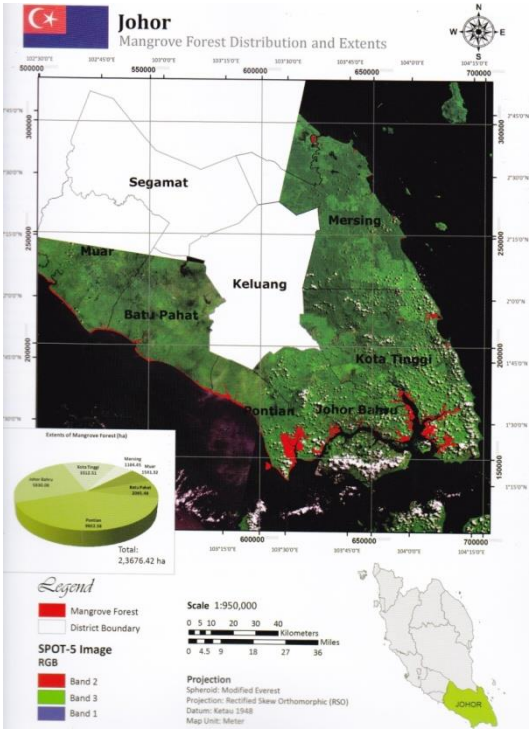



Figure 10.2: Distribution of mangroves in Johor (Source: Hamdan, 2012)

**I. Corporate sectors adoption of mangrove regeneration projects**

Various agencies including government, non-governmental organizations (NGOs) and private sectors can take part in this initiative. Such planting activities have been carried out by Forest Research Institute Malaysia (FRIM), Sime Darby, Shell Sdn. Bhd. Malaysia, Digi and Petronas in Kuala Gula, Perak, Sungai Haji Dorani, Selangor and Carey Island, Selangor.

**II. Involving students and schools in mangrove trees planting**

We can also involve school and university students in planting mangrove trees in IM. Such effort has been organized by FRIM and GEC (Global Environment Centre - an NGO) in Malaysia (Barizan, 2012).

## 10.3 Promote Urban Forests (Urban Recreation and Green Lungs)

Planting trees (any kind of woody plant vegetation) within the city is known as urban foresting (Justice, 1986). Like any other forests, urban forests also play a pivotal role in (i) reducing the amount of $CO_2$ in the atmosphere (ii) managing temperatures by providing evaporative cooling, shading, and allowing air to flow into urban areas.

### 10.3.1 Reintroduce Endemic Forest Species into Existing Urban Parks

The carbon storage and sequestration rate, shading and cooling effects varied among urban forest types with different species composition and age structure-type of species (Liu and Li, 2012). Big trees with large crown size at higher density can sequester more carbon (Liu and Li, 2012). In Malaysian urban forest (like Hutan Bandar Mutiara Rini, Hutan Bandar JB and Taman Layang-Layang, Pasir Gudang, Johor) most of the species are composed of the following species: *Dryobalanops Oblingifolius, Hopea dorata, shorealeposula, peterygotaalata, cinnamomuniners, shoreamacranta, alaquiumrasyanum, aquilariamalaccensis, anisapteraspp, styrex Sumatran, dipterocarpus, shorea, Dryobalanopsaromatic,* and *toonasureni.*

The capacity of these trees in carbon sequestration, shading and cooling effects will be studied. As trees grow, they remove carbon from the atmosphere via photosynthesis and store it. In this way, trees play a major role in reducing the atmospheric $CO_2$, air temperature and subsequently the impact of climate change.

A recent study (Kanniah et al., unpublished) in the urban forest of Hutan Bandar Mutiara Rini in the Skudai region of Johor (trees with diameter at breast height of between 10 and 30 cm) revealed that the total carbon sequestered by this forest is approximately 500 kt $CO_2$ per year. This amount can increase with years when the trees grow larger.

**I. Identify the species and location of trees to be planted.**

Further studies need to be conducted to estimate the carbon sequestration rate or storage capacity, shading and cooling effect of different forest species found in the urban park (Section 10.3.1). Suggestions and recommendations can be made of which species need to be planted more and at which location. Suitable number of trees that need to be planted in locations that will be identified (see section 10.3.2) will also be determined.

Another aspect that needs to be considered is developing the so called “carbon calculator”. This tool can be used for quantifying $CO_2$ sequestration from trees. Once the user enters information on the climate region and tree's species, size or age, canopy cover, leaf area index etc. the calculator can produce information on (McPherson et al., 2008):

- Carbon dioxide stored in the tree due to its growth over many years
- Carbon dioxide sequestered during the past year
- Dry weight of aboveground biomass that could be utilized if the tree was removed
- Annual energy savings in kWh of electricity and MBtu of heating per tree
- Carbon dioxide equivalents of these energy savings
- GHG benefits for an existing tree or to forecast future benefits for a planting project.

**II. Involving students and schools in forest tree planting**

School children and university students can be involved in urban tree planting activities via series of awareness seminars or workshops.

### 10.3.2 Create New Urban Parks

**I. Identify potential plots for urban parks (unused government land)**

Potential plots (unused government land) will be identified using a combination of remote sensing and Geographical Information System (GIS) techniques. These open spaces need to be mapped precisely and subsequently protected. Their function need to be enhanced so that they can contribute towards the improvement of health, opportunities for social interaction and education. In IM, about 31,461.63 hectares (15.3%) of the total area is developed, and a total of 4,207.93 hectares of land has been designated as Public Open Space to be used for passive as well as active recreation.

According to the Low Carbon Cities Framework and Assessment System (KeTTHA, 2011) a typical green development provides at least 10% of green open space over the total development area. The green open space types Include urban parks and formal gardens, towpaths along canals and riverbanks, cycle paths and disused railway lines, areas designed primarily for play and social interaction involving children and young people, natural or artificial surfaces either publicly or privately owned used for sports and recreation, allotments and community gardens and cemeteries and burial grounds (KeTTHA, 2011). The precise location of these areas must be identified first. This can be done using remotely sensed satellite imageries such as Worldview-2 or Quickbird. These satellite sensors can provide data at very high spatial resolution (2 to 4 meters) that are useful for identifying areas of as small as 2 meters. Subsequently the status (private or public ownership, size of land and so on) of the unused lands will be updated via GIS. From the list, the most appropriate lands will be considered for development of urban forest.

**II. Introduce endemic forest species in new urban parks**

Once the potential plots are identified, endemic forest species can be introduced in this area. In addition to that, alien species can also be introduced that might be able to adapt to changes in the environment. Planting lots of trees in the potential plots can help to fight climate change. In California, McPherson and Simpson (2003) showed that if 50 million trees were planted, they would sequester about 4.5 Mt $CO_2$ annually. If the trees were planted strategically to shade east and west walls of residential buildings, they would reduce air conditioning energy use by 6,408 GWh, equivalent to an average annual $CO_2$ equivalent emission reduction of 1.8 Mt (McPherson et al., 2008). The estimated total $CO_2$ reduction of 6.3 Mt annually is 3.6% of the 173 Mt state wide goal, about the same as would be obtained from retrofitting homes with energy-efficient electric appliances (McPherson et al., 2008). In another study in China, Liu and Li (2012) estimated that the carbon stored by urban forests equaled 3.02% of the annual carbon emissions from fossil fuel combustion, and carbon sequestration could offset 0.26% of the annual carbon emissions in Shenyang city, China.

Similarly, if all urban parks and open spaces (4208 hectares) in IM were planted by trees (about 128 trees in one hectare) we could expect them to sequester about 116kt $CO_2$ per year for a total of 538,624 trees. IM also intends to increase the open space to 6000 ha by 2015 (Iskandar Malaysia, 2012). In this case, the $CO_2$ sequestration would be 165.6kt $CO_2$ per year. However, it should be noted that this amount is based on small trees (10-30 cm diameter at breast height). Trees in urban areas have also been shown to remove other air pollutants. It is estimated that 2000 trees could remove about 390 metric tons of air pollutants (CO, NO2, O3, PM10, SO2) per year. In terms of economic benefits, this amount of air pollutants is equivalent to USD 2 million (Nowak et al., 2006).

**III. Create linear urban parks along river and waterway reserves**

Locations such as riverbanks and waterways will be identified as potential new urban parks. This is because water bodies can greatly reduce the air temperature. In a recent study, we found that the increase in air temperature is about 2°C and reduction in air humidity is 9%

respectively as the distance increased to 100 meter away from the lake. Figure 10.3 below shows the measurements of air temperature and relative humidity (RH) conducted at Taman Layang-Layang, Masai, Pasir Gudang district.

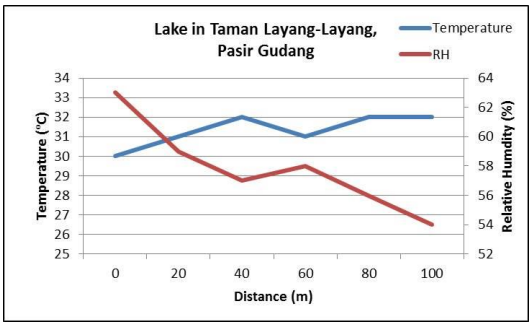



Figure 10.3: The increase in air temperature and decrease in relative humidity (RH) as distance increases from the lake.

As of 2005, the total area covered by rivers and water bodies in IM amounted to 12,401 hectare and there are more than 56 rivers in this region (Comprehensive Development Plan for South Johor Economic Region, 2006). From these, four rivers with its tributaries of rivers (Figure 10.4) form four major river basins, namely the Sungai Johor, Sungai Tebrau, Sungai Skudai and Sungai Pulai (SJER CDP, 2006). These areas can be considered for new urban parks in the future.

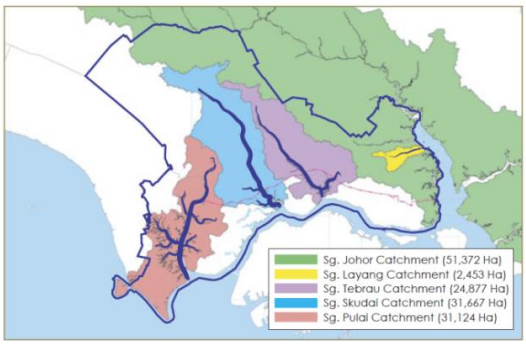



Figure 10.4: The River Basin of the Four Main Rivers in SJER (Source: Comprehensive Development Plan for South Johor Economic Region, 2006)

### 10.3.3 Increasing Green Cover

A study by Nowak and Heisler (2010) found that urban parks with about 20% tree canopy cover and 2% impervious cover can reduce air temperature by 0.04°C per hectare during day time (2 pm). In Greater Manchester, it was found that increasing green cover (including large trees) by 10% in the most built up areas could decrease maximum surface temperatures by 2.4°C to 2.5°C by the 2080s Low and High emissions scenarios, respectively (Gill et al., 2007). This also reduces the need for air conditioning, helping to mitigate climate change.

Similar policies can be adopted in IM by strengthening the existing planning policy by the department of urban and rural development to increase green infrastructure in areas at greatest risk for the urban heat island such as built up areas, areas with low levels of green infrastructure at present, and places where people work and gather such as town and local centers, transport hubs, tourist destinations, and so on. This can be implemented through the creation of new green spaces, street tree planting, and the creation of green roofs and walls. According to KeTTHA (2011), as a general rule a 10% increase in vegetation cover reduces the temperature by about three degrees, reducing ambient temperatures.

Maximum mid-day air temperature reductions due to trees are in the range of 0.04 to 0.2°C for every percent increase in canopy. In IM we found (Figure 10.5) that increasing vegetation density (Normalized Difference Vegetation Index) by 1% can decrease surface temperature by 0.07°C.

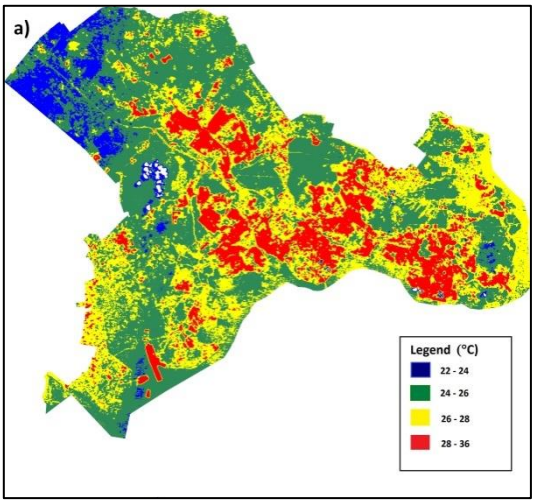



Figure 10.5: a) Map of land surface temperature (LST) in IM

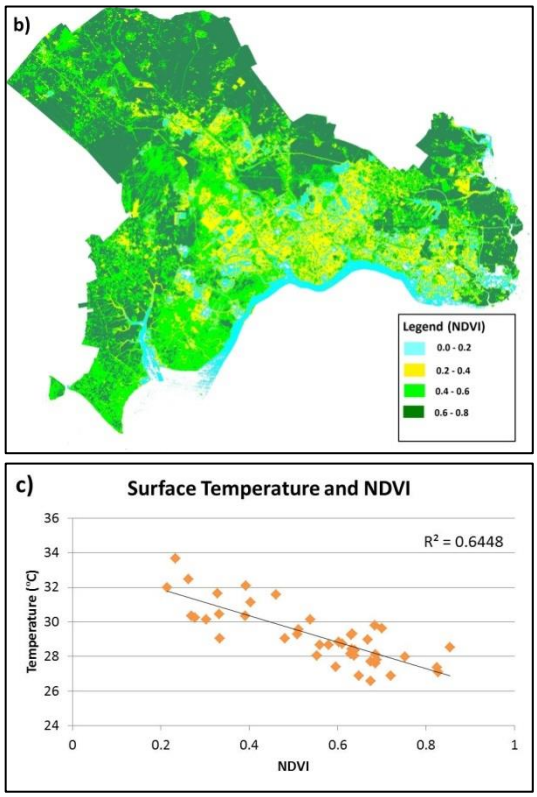



Figure 10.5: b) Map of NDVI in IM, and c) Correlation plot between LST and NDVI based on (a) and (b).

**I. Strengthening existing planning policy to increase green areas**

Various policies are already in place to protect the green areas in IM. These policies need to be strengthened or enforce strictly to ensure the existence of the green space in IM.

### 10.3.4 Reforestation

**I. Immediate replanting for cut down areas**

Trees that have been cut down in urban areas must be replanted as soon as possible. Reforestation can be conducted by the department of urban and country with the help from the public as described below.

**II. Public awareness for importance of reforestation**

The public (students and others) will be educated about the significance of trees in abating climate change. This will be achieved via hosting seminars, workshops and road shows. Subsequently the public will be encouraged to participate in tree planting activities. This will teach the citizens how they can make a difference themselves.

### 10.3.5 Ongoing Urban Tree Planning Campaign

As stated in section 10.2, there is a need to increase number and density of trees in urban areas, as the role played by trees is tremendous in terms of reducing the amount of $CO_2$ in the atmosphere and thereby combating the impact of climate change.

**I. One resident one tree program**

The loss of trees in Malaysia over the past decade amounts to 130 million hectares (or 1.3 million km²), an area as large as Sabah, Sarawak and Kalimantan put together (http://plantatree.org.my/). To compensate for the loss, Malaysia (Pertubuhan Amal Seri Sinar (P.A.S.S.) an environment activist in promoting a greener earth, has targeted planting one million trees by 2020. They also constantly engaged in negotiating new land and avenues (from the state government, municipal council, property developers etc) to plant trees. PASS is a local chapter in joining the forces with the United Nations Environment Program (UNEP) in planting one billion trees worldwide by 2015. Iskandar Malaysia also targets planting one million trees in a year. Trees can be planted in IM, as mentioned in section 10.2.2, by involving the school and university students and local residents. A target can be set such as one tree for one local resident per year. Trees can be planted at streets and industrial parks, which are hotspots that produce more GHG.

**II. Tree planting at government / corporate events**

We can make tree planting as a compulsory activity in all the government and corporate events or functions that may take place in IM.

**III. Government subsidy for tree saplings**

Subsides for tree saplings can be obtained from the government.

## 10.4 New Development to Retain Existing Vegetation

Various measures and programs as outlined below will be implemented in IM to retain the existing vegetation cover.

### 10.4.1 Enforcement of Act 172 (Part Va: Trees Preservation Order)

**I. Encourage reporting of illegal tree felling**

Act 172 will be enforced to encourage reporting of illegal tree logging. This can be achieved by rewarding public reporters.

**II. Carry out municipal tree surveys for existing green areas in IM**

But, before that, each Municipality in IM need to undertake surveys that are aimed at developing a database that contains information on green areas in their districts. Inventory of existing green areas must be done. This survey should be conducted on a regular basis to monitor the changes in the extent of the areas. More effectively this can be done by the use of remote sensing and GIS techniques.

However, currently Act 313 (Chapter 3 – excision of land from permanent reserved forest) is flexible in terms of providing accessibility to the state authority to excise lands that are categorized as permanent forest reserve. This act needs to be rigid by not allowing any further development in those areas.

## 10.5 Low Carbon Farming In Rural Areas

Low carbon farming practices in rural areas aim to help reduce greenhouse gases emissions and energy use on farm as well as to improve energy efficiency. Main measure of low carbon farming is through government promotion programs.

This is being supported by policies in Johor State Structure Plan, in sub-chapter 6.5 Policies, Chapter 6 Agriculture, Forestry and Mining. Policies FF 1.0, FF 2.0 and FF 3.0 in this chapter shows the government plans and support to promote farming activities (page 6-9 till 6-11).

### 10.5.1 Promotion Programs of Low Carbon Farming In Rural Areas

In order to enhance low carbon farming in rural areas, there are several programs proposed:

**I. Reduce agricultural CH4, N2O and CO2 emissions**

CO2, CH4, N2O and other greenhouse gas emissions of the greenhouse effect cause global warming, which subsequently threaten the mankind's survival and development (Lal, R., 2003).

The promotion programs include:

- The practice of organic farming
- Production of organic fertilizer through composting of biomass
- Practice of crop rotations and covering crops
- Applying precision farming to target nutrients.

**II. Plant high quality and fast growing crops and supply to urban area (plant and eat locally to reduce % import food)**

High quality and fast growing crops help generate more income for farmers and villagers, as it is more productive in the way to supply more frequently to urban areas. The percentage of import food to the village can also be reduced if the farmers are not only selling their production to the other place, but also eat it locally and sell it to local people.

The following crops to be encouraged:

- Vegetables farming

- Cash crops (sweet potato, yam, maize, groundnut, cassava)
- Fruit such as dragon fruit, papaya, melon

**III. Ongoing technical support & training from government**

In order to sustain the low carbon farming effort, it is essential to provide the farmers with all the necessary technical support, training and ongoing extension support especially from the government to maximize the chances of successful outcomes.

Expertise training using proper tools, ongoing incentives and funds, equipment and facilities support can assist the farmers in implementing low carbon farming. The main project under this program is the establishment of Rural Transformation Centre in Pekan Nanas, as proposed under NBOS4.

