Penang Organic Waste Management Plan: 
Up-scaling & Replication

The purpose of this report is to arrive at a policy for organic waste (including food waste) for the state of Penang. Organic waste is also called putrescibles or decomposable waste. This report will cover the beginning of pipe solutions such as up-scaling of organic waste diversion upstream targeting food waste separation from roadside hawker stalls, restaurants, hotels in the UNESCO World Heritage George Town inner city where a few main streets (especially those which have night hawking) for a pilot project as well as end of pipe solutions at the Pulau Burong Sanitary Landfill which continues to receive the bulk of the organic waste.

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TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS
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<td>Construction and Demolition Waste</td>
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1 INTRODUCTION

Reducing waste cannot succeed without a system that manages waste from the point of generation through to disposal. A more effective, integrated approach to material and resource efficiency is needed at every stage of production and consumption. Up to now, waste policies have tended to focus on end-of-pipe solutions by dealing with disposal rather than prevention.

There exists a direct link between the amount of waste we produce and our rate of economic growth. The long-term challenge is to break this link and achieve sustainable growth by learning how to use resources more efficiently — to produce more with less waste. The UNDP study on Structuring and Institutionalising Solid Waste Management in Penang (2007) recommended the resource recovery and composting approach which has been. Hence, all policy directions would be based on this approach for development and implementation of the SWM for the State.

The existing practice of mixed-waste collection is unsatisfactory as it can result in the contamination of waste which would otherwise be recyclable. Separation at source is required for a successful recovery of waste. Therefore, a better system is the wet/dry collection in which wet materials such as food waste, yard trimmings and animal waste are separated from other materials including recyclables for collection. A wet/dry rather than organic/non-organic collection is proposed because it is much easier for the public to recognise the physical state rather than the characteristics of the waste. Once separated, materials can be collected and hauled with existing equipment. One option is to collect the wet materials daily and the dry materials on alternate days. Since existing equipment can be used to implement the wet/dry collection system, the major start-up costs would be public education campaigns.

Depending on the level of public awareness and motivation, campaign to further separate the dry materials into recyclable and non-recyclable fractions can be promoted.

In order to ensure successful replication and up-scaling, this portion of the Penang Organic Waste Management Plan will discuss proposals which cover the supporting legislations that has to be in place as well as the beginning-of-pipe solutions which addresses organic waste diversion at points of generation and also the end-of-pipe solutions when organic waste ends up at the landfill.

2 SUPPORTING LEGISLATION

Supporting legislation is needed to ensure that the diversion of putresibles from the landfill. Penang is currently developing specific regulations for waste separation at source and also impose a Waste Generators Pay Principle to ensure that waste generators take ownership for the waste they generate. These two regulations are discussed in the following section.

2.1 Waste Separation at Source Regulation
Penang plans to adopt the Solid Waste and Public Cleansing Management (Scheme for Household Solid Waste and Solid Waste Similar to Household Solid Waste) Regulations 2011 to regulate the management
of controlled solid waste and public cleansing for the purpose of maintaining proper sanitation and for matters incidental thereto. Penang Island City Council and the Seberang Perai Municipal Council the local administration of Penang State.

The objectives of the Municipal Source Separation Regulation are:

(a) To encourage and facilitate the maximum recycling practicable on the part of each and every household, business, apartment complex, industry, and institution within State of Penang;

(b) To establish, implement, and enforce minimum recycling-related practices and procedures to be applicable to all Waste Generators, Waste Haulers/Recyclable Collectors, and Materials Recovery Facilities/Recycling Facilities located within municipality; and

(c) To require onsite source separation by each and every Waste Generator within Penang Island City Council and the Seberang Perai Municipal Council and to ensure that those Recyclable Materials that are Source Separated are recycled properly and kept separate from Solid Waste. The Solid Waste and Public Cleansing Management (Scheme for Household Solid Waste and Solid Waste Similar To Household Solid Waste) Regulations 2011, P.U. (A) 307

### Recyclable waste

14. (1) Where a recycling centre is available in a service area or scheme area, recyclable waste may be sorted by the owner or occupier of landed premises and brought to the recycling centre for the service area or scheme area.

(2) Where a collection schedule for recyclable waste is provided, the owner or occupier of landed premises shall keep the recyclable waste separated from other types of household solid waste and solid waste similar to household solid waste and—

(a) where the collection point is located inside the landed premises, bundle and tie the recyclable waste, or put the recyclable waste in bags or containers, and place the recyclable waste at the collection point before the time of collection as specified in the collection schedule; or

(b) where the collection point is located outside the landed premises, bundle and tie the recyclable waste, or put the recyclable waste in bags or containers, and place the recyclable waste at the collection point only on the day and time of collection as specified in the collection schedule.

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Figure 1: Solid Waste Separation Regulations under the SWM Act 2011

The proposed collection frequency for both MBPP and MPSP after the enforcement of the waste separation at source regulation is shown in the table below.
2.2 Waste Generators Pay Principle

The Waste Generators Pay Principle addresses all non-domestic waste generators i.e. commercial, institutional and industrial sectors. These sectors will be required to pay for the final disposal of their waste at the landfill. The cost of waste disposal for these sectors is currently borne by the two local authorities. This situation only occurs in Penang whereas in the other states the cost is borne by the waste generator.

The objective is to encourage these sectors to reduce their waste and or recycle as much as they possibly can.

a. All Commercial & Industrial waste generators must send their non-hazardous waste and other waste approved by DOE to the landfill for final disposal

b. These waste generators are required to submit updated waste generation data to the relevant local authority for business license on a yearly basis.

Documentation

a. All commercial or industrial waste generators shall provide the following waste generation particulars in their application via their service provider (hauler) to the relevant local authority.

The main objectives of these guidelines are to:

a. Document and set up a database on the quantity and types of waste from the Commercial & Industrial sector at the landfill.

b. Monitor the proper disposal of such waste to curb illegal dumping from the Commercial & Industrial sector.

c. Provide a mechanism for the local authorities to implement the “generators pay principle” where waste generators will bear the cost of final disposal instead of the local authorities saving the costs of Solid Waste Management.

Main Stakeholders
3 UP-SCALING & REPLICATION AT SOURCE OF GENERATION

In the various consultative sessions with selected stakeholders groups, it was found that certain patterns have emerged when willingness to separate waste at source and the degree of ease of implementing this are taken into consideration. This factor has enabled the stakeholders to be classified into “Low Hanging Fruits” i.e. early adopters - targets that are easily achievable, “Medium Hanging Fruits” i.e. targets that may take some effort to achieve and “High Hanging Fruits” i.e. targets that may take more effort to achieve.

3.1 “Low Hanging Fruits” Characteristics
Stakeholders that comprise this category are:

a. Hotels
b. Hospitals
c. Schools & Other Educational Institutions

Characteristics of this category indicated that they:
• are institutions that can easily control their SWM activities
• generate waste or collect waste at a single point source
• generate significant amount of organic waste which can be separated easily
• are willing to separate waste at source
• can separate their waste efficiently at source
• are willing to cooperate with Government programmes
• require some or minimum infrastructure
• need Government to develop and put some mechanisms in place.
• need sustained Public Education & Awareness Campaigns to educate the people.
• do not mind giving their waste to collectors or composting centres.
• need a mechanism to collect and dispose organic waste daily either by private contractors or the local authority.
• would appreciate some form of incentive for their efforts to separate waste
• usually have very supportive management.
• already have certain mechanisms in place such as already practicing recycling, have the adequate infrastructures such as proper garbage bins, storage area, workers etc
• may need a more proper receptacle for collecting larger amounts of food waste to be designed.
• need separate bins for separation of wet and dry waste

3.1.1 Recommended Strategies for “Low Hanging Fruits”

3.1.1.1 Hotels
Hotels are major generators of waste especially food waste. Rubbish is dumped at a rubbish collection depot. The 1-ton RORO bin is hauled away daily by a private contractor appointed by the individual hotel themselves. The hauler also collects all kinds of rubbish including garden wastes. The garden waste is estimated at around 10% of the total daily waste collection, but occasionally it can be higher, especially when grass-trimming activities are carried out. It is observed that recyclables such as papers and aluminum cans are collected by the staff separately and sold for their welfare funds, and as such reducing the inorganic wastes content of the rubbish. Some hotels, however, dump everything into the RORO and the appointed contractor picks up the recyclable items and hauls away the rest of the garbage. A typical arrangement may consist of a daily payment for haulage to the contractor while the contractor gives a rebate of a fixed monthly amount for the recyclable items he picks up.

Some of the strategies may include:

• Requiring all hotels to have two separate well-labelled bins RORO bins in their rubbish collection areas.
• Having an effective public education and awareness campaign for separation of food waste in to hotel management and staff.
• Teaching food separation techniques to food handlers in hotels
• Providing incentives to hotels to minimize, treat or reuse their food waste.
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
• Designing bins that collect food / organic waste with a leachate collection tank below.
• Inspecting all grease traps in hotels regularly to ensure that they are well-maintained and the Fats, Oils & Grease (FOGs) collected by an appointed contractor. Impose fines if they are not.
3.1.1.2 Hospitals

Hospitals are similar to hotels in that they provide both food and lodging and in many cases have canteens of their own. All waste collected including food waste is thrown into dumpsters that will be collected by MPPP’s contractor daily. Medical waste, which are biohazards, are collected by an appointed company such as Faber Mediserve.

The generation of food waste from each bed is estimated to be about 100 grams. This does not include the kitchen waste from food preparation in the hospital. Hospitals have numerous departments and some have been practicing recycling of common items such as glass, plastic, paper, cardboard, metal cans etc. Some departments do the recycling on their own and some join merge to do this. In addition to these waste, garden waste are also generated by hospitals.

Recommended strategies include:

• Targeting hospitals in the local council’s waste minimization programmes because of the amount of waste generated.
• Encouraging hotels to practice waste minimization activities
• Developing specific recycling activities for hospitals.
• Providing mechanisms to collect food waste from wards and canteens.
• Designing bins that collect food / organic waste with a leachate collection tank below.
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
• Inspecting all grease traps in hotels regularly to ensure that they are well maintained and the Fats, Oils & Grease (FOGs) collected by an appointed contractor. Impose fines if they are not.
• Providing incentives to hospitals, which may take the form of both monetary and non-monetary incentives such as recognition of their efforts.
• Highlighting hospitals that have good practices set them as Best Practices showcase for other hospitals to follow.

3.1.1.3 Schools other Educational Institutions

Many schools and educational institutions practice recycling in one form or another. They differ and vary in their recycling activities ranging from very active to somewhat sedated ones. Most often, students are requested to bring recyclables from home. These are usually sold and the proceeds used to fund activities in the school. Some schools collect only newspapers whilst some are practicing the full range of 3Rs activities to reduce, reuse and recycle resources in their school. Following the success stories of the SMK Seri Balik Pulau and SK Balik Pulau, recycle banks are viable and easy to set up in appropriate schools. Schools are good avenues to act as centres for collection of recyclables each student represents a household in the community and it acts as a one-stop-centre for the students to sell their recyclables. Schools also provide space and security – features that ensure the success of recycling centres. Recycle banks operated by teachers and students inculcate an awareness in students that discards are actually resources and managing these at the school recycle banks actually develop entrepreneurial skills in students.

There is no inventory of schools & educational institutions that practice recycling in the state.

Strategies may include the following:

• Setting up a permanent core team to educate the schools on proper recycling practices.
• Enabling and empower institutes, organizations or NGOs that have such resources by providing them with annual allocations to carry out educational activities on behalf of local authorities to save manpower.
- Providing funds to build holding areas in schools such as Recycle Banks.
- Providing on-going motivational talks to promote recycling activities.
- Registering schools that practice with the local authorities so that the recycling rates can be monitored.
- Making recycling activities mandatory for all schools & educational institutions via the State Education Department
- Setting aside allocations for environmental education and solid waste minimization activities for various parties to run such educational programmes. They can provide buses for field trips, sponsor exhibitions and awareness raising campaigns. Through such partnerships not only do the local authorities save on their manpower but also be able to use other organizations to reach a wider audience as well as go beyond their manpower and resource constraints to carry out effective programmes in the community.
- Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
- Encouraging schools to practice a more holistic programme of waste minimization to include the 3Rs and greening the environment and not merely recycling of discards.
- Capitalizing on the existing Chief Minister’s Green Award Programme and contributes to this effort either in cash or in kind to further expands this waste recycling programmes and its accompanying activities.