Figure 10.6: Rural Transformation Centre at the Agrobusiness Terminal in Gopeng, Perak.
(Source: New Straits Times on August 29, 2012, Wednesday)

## 10.6 Eco-Tourism & Rural-Cultural Tourism

Rural areas in Iskandar Malaysia have natural and cultural richness and uniqueness which are frequently depicted in various tourism product offerings, marketing publications and media. These include natural mangrove areas, rivers, and variety of rural settlements such as the *Orang Asli* village, Malay traditional villages, and FELDA Schemes. Promotion of tourism in rural areas integrates eco-tourism and rural-cultural tourism concept and enhances the hospitality and communication skills among village people.

This is parallel with Johor State Structure Plan in Chapter 9 Tourism, as stated in the policies TO 1.0 that tourism attractions and products in Johor should be enhanced and diversified in accordance with its location as a main southern development (page 9-8).

### 10.6.1 Promotion Of Natural Resource-Based And Rural Cultural Tourism

In achieving eco-tourism and rural-cultural tourism implementation in rural areas of Iskandar Malaysia, the programs include:

- Introducing low carbon rural tourism packages in potential areas such as Ramsar sites or Migratory Birds Festival during bird season between September to March and successful low carbon village settlement projects.
- Promoting rural low carbon lifestyle as a tourism product
- Conserving and enhancing natural resources
- Local resident participation is essential to the continuous operation and management of eco-tourism.

**I. Introduce low carbon rural tourism packages**

Low carbon rural tourism needs to give visitors the opportunity to enjoy the physical and human environment of rural areas. At the same time, the tourists can take part in the activities, traditions and lifestyles of the local communities. The activities that may be carried out in a rural environment must have its traditional features and different from the tourists' usual lifestyle. There are many activities that can be included in rural tourism packages, such as:

**a) Letting the tourists have an experience of a daily life as settlers**

For example, in the project site which is Felda Taib Andak, the tourists can exchange experiences and ideas with the locals by visiting the oil palm plantation area, which is the main income of Felda communities.

**b) Demonstration of the villagers**

The villagers can demonstrate low carbon lifestyle to the tourists, for example about the way they operate effective microorganism (EM) or compost projects, plant 'buluh madu' or bamboo, and carry out recycling activities.

**II. Promote rural low carbon lifestyle as a tourism product**

In enhancing the lifestyle as a tourism product, these are some of the ways that can be followed:

**a) Promoting cycling and walking activities or events**

In Felda Taib Andak, these type of activities have already been done by the communities, which are participating in the cycling club and '1000 steps in a day' weekly walking event.

Figure 10.7: Cycling activities in Felda Taib Andak

**b) Holding green events with low carbon**

Effective events that promote low carbon lifestyle such as festival, seminars, talks or competition can attract many visitors to come to this area as stated in guidelines for developing green tourism by Won Hee, L. (2011).

c) Handicraft products made from recycled materials

The community can generate income by producing handicraft products from recycled materials such as newspaper, tin and plastic. They can make egg containers for wedding ceremony, stationery containers, vase and many more unique products with different uses.

**d) Promoting traditional food and games**

The uniqueness of local cuisine and traditional games using natural resources will also attract tourism activities in this village.

**III. Conserving, enhancing & linking key rural natural resources in IM**

Low carbon measures can be implemented, including energy-saving, formation of green community, well-being culture based on new renewable energy and environmental friendly approach. Implementing all the tourism activities using natural resources can help reduce greenhouse gases through the conservation of natural environment and recycling of energy.

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Action 11

# Sustainable Waste Management

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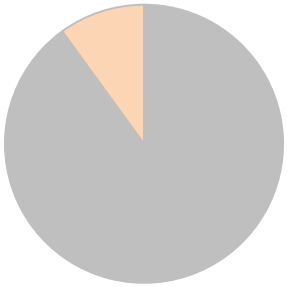
**GHGs Emission Reduction**



1,244 $ktCO_2eq$

10%

The main objective of Sustainable Waste Management is to figure out the best strategies for implementing effective solid waste management (SWM) system in Iskandar Malaysia. The system can reduce waste generation and enhance material and energy recovery of solid waste in order to fulfill the challenge of building both low-carbon and material recycling society. Five sub-actions were considered in the model system of Sustainable Waste Management to achieve the target of 50% reduction of final waste disposal to landfill sites and 50% GHG emission reduction as com-pare to the business as usual (BaU) scenario. The five sub-actions are (1) Sustainable municipal solid waste management, (2) Sustainable agricultural waste management, (3) Sustainable industrial waste management, (4) Sustainable sewage sludge management and (5) Sustainable construction and demolition waste management. Implementation of measures and programs under these sub-actions was projected to reduce carbon emission in Iskandar Malaysia by 1,224 $ktCO_2eq$ (10% of total emission reduction) in 2025. Total reduction of final waste to landfill is 3,480 kton by year 2025 for CM scenario.

## 11.0 Sustainable Waste Management

Generation of solid waste is a natural consequence of human life. In most developed and developing countries with increasing population, prosperity and urbanization, collecting, recycling, treating and disposal of increasing quantities of solid waste and wastewater are major challenges for municipalities.

Solid waste generation in Iskandar Malaysia (IM) is expected to increase with an expanding population base and increase in economic activity due to its rapid development. Figure 11.1 shows current waste generation at baseline year (2005) and forecasted waste generation at targeted year (2025). The waste management in IM in this Blueprint focuses on five type of waste: Municipal solid waste (MSW), agro-waste (AW), industrial waste (IW), construction and demolition waste (CW), and sewage sludge waste (sludge). Each type of waste is expected to increase significantly by 2025 due to annual population growth. The generation rate of AW, on the other hand, is expected to decrease by year 2025 compared to the baseline year.

To support the increase generation of waste in IM, the requirement of land for waste disposal is expected to increase to approximately 660 acre by year 2025 as shown in Table 11.1.

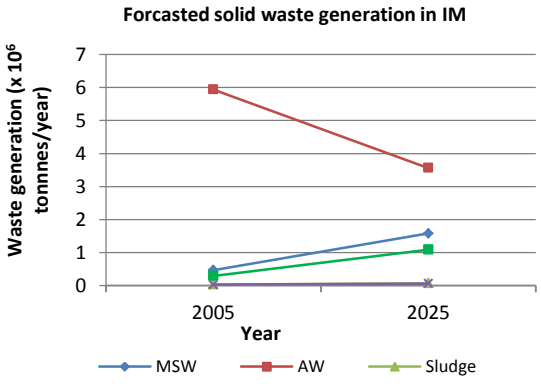



Figure 11.1: Summary of forecasted solid waste generation in IM from 2005 to 2025
(Source: IRDA Integrated Solid Waste Management Blueprint, 2010)

Table 11.1: Projected Land Requirements for Solid Waste Disposal - Sanitary Landfill till 2025
(Source: SJER CDP 2025)

| Item | 2005 | 2010 | 2015 | 2020 | 2025 | Total (acre) |
|---|---|---|---|---|---|---|
| **Domestic** | 80.3 | 91.3 | 113.4 | 142.1 | 177.9 | 670.2 |
| **Industry & Commercial** | 24.1 | 27.4 | 34.0 | 42.6 | 53.4 | 201.2 |
| **Total** | 104.3 | 118.6 | 147.5 | 184.7 | 231.3 | 871.3 |
| **Existing Sanitary Land** | n/a | n/a | n/a | n/a | n/a | 212.5 |
| **Additional sanitary Land until Year 2025** | | | | | | **(658.8)** |

Increase generation of waste not only creates a long term burden on landfills such as land limitation and pollution but also contributes to the issue of GHG emission. According to the report of The Second National Communication to UNFCCC (2007), GHG emission in waste sector in Malaysia had a significant increase from year 1990 to 2008. Figure 11.2 illustrates the trend of GHG emission in waste sector over fifteen years' time. The GHG emission in waste sector experienced a 54% increase from 1990 to 2008. Meanwhile, comparing the GHG emission across several sub-sectors within the waste sector, the main release of GHG comes from waste landfill site through organic waste degradation process, which released up to 90% of the total emission. GHGs emitted from different sources of waste management include:

- Emissions from combustion - Waste incineration produces emissions of carbon dioxide ($CO_2$) and nitrous oxide ($NO_X$).
- Emissions from transportation - Transporting waste to disposal sites produces GHG emissions from fuel used in the vehicles.
- Emissions from landfills - Waste in landfills decomposes anaerobically and produces methane ($CH_4$), a key GHG.

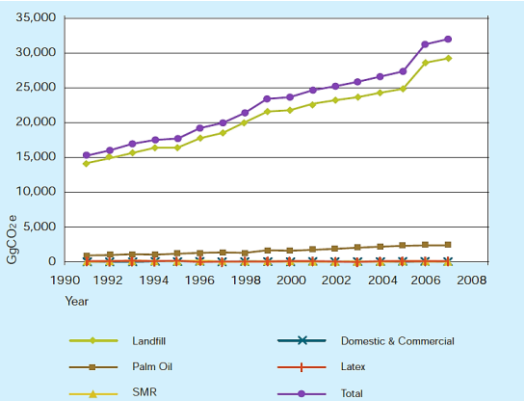



Figure 11.2: Emission time series from 1991 to 2007 for waste sector

(Source: The Second National Communication to UNFCCC, 2007)

Sustainable waste management is identified as the synergy concept of economically affordable, socially acceptable and environmentally effective for waste management. Recovery of resources from waste should slow the depletion of non-renewable resources and help lower use of renewable resources to the rate of replenishment.

Sustainable management of solid wastes is identified as one of the three key strategies by Malaysian government to reduce carbon emissions by 2020, while the other two key strategies are energy industries and Land Use and Land Use Change and Forestry (LULUCF) (National Solid Waste Management Department, 2007).

Iskandar Malaysia (IM), with a vision of being developed as a strong and sustainable metropolis of international standing, is committed to showcasing the best practices of a Low Carbon Society. The sub-chapter of this blueprint outlines the sustainable waste management strategies and best practices that can be adopted by IM as a model city by 2025.

The best practice for a sustainable and effective waste management can reduce waste generation and enhance material and energy recovery of solid waste. Effective waste management contributes to the formation of both the low-carbon and material recycling societies. A range of action plans on sustainable waste management are discussed in this Chapter, with support from measures and programs as shown in Table 11.2. Five sub-actions were considered in the model system of Sustainable Waste Management to achieve the target of 50% reduction of final waste disposal to landfill sites and 50% GHG emission reduction as compared to the business as usual (BaU) scenario. The five sub-actions are:

I. **Sustainable municipal solid waste management, (2) Sustainable agricultural waste management,**
II. **Sustainable industrial waste management,**
III. **Sustainable sewage sludge management, and**
IV. **Sustainable construction and demolition waste management.**

Implementation of measures and programs under these sub-actions was projected to reduce the carbon emission in Iskandar Malaysia by 1224 kt CO2 equivalent (10% of the total emission reduction for the entire LCS Blueprint) in 2025. The total reduction of final waste to landfill is 3480 kton at year 2025 for CM scenario. The summary for waste generation, waste final disposal and GHG emission for sustainable waste management in LCS is presented in Table 11.3. Almost all wastes are projected to largely increase by 2025 under the BaU scenario due to the population growth. Except for the generation of AW, volume is expected to decrease by 2025 compared to the baseline generation, mainly due to the change of land use for development.

Should all waste management action plans be successfully implemented, approximately 12% reduction of waste generation from source, 73% reduction of waste to final disposal, and 73% of GHG emission reduction can be achieved.

Table 11.2: Sub-actions and measures for Sustainable waste management of IM

| Sub-Actions | Measures |
|---|---|
| **1) Sustainable Municipal Solid Waste Management** | Reduction at source |
| | Recycling of municipal solid waste |
| | Extended final disposal |
| | Effective waste transportation |
| **2) Sustainable Agricultural Waste Management** | Biomass to wealth |
| **3) Sustainable Industrial Waste Management** | Scheduled waste reduction and recovery |
| | Non-scheduled waste reduction, reuse and recovery |
| **4) Sustainable Sewage Sludge Management** | Improved sewage treatment and sludge recycling |
| **5) Sustainable Construction and Demolition Waste Management** | Reuse and recycling of construction waste |

Table 11.3: Summary of forecasted waste generation, waste to final disposal landfill and GHG emission and its reduction by 2025 under LCS Sustainable waste management proposal

| Year | Wastes generation (tonnes/yr) | | | | Final disposal Landfill (tonnes/yr) | | | | GHG emission (ktonnes CO2 e/yr) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2025 (BaU) | 2025 (CM) | Reduction | 2005 | 2025 (BaU) | 2025 (CM) | Reduction | 2005 | 2025 (BaU) | 2025 (CM) | Reduction |
| **MSW** | 467,253 | 1,577,403 | 1,498,533 | 78,870 | 443,890 | 1,498,532 | 104,897 | 1,393,635 | 135 | 458 | 32 | 426 |
| **AW** | 5,936,376 | 3,561,825 | 4,749,100 | 1187275 | 4,155,076 | 2,504,803 | 860,262 | 1,644,541 | 1,748 | 1,054 | 361 | 6927 |
| **IW** | 296,023 | 1,089,885 | 790,260 | 136,329 | 193,729 | 620,296 | 272,658 | 347,638 | 41 | 131 | 57 | 73 |
| **Sludge** | 32,290 | 71,197 | 71,197 | 163,296 | 32,290 | 71,197 | 711 | 70,485 | 13 | 30 | 0.3 | 29.96 |
| **CW** | 27,064 | 60,000 | 60,000 | 0 | 27,064 | 60,000 | 36,000 | 24,000 | 1.27 | 2 | 1.53 | 1.02 |
| **Total** | **6,759,006** | **6,360,310** | **7,169,090** | **1,565,770** | **4,852,050** | **4,754,830** | **1,274,529** | **3,480,300** | **1,940** | **1,677** | **453** | **1,223** |

Business as Usual = BaU  Counter Measure= CM

**Summary of Relevant Policies**

In general, municipal solid waste management (MSWM) in Malaysia involves the participation of different Government agencies from federal to state and local authorities. The corresponding government agencies are involved either directly or indirectly with MSWM. Malaysia is governed as a parliamentary democracy with three tiers of government, namely the Federal Government, State Government and Local Authority.

There are 14 states and 144 local authorities in Malaysia. The relevant local authorities include the Municipal Council, District Council, City Hall

and Town Board. Several policies and blueprints pertinent to waste management are available and are relevant to most agencies involved with MSWM. For example, the National Communication to the UNFCCC was discussed in the Malaysia's Climate Change and Green Technology Policies which provides a framework to mobilize and guide government agencies, industry, communities as well as other stakeholders to address the challenges of climate change in an effective and holistic manner. The National Green Technology Policy aims to promote low carbon technology and ensure sustainable development while conserving the natural resources and environment. In the policy, there are five plans of strategic driving forces aiming to lead the adoption of green technology in government facilities (Malaysia Second National Communication to the UNFCCC, 2007).

Various plans and strategies were drafted in the National Strategic Plan (NSP) and the Waste Minimization Master Plan and Action Plan to attempt GHG emission reduction and achieve overall effective solid waste management. However, effort on organic waste management, especially on food and green waste, is still lacking (Malaysia Second National Communication to the UNFCCC, 2007).

Restructuring on solid waste management was the agenda in the Tenth Malaysia Plan. The government plans to fully enforce the Solid Waste and Public Cleansing Management Act 2007, in which the responsibility for the act will be transferred from the local authorities to the jurisdiction of the Federal Government (Tenth Malaysia Plan 2011-2015, 2010). Under the Tenth Malaysia Plan, several progressive national policies on environmental protection and conservation are in place including the National Policy on the Environment (2002), National Green Technology Policy (2009) and National Climate Change Policy (2009).

## 11.1 Sustainable Municipal Waste Management

MSW refers to the solid waste collected and controlled by the local authorities or municipality and typically consists of household waste, commercial waste and institutional waste (McDougal et al., 2001). Sustainable municipal waste management means less reliance on landfill and greater amount of recycling and composting. A sustainable system for municipal waste management must be environmentally effective, economically affordable and socially acceptable. The balance that needs to be achieved is reduction of overall environmental burdens of the waste management system as far as possible, within an acceptable level of costs. Several measures with their respective programs are outlined here in the quest to achieve sustainable SWM in IM. These include reduction at source, recycling organic and inorganic waste, waste to energy and effective waste transportation.

The key policies relevant to 3R in Malaysia include the Action Plan for a Beautiful and Clean Malaysia (ABC) in 1988, National Strategic Plan for Solid Waste Management in Malaysia (NSP) in 2005, Master Plan on National Waste Minimization and National Solid Waste Management Policy in 2006, and the Solid Waste and Public Cleansing Management Act in 2007. ABC was the first policy, with the objective of 3R program to reduce solid waste generation by Reduce, Reuse & Recycle. However, the campaigns failed to improve the existing waste management practice which led to the re-launching in 2001 by the Ministry of Housing and Local Government (MHLG). The failure was due to lack of effective policy to gear 3Rs (REF).

This blueprint is set to achieve the target of 93% reduction of total MSW to landfill and 93% GHG reduction from MSW through a series of measures and programs proposed to be implemented within IM region. The proposed measures and programs are supported by facts

and best practices from the literature as shown in Table 11.4. Two types of measures are considered for reducing the total landfill and total GHG emission, i.e.: quantifiable measure and non-quantifiable measure.

A quantifiable measure refers to a program in which the reduction of $CO_2$ can be reasonably estimated using GHG estimation models, while a non-quantifiable measure refers to a program typically involving behavioural change and implementation of policy which contribute rather indirectly to the reduction of waste volume at source and hence the resulted mitigation of GHG emission. Under this blueprint, only programs with significant contribution to GHG emission reduction will be quantified, as shown in Table 11.5. Based on Table 11.5, it is assumed that the practice of segregation takes place at the source, hence 5% of the recyclable waste is separated and about 93% of the overall wastes and other wastes are treated by the integrated waste management. Prior to the treatments by composting, incineration and landfilling, 22% of the waste could be recovered in the Material Recycle Facility (MRF) process. After treatment, the residue from composting and incineration process will be sent to the landfill. A summary of this process is given in Table 11.5.

Table 11.4: Measures and programs of LCS Sustainable MSW management

| **Measure 1 : Reduction at source** |
|---|
| **Programs :**<br>• Smart consumption (buy in bulk, refill & concentrate local products)<br>• Choose durable and reusable item<br>• Restrict of using non-recyclable packaging<br>• Encourage culture of sharing, borrowing or renting instead of buying<br>• Choose online digital services, paperless services<br>• Buy product from recyclable material<br>• "Pay-as-you-throw" system by 2015<br>• Scheduled waste collection for bulky waste |
| **Measure 2 : Recycling of municipal solid waste** |
| **Programs :**<br>• Composting at home<br>• Decentralized composting plant<br>• Establishment of material recycling facilities (MRF)<br>• Waste Incineration[1]<br>• Recycling of E-waste |
| **Measure 3: Extended final disposal** |
| **Programs :**<br>• Sanitary landfill with methane gas capture[1] |
| **Measure 4: Effective waste transportation** |
| **Programs :**<br>• Separate waste collection at source<br>• Effective use of transfer station<br>• Optimization of waste collection routes<br>• Selection of appropriate size of collection vehicle<br>• Use of collection vehicle driven by biodiesel fuel (BDF) or Natural Gas Vehicle (NGV) |

Table 11.5: Programs contributed to the reduction target in terms of waste volume reduction (Source: UTM-Low Carbon Research Centre, 2012)

| Measures/Programs | Contributors to MSW reduction to landfill (%) |
|---|---|
| **[a]11.1.2 Recycling of organic waste** | |
| • Decentralised composting plant. | 5 |
| • Composting at home. | 3 |
| • Incineration | 63 |
| **[b]11.2.3 Recycling of non-organic waste** | |
| • Material recycling facilities | 22 |
| • Recycling of e-waste | 0 |

Table 11.6 shows the reduction of waste generation, waste disposal to landfill and GHG

emission reduction by considering all the non-quantifiable and quantifiable programs and measures of sustainable waste management. From the estimation, a 5% reduction in waste generation can be achieved under the counter - measure scenario by 2025 (2025 CM), with the implementation of reduction at source programs as presented in section 11.1.1. The total volume of waste to landfill and GHG emission can be reduced by 93% under the 2025 CM scenario compared to the business as usual scenario (2025 BaU). Mitigation of 93% of GHG emission is estimated by 2025 because a majority of the MSW would go through the proposed technology treatments instead of being sent directly to the landfill.

Table 11.6: MSW generation, final disposal to landfill and GHG emission in IM by year 2025
(Source: UTM-Low Carbon Asia Research Center, 2012)

| Year | MSW generation (tonne/yr | MSW sent to landfill (tonne/yr) | GHG Emission (ktonnes CO2 eq/yr) |
|---|---|---|---|
| **2005 (Baseline)** | 467,253 | 443,891 | 135.84 |
| **2025 (BaU)** | 1,577,403 | 1,489,533 | 458.59 |
| **2025 (CM)** | 1,498,533 | 104,897 | 32.10 |
| **% Reduction** | 5 | 93 | 93 |

The following sections will further describe the quantifiable and non-quantifiable measures and programs that contributed to waste reduction to landfill and mitigation of GHG.

### 11.1.1 Reduction at Source

In the conventional waste management hierarchy, the most highly preferred method is to prevent the creation of waste or to reduce the amount of waste at source. The logical starting point for solid waste management is to reduce the amounts of waste that must be managed, collected and disposed of as nuisance and hazards (UNEP, 2012). Waste reduction can be achieved at several levels. It can be helped by source separation of recyclable materials and separate collection for recycling purposes. At least 5% of waste can be reduced at the source by practicing several programs outlined as follows.

**I. Smart consumption (buy in bulk, refill & concentrate local product)**

Nowadays, consumer are advised and encouraged to consider the environmental and social impact of their purchasing behaviour. The choice to buy item in bulk seems more advantageous as it may reduce shipping costs, cut shopping trips and more importantly it may reduce the packaging waste. However, buying in bulk is not always the most frugal option, as it applied to certain item only. For example, some items such as candy, spices, mayonnaise and also vitamin and supplements might become wasted as they cannot be stored for long (The Digerati Life, 2012).

A smart consumer also thinks about what they eat, where it comes from and where the packaging ends up. For example, instead of buying another bottle of mineral water, you might want to find refillable water pitchers to reduce the use of plastic bottles. Buying local products with lower carbon footprints could contribute to reducing carbon emissions in long run. This means that if we drive or walk to the market nearby to buy the necessities, it cuts down GHG emissions and gas expenses. Products from local community require less packaging than those shipped from far away (Regional District of Kootenay Boundary, 2012). The other concept is for shoppers to bring their own containers to the store for food or other grocery. This will significantly reduce the use of plastic bags and packaging.

**II. Choosing durable and reusable items**

Choosing durable and reusable item may also help in reducing waste at the source. For companies, this would help in reducing purchasing cost, needed storage space and disposal costs. Providing company mugs and

reusable lunch bags or boxes is also an encouragement to reduce lunch waste. The use of reusable bottles instead of bottled water should be encouraged to reduce plastic waste.

### III. Restrict of using non-recyclable packaging

Restriction on the use of non-biodegradable plastics and food packaging which is non-recyclable should be implemented by 2015. Non-recyclable packaging has been identified as the main source of plastic waste in certain studies (Dorigo, 2012). This measure can help reduce the amount of solid waste produced, either as industrial, commercial or domestic waste. Even though non-biodegradable plastic bags are not the only source of environment and sea pollution, they are currently the polluting plastic products which can be replaced by biodegradable materials which are safer for the environment (Dorigo, 2012). In fact, conventional plastics are made from oil which takes up to 300 million years to form. But oil-based plastics packaging which is not recyclable will usually end up in landfill sites or be washed out to sea and become sea pollution.

Recommendation on the use of degradable packaging from natural plant materials like corns or sugarcane should be recommended. These materials use up to 70% less $CO_2$ to produce compared to the production of conventional plastics. In contrast to oil-based plastics, degradable packaging can be turned into natural compost in just 12 weeks. Switching to sustainable packaging can substantially reduce carbon footprint and waste packaging previously destined for landfill sites. The degradable waste could be composted or recycle instead which greatly lower the environmental impacts (Greenpackage, 2012). In other word, they are improvements in efficiency in long run to use degradable materials, in terms of materials and energy consumptions.


Figure 11.3: Example of biodegradable packaging

### IV. Encourage a culture of sharing, borrowing or renting instead of buying

Encouraging reuse things can be a good practice to reduce waste at the source. It is also good to borrow or rent things that only need for a short period of time instead of buying. Agreements with friends or relatives can be arranged to share ownership of items that are used only occasionally. The concept of having more rental shops which provide community co-sharing and economic opportunity as well as conserving resources should be promoted by government agencies and NGOs.

### V. Choose online digital services or paperless service

Companies and organizations can reduce or eliminate paper usage by switching to provide services through online digital services such as e-mail. Electronic editing features through track changes to edit documents should be encouraged to avoid multiple editing copies in a hard copy format. Electronically scanned copies of documents for archiving purposes should be encouraged to reduce the usage of file folders. However, in cases where a hard copy is essential, document should be printed double-sided (Kitsap County). Incentives should be provided by government to promote paperless business operation model, at least in the form of high star rating for sustainability.

### VI. Buy products from recyclable material

A quote by Western Cape on the recyclable says "You're not recycling until you're buying recycled!" By buying goods with recyclable material, it saves on new materials and energy required for mining, processing and transport. This in turn will reduce GHG emissions and reducing the impacts on climate change. The discarded materials can have remarkable value if it is properly collected and transformed into good of materials. It is also recommended for stores and wholesalers to support local suppliers who reuse and recycling their packaging. The concept and incentives on Green product labels should be implemented by the government to the SMEs and MNCs to promote awareness on green products. For example, in Malaysia, the Standards and Industrial Research Institute of Malaysia (SIRIM) launched a national eco-labelling program to verify products according to environmental criteria such as Environmentally Degradable, Non-toxic Plastic Packaging Material, Hazardous Metal-Free Electrical and Electronic Equipment, Biodegradable Cleaning Agents and Recycled Paper in 1996 (Nik Ramli, 2009). Meanwhile, Federal Agriculture Marketing Authority (FAMA) won the Malaysia Best logo for environment friendly agriculture product, while the Malaysian Energy Commission provides green label for electrical products with enhanced energy efficiency.

### VII. 'Pay-as-you-throw' system by 2015

In the USA and Germany, waste collection charges are scaled according to the volume or in some cases on the mass of waste generated, but in most communities, a flat rate of collection fee applies (McDougal et al., 2001). This system also known as 'pay-as-you-throw system' which imposes fee charges for collection and disposal of waste. The fee increases with the amount of waste being discarded. It has been suggested that this system might be implemented in Malaysia by 2015 although more considerations are needed prior to full implementation. Malaysian governments should consider the implementation of 'pay-as-you-throw' systems already in practice in other countries. The government should establish goals for the system based on the needs of local community on solid waste management. Some common pre-requirements for 'pay-as-you-throw' systems include campaign to promote waste minimization and recycling, raising sufficient revenue to cover solid waste costs, and subsidizing other waste related activities (e.g., anti-littering campaigns) (DCA, 2012).

In addition to reduce waste and waste related costs, some of the potential benefits of pay-as-you-throw systems include (DCA, 2012):

i. Equitable fee structure
ii. Successful recycling and composting programs
iii. Increased awareness in waste management issues
iv.

Example of 'pay-as-you-throw' bins is shown in Figure 11.4.


Figure 11.4: Example of 'pay-as-you-throw' bins

### VIII. Scheduled waste collection for bulky waste

Some people may not know how to handle their bulky waste such as old beds, settees, fridge and cookers (Portsmouth, 2012). A proposal was made here for the local council to offer a chargeable bulky waste collection service to pick up the more awkward items of rubbish from home and dispose of them in proper manners. However, if household items are still of good quality the better solution is to reuse it. There are a number of ways to reuse it such as

donation to charities, selling to local second hand furniture companies, or taking it to the recyclers. Household items, electrical goods and furniture can all be put to good use for other residents in the area (Bromsgrove District Council, 2011). As last resort, one could choose to pay for bulky household waste disposal to landfill. Fridges and freezers are disposed of according to legislative requirements in Malaysia.

### 11.1.2 Recycling of Municipal Solid Waste

IM generated 467,253 tonnes of municipal MSW in year 2005 and is projected to increase to 1,577,403 tonnes by 2025, as shown in Table 11.7. The composition of the MSW determines the potential utilization of MSW. The composition of MSW in IM is shown in Table 11.7. The MSW sample was from the Sanitary Landfill at Seelong, Kulai, Johor.

Table 11.7: Waste Physical Composition (Source: UTM-Low Carbon Research Center, 2012)

| Items | Waste composition % |
|---|---|
| **Food** | 41.06 |
| **Paper** | 20.93 |
| **Plastic** | 22.23 |
| **Glass** | 3.56 |
| **Metal** | 1.96 |
| **Textile** | 7.74 |
| **Rubber** | 0.01 |
| **Leather** | 0.0 |
| **Ceramic** | 0.07 |
| **Garden waste** | 2.45 |
| **Total** | 100.0 |

In Table 11.7, about 43% of MSW is organic waste (food waste + garden waste) and 35.49% of waste is recyclable waste (paper, plastic, glass, metal and textile).

***Recycling of organic waste***

The recycling of organic waste is based on the waste-to-wealth concept, where organic waste can be transformed into value-added products including compost, biofuel, biogas and electricity. This prevents the waste to be sent to the landfill sites that would incur extra transportation and handling costs. The successful operation of an organic treatment plant will depend on numerous expenses as well as a sufficient and constant supply of organic waste.

Several programs are outlined as follows to promote the effective recycling of organic waste:

i. Decentralized composting plant
ii. Home composting
iii. Incineration for energy recovery

A close-to-perfect CM scenario is proposed for organic waste management in this blueprint. This carries the assumption that most of the mitigation program and measures are successfully implemented where approximately 80% of the organic waste can be reduced at landfill under CM scenario, as shown in Table 11.8.

Table 11.8: Projection of organic waste from municipal waste generation in IM by 2025 (Source: UTM-Low Carbon Research Center, 2012)

| Year | Organic waste (tonne/year) |
|---|---|
| **2005 (Baseline)** | 200,919 |
| **2025 (BaU)** | 678,283 |
| **2025 (CM-80%)** | 135,657 |

**I. Composting at Home**

Decentralised and centralised composting plant required organic waste generation at moderate to large scales and need competent management structures to maintain the facilities at extra cost, it also requires educational and consciousness input to impart behaviour change in the consumers for successful implementation. As a consequence, composting at home should be initiated through a public awareness campaign to reduce organic waste at source. Composting at home works on an average quantity of source and can be

facilitated by simple techniques. Simple solutions are available at reasonable costs to promote composting at home using specially designed containers to facilitate leachate collection and the use of commercial microbial inoculums (such as EM1)(IGES,2010) or the Takakura technique to accelerate the degradation rate of the waste and also for odour control purposes. The compost produced can be used for home gardening purposes. This practise requires continuous educational and consciousness input through workshops and campaigns. The practices can be promoted to a larger community if there are compost and organic waste buy-back schemes by government or private operators

**II. Decentralised composting plant**

Large scale composting can be costly due to the high cost of operational, transport and maintenance. It is not likely to be feasible if segregation at source by consumers has not been established. Decentralized composting is one possible approach to treat and recover the biodegradable fraction of the solid waste stream.

A decentralized composting plant can be set up at the community level to significantly reduce waste within the community or residential area. This approach can be initiated by the developer of the residential area in fulfilment of the corporate social responsibility. Similar to the Centralized Composting plant, such plants also need most of the enablers as mentioned in the next section (section 11.1.2) as supported and further driven by the local authorities, NGOs and commercial entities to establish a sustainable economic model for sustainable production of compost products from organic waste. Table 11.9 shows a comparison of a large-scale centralised composting system and a decentralised composting system.

Table 11.9: Comparison of centralized and decentralized composting systems
(Source: UN ESCAP's Sustainable Urban Development Section, 2011)

| Large Scale Centralized Composting | Decentralised Composting |
|---|---|
| Large capacity (> 30,000 tonnes/year) | Small capacity (<1,000 tonnes/year) |
| High mechanised technologies. | Small technologies and labour intense. |
| Large investment for advance machineries. | Lower capital cost and locally available materials. |
| High operation and maintenances cost and high degree of specialized skills. | Comparatively less maintenances costs and low level skills required. |
| Less interaction and involvement of residents. | Community voluntary on waste separation at source. |
| High transportation cost. | Less transportation cost. |

A case study on community-based composting was successfully implemented in Surabaya City, Indonesia. The project was initiated under the Kitakyushu Initiative for a Clean Environment by the Institute for Global Environmental Strategies (IGES), a research institute in Japan and also by UN's ESCAP. The program achieved a significant improvement in solid waste management through community-based and decentralised composting strategy. Multi-stakeholder approach, involving international counterpart of Kitakyushu International Techno-cooperative Agency and a local NGO known as Pusdakota, is identified as the major drivers for the effective implementation. A total of 14 composting centres were established in the Surabaya City to handle organic waste from the public using Takakura composting technique. The 5-year project (2007-2012) reduced up to 80 tonnes of organic waste per day (about 300,000 tonnes/yr) in the Surabaya city and is estimated to reduce approximately 12,500 tonnes of $CO_2$ in year 2012, the amount of GHGs

that would otherwise released at the disposal sites (Maeda, 2009). An example of a composting plant in Surabaya is shown in Figure 11.5.


Fig. 11.5: Composting centre in Surabaya City, Indonesia (Source: Meada, 2009)

### III. Establish of Material Recycling Facilities (MRF).

MRF is a specialized plant that receives, separates and prepares recyclable materials for marketing to end-user manufacturers. It accepts a mixed solid waste stream and then proceeds to separate out designated recyclable materials through a combination of manual and mechanical sorting. The material must be sorted in an intermediate "clean" MRF so that the materials are divided into their respective streams of clean paper (white paper, newsprint, cardboard), sorted plastics (e.g. HDPE, PET), metal (ferrous and non-ferrous), and glass (clear, brown, green), as these materials are in forms which scrap traders and users would seek to buy. MRFs are to be sited at centres with high waste generation to maximize the potential for waste recycling. The MRF will have to be designed to provide flexibility to accommodate fluctuations in market demand for recyclables. The sorted recyclable materials may undergo further processing required to meet technical specifications established by end-markets while the balance of the mixed waste stream can be sent to a disposal facility such as a landfill.

The establishment of MRF is suggested in the blueprint in line with the planning of IM. The proposed location is within the Kulai sub-district, south of Sedenak. The MRF, with a capacity of 200 tonnes/day, has been planned for operation in 2025, together with the organic treatment and thermal treatment plants. The facility is operated under Sedenak Integrated Waste Facility.

### IV. Waste Incineration

Incineration technology is commonly implemented in countries such as Japan and Singapore where the availability of land is scarce. Incineration can be considered either a pre-treatment of waste prior to final disposal or as means of valorising waste by recovering energy. It includes both the burning of mixed MSW in municipal incinerators and the burning of selected parts of the waste stream as fuel. The technology applied the waste-to-energy concept includes combustion of organic waste in a furnace or boiler to generate heat, steam or electricity. The heat produced by an incinerator can be used to generate steam, which is then used to drive a turbine in order to produce electricity

Incineration is an efficient way to reduce the waste volume and demand for landfill space. Implementing an incinerator can reduce the cost of waste transportation because it can be placed close to the centre of gravity of waste generation. It is also the best way to eliminate methane gas emissions from waste management processes. Moreover, energy from waste projects provides a substitute for fossil fuel combustion. This show that incineration helps reduce greenhouse gas emissions.

The cost of control equipment will, however, depend upon the air pollution regulations existing in a given lesser developing country. Study of emissions of pollutant from various incinerator plants in Malaysia showed that dry type air pollution control unit is able to meet the emission limits regardless of capacity and type of waste incinerated (Taib, 2008).

The non-organic waste such as E-waste, construction waste, metal, wood, plastic, and glasses can be recycled into useful products. There are a total of 50 recycling companies or centres available in the IM region. The collections of the wastes are facilitated by collection agents and also individuals. Several programs are proposed to enhance the efficiency of such recycling activities as follow:

**V. Recycling of E-waste**

Waste from electrical and electronic appliances (E-waste) is valuable especially for E-waste recyclers. E-waste covers a wide range of electrical and electronic products, including major consumable appliances such as televisions, phones, computers, refrigerators, and radios. In Malaysia, there is a lack of consensus as to whether the E-waste should apply to resale, reuse, and refurbishing industries, or only to products that cannot be used for their intended purpose. Most of the e-waste in Malaysia is abundant at landfill sites. This creates environmental issues as some electronic scrap components, such as CRTs, may contain contaminants such as lead, cadmium, beryllium, or brominated flame retardants. Recently, the Department of environmental Malaysia initiated the E-waste recycling program in Malaysia by establishing the E-waste collection centres.

Nevertheless, the E-waste recycling program is only limited to certain wastes, such as the used mobile phones and their batteries and accessories, computers and their accessories, and television. In IM, the E-waste collection centres are operated by SWM Environment Sdn Bhd. Although the initiative action on E-waste recycling is implemented by government, the recycling of E-waste received low attention from the public. Currently, only a very limited number (total of 5) of E-waste collection centres are available in IM, and most of the centres lack propagation to raise the awareness of citizen to recycle their E-waste. An estimation of household E-waste generation in IM was made for the Malaysia E-waste generation rate at 706,000 tonnes of waste in 2010 (Agamuthu, 2010), equivalent to 0.41 tonnes/capita/year.