3.2 “Medium Hanging Fruits” Characteristics

1. Wet Markets
2. Food Courts / Hawker Centres
3. High Rise Dwellings

Interviews with the stakeholders in this category indicated that they:
- generate a lot of organic waste or mixed waste from many sources.
- are willing to separate waste at source
- are willing to cooperate with Government programmes
- need some or minimum infrastructure required to facilitate
- need Government to develop and put some mechanisms in place.
- need sustained Public Education & Awareness Campaigns educate the people.
- show willingness to separate their waste & cooperate with Government programmes.
- do not mind giving waste to collectors or composting centres.
- need a mechanism to collect and dispose of organic waste daily either by private contractor or Govt.
- need some form of incentive for their efforts to separate waste
- may or may not have supportive management.
- already have minimum mechanisms in place such as proper garbage bins, workers etc
- are using communal bins that are shared by the rest of the neighbourhood resulting in unhygienic conditions with rubbish strewn around.
- indicated that separate bins for waste separation

3.2.1 Recommended Strategies “Medium Hanging Fruits”

3.2.1.1 Wet Markets
- Wet markets are usually provided with communal bins that are used by the wet market stall operators, hawkers and the surrounding residents. Communal bins are often unkempt and contain mixed waste. Strategies that should be considered include:
  - Providing clearly labelled communal bins for wet and dry waste at wet markets
  - Working with market management bodies and hawker complexes to educate users
• Providing public education and awareness to surrounding residents
• Making it mandatory for market stall and hawkers to separate their waste before disposal at communal bins
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)

3.2.1.2 Food Courts / Hawker Centres
Food courts and hawker centres have a central management to coordinate their activities. They differ in the way they handle their food waste. Some food courts utilize the centralized system whereby food scraps and utensils are collected by a third party washed the utensils and return them to their respective stalls. They are also responsible for discarding food waste into receptacles provided. Other food courts and eating places require the individual operators to collect and wash their own utensils and discard their own waste at a centralized bin.

Strategies for food courts and hawker centres include:
• Providing two separate well-labelled RORO bins in commercial areas and eating-places such as food courts, food complexes, restaurants etc. for food waste separation.
• Having an effective public education and awareness campaign for separation of food waste in the communal bins.
• Having regulations for individual hawker stalls to have to bins and to separate their waste. This should be part of the licensing approval condition. All hawkers are required to have 2 bins at their stalls.
• Teaching food separation techniques to hawkers and incorporate it as part of the hawkers’ food handling course which is a prerequisite for license approval.
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
• Designing bins that collect food / organic waste with a leachate collection tank below.
• Inspecting grease traps regularly to ensure that they are well-maintained and the FOGs collected by an appointed contractor. Impose fines if they are not.
• Collecting food waste and used cooking oil.
• Collaborating with management for waste separation activities

3.2.1.3 High-rise dwellings
High-rise dwelling comprises of up to 60% of housing in Daerah Timur Laut. Most high-rise dwellings in Penang provide centralized facilities that residents can dispose their garbage. Communal bins are provided and residents from individual units are required to bring their waste to these facilities. The garbage is often collected by waste collection contractors. However, in a few instances in George Town, there exist low-cost flats such as the Rifle Range flats where chutes are still in use. In such cases, residents are not required to bring their rubbish down to a centralized collection area.

Strategies for high-rise dwelling are:
• Making it mandatory for developers must be set aside space to provide for recycling centres and composting facilities.
• Making it mandatory for the management to provide 2 bins for separation of food waste and recyclables
• Closing down all chutes to encourage residents to carry down their waste to centralized areas
• Making regulations to make waste separation compulsory.
• Providing incentives to unit owners for waste separation.
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
• Identifying and train local champions among members of the organization or community who are passionate in environmental protection programmes to run recycling activities
• Encouraging local authorities to collaborate with the Residents’ Associations on waste minimization activities

3.3 “High Hanging Fruits” Characteristics
Stakeholders that comprise this category are:

1. Residential Landed Property
2. Coffee Shops / Restaurants
3. Kampongs
4. SMI / SMEs
5. Renovators / Contractors

The characteristics of this category shows that:

• they generate a lot of organic waste or mixed waste from many sources.
• the willingness to separate waste at source in doubt
• the willingness to cooperate with Government Programmes uncertain
• there is a need for legislation and strong enforcement to ensure compliance
• they need a variety of infrastructure
• they need a variety of mechanisms for different places e.g. landed and high rise dwellings
• changing people’s attitude through public education and awareness is critical
• sustained efforts for public education and awareness to be successful

Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable).

3.3.1 Recommended Strategies for “High Hanging Fruits”

3.3.1.1 Residential Landed Property
Residential property in Penang consists of terraced, semi-detached or bungalows. These may be single or multiple storeys. Some have small gardens whilst other do not. Individual landed property owners on Penang Island only are provided with green bins to discard their mixed waste, which are collected on every alternate day. Separate collection of garden waste and yard trimmings and bulk waste (e.g. furniture, large household appliances) are additional services provided by the local authorities.

Strategies that can be implemented include:

• Dividing waste into 2 streams for waste separation for each household - one for wet waste and the other for dry waste. The wet waste may be collected every alternate day whilst the dry waste, which comprise mainly of recyclable items may be collected once a week. Bins may be distributed to households if the local authorities are able to afford it.
• Increasing participation rate by providing incentives
• Making waste separation mandatory through legislation.
• Building community recycling centres and centralized composting sheds may be constructed where space permits.
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
• Identifying and train local champions among members of the community who are passionate in environmental protection programmes to run recycling activities

### 3.3.1.2 Kampongs (Villages)

Kampongs and villages are usually located in the suburban but in there exists cases where kampongs are still found in Daerah Timur Laut. Kampong houses are often provided with communal bins situated at strategic places in the kampong. Residents are usually required to bring their garbage to these communal bins but recent contracts require the appointed contractors to provide door-to-door collection. Strategies that can be considered include:

• Providing clearly labelled communal bins for wet and dry waste at convenient spots. The wet waste may be collected every alternate day whilst the dry waste, which comprise mainly of recyclable items may be collected once a week.
• Providing 2 clearly labelled bins for waste separation for each household - one for wet waste and the other for dry waste
• Providing door-to-door collection service using smaller carts and trucks, which is then transported to communal bins.
• Increasing participation rate by providing incentives
• Formulating mandatory regulations with strong enforcement to ensure successful waste minimization projects.
• Conducting frequent public education and awareness campaigns needed. It was also proposed that Government set aside money to do this and start from students.

### 3.3.1.3 Coffee Shops and Restaurants

Coffee shops generate off-table scraps (comprising mainly plastic bags, straws and food waste) hawker stall waste (wrappings, trimmings, cuts, etc. and the beverage operator waste (coffee, tea grounds, fruit skins, mineral water bottles, tin cans plastic wrappings etc.) Since restaurants are often sole owner operated, they produce waste to coffee shops but generated by a single source. Strategies for this category include:

• Providing clearly labelled communal bins for wet and dry waste at convenient spots.
• Collecting wet waste every alternate day whilst the dry waste, which comprise mainly of recyclable items can be collected once a week.
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
• Increasing participation rate by providing incentives.
• Collecting food waste and used cooking oil.
• Making it mandatory for all coffee shops and restaurants to separate their food waste

### 3.3.1.4 SMI / SMEs

The field checks showed that SMIs /SMEs do not generate much waste as their waste are usually recycled or reused. E.g. chicken slaughtering house turns its waste into food for fish and animal feed; the only problem is feathers as a use is yet to be found for these. Strategies for SMIs and SMEs may include:

• Providing clearly labelled communal bins for wet and dry waste at convenient spots.
• Collecting wet waste every alternate day whilst the dry waste, which comprise mainly of recyclable items can be collected once a week.
• Providing a mechanism whereby such food waste are collected regularly and sent to a composting facility or install in situ food waste processing machine (where applicable)
• Increasing participation rate by providing incentives
• Making it mandatory for all SMIs / SMEs to separate their waste at source

3.3.1.5 Contractors and Renovators
Interviews with REHDA and some small-time renovators indicate that C&D waste is not indiscriminately discarded although instances of these do occur. Big time contractors and developers use the C&D for land filling or land levelling in their project site and do not often discard them.