With the best practice of E-waste recycling system in Japan that can serve as the model E-waste recycling system in IM. Referring to Figure 11.8 an e-waste recycling program is in place in Japan enforced by the Japanese Home Appliance Recycling Law in 2001 (METI, 2006). The law emphasised the recycling of home appliances such as large TV sets, washing machines, air conditioners, refrigerators, personal computers and copiers (Savage, 2006). Apart from that, the Law also specified the responsible of electronic device manufacturer (ECOLAS/RPA, 2007).

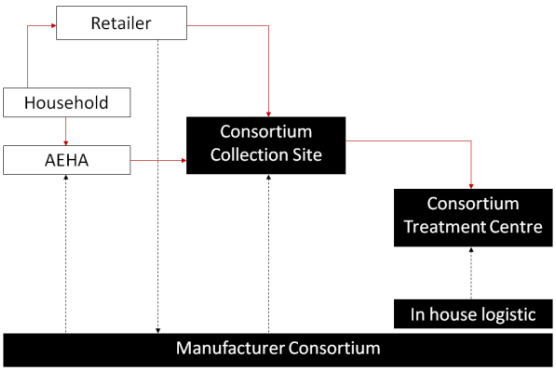



Figure 11.6: Japanese E-waste Take back Systems – A Consumer/Retailer based System
(Source : Savage et al., 2006)

In Japan, the e-waste take back system is a consumers/ retailer based system where retailers are the primary responsible party for collecting the end-of-life products from household to the regional aggregation stations (ECOLAS/RPA, 2007). Besides, the government also appointed the Association for Electric Home Appliances (AEHA) as a designated legal entity to collect E-waste. The collected e-waste will be transferred to the recycling plants.

### 11.1.3 Extended Final Disposal

**I. Sanitary Landfill with Methane Gas Capture**

Landfilling stands alone as the only waste disposal method that can deal with all materials in the solid waste stream. There will always be a

need for landfilling in any solid waste management because other options produce waste residues that subsequently need to be landfilled.

Sanitary landfill is described as controlled filling of compacted layers of solid waste and soil into pre-prepared land. As there are emissions from the process such as landfill gas and leachate, these also need to be controlled and treated as far as possible. To be classed as sanitary, the site must be managed to minimize any negative environmental impact.

Landfill gas is collected using a system of either vertical or horizontal perforated pipes. Pumped extraction of gas is needed for efficient collection, and thus fewer odour and emission problems. Once collected, the gas can either be flared off, to destroy the methane and organic contaminants, or used as fuel. The rate of gas production also depends on how the landfill is managed.

### 11.1.4 Effective Waste Transportation

Waste transport vehicles should be authorized and able to transport the specified wastes from the customer's work place or residence to the landfill or processing plant. Waste must be transported by the vehicle designed for it. For example, general waste requires a vehicle with thicker compactor walls, compared to those transporting the cardboard and paper waste. Thus, a series of vehicles may be required by different customers to meet their specific needs for effective waste management. Vehicles, drivers and companies need licenses and approval for certain council areas to transport waste, and drivers must also undergo training for emergency circumstances that may arise.

#### I. Separate Waste Collection at Source

The best waste management practice is to separate waste at the source. This goes as well for the waste collection process. Each day should be designated for collection of different t ypes of wastes. For instance, the first day for recyclable waste, next is for organic waste and other waste on another next day. This practice will also educate the public on the importance of separating waste according to its type. As a result, there will be no recyclables and no organic waste in the trash which leads to an immediate reduction in the amount of waste being transported to the landfill. Consequently, this will lead to better result in cost saving for waste disposal and most importantly a much lighter footprint left on the environment (Ecosafe~6400, 2010). At the same time, the collection of segregated organic waste would enable the set-up of larger scale composting plants which convert waste to higher value of products.

#### II. Effective use of transfer station

Transfer stations (TS) play an important role as a link between community's solid waste collection program and a final waste disposal facility. The basic purpose of having a TS is consolidating waste from multiple collection vehicles into larger, high volume transfer vehicles for more economical shipment to distant disposal sites. Merging smaller loads from collection vehicles into larger transfer vehicles would reduce the hauling costs by enabling collection crews to spend less time for travelling within disposal sites. Fuel consumption and maintenance costs for the collection vehicles can also be reduced. Overall, such practices would reduce the overall traffic, air emissions, and road wear (USEPA, 2000).

In addition, a transfer station also provides:

- An opportunity to screen waste prior to disposal.
- Flexibility in selecting further waste disposal options.
- An opportunity to serve as a convenience centre for public use.

Furthermore, if reductions step as stated in the previous section (source reduction and recycling

program) are significant enough, a community may find that fewer or smaller TSs can meet their needs. Waste transfer stations also offer more flexibility in terms of disposal options. Decision makers have the opportunity to select the most cost-effective and/or environmentally protective disposal sites, even if they are more distant. They can consider multiple disposal facilities, secure competitive disposal fees, and choose a desired method of disposal, such as landfilling or incineration.

Even though IM plans to build about 3 Integrated Waste Management Facilities (IWMF), there are no plans to build additional transfer station (TS) for the time being. However, a small transfer station could be built at the current Pekan Nenas sites for transfer to Seelong if necessary after the closure of landfill in Pekan Nenas in 2019 (IRDA Integrated Solid Waste Management Blueprint, 2010). That is because National Solid Waste Management Department (NSWMD/JPSPN) had formulate the Scheme Area for waste collection which state that the average distance of transfer station to landfill must exceeding 20 km. For now, only waste collected in certain areas in MBJB and waste disposed in Seelong will go to Taruka transfer station, while the other areas in IM will use direct haulage to the landfill.

**III. Optimization of waste collection routes**

Transportation for waste collection is also a crucial factor in sustainable waste management. Hence, implementing integrated collection system will contribute to the effective transportation for waste. Integrated collection method combines various systems (material banks, close-to-home drop off centres, central collection sites for garden/bulky waste) and/or kerbside collection (for recyclables, biowaste and/or restwaste) into considerations for optimized waste collection routes. Moreover, waste materials can be collected in suitable streams for subsequent treatment or disposal with minimum environmental and economic burdens (McDougall et al, 2001).

**IV. Selection of appropriate size of collection vehicles**

Selection of appropriate size or design of vehicles can also be a way for sustainable waste management. A study in Worthing, UK (McDougall et al, 2001) introduced a specially designed truck with two compartments which could be used to collect the recyclables items as well as having a normal compaction compartment for the restwaste. This allows both recyclables and restwaste to be collected on a single visit to each household. On the other hand, Viridor, a waste collection company from the United Kingdom (UK), has introduced a new vehicle with three compartments for dividing waste and recyclable material in 2011 (Place North West, 2011). This vehicle will reduce the need for multiple collections from customers. The vehicle will collect three streams of waste in one visit. The waste will be split into glass, cans and plastic bottles; paper/cardboard; and non-recyclable and organic waste. If Malaysian successfully practices segregation at source by 2015, this type of vehicle can be considered for waste collection in Malaysia. Furthermore, this 'trio' system vehicle enhances the efforts to maximize recycling yet not increasing carbon output.

**V. Use of collection vehicles driven by biodiesel fuel (BDF) or Natural Gas Vehicle (NGV)**

Biofuels include fuels derived from biomass conversion, as well as solid biomass, liquid fuels and various biogases. Biodiesel is part of biofuel which is made from vegetable oils and animal fats (Demirbas, 2009). Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel is the most common biofuel in Europe due to incentives provided. Biodiesel claims to offer attractive benefits including the reduction of GHG emission, the diversification of the fuel sector,

biodegradability, sustainability, and an additional market for agricultural products (Demirbas, 2009). Transportation is one of the key elements in the life cycle analyses for waste management. Selection of waste collection vehicle will help in reducing the environmental impact during the waste life cycle analyses.

Another cleaner fuel is natural gas, which is generated from the decay of ancient organisms. It naturally takes a gaseous form instead of liquid and commonly occurs in association with crude oil. Natural gas consists primarily of methane and other hydrocarbon gases. The most significant advantage of NGVs is that they reduce environmentally harmful emissions. NGV can achieve up to a 93% reduction in carbon monoxide (CO) emissions, 33% reduction in emissions of various oxides of nitrogen and a 50% reduction in reactive hydrocarbons compared to a gasoline vehicle (William, 2011). Like gasoline, natural gas is combustible in combustion engine. Use of NGV as a fuel for waste collection vehicle offers other benefits such as better safety measure as its fuel storage tanks is thicker and stronger than a gasoline or diesel tank. Natural gas also costs less than the gasoline, where on average it costs one-third less than the gasoline at the pump in Malaysia. As natural gas burns so cleanly, it results in less wear and tear on the engine and extends the time between tune-ups and oil changes, thus resulting in lower maintenance costs.

## 11.2 Sustainable Agricultural Waste Management

Agricultural activities affect our environment in many ways, including the direct production of GHG. Statistical data reported by IPCC (2001a) anticipated that agriculture activity had contributed approximately 15% of total GHG emission in year 2000, among the five top economic end-user sectors including: industry, transportation, residential, commercial and agricultural. Other studies also reported significant amounts of $CO_2$, $CH_4$, and $N_2O$ released into the atmosphere during the past two centuries by agriculture activities (Cole et al., 1997; IPCC, 2001a; Paustian et al., 2004). To mitigate the GHG emission by agricultural sector, sustainable agricultural waste (agro-waste) management is suggested to be a promising strategy. Agro-waste is characterized as a higher proportion of organic materials of biomass origin, where the carbon contained in the agro-waste contributes to large production of methane gas ($CH_4$). $CH_4$ is among the key GHGs, four times more damaging than $CO_2$ that threatens the world's ozone layer and caused global warming. Efficient management of agro-waste using integrated strategies as proposed. Significant co-benefits in terms of public health, environmental protection, quality of life, availability of renewable energy and production of value-added products such as composts.

In the case study of IM as outlined in this blueprint, agro-wastes cover the biodegradable wastes and residues resulting from diverse agricultural activities ranging from those produced from the agricultural land and agricultural factories. It also covers the trimmed wastes from the green areas. The research targets on the agricultural waste produced in IM are listed as follows:

a. **Agro-wastes:** Majority of agricultural crops residues are palm oil biomass;
b. **Public green waste:** Trimmed waste from park, garden and street and green areas.

***Agro-waste Generation in IM***

There is no specific record for agro-waste generation in IM as the agricultural land in IM is distributed across several districts in Johor Bahru and hence the waste volume is recorded discretely under the respective district. The major crops in the IM region are oil palm, which consisted of about 120,000 hectares in year 2005 and made up approximately 90% of the agricultural sector in IM. Other crops such as rubber, coconut, coffee and pineapple have

minimum impact on the amount of residues generated, as they are typically left on the farm for natural degradation and nutrient recycling, and are therefore not considered in the waste estimation in this blueprint.

The waste generated from oil palm plantations is estimated based on the guideline from Malaysia Palm Oil Board (MPOB, 2011). Total palm oil waste includes the empty fruit branch (EFB), palm kernel shell (PKS), palm kernel cake (PKC), mesocarp fibre (MF), palm oil mill effluent (POME), oil palm fronds (OPF), and oil palm trunks (OPT). The palm oil waste generation is calculated based on the current plantation size without considering the re-plantation scenario. It is estimated that 5,936,376 tonnes of palm oil biomass were generated in year 2005. Under the BaU scenario, the palm oil plantation in IM is estimated to be reduce by 40% of the total area in base year (2005) by year 2025 (Renewable Energy and Energy Efficiency Blueprint for Iskandar Malaysia, 2010). Under the CM scenario for realizing a Low Carbon Society, it is predicted that the palm oil plantation would reduce by 20% instead of 40% under BaU from the base year, based on claims that palm oil plantations are potential carbon sinks.

Public wastes are wastes generated from the trimmed waste from the city green zone. The wastes include trimmed branches, leaves, and yard waste. Based on several interviews conducted with the Malaysia Agricultural Department and the Southern Waste Management Sdn. Bhd., green waste data is not recorded, hence the public green waste generation factor in IM cannot be computed. Therefore, the green waste generation is estimated based on a report of Biomass Town in Chiba prefecture, Japan. The factor of tree clipped branch was reported as 1.8tons/ha/year and that of cut grass is 4.0tons/ha/year. Based on these factors, the green waste generation in an area of open space and park in IM region by 2025 is projected to be 24416 tons/year using Equation 1.

**Total green waste generation**
**= Green Waste Generation Rate x Area (1)**
**= (4,208 ha x 4.0) + (4,208 ha x 1.8)**
**= 24406.40 tonnes/year**

The total agro-waste generation in IM for based year (2005) and year 2025 is projected in Table 11.10.

Table 11.10: Projection of palm oil waste generated in IM under BAU and CM scenarios (year 2005-2025)

| Year | 2005 | 2025 (BaU) | 2025 (CM) |
|---|---|---|---|
| **Palm oil plantation (hec)** | 120,000 | 72,000- | 96,000 |
| **Change rate (2025/2005)** | - | -40% | -20% |
| **Agro-waste generation** | | | |
| **MF** | 307,848 | 184,708 | 246,278 |
| **PKS** | 269,064 | 161,438 | 215,251 |
| **POME** | 1,454,400 | 872,640 | 1,163,520 |
| **OPF** | 2,908,800 | 1,745,280 | 2,327,040 |
| **OPT** | 484,800 | 290,880 | 387,840 |
| **Green waste** | 16,182 | 24,406 | 24,406 |
| **Total agro-waste** | 5,952,558.00 | 3,586,232.00 | 4,773,507.20 |

### 11.2.1 Biomass to Wealth

IM has abundant of biomass resources, especially the palm oil biomass. Out of the total yield of oil palm fruits, only 10% are finished products (the palm oil and palm kernel oil), while the remaining 90% are harvestable palm oil biomass. The conventional practice of palm oil industry returned the biomass to the fields as soil amendment or organic fertilizer and burning the biomass as the heat source, but majority of them are left as the waste in a dumpsite. The current practice of biomass is not the most economical and sustainable solution. Landfilling of palm oil waste is a common agricultural waste treatment; this could lead to excessive GHG emission problems in the long

run. Several current problems of biomass management of oil palm are presented in Table 11.11.

Table 11.11: Current issues of palm oil biomass management in Malaysia

| Issues | Problems |
|---|---|
| Increasing biomass/waste generation due to increase demand of foods. | Problem with waste treatment and disposal of biomass |
| Open dumping/landfill of biomass | Release of GHG from landfill |
| Unmanaged wastewater treatment facility | Contamination of groundwater by leachate |
| Indiscriminate dumping | Environmental pollution |
| Burning of biomass | Emission of smoke and haze hazard<br>Emission of toxic chemicals such as dioxins |
| Lack of support from incentives or provisions to utilize the biomass | Sustainable Biomass business involves new technology that needs capital cost and technology know-how. |

To achieve sustainable waste management, the concept of waste to wealth by utilizing a share of this biomass for a variety of additional end uses or products is desirable. . These include the production of pellets, bio-energy, bio-fuels and bio-based chemicals and without significantly depleting the soil. Several programs are outlined as follows for promoting sustainable agriculture waste management in Table 11.12.

Table 11.12: Measures and programs of LCS Sustainable Agro-waste management

| **Measure 1 : Biomass to wealth** |
|---|
| 1.0 **Programs:**<br>• POME to biogas (Anaerobic digestion)[1]<br>• Onsite co-composting<br>• Onsite combustion[1]<br>• Formulation of biomass into animal feed |

It is expected that with the implementation of these programs on agro-waste management as proposed in this blueprint, up to 80% of agro- and green waste reduction to landfill can be targeted for up to the year of 2025 under the CM scenario as compared to the BaU, as shown in Table 11.13.

Table 11.13: Reduction of agro waste and public green waste to landfill
(Source: UTM-Low Carbon Research Center, 2012)

| Year | Palm Oil Waste (Tone/ Year) | Green Waste (Tone/ Year) | Total |
|---|---|---|---|
| **2005** | 4,142,131.20 | 12,945.60 | 4,155,076.80 |
| **2025 (BaU)** | 2,485,278.72 | 19,525.12 | 2,504,803.84 |
| **2025 (CM)** | 855,381.12 | 4,881.28 | 860,262.40 |
| **BaU/CM** | 80% | -75% | -66% |

Each of the proposed sustainable waste management programs are outlined as follows:

**I. POME to Biogas**

POME is a major waste stream in the crude palm oil production plant with high emission rate of GHG. Upon discharge from the mill, POME exists in the form of thick dark brownish colloidal slurry with water, oil and fine cellulosic materials. Freshly produced POME contains 96% water, 0.6-0.7% of oil and comprises solid in the form of suspended and dissolve solid (Zakaria, 2000). For every tons of crude palm oil (CPO) produced, about 2.5 tonnes of POME will be generated from sterilization, crude oil clarification and cracked mixture separation operation (Ma, 2002). Anaerobic decomposition of POME can reduce the BOD content for up to 95% of its original BOD (Hassan et al*.,* 2000). It involves the breakdown of organic waste to primarily methane (65%) and carbon dioxide gas (35%) in the absence of oxygen where methane can also be harnessed for heat and electricity generation. It is particularly suited for the treatment of high temperature and high strength wastewater. The process will produce

a significant quantity of biogas that can be converted into electricity. (Please refer to Chapter 5, section 5.2).

**II. On-site Co-composting**

On-site composting refers to the activity of composting carried out near the factory for the productions of crude palm oil and oil palm biomass. This practice could significantly reduce the expenses of transportation and hence cut down the emission of GHG from vehicles. Co-composting used mainly the palm biomass of empty fruit bunch (EFB) and the POME slurry. The quality of the compost from palm oil biomass was recognised by Azhari et al. (2010). In his study of physio-chemical changes of the co-composting EFB with partially treated POME, it indicated that the compost obtains good properties such as ph 7-8, CN ration of 12 are able to comply with United States Environmental Protection Agency (USEPA) standards.

There are two types of co-composting designs: open and in-vessel. In open composting, the mixed material (sludge and solid waste) is piled into long heaps called windrows and left to decompose. Windrow piles are turned periodically to provide oxygen and ensure that all parts of the pile are subjected to the same heat treatment. In-vessel composting requires controlled moisture and air supply, as well as mechanical mixing; it is known as anaerobic digester, as the vessel is not supplied with air or oxygen.
Co-composting can also refer to the mixing of agro-waste and the sludge waste from the domestic waste treatment plants (refer to section 11.4.1-II).

**III. On-site Combustion**

Biomass residues from the oil palm sector have been identified as one of the biggest potential resources of energy to meet the national renewable energy target. Biomass first needs to be combusted in order to release thermal energy (heat) that can then be used for heating applications and/or the heat is subsequently converted to electro-mechanical energy. Combustion of palm oil biomass is able to reduce at least 60% of total waste.