Small-time renovators are aware of the local authorities’ regulations against indiscriminate dumping of waste at the project site, in front of buildings and in back lanes. They indicated that they often clear up the debris and waste after job completion or they will be fined for littering. They said that they send their waste to the Jelutong Landfill or to Pulau Burong (for contractors on the mainland). Renovators or contractors that do not possess their own trucks often engage others to discard their C&D waste. Strategies that can be considered include:

• Enforcing regulations to ensure compliance to already existing regulations
• Continuing to encourage proper disposal of waste by providing free access to landfills.
• Providing facilities such as material Recovery Facilities (MRFs) to recycle C&D waste.

3.3.1.6 Other Stakeholders
Other stakeholders that must be addressed are the Community based organizations and Non-governmental organizations (CBOs & NGOs), private recycling businesses as well as the local authorities. All these parties also play important roles in waste minimization, resource recovery and diversion of recyclable items from the landfill.

3.3.1.6.1 CBOs & NGOs
CBOs & NGOs are voluntarily organizations that often act as collecting centres in the community. The motives and purposes of NGOs in recycling activities differ. There are several models of waste collection already in practice in Penang. Some have permanent collection centres to store recyclables whilst others have recycling days for their members to collect or bring recyclables for sale to recycling agents. Strategies that may work for CBOs & NGOs include:

• Providing clearly labelled communal bins for wet and dry waste at convenient spots.
• Collecting wet waste every alternate day whilst the dry waste, which comprise mainly of recyclable items can be collected once a week.
• Increasing participation rate by providing incentives
• Encouraging NGOs to identify clear objectives and goals for their recycling programmes so that members are aware and can contribute time and effort for the “cause”.
• Involving the NGOs as the local authorities’ allies in designing ground programmes.
• Providing Incentives to NGOs for recycling activities.
• Encouraging Local authorities to collaborate with NGOs for outreach programmes.
• Identifying and train local champions among members of the organization or community who are passionate in environmental protection programmes to run recycling activities

3.3.1.6.2 Private Sector
Private sector participation in the form of recycling business consisting of small time itinerant collectors to big business are an integral and crucial component of Penang’s recycling network. This economic activity can be regarded both as a model of resource conservation and efficient materials utilization. Private sector can be expanded if some of these strategies are in place. They include:

• Establishing new networks to meet future challenges
• Establishing more drop off recycling programmes in shopping complexes
• Expanding existing PC Recycling Programme into a Household Electronic and Electrical Appliances Collection Programme involving more private sector participation
• Providing incentives for private companies practicing recycling and installing environmental protection equipment
• Encouraging private businesses to collect and purchase bulk items such as furniture and obsolete equipment
• Setup a mechanism to monitor highly volatile market prices of recyclable items
• Providing subsidies as a form of Government intervention in the case of sharp price drops of recyclables resulting in non-collection.
• Deriving win-win solutions and reduce undercutting practices in order for recycling businesses to remain sustainable
• Introducing tax incentives for purchase of equipment for processing recyclables
• Providing soft loans to businesses involved in recycling and material recovery

3.3.1.6.3 Local Authorities
The local authorities play very crucial roles to ensure that the mechanism of waste minimization is in place and runs smoothly at all levels of stakeholder activities. They provide the legislative, administrative functions as well as essential services to all parties. The two local authorities in Penang operate under the ambit of the Federal Acts, laws, regulations and bye-laws but their practices in relation to solid waste management differ. A clear example is the number of contractors that are engaged in street cleansing and waste collection. The MPS offer cash incentives for waste minimization activities while the MPPP offers aids in kind and also provide infrastructures and mechanisms to the stakeholders. Some of the strategies that can be implemented for the local authorities are:

• Setting up Waste Minimisation Units (WMUs) in the local authority as proposed in the JICA Study (2005/06) to oversee and monitor solid waste management
• Setting up a website for recycling and waste minimisation to promote ground activities.
• Maintaining and update the website that has been set up Provide adequate personnel to carry out and monitor Waste Minimisation policies, strategies and programmes on the ground.
• Developing a comprehensive plan and programmes for public awareness and education.
• Outsourcing work to qualified experts to work around manpower and financial constraints.
• Establishing a sound legislative basis for waste minimization and management
• Infrastructure support for recycling is still lacking and needs to be further strengthened e.g. collection centres, collection of household hazardous materials etc.
• Expanding present household hazardous waste collection points throughout Penang
• Setting up a Hazardous Waste collection depot for other household hazardous items such as paints, oil, acids, aerosol cans, etc. to remove them from the waste stream.
• Expanding the present e-waste collection programme into Household electronic & Electrical Appliances (e.g. refrigerators, washing machines, TVs, toasters, electric ovens, radios etc.) programme in collaboration with private recycling businesses
• Setting up a mechanism for the collection of bulky furniture.
• Selecting appropriate technologies for material/ resource recovery and composting at the municipal level
• Setting up legislations that make it mandatory for recycling businesses to register with the LAs so that activities can be monitored and regulated.
• Making it mandatory that registered agents and businesses surrender monthly data on the recyclables collected.
The ease of adoption of waste separation at source by stakeholders can be summarised in the Chart below.

<table>
<thead>
<tr>
<th>Level</th>
<th>Group</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Hanging Fruits</strong></td>
<td><strong>GROUP B:</strong> Hotels, Hospitals, Institutions with Hostels</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>GROUP C:</strong> Educational Institutions, Schools, Colleges, Universities, Factories</td>
<td></td>
</tr>
<tr>
<td><strong>Middle Hanging Fruits</strong></td>
<td><strong>GROUP A:</strong> Residential High-rise, Low rise</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>GROUP D:</strong> Food Courts / Complexes, Wet Markets / Fresh Wholesale Markets</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>GROUP E:</strong> Parks &amp; Gardens</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>GROUP F:</strong> Turf Club, Farms, Transfer Station, Landfill, Others</td>
<td></td>
</tr>
<tr>
<td><strong>High Hanging Fruits</strong></td>
<td><strong>GROUP A:</strong> Residential landed Property, Villages, Neighbourhood Watch</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>GROUP D:</strong> Restaurants, Roadside Hawkers, Coffee Shops</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SMI / SMEs</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Renovators / Contractors</strong></td>
<td></td>
</tr>
</tbody>
</table>

Public awareness and education programmes must continually be conducted to change mind-sets of the citizens.

Wherever possible, **household composting, community composting, the use of food waste processing machines** at the point of generation must continue and expanded to other areas. E.g. from wet markets, schools, selected hawker centres to other eateries and food business such as food courts, restaurant hotels to divert and convert organic waste and putresibles into useful product instead of ending up in the landfill cells.
The local authorities should also have buy-back programmes for the products such as compost or liquid soil amenders from the community or private firms as an incentive. The demand and market for compost globally is relatively small and successful case studies are those where government intervention is seen; such as in the case of Bandung, Indonesia. The local authority buys back compost from the producers for the landscaping of the city.

Roughly 80 percent of Dhaka’s municipal solid waste was organic in nature, Waste Concern an NGO worked with local governments, the private sector and international organizations to implement a highly successful community-based composting system and has replicated the system across several cities in Bangladesh. The centralized composting project in the city of Dhaka warrants special mention. The composting plant has a capacity of 700 tons per day and processes organic waste from the city of Dhaka in three phases. The project has led to many economic, social and environmental benefits such as new job opportunities to the communities and better livelihoods in the region.

A private sector company was involved to ensure the sale of compost by carrying out enrichment of the compost with nutrients and its subsequent distribution in the market. As a result, 75 per cent of the total revenue of the project came from sale of compost. The project was also successfully registered as a Clean Development Mechanism (CDM) project under United Nations Framework Convention on Climate Change (UNFCCC). Thus, the remaining 25 percent of the project revenue came from the sale of certified emission reduction (CER) credits, making the project financially viable and profitable.

Incentives should be provided for stakeholders who divert waste away from the landfill. The World Bank has proposed an incentive system that is described in the following section for residential areas.
3.3.2 The Results-Based Financing (RBF) Program for Penang

The World Bank has provided technical assistance for the design and implementation of the RBF scheme in Penang in 2014. The program will be first implemented as a pilot projects in selected high-rise communities based on earlier reports and, if successful, scaled-up across the State. The source of financing for these pilot projects would be borne by the Penang State Government, Penang Island City Council, and the Seberang Perai Municipal Council.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Waste Generation rate (kg/c/d)</th>
<th>Amount of Waste (tonne/day)</th>
<th>Organic Waste (tonne/day)</th>
<th>Recyclable Waste (tonne/day)</th>
<th>Non-Recyclable Waste (tonne/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household (High-rise)</td>
<td>0.91</td>
<td>400.7</td>
<td>143.1</td>
<td>194.5</td>
<td>63.2</td>
</tr>
<tr>
<td>Household (Lowrise)</td>
<td>0.91</td>
<td>119.0</td>
<td>42.5</td>
<td>57.7</td>
<td>18.8</td>
</tr>
<tr>
<td>Household (Individual)</td>
<td>0.84</td>
<td>98.3</td>
<td>35.1</td>
<td>47.7</td>
<td>15.5</td>
</tr>
<tr>
<td>Industrial</td>
<td>1.5</td>
<td>246.4</td>
<td>6.6</td>
<td>234.1</td>
<td>5.7</td>
</tr>
<tr>
<td>Wet market (stall)</td>
<td>19.3</td>
<td>40.6</td>
<td>37.5</td>
<td>3.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Hawkers stall</td>
<td>8.67</td>
<td>19.7</td>
<td>18.7</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Hotel (room)</td>
<td>1.35</td>
<td>17.0</td>
<td>15.8</td>
<td>1.1</td>
<td>0.0</td>
</tr>
<tr>
<td>School</td>
<td>0.009</td>
<td>2.8</td>
<td>1.7</td>
<td>1.1</td>
<td>0.0</td>
</tr>
<tr>
<td>College</td>
<td>0.016</td>
<td>0.3</td>
<td>0.1</td>
<td>0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Hospital (Beds)</td>
<td>0.57</td>
<td>2.3</td>
<td>1.5</td>
<td>0.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Hypermarkets (m2)</td>
<td>0.0013</td>
<td>0.9</td>
<td>0.2</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Universities</td>
<td>0.99</td>
<td>14.9</td>
<td>11.7</td>
<td>11.3</td>
<td></td>
</tr>
<tr>
<td>Turf Club (Manure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>962.9</td>
<td>320.2</td>
<td>541.8</td>
<td>103.2</td>
<td></td>
</tr>
</tbody>
</table>

*Source: estimated by Study Team, 2005 (UNDP SWM Project)*

The participation of Penang in the activities of CCAC is led by the Penang State Government, Penang Island City Council (MBPP), and the Seberang Perai Municipal Council (MPSP) in collaboration with the International Environmental Technology Centre of the United Nations Environment Program (UNEP-IETC) and the World Bank.

A pilot was designed for Penang is to embark on a resource recovery - organic composting objective. Removing and recycling organic waste can reduce the co-mingled waste portion by potentially 40% of the total waste stream.
"Incentive payments"—cash awards—are given to participating high-rise communities if they successfully separate food/organic wastes at source. Separated food/organic waste will be evaluated on pre-determined measures. The high-rise households, organized around a High-rise Management Committee (HMC) will receive an incentive payment based on this score, subject to both a minimum score and a maximum incentive payment ceiling.

Each of the municipal councils, MBPP and MPSP, has chosen moderately different systems and technologies for the collection and processing of separated household waste. As a result of these differences, the specific project designs (specifically with respect to evaluation) are also different.

On Penang Island, the MBPP has chosen a decentralized system—medium-capacity waste processing machines that are installed on-site at each high-rise building. Households separate their food wastes and bring them to this machine, where it is ground, mixed with water and microbial liquid called bokashi, and processed into a liquid soil enhancer or “slurry”. The company that markets the machine also is responsible for collection, removal, and transportation of the slurry. It owns the slurry that the machines produce.

On the mainland, the MPSP has chosen a more centralized system. High-rise buildings separate their food wastes and the Urban Services Department of the MPSP is responsible for providing them standard-sized waste bins and regular collection of the food waste. It transports the food waste to a high-capacity, privately-owned and operated waste processing centre.

The application of RBF remains neutral to the chosen technology of each city. That is, the general principles of payment only upon verified outputs holds true regardless of a centralized or decentralized waste collection and processing system. Nevertheless, because of the MBPP and MPSP’s differences, the document explains each sides’ process for evaluation and payment separately.