**IV. Formulation of biomass into animal feed.**

The palm kernel cake (PKS), a residue cake from the biodiesel production can be used as a fertilizer, animal feed, or biomass energy feedstock. According to Aspar (2001), the high phosphorus to calcium ratio in the PKC makes it a good choice to be used as feed for dairy cow. Besides, other elements such as magnesium, copper, zinc and iron, which are essential to animals, are also available in PKC.

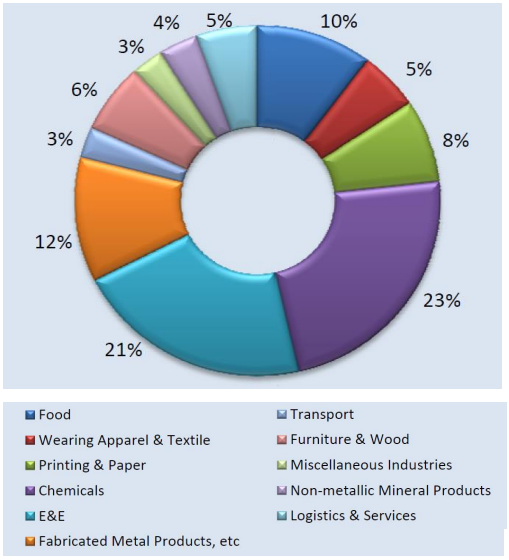
PKC is a useful source of protein and energy for livestock and is commonly used in animal feed, especially for ruminants (Hutagalung, 1981). PKC has been utilised as one of the major components in animal feeds in the EU country. It is used as a common ingredient in German and Dutch, with approximately 10% of the cake in the dairy ration; whereas in Malaysia, dairy farmers use more than 50% of PKC in the ration (Osman and Hisamuddin, 1999). In Malaysia, most of the palm oil industries have expanded to the agriculture industry in maintaining and recycling the natural biomass to products such as animal feeds by providing value to waste from the oil palm sector. PKC is recognized as a promising source of energy and protein in animal feeds. Its nutritional value, attractive prices compared to other meals such as corn and soy, and long-term availability make PKC from Malaysia an attractive and competitive meal in the international meal market.

## 11.3 Sustainable Industrial Waste Management

Generally, industrial waste accounts for a large percentage of total waste generation. Industrial waste is residue arising from the manufacturing factory, production processes and employees (IPCC, 2006). The generation and composition of industrial waste differs by industry activities,

process technologies and revenue (UNDEP, 2009). They can be categorized into scheduled and non-scheduled waste. At present, the industry waste in IM comprises of 37% scheduled waste (also known as hazardous waste) and 63% of non-scheduled waste (known as non-hazardous waste). **Figure 11.7** shows the distribution of industry sectors in IM.

Figure 11.7: Distribution of industry sectors in Iskandar Malaysia
(Source: Iskandar Regional Development Authority)




Manufacturing industries are the main economic driver for IM as the region houses 60% of the manufacturing industries in Johor State (Khazanah Nasional, 2006). The chemical, electric and electronic, and fabricated metal industries are among the largest sectors. Estimations by Maunsell (2009) indicated that commercial and industrial waste has contributed 40-50% to annual waste generation in IM within 2010 - 2025.

Industrial waste in IM will continue to increase from 473,031 tonnes in 2010 to 1,089,885 tonnes in 2025, as shown in Table 11.14 under the BaU scenario. For ensuring a low carbon emission from industrial waste management, it is important to reduce waste generation and final disposal of both scheduled waste and non-scheduled waste into landfills, which would contribute to methane emissions and compromise the quality of the environment. To mitigate these issues, innovative technologies, program and system are needed to introduce into present practices. A reduction target of 50% (544,943 tonnes) of current industrial waste volume has been set as the CM scenario under current blueprint. More details of these measures will be explained in the following sections.

### 11.3.1 Scheduled Waste Reduction and Treatment

Industrial scheduled waste is a harmful substance with a hazardous nature such as flammability, explosiveness, reactivity, corrosively, infectiousness, causticity and toxicity. They are managed as the First Schedule Environment Quality-Scheduled Wastes by the Regulations 2005, under the Department of Environment, Ministry of Environment and Natural Resources Malaysia.

Figure 11.8 shows the facility used in Kualiti Alam for treatment of scheduled waste. As discussed in the early section, the amount of industrial scheduled waste is likely to be small, and hence contribute less towards greenhouse gases emission. Yet, the significant feature of scheduled waste lies on the direct impact to human health and environment. Compared to the non-schedule industrial waste, schedule waste requires special handling, treatment and disposal. To minimize the environmental impact of scheduled waste, four programs are proposed in this blueprint to meet the waste reduction target of 50%, as shown in Table 11.14.

Figure 11.8: Physical treatment to detoxify the waste before final disposal to secured landfill

Table 11.14: Projection of waste generation and potential reduction of industrial wastes in Iskandar Malaysia within year 2010 to 2025
(Source: [a]Low Carbon Asia Research Center, 2012; [b]Iskandar Regional Development Authority, 2010)

| Types of Industrial Waste | 2010 | 2025 (BaU) | 2025 (CM) | Reduction Target | Volume Reduction |
|---|---|---|---|---|---|
| Scheduled (tonnes) | 177,184[a] | 408,240[a] | 204,120 | -50% | 204,120 |
| Non Scheduled (tonnes) | 295,847[b] | 681,645[b] | 340,823 | -50% | 340,823 |
| Total | 473,031 | 1,089,885 | 544,943 | -50% | 544,943 |

Table 11.15: Mitigation program for industrial scheduled waste

| Program for Industrial Scheduled Waste | Volume Reduction | Percentage |
|---|---|---|
| Encourage Cleaner Production Initiatives | 163,296 | 40% |
| Select Treatment Method with Less Energy and Less Material | n/a | n/a |
| Decentralized Scheduled Waste Treatment Plant | n/a | n/a |
| Smelting of Inorganic Waste | 40,824 | 10% |
| Total | 204,120 | 50% |

Table 11.16: Mitigation program for industrial non-scheduled waste

| Program for Industrial Non-Scheduled Waste | Volume Reduction | Percentage |
|---|---|---|
| Encourage Cleaner Production Initiatives | 136,329 | 20% |
| Introduce Industrial Symbiosis for Waste Reusing System | 68,165 | 10% |
| Waste to Fuel (Petrochemical) | 68,165 | 10% |
| Waste to Energy (Incineration with Power Generation) | 68,165 | 10% |
| Total | 340,823 | 50% |

Each of the proposed programs for sustainable industrial waste management is described as follows:

**I. Encourage cleaner production initiatives**

Cleaner production is one of the key strategies for green industry (See Action 2). It is the continuous application of an integrated environment strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment. This idea was developed by the United Nation Environmental Programme (UNEP) back in 1990. Malaysian Government through its Department of Environment has introduced this concept to the local industries in 1996. As a consequence, blueprints for Cleaner Production and various pilot projects were developed in Malaysia to promote cleaner production practices among the local industries.

To date, several industries have adopted cleaner production. The concept aims to increase the productivity with higher resource (raw material, energy and water) efficiency with lower waste emissions. The concept stresses cleaner production through waste reduction, notably reduction at the source. The schedule waste can be minimized and prevented using the following methods:

- Input substitution – minimize the use of hazardous raw material,
- Production method – process operation at lower waste generation,

- Equipment modification – modify the existing production equipment and utilities to produce less waste,
- Technology change - adopting technology with low waste generation,
- On-site recovery/recycle - reuse of the wasted materials for another useful application within the company; and
- Product modification – design products that would impart minimal environment impact.

To reduce the schedule waste, cleaner production should be encouraged in industries of IM.

**II. Select treatment methods with less energy and less material**

Scheduled waste with hazardous characteristic required further treatment into less harmful material before being discarded to secured landfill. Based on the chemical attribute, these scheduled wastes will be treated by different methods. For organic waste such as mineral oil waste, solvent waste, pesticide waste as well as waste containing halogen and sulphur will be sent to the incineration plant. Inorganic liquid waste such as spent acid and alkaline, chromate and cyanide will be neutralized and oxidized in the physical plant. Last but not least, inorganic solid waste metal hydroxide sludge, filter cake residue from the physical plant and fly ash from incinerator will be treated in solidification plant. Each of these treatment plants consumes energy and material to turn hazardous waste into harmless waste. The treatment process often associates with higher energy and material consumption which would contribute to GHG emission. To reduce the GHG emission through industrial waste management, particularly for the management of schedule waste, improved and more efficient treatment technologies which require low energy and less material are highly desirable.

**III. Decentralized scheduled waste treatment plant**

The scheduled waste generated from the manufacturing industries in IM will be collected and transported to the Integrated Hazardous Waste Management Centre in Bukit Nanas for treatment. The centre is located at Port Dickson, Negeri Sembilan, which is about 300 kilometers away from IM. The long distance contributed to significant GHG emission through transportation by the transportation trucks. For that reason, another scheduled waste treatment plant should be set-up within or close to the IM.

**IV. Smelting of inorganic wastes**

Thermal technology can be applied to smelt inorganic hazardous wastes to recover the mineral substance and metals for resource conservation and to reduce the waste to landfill. According to a case study on the THERMOSELECT resource recovery facility (Mucha and Drost, 2002), these wastes will be subjected to extremely high temperature until all of the compounds are molten. Metals and minerals will separate automatically due to their different relative density. The potential valuable resources to be recovered are:

i. Mineral granulate reused as gravel substitute in concrete, as shot blast or as road base
ii. Metal granulate recycled into the metal industry
iii. Sulfur reused in the sulphuric acid and fertilizer industry
iv. Zinc concentrate reused in the zinc smelting industry
v. Salt reused in the chlorine manufacturing industry

**11.3.2 Non-Scheduled Waste Reduction, Reuse and Treatment**

In comparison to the schedule waste, non-scheduled waste is harmless yet is the largest portion of the industrial waste. The content of

the non-schedule waste from manufacturing industries is quite similar to the municipal waste; that is, it is comprised of food waste, paper/cardboard, ceramics, wood, textiles, rubber/ leather, plastic, metal, glass and Others (IPCC 2006; UNEP 2009). Large volume of the non-schedule industrial waste discarded will increase methane gases generation and shorten the lifespan of landfill, hence more landfills will be needed and hence more carbon emission is expected. To overcome this problem, industrial non-schedule waste has to be eliminated via the 3Rs practices (reduce, reuse and recycle) to minimize the amount. Potential solutions for these issues are:

i. Waste reduction at source though cleaner production,
ii. Waste reusing/ recycling between industries,
iii. turning plastic waste into fuel; and
iv. Incineration of waste to energy (Table 11.16).

They bring for another 50% of reduction from industrial non-scheduled waste into landfill.

**I. Encourage cleaner production initiatives**

Industries that perform cleaner production are able to reduce on-site waste generation (both scheduled and non-scheduled waste). As discussed on the early section for management of schedule waste, less waste emission from the manufacturing plant can be achieved through either one of the schemes: raw material substitution, production approach, equipment modification, technology change, on-site reuse/recycling, and product modification.

Table 11.17 demonstrates how a textile industry in Beirut, Lebanon has successfully cut down its waste emission via cleaner production practice. Within year 1993 to 1996, the enterprise reduced 75% of its waste through improved management of the waste logistic, for instances through composting of the dust and dirt wastes and external recycling of the textile waste.

**II. Introduce industrial symbiosis for waste reusing system**

Waste from one industry can become a source for another industry. Many non-schedule industrial wastes contain useful material which can be reclaimed and reused. They can be used by other industry as the raw material for their products. Hence, by-products can be exchanged between the industries. A synergistic industrial network can be formed among the enterprises to practice waste exchange. Such concept is known as industrial symbiosis. Industries can minimize their waste and virgin material. Japan has implemented the industry symbiosis concept on the 26 industrial parks throughout the country (Fujita, 2006). Locally, the Japanese Government named it the Eco-town project.

Among the best practices is the Kawasaki Eco-town. According to the latest investigation by Van Berkel et al. (2009), they are 14 symbioses found in the Kawasaki Eco-town, as shown in Figure 11.19. The by-products and waste exchange contributed to the solid waste reduction of 565,000 tonnes and an estimated economic opportunity of more than 13.3 billion JPY (approx. RM 0.54 billion). Learning from the best practices of Kawasaki Eco-town, this concept should be introduced in the industrial parks within the IM to establish the industrial symbiosis so as to cut down the industrial waste to landfill.

**III. Waste to fuel (petrochemical)**

Plastic waste is one of the mainstreams of non-scheduled industrial waste. It can be diverted from the landfill through recycling by converting them into hydrocarbon liquid fuel, a valuable resource to be used for transportation sector. This will reduce waste to be sent for landfill while contribute to resource conservation from fossil fuels.

**IV. Non-Scheduled Waste Incineration**

Organic solid waste/biomass (food waste, paper, wood) from the non-scheduled industrial

waste can be combusted in the incineration plant with energy recovery. The plant combusts these organic solid wastes to generate heat for the boiler, which powers the steam generators to produce electricity for homes and businesses. It reduces the organic solid waste to landfill and contributes to electricity generation. (For more details on waste-to-energy, see Chapter 5).

This subsection highlighted the main programs that can be implemented to achieve the waste reduction target (50%) to landfill both for schedule and non-schedule industrial wastes in the IM region. These programs contribute directly (with % quantified) or indirectly (not quantifiable at this stage) to waste reduction.

Table 11.7: Cleaner production measures taken by a textile mill in Beirut, Lebanon.
(Source: Lebanese Cleaner Production Center, 2010)

| Year | Measure | Result |
|---|---|---|
| 1993 | Control of water in washing machine | -20% water use, no relevant cost |
| 1993 | Reuse of cooling water as process water | -10% water use, no relevant cost |
| 1993 | Installment of vacuum cleaner and rotary sieve to keep solids out of washing water | -30% COD |
| 1993 | Changing operational sequences in finishing | less wasted finishing bath rests no relevant cost |
| 1993 | Filtering of spilled paste | contributes to less COD in waste water and saves several US$ 10,000 a year, no relevant cost |
| 1993 | Substitution of components of finishing bath | Lower emissions of hydrocarbon to the exhaust fumes, hardly quantifiable |
| 1993 | changing lighting system | -30% electricity for lighting in certain areas, payback 2 years |
| 1993 | Fine filtration of gear and hydraulic oils | -60% hazardous waste, payback 2 years |
| 1993 | Frequency control of blower | less electricity-11115% gas consumption in dryers, payback 1 year |
| 1993-1996 | Better wase logistic, composting of dust and dirt, external recycling of textile waste | -75% industrial waste (quality domestic waste) |
| 1993 | Installation of a waste water buffer basin | elimination of peaks |
| 1994 | Reuse of spent dye bath | -50% colour in waste water |
| 1994 | Installation of own laboratory | |
| 1994 | Input/Output analysis as a controlling tool | |
| 1995 | Modification of burners in stenter<br>First drying step by vacuum removal of water | not yet quantified |
| 1995 | Dosage system for finishing chemicals | Annual savings of US$ 100,000, payback 2 years |
| 1995 | Voluntary emmisions report | |
| 1996 | Introduction of quality management system | |
| 1996 | Open Day | |

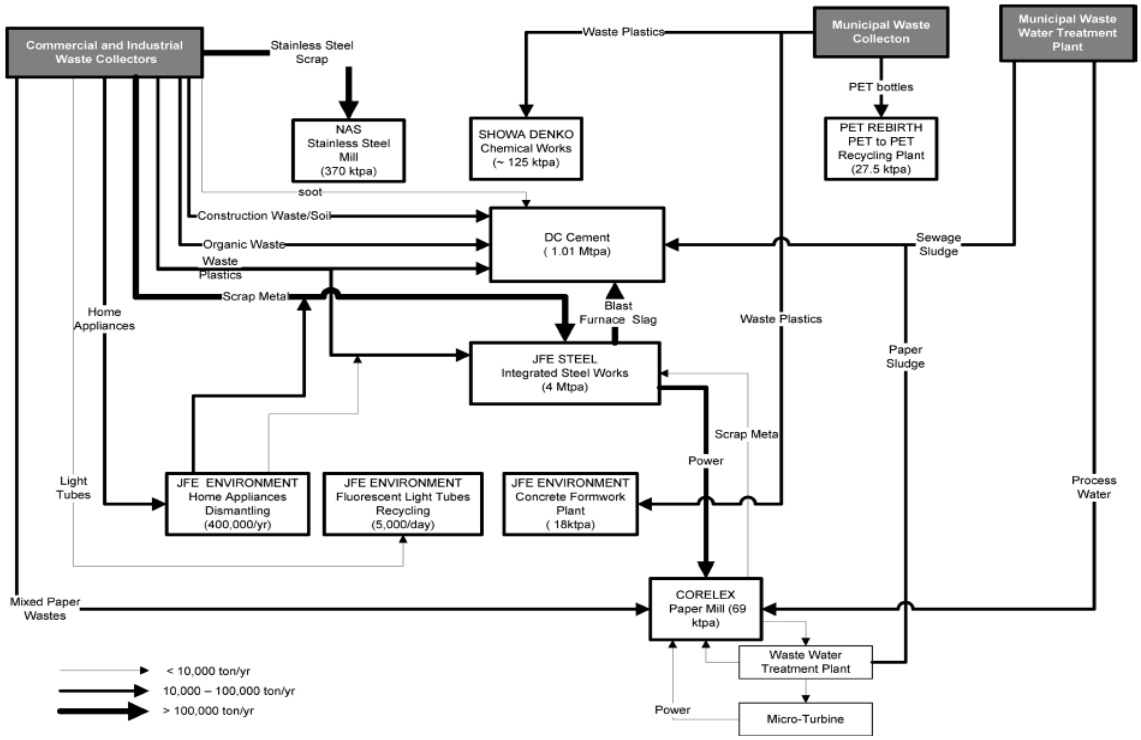



Figure 11.9: Material exchange between the industries in Kawasaki Eco-town, Japan.
(Source: Van Berkel et al, 2009)

## 11.4 Sustainable Sewage Sludge Management

Sewage sludge has been considered a nuisance in wastewater treatment, it and viewed as an expensive nuisance fit only for treatment and disposal. Roughly, in Malaysia, its generation is top listed (64.4%), followed by animal husbandry waste (32.6%), agro-based (1.7%) and industrial effluent (1.3%) in terms of BOD load (Alam et al., 2008). Roughly, IM produces about 15,300 tons of sewage sludge annually. I.M has to adopt a practical, economic and acceptable approach in managing and disposing sewage sludge since the treatment and disposal of sewage sludge is an important phase in sewage treatment.

The approach of the proposed program is not an entirely new concept. The approach uses un-tapping unused energy from the sludge itself. Most have been applied in other country such as China, Japan, India and so forth. There is a saying that goes 'one man's trash is another men's treasure'. Reusing this 'treasure' from the sludge waste, concerns GHG emission and waste reduction could be achieved. Table 11.19 summarized the propose program and measure for sewage sludge management in Low Carbon Scenario (LCS) study.