Program flow chart, Verification Procedure, Food Waste Collection Form B1 (MBPP/MPSP) as per attachment will be used for the implementation of the program. It will be used and replicated in other areas.

Only project sites with participation rate of 20% above will qualify for the RM600 incentive. Both High-rise Committee Management and Verification Agent shall keep the participation records.

All stakeholders involved in the program should clearly understand their roles and responsibilities in the program as stipulated in the Instructions and Procedures (please refer to the attached documents for detailed information). The following are the brief notes on the roles and responsibilities for all stakeholders involved:

High-rise Committee Management (HMC) to record, keep and maintain the records of the weight of the food wastes collected and residents’ participation records for auditing and verification purpose.

Collector/Food Waste Processing Technology Providers to follow the instructions and procedures in implementing the program.

Verification Agent (VA) to conduct field check and verify the field data, prepare verification report and submit to Urban Service/Community Department for review and approval every month.
Project Implementation Unit (PIU) to compile data, calculate score and incentive amount for participating pilot project sites, and submit evaluation report to Urban Services Department, MBPP/Community Department, and MPSP for review and approval every month.

Director of Urban Services Department from MBPP/Community Department from MPSP to review and approve report and claims submitted by HMC, PIU and VA, and submit report to the Chairman of Local Government Committee every three months.

All food waste data collected should be documented, verifiable and well-kept for future reference.

All project sites that participate in the program will be given a plaque as a form of recognition and appreciation. Both Councils will prepare the budget for the plaques. The proposed design for the plaque and the quotations are attached for your reference and action.

Financial Incentive which is RM600 will be given once a year to the High-rise Management Committees. All incentives given will be back dated to 2014.

The documents that are developed for the implementation of activity 4-Output based program to incentivize organic waste separation are attached in the Appendix.

Program Flow Chart

MPPP-Food Waste Collection Form B1
MPPP-Instructions and Procedures
MPSP-Food Waste Collection Form B1
MPSP-Instructions and Procedures

The up-scaling and replication activities are focused on waste separation at source for high-rise dwellings (World Bank Technical Assistance), awareness raising for waste separation and separate collection of organic waste at source is in place.

The local authorities are aware that although there ought to be further expansion of upstream activities for organic waste diversion (such as hawkers, restaurants, hotels, food outlets etc.). The up-scaling of organic waste diversion upstream targeting food waste separation from roadside hawker stalls, restaurants, hotels in the UNESCO World Heritage George Town inner city where a few main streets (especially those which have night hawking) has been identified for a pilot project under CCAC Phase 3 for Penang.

**OUTPUT BASED PROGRAM TO INCENTIVE SOLID WASTE SEPARATION**

**PENANG STATE**

<table>
<thead>
<tr>
<th>Personnel Involved</th>
<th>Description of Works</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-rise Management Committee (HMC)</td>
<td>Record readings as required in Form B1 for claiming incentives.</td>
<td>When every collection is made</td>
</tr>
<tr>
<td></td>
<td>Keep and maintain the records for auditing and verification purpose.</td>
<td></td>
</tr>
</tbody>
</table>

17
4 UP-SCALING & REPLICAION AT INTERMEDIATE DISPOSAL SITES

Up-scaling of organic waste diversion should also be undertaken at the intermediate disposal sites such as the Jelutong Dumpsite on Penang Island and also at Ampang Jajar Transfer Station in Seberang Perai.

Both these sites divert green waste from the municipal waste stream and turn them into compost and compost-like materials (not fully fermented material).

4.1 Jelutong Dumpsite, Penang Island

C&D waste includes bricks, concrete, masonry, soil, rocks, lumber, paving materials, glass, plastics, aluminium, steel, drywall (gypsum), plywood (formwork), plumbing fixtures, electrical, and roofing materials. Some European countries have been practicing C&D waste management based on prevention (minimisation), recovery and restriction (reusing and recycling).

Developers and contractors are required by law to dispose C&D at the landfills. However, some are illegally dumped along roads, ravines and the countryside etc. by the haulers they engage instead of at the Jelutong or Pulau Burong landfills. There is no treatment of C&D waste as the current system of management does not require or make it mandatory for contractors to undertake such measures. Hence, there is little C&D recovery in Malaysia unlike countries like Japan or Denmark where C&D constitutes a certain percentage of construction material thus providing a ready market for such waste.

Table 3: Waste disposal at Jelutong Dumpsite

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BULKY WASTE</td>
<td>10,379</td>
<td>19,500</td>
<td>70,299</td>
<td>79,139</td>
<td>78,763</td>
<td>17,278</td>
<td>25,737</td>
<td>25,089</td>
<td>51,955</td>
<td>58,504</td>
<td>60,341</td>
</tr>
<tr>
<td>C&amp;D</td>
<td>49,768</td>
<td>85,107</td>
<td>91,294</td>
<td>88,744</td>
<td>91,346</td>
<td>180,403</td>
<td>164,432</td>
<td>164,432</td>
<td>82,358</td>
<td>140,762</td>
<td>67,349</td>
</tr>
<tr>
<td>EXCAVATION WASTE</td>
<td>10,751</td>
<td>56,384</td>
<td>50,547</td>
<td>102,783</td>
<td>40,693</td>
<td>155,850</td>
<td>243,404</td>
<td>243,404</td>
<td>137,923</td>
<td>203,872</td>
<td>82,856</td>
</tr>
<tr>
<td>GREEN WASTE</td>
<td>647.61</td>
<td>3,152.1</td>
<td>1,192.2</td>
<td>2,389.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: MBPP 2016
There is some information on C&D waste from the Jelutong landfill and also for Seberang Perai. In Jelutong, the estimate is 400 metric tons/day of construction waste and for Seberang Perai; the estimate is 100 metric tons/day. These estimates are provided by officers from both councils. However, there is no aggregated data being compiled by the Councils on indiscriminate dumping from complaints by citizens.