Table 11.18: The programs and measures suggested for IM

| **Measure 1: Improved Sewage treatment & Sludge Recycling** |
|---|
| **Programs:**<br>• Improved Wastewater treatment by Anaerobic Digestion<br>• Sewage Sludge Recycling in Construction Material<br>• Sewage Sludge Recycling through Composting<br>• Sewage sludge energy recovery through incineration |

Based on Ujang and Salmiati (2011) the perspective sewage sludge production by national sewage company was about 5.3 million $m^3$ per year. As stated by Indah Water Konsortium (IWK), by the year 2005, Malaysia will be producing 4.3 million cubic meters of

domestic sludge annually. From this point on, the estimation of the amount of sewage sludge generation in IM for the year 2025 could be projected. From the projection, the potential reduction after appropriate treatment processes is estimated as shown in Table 11.18

Table 11.18: Projection of sewage sludge produced and potential reduction in Malaysia for year 2025 (Source: Water 21 Market Briefing Series, 2011)

| Year | Sewage sludge (tonne) |
|---|---|
| **2005 (Baseline)** | 32,290 |
| **2025 (BaU)** | 71,197 |
| **2025(CM)** | 71,197 |

Table 11.18 shows the estimation of sewage sludge produce. It can be seen that the amount of sludge produce with CM is the same with usual BAU. This is because even though the utilization or the method used differs, the amounts of waste produced are more or less the same. The amount of dry solids previously mentioned make up 1% of the total waste.

However several options could be implemented, where the sludge is subjected to the following breakdown of treatment processes. From the total sludge produced, 10% is sent to the co-composting plant where the sludge would be composted together with the agro-waste and animal waste. The rest of the sewage sludge is anaerobically digested, which would yield methane gas. The biogas is recovered for energy. After digestion around 10 – 20% of the digested sludge would be recycled as a construction material.

Table 11.19: Estimation of $CH_4$ emission from sewage sludge

| Year | CH4 Generation (ktonnes CO2 e/yr) |
|---|---|
| **2005 (Baseline)** | 13.78 |
| **2025 (BaU)** | 30.26 |
| **2025(CM)** | 0.3 |

***Relevance Policy Summary***

Generally, the volume of sludge produced in a wastewater treatment plant is only about 1%, whereas dewatered sludge is 0.5% of the volume influent wastewater to be treated. (Turovskiy and Mathai, 2006)

Even though the value seems small compared to other generated waste listed in this blueprint, still the country does not take this matter lightly. There have been numerous policies which contribute in guiding the sludge management both directly and indirectly. Below are the brief explanations on the Malaysia policy.

One of the best practices proposed in sludge management is the Anaerobic Digestion treatment. This is in line with Renewable Energy & Energy Efficiency Blueprint for Iskandar Malaysia report (2010) on using a source of clean energy in generating electricity as well as re-using untapped energy from bio-solid, also known as treated sludge. Other than that, from the 10$^{th}$ Malaysian Plan, Chapter 6 elaborates on restructuring waste management by enforcing Solid Waste and Public Cleansing Management Act 2007 with effort from federal and public sectors. Sludge

management policy in Malaysia is centralized, governed by the National Water Services Commission (SPAN) which aims to:

i. reduce the amount of sludge production;
ii. produce a safe and hygienic material; and
iii. Apply reuse options instead of disposal ones.

### 11.4.1 Improved Sewage Treatment and Sludge Recycling

According to the Comprehensive Development Scenario (CDP) of South Johor Economic Region (SJER) report, SJER lacks a modern sewerage system and most household rely on individual septic tanks in the city of Johor Bahru. This is main source of pollution in many of the rivers in SJER and measures need to be taken to resolve the issue.

Based on Spinosa (2011) the development of sludge management for developing countries must be seen within the framework of sustainability concept. The term 'sustainability' usually refers to the development of human activities, especially in the environmental field, including sludge management (Spinosa, 2011). Therefore, the development of correct sustainable sludge management procedures must mainly be promoted through integrated approaches address towards:

i. Reduction of the amount of sludge to be disposed
ii. Application of reuse options, aimed at recovering useful products or energy, instead of simple disposal
iii. Development of integrated systems that are self-sustaining from an energy point of view
iv. Production of materials to be safely handled from an environmental point of view and conveniently marketed
v. Development of operational systems appropriate to local circumstance, including social ones, i.e. interactions with the public through informing them and customers about sustainability efforts, and encouraging them to participate

Thus, a sewage treatment system requires updating, and the strategies of placing the treatment can either be centralized or decentralized depending on the available land as well as the human capacity. Table 11.21 shows the projected land requirement or sewerage treatment plants.

Table 11.20: Projected Land Requirement or Sewerage Treatment Plants (Source: SJER CDP 2025)

| | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| **MBJB** | 26 | 30 | 32 | 38 | 47 | 59 |
| **MPJBT** | 24 | 29 | 35 | 46 | 60 | 75 |
| **MPKu** | 8 | 8 | 9 | 11 | 14 | 17 |
| **PDJB** | 10 | 11 | 12 | 14 | 18 | 22 |
| **PBTPG** | 3 | 10 | 12 | 15 | 18 | 22 |
| **SJER** | 72 | 88 | 100 | 124 | 156 | 195 |

Centralized treatment management consist of:

i. Centralized collection system (sewers) that collects wastewater from many wastewaters producers
ii. Centralized wastewater treatment plant in an off-site location outside the settlements
iii. Disposal/reuse of the treated effluent, usually far from the point of origin. (Wilderer and Schre, 2000; Crites and Tchobanoglous,1998)

The method is suitable to the development of urbanization and urban life style such as IM. Other than that, there have been many efforts and research on recycling on sludge waste. For instance, IWK has been collaborating with local institutions on reusing dry solid onto land application as well as fertilizers. Figure 11.9 shows the overall effort from IWK in reusing biosolids from sludge.


Figure 11.9: IWK Biosolid Research
(Source: IWK Official Website: Green Technology)

***Improved Wastewater treatment by Anaerobic Digestion***

Figure 11.12 portrays the usage of Anaerobic Digester (AD) in sludge treatment. The benefit of implementing AD into sludge treatment is not only reducing the amount of sludge, but also the proper collection of $CO_2$ and fugitive methane release from sludge, which then has the potential of being converted into electricity. The target is for the development of innovative and new low energy technology for sewage treatment. This is essential in order to improve treatment performance and attaining positive energy balance with low carbon footprint. Besides that, by-product recovery such as energy recovery from sewage sludge can be achieved. For the development of low energy sewage treatment plant, several technicalities should be considered such as:

- Enhancement of energy efficiency through the recovery of energy as well as reducing energy consumption in the treatment processes. This can be achieved by understanding the fundamental mechanism of the treatment processes and through best practices, automated control and more efficient mixing, aeration, and pumping technologies.
- Development of treatment technologies, such as membrane bioreactors and sequencing batch reactor.
- Implementation of nutrient recovery as fertilizers, and renewable energy for bio-fuel through increasing methane production from sewage sludge.
- Optimization of treatment processes that allows for heat recovery and carbon recovery for energy through anaerobic processes.

Through the implementation of low energy sewage treatment plant, reduction of total energy consumption could be achieved. Optimization of the treatment plant requires ratification of the sewerage networks and integration of different treatment processes.

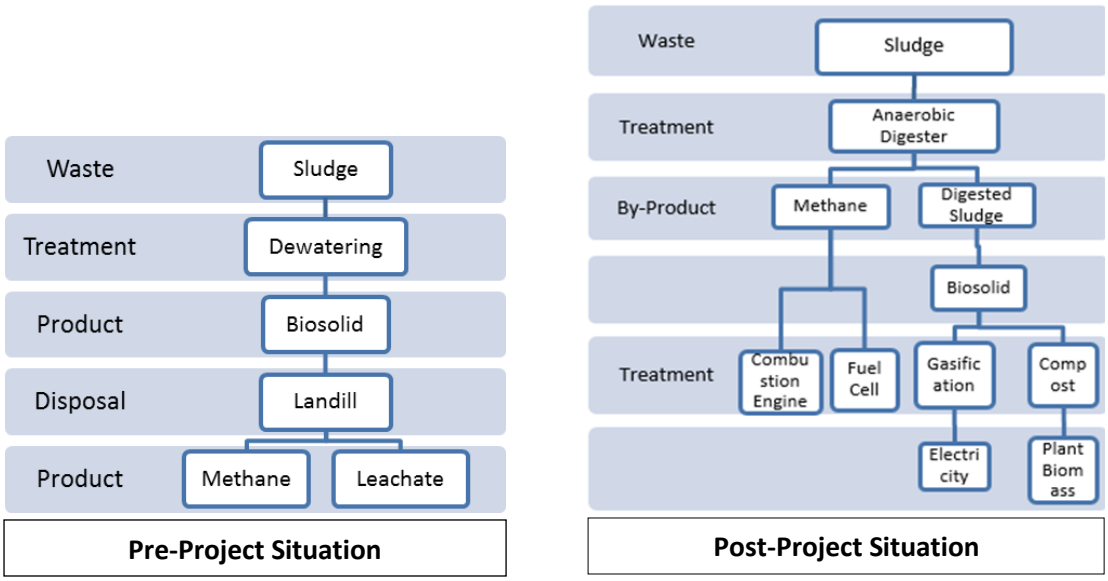



Figure 11.10: The pre and post project situation I AD was to be applied

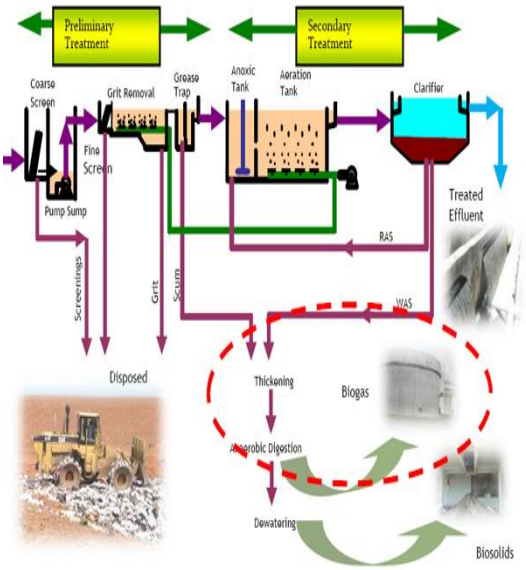



Figure 11.13: Green Technology Application Renewable Energy from Sewage by Product (IWK: Green Technology; Biogas)
(Source: http://www.iwk.my/sewerage-fact-gt-gas.htm)

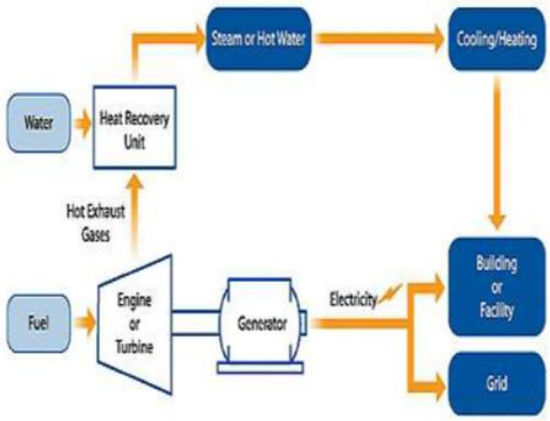



Figure 11.14: CHP: Gas Turbine or Engine with Heat Recovery Unit (IWK: Green Technology; Biogas)

Figure 11.13 portray IWK typical sludge treatment with green technology and anaerobic digester applications. An example area where this AD has been applied is in Jelutong, Pulau Pinang. The gas is used to generate electricity for the lighting on-site. Research from Burton and the Electric Power Research Institute (EPRI) shows that anaerobic digestion with biogas utilization can produce about 350 kWh of electricity for each million gallons of wastewater treated at the plant. A process called 'Combined Heat and Power' (CHP) or 'Cogeneration' Cogen (Figure 11.14). By harnessing the energy produced by burning methane to generate electricity similar to coal-fired or natural-gas fired power plants.

Figure 11.15 shows an improvement of conventional plant through the use of sequencing batch reactor, which has lower footprint, energy saving and cost effective. Apart from this, benchmarking and best practices need to be reviewed for target setting. Ratification of sewerage network assists in the assessing sustainable decentralized treatment.

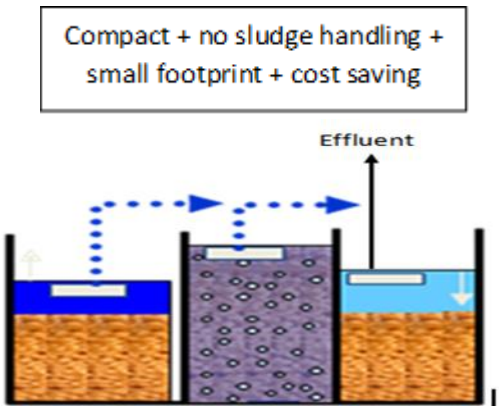



Figure 11.15: Sequencing batch Reactor (SBR)

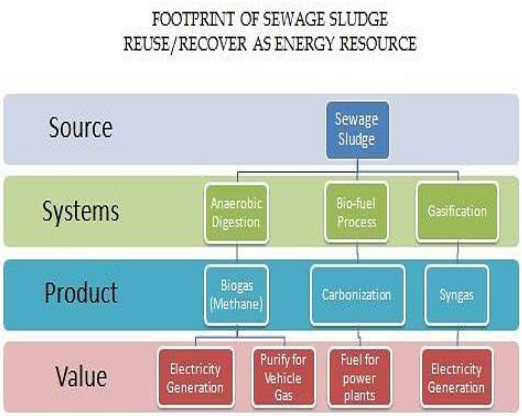



Figure 11.16: footprint of Sewage Sludge

## II. Sewage Sludge Recycling as Construction Material

Alternative ways to reuse or to incorporate several types of waste materials have been attempted in recent decades, including incorporation into building materials. Heavy clay ceramic materials, namely bricks and roof tiles, as well as floor tiles, are generally very heterogeneous, because they consist of natural clays with a very wide ranging overall composition. For this reason, such materials can tolerate the presence of different types of wastes, even in considerable percentages.

Incinerated sewage sludge ash may be used in ceramic products as a sand or clay substitute, in concrete mixes as a cement substitute (up to 20% replacement), as a secondary fine aggregate in concrete (replacement up to 30%) and in asphalt (replacement up to 10%). The use of incinerated sewages sludge ash in bricks is not new. Several past trials were undertaken in the UK and overseas, where the incorporation of sludge into bricks as clay or/and sand substitute was investigated. The production of 100% bricks made from sludge is common practice in Japan and there are currently eight plants operating (Gunn et al, 2004).

The composition of sludge varies substantially from different sources and it may not always comprise an appropriate alternative material for brick making. The purpose therefore is not to prove that sludge could find application in brick manufacture, but to investigate the properties and performance of sludge from a specific standpoint.

IWK, working together with local institutions, studied the potential of using the sludge to mix with clay and other brick making material. The present work aims at studying the recycling ability of a sludge generated from sewage treatment plants. In the study, suitable conditions for using dried sludge for hand molded bricks under the criteria of the Malaysian Standards were also investigated. The influence of sludge proportion in the raw materials was examined. The quality of varying proportion of sludge cake mix ration was evaluated in terms of physical appearance mechanical properties and chemical properties. Results of the tests indicated that the sludge proportion is a key factor in determining the brick quality. The sludge-brick were compared with clay brick in terms of water absorption, linear firing shrinkage, bulk density and strength. Increasing the sludge content will results in a decrease in brick shrinkage, bulk density, and compressive strength. The physical, mechanical, and chemical properties of the bricks that were supplemented with various proportions of dried sludge from 10 to 40 wt% and generally complied with the General Specification for Brick as per the Malaysian Standard MS 7.6:1972, which dictates the requirements for clay bricks used in walling in general. A standard leaching test method also showed that the leaching of metals from the bricks is very low. The proportions of sludge mixture should be monitored. From a study carried out by Liew et al. (2003), the water absorption of the bricks was found to increase with increased sludge addition and therefore leads to decrease resistance to weathering. This is due to the lowering of the mixture bonding ability resulting from the decrease in adhesiveness and increasing of brick internal pores.

All construction materials must resist stress resulting from dead and imposed loadings of buildings. The strength of a material is, in general terms, its ability to resist forces at failure. Because the strength of dry bricks is obviously higher than that of wet bricks, the former was immersed in water before testing to subject the bricks to a more severe condition. Liew et al. (2003) found that the strength is greatly dependent on the amount of sludge addition in the brick. However, bricks with more than 30wt% sludge are not recommended for this latter purpose because they were simply too brittle and easily broken, even when handled gently.

***Benefits of using sludge and waste product in brick manufacturing***

1. Contribution to the end product. Sludge could be used primarily as a filler material (sand substitute), but it may also comprise a clay substitute, a fluxing agent and to lesser extend a colorant.
2. Potential benefits:

**a) Environmental:**

i. Conservation of resources of virgin materials
ii. Emission reduction and less energy requirements due to the fluxing properties of ISSA
iii. Production of 'green products' with recycled content
iv. Achieving brick sector sustainability objectives by minimizing the use of primary resources

**b) Economic:**

i. The need to buy primary materials such as sand is reduced
ii. Reduced energy cost due to the fluxing properties of bricks

IWK and University Kebangsaan Malaysia (UKM) conducted a research study to identify the underlying public perception and potential of using intervention tools and programs to increase public acceptance. Figure 11.18 shows the result of the survey conducted.

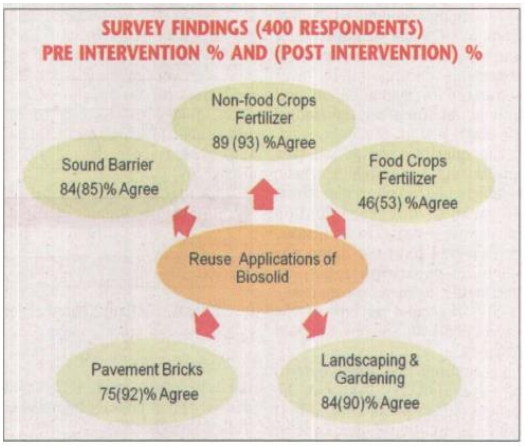



Figure 11.18 Survey findings on reuse application of bio-solid. (IWK, 2007)

## III. Sewage Sludge Recycling through Composting

It is an important element of sustainable solid waste management as it offers a way of processing the biodegradable waste fraction. It reduces the amount of waste to be transported and disposed of, thus also reducing negative effects to the environment. Waste comes from all sources and types. Co-composting has been successfully applied on a variety of wastes including, paper mill sludge and hardwood sawdust by Dinel et al. (2004), soil contaminated with creosote, cattle manure and vegetable waste by Atagana et al. (2003), soil contaminated with diesel oil and bio-wastes (vegetable, fruit and garden waste) by Van Gestel et al. (2003) and olive mill wastewater sludge and agricultural wastes (maize straw and cotton waste) by Parades et al. (2002).