Table 4: Estimation of Construction and Demolition Waste in Penang, 2005-2025

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPP</td>
<td>438,840</td>
<td>477,943</td>
<td>516,390</td>
<td>553,526</td>
<td>601,979</td>
</tr>
<tr>
<td>MPSP</td>
<td>511,150</td>
<td>563,328</td>
<td>616,044</td>
<td>668,386</td>
<td>726,892</td>
</tr>
<tr>
<td>Penang</td>
<td>949,990</td>
<td>1,041,271</td>
<td>1,132,434</td>
<td>1,221,912</td>
<td>1,328,871</td>
</tr>
</tbody>
</table>

* C&D waste generation rate is 1.772 kg/cap/day based on Danish Waste 21 strategies 1998-2004

In 2005, it is estimated that Penang has generated about 950,000 metric tons of construction and demolition waste (C&D), if the assumption of C&D waste generation rate is 1.772 kg/cap/day. By 2020, it is estimated that about 1.2 million metric tons of C&D waste will be generated.
### Table 5: Current Collection Schedule for MBPP

<table>
<thead>
<tr>
<th>Type of Premise</th>
<th>Frequency</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOMESTIC WASTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landed Properties</td>
<td>3 x per week except on Sunday</td>
<td>Padang Kota : Daily except on Saturday</td>
</tr>
<tr>
<td>High Rise, Commercial and Industries</td>
<td>Daily except on Sunday</td>
<td></td>
</tr>
<tr>
<td><strong>BULK WASTE AND GARDEN WASTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All areas in the collection scheme</td>
<td>Daily except on Sunday</td>
<td></td>
</tr>
<tr>
<td><strong>MARKET WASTE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All markets</td>
<td>Daily</td>
<td></td>
</tr>
</tbody>
</table>

#### 4.2 Ampang Jajar Transfer Station

The site at Ampang Jajar was originally a landfill which started operations in 1988/89 but was officially closed in December 2001 when it reached its maximum capacity. All MSW from SPU and part of SPT are transported to the Ampang Jajar Transfer Station (AJTS). These wastes are compacted before being sent to the Pulau Burong Landfill for final disposal. For the surrounding areas especially for Seberang Perai Selatan, collection trucks directly transport MSW to the landfill.

In July 2011, this transfer station also receives domestic solid waste from the island and will continue to do so until the Batu Maung Transfer Station is in operation again.

Currently, about 10 acres is being used to process about 40-50 tons of green waste daily and about 2,250 ton of green waste per year. These are mainly green waste from the North and Central Districts.

More green waste needs to be diverted to this site for processing into compost from North and Central districts.
Photo 2: Green Waste Processing at Ampang Jajar Transfer Station
5 UP-SCALING & REPLICATION AT FINAL DISPOSAL SITE

The CCAC Stage 2 project also involves the search and identification of available environmentally sustainable technologies (EST) not only to treat organic waste at source but also at the landfill. Technologies such as bio-digester systems / MBT systems etc. and other appropriate technologies that are suited to local conditions will be considered.

Penang still needs to solve the remaining portion of 40% - 60% of organic waste that ends up in the landfill daily. The Pulau Burong Sanitary Landfill comprises 3 Phases. It receives about 1,600 to 1,800 metric tons of daily incoming solid waste from Penang Island as well as Seberang Perai.

The Level 3 Sanitary Landfill is approximately 66 hectares of which 33 hectares are already in use. The landfill has a natural liner of clay soil and is operated using the semi-aerobic (Fukuoka) method. The current tipping fee charged at the landfill is RM20.20 (USD6.70) for both domestic wastes and industrial waste.

MPSP charges for tipping using an individual permit system issued to lorries carrying the wastes. The fee for a day’s permit is RM20, irrespective of the number of trips made by the lorry to dispose the wastes at Pulau Burong.

There are 3 phases in the landfill:

Phase 1: 32.40686 hectares
Phase 2: 18.94 hectares
Phase 3: 127.47 hectares
Phase 1 and Phase 2 which were using the semi-aerobic Fukuoka Method for final disposal are already closed but being used temporarily for daily incoming waste as Phase 3 which will be designed as an anaerobic Level 4 landfill is about to be handed over to the current concessionaire for development.

The Sanitary Landfill also has a transfer bay for daily incoming waste from the Ampang Jajar Waste Transfer Station. There is a leachate treatment plant and also a small semi-automated pilot project for resource recovery activities at the landfill. This resource recovery activity is to be up scaled for Phase 3. Hence this is the appropriate time for feasibility studies.
6 CONCLUSION

The management of Municipal Solid Wastes (MSW) in Penang still faces many challenges as the population grows. The current regulation system is not perfect and the existing management system and the collection facilities needs to be fine-tuned towards mandatory waste separation at source. Municipal solid wastes are still collected without separation at the source, treatment facilities are limited and much of the collected wastes are still unrecovered. Government, NGOs, CBOs and private sectors must continue to collaborate as there is still much needs to be done. The main management strategies to remedy this should include amendment of current laws and regulations, improve current management systems and introduce classified collections. The effective implementation of these strategies will help to reduce the problem of waste generation and divert waste from the landfill and through the effective and widespread practice of the 3Rs.

The proposed Organic Waste Management for Penang is to embark on a more aggressive resource recovery and diversion of putrescible materials from the landfill. The rationale behind the objective is that removing putrescibles from the waste stream will enhance recycling because it reduces the co-mingled waste portion up to 40% or more from landfilling.

Three types of actions are required to achieve this objective, i.e.

1. Re-designing the waste management system to facilitate the collection of organic waste from identified priority groups;
2. Developing capacities in selected local communities, NGOs, etc. to increase the participation in organic waste separation, and sustaining this effort with a social program that aims at improving public awareness; and
3. Introducing economic incentives to improve the segregation of waste into “pure” fractions.

There is a need to promote public education and also to raise awareness on SWM issues on a sustained basis. Courses for politicians and decision makers are also necessary to ensure correct policies and regulations are formulated to ensure a sustainable environment. Ultimately, the policy should be able to bring about a change in attitude of the public in attitude and behaviour on solid waste management. The Government should allocate funds on an annual basis for public education and awareness programmes for sustainability.

Public awareness and education are necessary ongoing activities and Best Practices for organic waste diversion will be documented and uploaded onto the State Government's website.

The proposed feasibility studies for up-scaling the organic waste diversion at the landfill to handle the daily incoming domestic as well as organic waste from point of generation are:

- Activity 1: Waste Diversion at Landfill site:
  FEASIBILITY STUDY FOR MATERIAL RECOVERY FACILITY (MRF) & BIO-DIGESTER AT PHASE 3, PULAU BURONG SANITARY LANDFILL, PENANG, MALAYSIA
  Objective: To divert organic waste from the landfill cells through efficient resource recovery of both recyclables and organic material as a useable product through the implementation of environmentally sustainable technologies.
**Outcome:** The landfill will divert 40-50% organic waste (400 – 600 tpd) from daily incoming MSW away from the landfill cells. This is done through efficient resource recovery of both recyclables and organic material as a useable product through environmentally sustainable technologies.

- **Activity 2: Waste Diversion at Point of Generation:**
  **PILOT PROJECT: UP-SCALING OF FOOD WASTE DIVERSION FROM THE LANDFILL IN GEORGE TOWN, PENANG, MALAYSIA**
  **Objective:** Up-scaling of organic waste diversion upstream targeting food waste separation from roadside hawker stalls, restaurants, hotels in the UNESCO World Heritage George Town inner city on selected main streets (especially those which have night hawking) for a pilot project.