A centralized co-composting system using agro-waste and sludge is proposed to manage sludge in I.M, to address limited land resources as well as to reduce GHG. Treatment of waste by composting would produce a natural fertilizer that would improve soil fertility and be beneficial to crop production. There has been numerous and successful research on this issue. The local wastewater treatment facility, Indah Water Konsortium (IWK) has been actively involved in more than 30 research projects to study the potential of local bio-solids potential for reuse since 1998. The studies encompassed characterization of the bio-solids produced from IWK's sewerage treatment plants.

The effect of bio-solids application towards soil, plants varying methods and technology for bioconversion of bio-solids into fertilizers and value added products as soil amendments fertilizers and brick building material. Reuse of bio-solids as fertilizers for non-food crops will serve to reduce Malaysia's dependence on the import of inorganic chemical fertilizers, which may not be sustainable.

## IV. Sewage sludge energy recovery through incineration

Another option in bio-solid management is through incineration. It is a surprising technology. Incineration is attractive both for volume reduction and energy recovery. The bio-solid; refer as treated sewage sludge that meets a certain requirements in order for it to use in land application and surface disposal (Gomez et al. 2010. As mention earlier, the approach is not new. It has been applied in various developed countries such as the United States, Japan as well as Europe. This method is the current bio-solid management in the above countries.

Previous studies show that land-filling was the least favourite option due to the increasing GHG emission (CH4 and CO2) and leaching of heavy metals to water and soil from land-filling (Roy.M.M et al*.,* 2011). Due to stricter regulations concerning land-filling and land application it can be expected that there will be an increase in the role of incineration in the long term (Malerius and Werther, 2003). The technology of incineration in terms of process engineering, energy efficiency and compactness of plant has greatly improved. One of the major constraints in the widespread use of incineration is the public concern about possible harmful emissions. However, introducing new technologies for controlling gaseous emissions can minimize the adverse effects, while the reduction in the correspondent cost gives incineration considerable advantages in the future when compared to other available disposal routes. Modern fluidized bed incinerators have great potential for this application in comparison with conventional multiple hearth type (Mininni et al., 1997).

Sludge incineration offers a combination of several advantages not found in other treatment alternatives, including a large reduction of sludge volume to a small stabilized ash. In large urban areas where vast quantities of wastewater sludge is produced, lack of readily available disposal space, the need to minimize odour generation from landfill and aesthetic objections from nearby residents makes incineration an attractive sludge disposal method. Incineration as a competitive treatment option for bio-solids management is reported in several recent studies (Cherubini et al*.,* 2009; Houillon and Jolliet, 2005; Lundin et al*.*, 2004; Apedaile, 2001; Davis et al*.,* 2007; Cartmell et al., 2006).

Cherubini et al. (2009) performed life cycle assessment to compare the environmental impact of incineration and the landfilling of municipal solid waste in São Paulo City, Brazil. Incineration with energy recovery and landfilling treatment systems were assessed. Energy consumption, recovered resources and emissions to both air and water were quantified and analysed in terms of their potential impact. Global warming, acidification and nutrient enrichment were assessed as environmental impact categories. Landfilling presented the highest environmental impact in the investigation, while incineration with ash disposal to a landfill site presented the lowest environmental burden regarding the impact categories assessed in this study. The results showed that a shift in waste treatment from landfilling to incineration would decrease the overall environmental impact while also allowing energy recovery.

A study by Houillon and Jolliet (2005) quantified the environmental impact of six processes used for wastewater urban sludge treatment: agricultural land spreading of limed pasty sludge; specific incineration in fluidized bed of pasty sludge; wet oxidation of liquid sludge; pyrolysis of dried sludge; incineration in cement kilns of dried sludge; and landfill of limed pasty sludge. The study focused on energy and emissions contributing to global warming over the whole treatment life cycle. The energy balance suggests that incineration and agricultural spreading have the lowest non-renewable primary energy consumption. For global warming, incineration in cement kilns has the best balance, while landfill and agricultural spreading have the worst.

## 11.5 Construction Waste Management

### 11.5.1 Reuse and recycling of construction and demolition waste

The term 'C&D waste' is generally used to refer to the solid construction and demolition waste generated in the construction sector. More specifically, the term is defined as waste which arises from construction, renovation and demolition activities. This includes land excavation or formation, civil and building construction, site clearance, demolition activities, roadwork and building renovation (Yuan et al, 2010). A significant amount of C&D waste is annually generated globally. Construction waste (CW) has a major impact on the environment. With the demands in implementing major infrastructure projects in Malaysia, together with many commercial building and housing development programmes, a large amount of construction waste is being produced by the construction sector. The construction industry is responsible for producing a whole variety of waste, the amount and type of which depends on factors such as the stage of construction, type of construction work and practices on site. Thus, waste minimization is an important area for construction waste management in Malaysia.

In the Malaysian context, a study by Mohd Nasir et al.,(1998) showed that 28.34% waste comes from industrial and construction waste in the central and southern regions of Malaysia. In IM, extensive building and development projects will lead to an increase in construction waste generation. This will significantly impact the environment and cause increased public concern among local communities. The environmental impacts of the building industry are directly related to the quality and quantity of waste it generates. Construction waste can significantly affect the performance and productivity of an organisation (Yuan et al., 2010).

Table 11.22 shows the construction waste generation in IM. The CW generation is estimated based on the assumption of 1kg of CW generation for every house due to development of IM as a new economic hub. It has been assumed that the 90% of CW is generated from housing development while 10% of CW is generated from the industry sector.

Table 11.22: Construction waste generation in IM.

| Year | Total CW generation (tonnes) |
|---|---|
| **2005** | 27,064.00 |
| **2010** | 30,778.00 |
| **2015** | 38,252.00 |
| **2020** | 47,924.00 |
| **2025** | 60,000.00 |

Construction waste disposal has not been a prominent issue, as no guidelines were provided by the authorities. Current practice of CW management in Malaysia is either burning or illegal disposal elsewhere. Besides, there is no industry available to recycle CW properly. CW which contains concrete, metal, wood, gypsum, cardboard and other non-organic material, do not have a significant contribution to GHG emission at landfill, Nevertheless, it serves a significant impact to amount of waste in landfill, the management of large quantity of CW at landfill incurs high carbon practice.

To achieve low carbon scenario, it is proposed that at least 30% of such wastes can be reused and recycled within 2005 to 2015 and the reduction can further be increased to 50% within 2015 to 2025. Crushed tile, concrete and asphalt materials from CW can be used for construction projects, for example for sub-bases, concrete aggregate, while other used building materials such as flooring, timber, doors, windows and sanitary appliances could be reused depending on the quality. Some countries such as Hong Kong, China and Denmark have provided CW recycle education guideline to create awareness on the reduction of CW.

The Integrated Solid Waste Management Blueprint for Iskandar Malaysia had outlined a

drafted planning of sustainable CW management for IM, as shown in Figure 11.19.

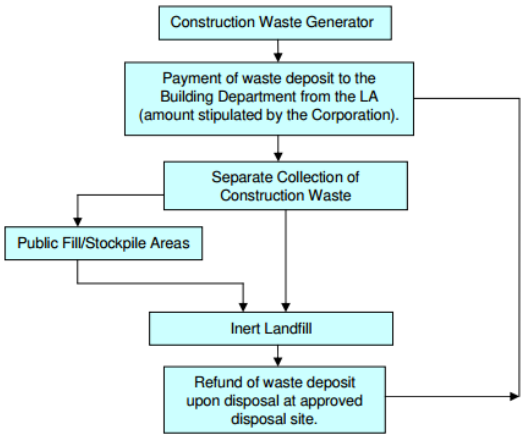



Figure 11.19: Management of Construction Waste in IM (Source: The Integrated Solid Waste Management Blueprint for Iskandar Malaysia,2009)

Apart from that, Industrialized Building System (IBS) will be implemented for up to 75% of the new building (from 35% in year 2005). A charging scheme on such the disposal of wastes is recommended from 2015, as enforced in Hong Kong.

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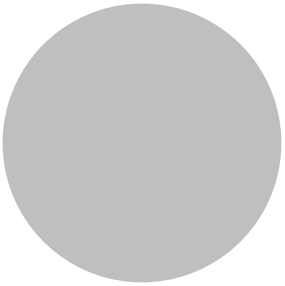
Action 12

# Clean Air Environment

Mohd Rashid Mohd Yusof, Mohammad Rafee Majid, Gakuji Kurata, Muhamad Azahar Zikri Zahari and Guo Minna

**GHGs Emission Reduction**



- $ktCO_2eq$

-%

Air pollution issue in current Iskandar Malaysia is mainly caused by the emission of particulate matter (PM), $SO_2$, $NO_x$, CO and VOC from vehicles in road transportation, industrial activity and trans-boundary pollution by biomass burning, which is known as “Haze”. There are many good strategies to improve local and regional air quality under the Low Carbon Society policies.

## 12.0 Clean Air Environment

Currently, air pollution issues in Iskandar Malaysia are mainly caused by emissions of particulate matter (PM), $SO_2$, NOx, CO and VOC from vehicles in road transportation, industrial activity and trans-boundary pollution by biomass burning, known as "Haze".

One of the targets of green & clean environment is to protect our living environment through air quality management. Rapid industrialization and urbanization have caused tremendous amounts of energy consumption, consequently increasing the rate of pollutant emissions. In addition to this, rapid increase of road transportation causes severe air pollution along the highway and downtown area.

There are many viable strategies for improving local and regional air quality under the Low Carbon Society policies. To investigate the relationship between the low carbon society countermeasures (LCS CM) and air pollution abatement, the modeling technique is the most appropriate approach to reproduce current air quality condition and to predict the future situation of air quality under certain LCS scenarios. These predictions can help policy making process for both climate change mitigation and air pollution abatement. In addition to this, the monitoring of current air quality condition around the target area is very important.

A detailed list of sub-actions and measures which may be implemented in the Iskandar Malaysia Region is seen in Table 12.1 below.

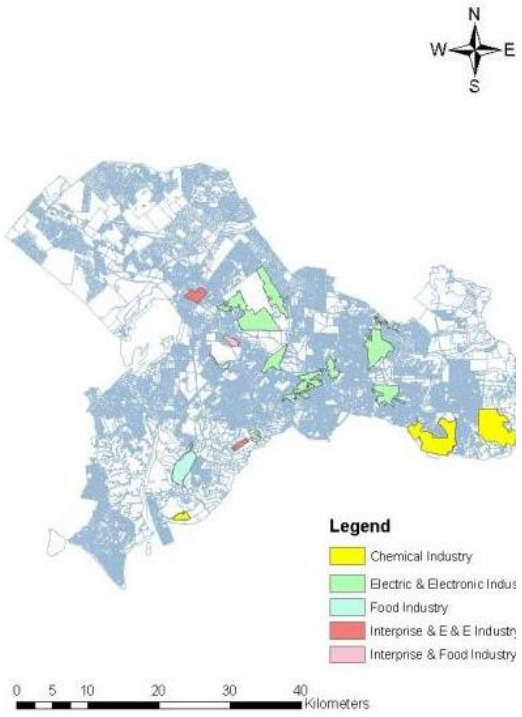



Figure 12.1: the location of industrial areas in IM

### 12.1 Clean Air Quality

It was reported that the number of stationary air pollution sources in the State of Johor is accounted approximately for 35% of the total air pollution sources in Malaysia in recent year (Environmental Planning Blueprint for Iskandar Malaysia, 2011).

Therefore, sustainable development of IM in a local context requires continual effort to clean the environment and minimize adverse human health impacts, in line with the climate change management issues at the global scale.

Table 12.1: Sub-actions and Measures for Action 12 ( Clean Air Environment)

| | Sub-actions | Measures |
|---|---|---|
| 1 | Clean Air Quality | Implementation of co-benefits of approach in policymaking process |
| | | Promote win-win actions in Industry |
| | | Promote low-emission vehicle and public transportation |
| | | Compensate the negative impact of LCS CM on local air quality |
| 2 | Improve Regional Air Quality | Continuous monitoring & real-time of publishing of Air Pollution Index (API) information |
| | | Strengthen cross-border cooperation towards reducing perennial haze occurrences |

Development of Iskandar Malaysia (IM) may result in socio-economic benefits for the people. Although Pasir Gudang is considered as a key contributor towards Johor's industrialized status, deterioration of air quality is one of the major physical worries concerning the development of IM. Figure 12.1 shows the industrial areas in IM, with Pasir Gudang in the east, comprise large point industrial pollution sources from chemical related industries. Besides emissions from industrial sources, emissions from the transportation sector contribute to the deterioration of the air quality in IM. Hence, development of IM should include implementation of an advanced strategy for a low carbon society, to reduce both greenhouse gas emissions and air pollutants.

### 12.1.1 Implementation of Co-Benefits Approach in Policymaking Process

Industries, power plant and motor vehicles are the main factors contributing to high emissions of air pollutants, such as PM, SOx, NOx, CO and $O_3$, which are all linked to human health risk. In order to introduce suitable countermeasures effective for the emission reductions of both GHG and air pollutants, it is necessary to conduct a quantitative evaluation of co-benefits of each countermeasure during the policymaking process.

To quantify the co-benefit of each LCS CMs, detailed spatial and temporal emission estimation is required using the Geographical Information System (GIS). Then, air pollution models and exposure model are used to evaluate the impact to human health and eco-system. After that, the effects of air pollution abatement potential of each LCS CMs must be visualized simply and intelligibly.

**I. Quantification of co-benefit of LCS CM**

**a) Quantitatively evaluate the reduction of pollutant emission for each LCS CM**

This is an attempt to investigate the effect of different mitigation measures on the ambient air pollution and human health impact under various scenarios. By considering a baseline year, the air pollution status of this region will be compared with projected situations under various scenarios (Li et al., 2010). The scenarios will be based on business as usual scenario (BAU), considering no mitigation measures, and low carbon society (LCS) scenario, assuming changes in air pollution emissions in selected industrial sectors. Reliable information for the future status of the air pollution concentration from different scenarios of BAU and LCS help the decision makers to manage the urban air quality and implementation of the preferred air quality policies.

Fong et al. (2009) and Phdungsilp et al. (2010) performed similar studies in Iskandar Malaysia and Bangkok, respectively. The policies of a low carbon city are mostly relevant to the changes in the energy consumption patterns in different sectors which lead to emission mitigation. Chen et al. (2007) estimated the useful affects of some low carbon policies on the air pollution reduction and public health impact. Modifying fuel type, mainly in industrial and transportation sectors, has great potential in energy saving and air pollution mitigation(Li et al., 2010; Ru et al., 2010; Fong et al., 2009; Phdungsilp et al., 2010).

A fuel shift from coal to natural gas in power plant, which is the main source of air pollution, causes a greater burden on the industry. However, fuel shifts to natural gas can reduce the $CO_2$ emissions and reduce adverse impacts on local air quality.

In order to estimate the effect on emission reduction of each low-carbon countermeasures quantitatively, adequate emission inventory techniques is required. In addition, the development of technology databases for estimating emissions is also necessary.

**b) Evaluate/ predict the improvement of Local air quality by model simulation**

Air quality modeling provides an opportunity to investigate the current and future trends of pollutants and their behavior in the environment, while the monitoring stations give only limited information. Although some studies

have been done on the effects of LCS scenarios on mitigation of $CO_2$ emission, most of these studies have not directly considered the effects of different strategies in air quality management. Modeling air quality was conducted in some studies using USEPA developed models for predicting ground level concentration of the pollutants (Orloff et al., 2006, Zou et al., 2009, Onofrio et al., 2011).

The air quality of the study area will be modeled in the current condition of the main air pollution sources in IM and also under Business As Usual (BAU) and Low Carbon Society (LCS) scenarios in the future. The predicted dispersion patterns will indicate Ground Level Concentrations (GLC) of the pollutants and areas with maximum GLC levels. In addition to the predicted pollutants concentration from air quality modeling, a health risk assessment should be considered to estimate the human pollutant exposure.

The research outlines regarding above program are as follows:

1) Collecting available emission, meteorological and statistical data.
2) Performing air quality and meteorological monitoring.
3) Predicting the GLC levels of pollutants using air quality model in the current situation.

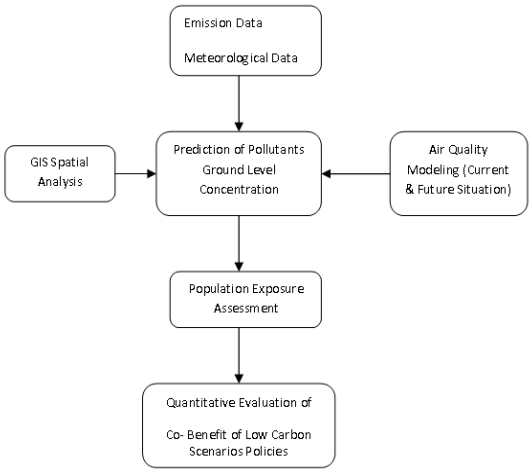



Figure 12.2: Program design flowchart

4) Validating the simulated data by comparing model output and observed data.

(1) Predicting future pollutants emission and GLC levels under several low carbon scenarios considering the current situation of predicted air quality.

(2) Predicting the human exposure and health impact for current and future situations.

Figure 12.2 presents the program design flowchart.

### 12.1.2 Promote Win-Win Actions in Industry

#### I. Visualization of co-benefit of LCS CM in the industrial sector

Shifting fuel, improving the energy efficiency and shifting of industrial structures are among the available GHG emission mitigation options, and these may vary by cost, timing and the ability to be represented in an economic analysis. All those LCS CMs have a significant contribution to the reduction of air pollutants emission. Qualitification and visualization the co-benefit of those CM is necessary.

**a) Fuel Shift**

Economic and technological development are linked with shifts in sources of energy from coal (solid) to oil (liquid) and natural gas (gas).

Coal has been a dominant fuel in power industries for so long because it's a cheap and abundant domestic resource. Power plants that burn coal produce much more sulfur dioxide, nitrogen oxide and carbon dioxide. Sulfur dioxide causes acid rain; nitrogen oxides cause smog. Natural gas produces far fewer emissions of toxic chemicals and gases which contribute to climate change.

**b) Improve the energy efficiency**

Energy efficiency for each industry is defined as total energy consumed per unit of industry output. Mitigating GHG emissions through energy efficiency improvements can be reflected in a number of policies such as

established standards for all kinds of technologies. Energy efficiency has been an area of concern which may be developed in industry through investing in more energy-efficient production and consumption equipment.

Improvement of energy efficiency can reduce the consumption of fossil fuel and reduce the emission of air pollutants simultaneously.

**c) Shift of industrial structure**

In 2005, based on gross output, primary, secondary and tertiary industry accounted for 1.5, 68.8 and 29.7%, respectively. This is predicted to change to 1.1, 55.6 and 43.3% in 2025. Energy intensity of tertiary industries is usually smaller than secondary industry. So, a shift of industrial structure can reduce GHG emission. At the same time, emission of AP can be reduced.

However, an increase in the leisure industry may increase of long-distance traffic demand and increase emissions from private vehicle. It is necessary to consider the LCS CM on the leisure industries.

**d) Green Energy and Renewable Energy**

The energy source which can be regenerated in the natural energy cycle is considered as renewable energy. The development of renewable energy is faced with the political and financial barrier and requires governmental support. Renewable energy such as wind, solar and biomass energy do not contribute to climate change which has caused its increasing importance in the last two decades.

**Wind and Solar**

Wind and Solar does not emit any GHG and AP during the operation. So, diffusion of Wind and Solar can reduce health impact by AP emission from power plant.

**Biomass**

Biomass energy is considered green energy from the view point of GHG emission. However, combustion of biomass produces a lot of atmospheric pollutants, such as PM, NOx, VOC and CO. So, it is necessary to consider the health impact carefully in introduction.

**II. Formulation of guidelines on good technology in the industrial sector**

Many effective technologies are available for the reduction of GHG and Air Pollutants (AP) in the industrial sector. It is necessary to formulate guidelines to evaluate individual technologies in the context of LCS Policy and air pollution abatement.

**III. Implement tax incentives to new technologies for improving air quality**

The good design of tax incentives and subsidies for new technologies is necessary for further investment to low-carbon industry and low-carbon product.

**IV. Improve air quality monitoring networks**

In addition, the monitoring network is very important. Current air quality monitoring networks are not adequate to capture the actual condition of local air quality in a wide area of Iskandar Malaysia. Implementation of additional monitoring stations is necessary in combination with modeling system.

### 12.1.3 Promote Low-Emission Vehicles and Public Transportation

As shown in Table 12.2, atmospheric pollutants emitted from transportation sector (mobile sources) contributes 90% of anthropogenic CO emission and 30% of NOx emission in Malaysia, 2010. (DOE, 2011) Currently, most of road traffic uses petrol and diesel oil. Combustion of these fuels generates a large amount of $CO_2$ and atmospheric pollutants, such as CO, NOx, VOC and PM.

Also, road traffic are usually concentrate in urban central area and in the suburbs, commercial establishment are developed along the highway or major road. From the view point of human health impact, reduction of the

Table 12.2: Emission of pollutants to the atmosphere by type and source, Malaysia, 2010

Tan metrik
*Tonnes*

| Sumber *Source* | Punca tetap *Stationary sources* | | | Punca bergerak *Mobile sources* | Lain-lain[1] *Others* | **Jumlah** *Total* |
|---|---|---|---|---|---|---|
| | Industri *Industrial* | Stesen janakuasa *Power plant* | **Jumlah** *Total* | | | |
| **Jumlah** *Total* | **113,871** | **619,211** | **733,082** | **1,829,691** | **60,457** | **2,623,230** |
| CO | 10,816 | 68,213 | **79,029** | 1,597,955 | 4,456 | **1,681,440** |
| $NO_2$ | 51,364 | 455,182 | **506,546** | 213,788 | 19,672 | **740,006** |
| $SO_2$ | 38,796 | 88,936 | **127,732** | 13,450 | 33,638 | **174,820** |
| $PM_{10}$ | 12,895 | 6,880 | **19,775** | 4,498 | 2,691 | **26,964** |

**Sumber:** ***National Energy Balance 2008***, **Jabatan Alam Sekitar**
*Source: Department of Environment*

pollutants from road traffic has very high priority.

**I. Encourage consumers to purchase low-emission vehicles**

Due to the expansion of population and economic development, usage of private vehicle is estimated to be increased in the future. Therefore, in order to control the increasing emission of GHG and air pollutants from private vehicle, it is important to introduce a low emission vehicle.

**a) Hybrid Vehicles**

Hybrid car can improve the energy efficiency and reduce the GHG and AP emission. Also, assisted by motors at the time of acceleration, it can reduce the high loading condition of engine and cause drastic reduction of emission of PM and NOx.

Fig 12.3 Significant co-benefits can be expected by LCS CM on transportation.

**b) Electric Vehicles and Fuel Cell Vehicles**

Electric vehicle and fuel cell vehicle does not discharge GHG and AP. However the technology is still under development and high cost is estimated even in the future.

**c) Biofuel Usage**

Usage of bioethanol and biodiesel in the passenger and freight transportation is one of the important LCS CMs. However, from the view point of air pollution, inadequate usage of biofuel in transportation increase the emission of PM, NOx and VOC. It is necessary to consider the emission of AP when the introduction of biofuel.

**d) Fuel Improvement**

Fuel quality used for road transportation directly affect to the emission of AP. Currently EURO 2M is used as a regulation of petrol and diesel oil. The Malaysian government plans to implement new regulation Euro-4M by 2015. (Table 12.3) However European Union already implemented EURO V in 2009. Further improvement of fuel for road traffic can decrease the emission of AP and mitigate the health impact of roadside air pollution.

**II. Implement tax incentives on purchase of low-emission vehicles**

To encourage the purchase of low-emission vehicles, suitable tax incentives or subsidy is necessary.

**III. Increase investments in public transportation**

**a) Control of traffic demands (demand decreasing)**

Decreasing traffic demand by following LCS CMs can decrease both GHG emission and AP emission.

**Compact city**

Concept of compact city aims for the decreasing of transportation demand by making the working place to close to their home. Also, compacting the city area eases the design of public transportation systems.

**Walkable city**

Currently, the infrastructure for pedestrian and cyclist is lacking in the IM region. By installing thid infrastructure, a modal shift from private vehicle to bicycle, walking and public transportation will be accelerated.

**b) Investment of public transportation (Modal shift)**

**Passenger's transport (LRT and BRT)**

The per capita emission of GHG and air pollutant can be reduced by the shift of a transport demand to a green public transportation. Especially, the countermeasure, such as LRT and BRT can reduce the traffic in the urban central area, and has a large effect in reduction of individual exposure concentration to PM and NOx. Since the emission of PM and NOx from the conventional type bus is large, the pollution near the bus terminal and arterial routes tend to be high. It is necessary to introduce a low discharge type bus (such as LNG Bus) into the city central area.

Table12.3: Requirement of Fuel Quality

Petrol

| Properties | Euro 2M | Euro 4M | Euro IV | Euro V |
|---|---|---|---|---|
| Benzene (% vol) | 5 | 3.5 | 1 | 1 |
| RVP (kPa) | 65 | 60 | 55 | 55 |
| Sulphur (ppm) | 500 | 50 | 50 | 10 |
| Aromatics (% vol) | - | - | 35 | 35 |

Diesel

| Properties | Euro 2M | Euro 4M | Euro IV | Euro V |
|---|---|---|---|---|
| Cetane Numver | min 49 | min 51 | min 52 | min 55 |
| Distillation 95% (deg C) | max 370 | max 360 | max 340 | max 340 |
| Sulphur (ppm) | 500 | 50 | 50 | 10 |
| Polyaromatic Hydrocarbon | - | - | 11 % wt | 2 % wt |

**Passenger's transport (High Speed train to KL and Singapore)**

Long-distance trips of private vehicle on the inter-state highway and causeway to Singapore largely contribute the regional anthropogenic emission of pollutant. High speed trains link to KL and Singapore can reduce both GHG emission and air pollutants.

**Freight transport**

Heavy duty truck emit large amount of GHG and atmospheric pollutants. Modal shift of freight transport from truck to ship contribute largely the reduction of both GHG and air pollutants.

Also, the truck with empty load or near empty emit almost same amount of GHG and air pollutant. Adequate logistic management can reduce the total mileage of freight transportation.

**IV. Improve roadside air quality monitoring**

To clearly understand air quality along the road, an adequate monitoring network along the major highway and downtown area must be implemented.

**12.1.4 Compensate the negative impact of LCS CM on local air quality**

**I. Establish a mechanism to authenticate the quality of biofuels**

Adequate management of agricultural residue is necessary. One of the countermeasures for the adequate management of agriculture residue is use as a biomass fuel in industrial sector.

Using the agricultural residue for energy source in industry, power generation or residential sectors can reduce GHG emission from the view point of climate change, because biomass energy is considered as neutral for GHG emission. However, combustion of biomass fuel sometime emits a large amount of AP, such as PM, CO, NOx and VOC.

**II. Install the appropriate removal device when using biomass as fuel**

Installation of removal device is necessary for large scale usage of biomass energy. Also adequate measures, such as ventilation and combustion control in cooking device of residential sector.

## 12.2 Improve Regional Air Quality

Malaysia's commitment to air quality management is reflected through its Environment Quality (Clean Air) Regulations 1978. Its Recommended Malaysian Ambient Air Quality Guidelines and the National Policy on the Environment are used to achieve a healthy status of ambient air quality in IM. (Environmental Planning Blueprint for Iskandar Malaysia, 2011) However, success of Iskandar Malaysia's environmental initiatives such as air quality management must be achieved through integrated strategies.

Air quality management should consider both local and/or trans-boundary aspects. The levels of air pollution and the ways of their effects can be shown through API. API is defined as the Air Pollution Index which is complied by department of environment to inform the public about the air pollution levels. The levels of critical air pollutants such as $PM_{10}$, CO, $SO_2$, $NO_2$ and $O_3$ are converted into API at each air quality monitoring station. API varies in a number ranging from 0 to 500 (table 12.4) where determines the health status from good to hazardous. Exposure to low and medium levels of air pollution is not of concern, while persistent exposure to high level of pollution significantly aggravates the symptoms to people with heart or reparatory illness. The state of emergency is declared in the reporting area in the case that API exceeds 500.

One of targets in achieving the objective of good air quality for IM through pollution reduction is maintaining air quality in IM at the Moderate level (API less than 100) at least 20% of the time, and Good level (API less than 50) at least 80% of the time. In contrast, the air quality status of Pasir Gudang was reported in 2009, at the Moderate level for 74.2% of the time, Good level at 24.5% and Unhealthy at 1.3 % (Environmental Planning Blueprint for Iskandar Malaysia).

**12.2.1 Continuous Monitoring & Real-Time Publishing of Air Pollution Index (API) Information**

**I. Increase number of API reading stations across the Iskandar Region**

Air pollution monitoring stations are necessary for regional and urban air quality management to attain the national ambient air quality standards (NAAQS). Both spatial and temporal considerations are important in the design of a measurement network for air quality monitoring stations. The objective of creating of air pollution monitoring networks is producing databases of spatio-temporal air quality data for long-term trends analysis and validation of mathematical models. These kinds of data can be used to evaluate the control strategies in the areas with high pollution concentrations and to assess human health effects. Checking the compliance of ambient air quality with the standards, determination of the risk of damage to vulnerable receptors and updating of land

use planning data bases can be done using air quality values. Further more air pollution monitoring network brings the possibility of controlling of emissions from large point sources, for example power plant or big industrial sites (Dimosthenis et al., 2008).

**II. Conduct continuous regional API monitoring & publishing of real-time API readings**

Most of the new monitoring stations are equipped with automatic continuous monitoring devices measuring time-averaged values of pollutant concentrations over short intervals for example in seconds. Furthermore the mobile monitoring of air quality in the industrial areas and along the roadside can come up with the air quality values in the areas with no stationary monitoring station (Dimosthenis et al., 2008).

Currently, there are three air quality monitoring

Table 12.5: Summary of air quality status in Iskandar region

| Location | API | API Status |
|---|---|---|
| Johor Bahru | 62 | Moderate |
| Pasir Gudang | 56 | Moderate |
| Larkin | 65 | Moderate |

stations in the IM region namely Johor Bahru, Pasir Gudang and Sekolah Vokasional Larkin. Johor Bahru measures and records five air quality parameters, namely $PM_{10}$, CO, $SO_2$, $NO_2$ and $O_3$. The data relevant to Air Pollutant Index (API) extracted from these parameters in Iskandar region is shown in table 12.5 (Environmental Planning Blueprint for Iskandar Malaysia, 2011).

### 12.2.2 Strengthen cross-border cooperation towards reducing perennial haze occurrences

**I. Malaysia-Singapore-Indonesia joint surveillance of regional open burning hotspots particularly during the Southwest monsoon season**

Haze pollution in Malaysia is a significant problem. The haze was mainly caused by land clearing via open burning in the Borneo and

Table 12.4: Range of API and its health classification used by Malaysian government

| API | Health Classification |
|---|---|
| 0-50 | Good |
| 51-100 | Moderate |
| 101-200 | Unhealthy |
| 201-300 | Very unhealthy |
| 301+ | Hazardous |

(Source : Department of Statistics Malaysia, 2008)

Sumatra Island, Indonesia and Peninsula Malaysia and Indochina peninsula. In 2002, the ASEAN Agreement on Transboundary Haze Pollution was signed. In addition to this, Malaysia-Singapore-Indonesia joint surveillance of regional open burning hotspots from satellite monitoring is necessary.

**II. Lobby for ministerial level imposition of tougher penalties on slash & burn activities in the region**

Open burning of agricultural residue is prohibited by the national regulation in Malaysia. However hotspots (fire areas) are still detected by satellite monitoring over Peninsula Malaysia. Therefore, the imposition of tougher penalties on slash & burn activities are necessary.

**III. Joint R&D towards identifying alternative approaches to slash & burn and open burning approaches in the region**

To avoid the slash & burn and open burning in the region, it is necessary to launch a joint R&D towards identifying alternative approaches to slash & burn and open burning approaches in the agriculture, plantation, forestry and related industries.

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# Appendixes

**Acronyms and Abbreviations**

**About the Team**

| | |
|---|---|
| **AC** | Alternating Current |
| **ACA** | Accelerated Capital Allowance |
| **AD** | Anaerobic Digester |
| **AP** | Air Pollution |
| **API** | Air Pollution Index |
| **AW** | Agro-waste |
| **BaU** | Business As Usual Scenario |
| **BEMS** | Building Energy Management System |
| **BIPV** | Building-Integrated PV |
| **BDF** | Biodiesel Fuel |
| **BL** | Baseline |
| **BOD** | Biochemical oxygen demand |
| **BRT** | Bus Rapid Transit |
| **BTP** | Biomass Thermal Plant |
| **CASBEE** | Comprehensive Assessment System for Built Environment Efficiency |
| **CBD** | Central business district |
| **CBU** | Completely built-up |
| **CCS** | Carbon capture and storage |
| **cCCR** | carbon Cities Climate Registry |
| **CCTV** | Close Circuit Television |
| **CDC** | Curriculum Development Centre |
| **CDP** | Comprehensive Development Plan |
| **CHP** | Combined Heat and Power |
| **CIQ**) | Sultan Iskandar Customs, Immigration and Quarantine |
| **CM** | Carbon emission management |
| **CW** | Construction waste |
| **CO** | Carbon Monoxide |
| **CO2** | Carbon Dioxide |
| **CPB** | Community Police Beat |
| **CPP** | Community Police Post |
| **CSR** | Corporate Social Responsibility |
| **CW** | Construction And Demolition Waste |
| **DC** | Direct Current |
| **DEG** | Distributed (Or Decentralised) Energy |
| **DHC** | District Heating And Cooling |
| **DMS** | Dynamic message sign |
| **EDL** | Eastern Dispersal Link |
| **E&E** | Electrical And Electronics |
| **EEI** | Energy Efficiency Improvement |
| **EPC** | Energy Performance Contracting |
| **ESCOs** | Energy Services Companies |
| **EFB** | Empty Fruit Bunch |
| **EIP** | Eco-industrial park |
| **ETC** | Electronic Toll Collection |
| **FGD** | Focus Group Discussion |
| **FiT** | Feed-in-Tariff |
| **FIAH** | Feed-in Approval Holder |
| **GBI** | Green Building Index |
| **GLC** | Ground Level Concentrations |
| **GHG** | Greenhouse gas |
| **GIS** | Geographical Information System |
| **GTP** | Government Transformation Programme |
| **HEVs** | Hybrid-electric vehicles |
| **HSRT** | Intercity High-Speed Rail Transit |
| **IBS** | Industrialized Building System |
| **ICLEI** | Local Environmental Initiatives |
| **IGES** | Institute for Global Environmental |
| **IM** | Iskandar Malaysia |
| **IMLRT** | Iskandar Malaysia Light Rail Transit |
| **INC** | Incinerator |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **IRDA** | Iskandar Regional Development Authority |
| **ITA** | Investment Tax Allowance |
| **ITS** | Intelligent Transportation System |
| **IW** | Industrial Waste |
| **IWK** | Indah Water Konsortium |
| **JB** | Johor Bahru |
| **JPNJ** | Jabatan Pelajaran Negeri Johor |
| **KIM** | Kawan Iskandar Malaysia |
| **LCS** | Low Carbon Society |
| **LCS CM** | Low Carbon Society Countermeasures |
| **LEED** | Leadership in Energy and Environmental Design |
| **LEED EB** | LEED for Existing Building |
| **LEED NC** | LEED for New Construction |
| **LF** | Landfill |
| **LST** | Land Surface Temperature |
| **LULUCF** | Land Use and Land Use Change and Forestry |
| **MEGTW** | Ministry of Energy, Green Technology and Water |
| **MIDA** | Malaysian Investment Development Authority |
| **MRF** | Material Recycling Facilities |
| **MSW** | Municipal Solid Waste |
| **MSWM** | Municipal Solid Waste Management |
| **NBS** | Non-Building Structures |
| **NGOs** | Non-governmental organizations |
| **NGV** | Natural Gas Vehicle |
| **NKRA** | National Key Results Area |
| **NOx** | Nitrogen oxide |
| **NSP** | National Strategic Plan |
| **NPP** | National Physical Plan |

| | |
|---|---|
| **NUP** | National Urbanisation Policy |
| **$O_3$** | Ozone |
| **O&M** | Operating And Maintenance |
| **OPF** | Oil palm fronds |
| **OPT** | Oil palm trunks |
| **PC** | Portland cement |
| **PKC** | Palm kernel cake |
| **PKS** | Palm kernel shell |
| **PS** | Pioneer Status |
| **PPD** | District Education Office |
| **POME** | Palm oil mill effluent |
| **PM** | Particulate Matter |
| **PV** | Solar photovoltaic |
| **PQ** | Power Quality |
| **RE** | Renewable energy |
| **RTS** | Rail Transit System |
| **R&D** | Research and Development |
| **SEDA** | Sustainable Energy Development Authority |
| **Sludge** | Sewage Sludge Waste |
| **SJER** | South Johor Economic Region |
| **SMRT** | Singapore MRT |
| **$SO_2$** | Sulfur dioxide |
| **SOHO** | Small office/home office |
| **SREP** | Small Renewable Energy Programme |
| **TDM** | Transportation Demand Management |
| **TPD** | Third Party Distributors |
| **TOD** | Transit Oriented Developments |
| **TS** | Transfer station |
| **UGB** | Urban Growth Boudary |
| **UNEP** | United Nation Environmental Programme |
| **UNESCO** | United Nations Educational, Scientific and Cultural Organization |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **USEPA** | United States Environmental Protection Agency |
| **VMT** | Vehicle miles travelled |
| **V2I** | Vehicle-To-Infrastructure |
| **V2V** | Vehicle-To-Vehicle |
| **VOC** | Volatile Organic Compounds |

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