  **Outcome:** Pilot project for up-scaling of organic waste diversion upstream targeting food waste separation from roadside hawker stalls, restaurants, hotels in the UNESCO World Heritage City of George Town on selected main streets (especially those which have night hawking) for a pilot project avoiding SLCP emissions at the landfill.

- **Activity 3: Waste Diversion at Point of Generation:**
  **FEASIBILITY STUDY FOR A ZERO DISCHARGE AND CLOSED FARMING SYSTEM TO ADDRESS THE ISSUE OF PIG WASTE MANAGEMENT**
  **Objective:** To avoid methane emissions of pig waste sludge fermenting on site or openly dumped in plantations through the implementation of zero discharge and closed farming systems.

  **Outcome:** This activity has the potential to avoid methane release up to 649,474 metric tons of daily piggery waste in-situ throughout the State through the implementation of zero discharge and closed farming systems to treat pig waste at point of generation.

These projects are proposed so that as little organic waste as possible ends up in the landfill cells. The overall scope of work for organic waste is at the municipality level and addresses the issue of organic waste diversion from the landfill (Activity 1) as well as from point of generation (Activity 2 & 3) in order to avoid the emissions of SLCPs. Activity 1 focuses on diverting the bulk of the putresibles from the landfill cells. Activity 2 focuses on the up-scaling of existing organic waste diversion upstream targeting food waste separation from wet markets, schools and high-rise residential areas to roadside hawker stalls, restaurants, hotels in the George Town World Heritage site on a pilot project basis. Activity 3 addresses the problem of agricultural waste focussing on the pig farming industry which has been a persistent polluting issue for the State. A small pig farm has been selected to be a model for the other 200 over pig farms in the State.

To further support the above activities, Penang is now at the final stages of developing a "Waste Separation at Source Regulation" and a "Waste Generators' Pay Principle" targeting the industrial sector and later the commercial sector.

Included in this Plan are up-scaling & replication strategies organic waste collection and diversion according to ease of adoption by stakeholders for “Low Hanging Fruits” i.e. Hotels, Hospitals, Schools & Other Educational Institutions; “Medium Hanging Fruits” i.e. Wet Markets, Food Courts / Hawker Centres and High Rise Dwellings and finally “High Hanging Fruits” i.e. Residential Landed Property, Coffee Shops / Restaurants, Kampongs, SMI / SMEs and Renovators / Contractors.

Specific strategies for NGOs/CBOs, Private firms and companies as well as the government sector have also been identified for a holistic approach.

Incentive schemes have also been adopted following the Results-Based Financing (RBF) Program developed by the World Bank under CCAC Stage 2 by the State Government to incentivise the waste diversion efforts.
As for the MRF project (Activity 1), the municipal solid waste landfill sites are co-owned by the Penang Island City Council (MBPP) and the Seberang Perai Municipal council (MPSP), and the project implemented and managed by private companies will be supported by the government. MSW stream ends up at the landfill, and this needs to be addressed by resource recovery and waste. This ensures the project sustainability in the long term. This MRF project will be a good model for landfill sites in other administrative districts and other countries that have similar landfill-related problems and, therefore, the local and national governments will support replication in other cities domestically and internationally by dispatching the information on their good practice at every occasion.

As for the biogas project (Activity 3), project sustainability will be ensured basically through the sound management of pig farming business. The Federation of Livestock Farmers' Associations of Malaysia (FLFAM) could play an important role on the sustainability and replicability of the project in collaboration with domestic local livestock industries and also with livestock industries in other countries in the long term. Biogas projects like the proposed one could be implemented and registered as CDM (Clean Development Mechanism) projects or JCM (Joint Crediting Mechanism between Japan on one hand and host countries on the other). These mechanisms also could support replicability of the proposed project activity domestically and internationally.

Feedback and recommendations from the Awareness raising and capacity building on organic waste management plan stakeholder workshop on 13-14 April 2015 and the Environmentally Sound Technologies (EST) and Public Private Partnerships for Organic Waste Management Workshop 8-9 June 2015 calls for the Penang's State Government to be more involved in holistic solid waste management for both inorganics and organics through the following ways:-

1. Educate the public to increase the awareness towards solid waste management by promoting 3R (Reduce, Reuse and Recycle). Reduce, reuse and recycle is a solid waste management practice to minimize waste generated.

2. Source separation by-laws should be enacted with adequate enforcement and appropriate penalties be imposed on the violators.

3. Provide funding and incentives to start composting and the promotion of composting at home to encourage public to compost so that the organic waste is diverted from the landfill.

4. Give more incentives to those NGO's involved in recycling ad well as in organic waste management. A reasonable amount of money up to a maximum of RM600 per month to be paid to project implementers active and serious in recycling and organic waste management. Money to be used for setting up, upgrading and maintenance of facilities. This is to make organic waste management more attractive for community participation.

5. Buying back the finished product i.e. organic fertilisers from the recyclers at a reasonable price. These organic fertiliser could be used by the local authorities in parks as well as for landscaping. State and Local Government should be supportive in this aspect. Liquid fertilizers produced by Bio-regen machines of MBPP at several markets must be economically viable.
6. Fast track approval should be given by the state as well as local authorities to development projects involving recycling and composting activities e.g. land conversion for this purpose.

7. Building and maintaining recycling as well as organic waste processing centres.

8. Facilitate more wet markets to start composting in order to reduce waste at source.

9. Collection of organic waste from restaurants, housing estates, flats, hotels etc. as those involved in this project are having problem transporting the organic waste to site. In particular MPSP has been singled out as not supportive of waste composters’ efforts in this aspect.

10. Enforcement of green waste disposal. Local Authorities must have strict enforcement and close monitoring of green waste to ensure green waste are disposed of at approved sites. Declaration of green waste disposal are to be submitted by contractors.

11. Plastics that are non-recyclable or bio-degradable should be taken of the market so that it will not end up at the landfill.

12. Increase the price of plastic bags available at supermarkets from the present RM0.20 to RM1.00 to discourage plastic bags usage.

13. Address current issues for each type of waste. For example, recycling contractors are no longer collecting glass bottles and this has become a huge waste problem and the means to recycle e-waste.

Both local authorities in Penang, MBPP and MPSP should be more involved in recycling as well as in organic waste management by:

1. Opening more recycling centres near housing to increase the recycling rate;

2. Providing organic and non-organic bins at residential areas for example multi-storey housing to facilitate the collection of separated waste;

3. License renewal should incorporate the criteria of waste segregation in order for the commercial sector to play a more important role in solid waste management.

As part of the Penang Government’s effort to divert organic waste at the point of generation, a programme to collect to collect used cooking oil has been started in 2016. The collected oil will be converted to biodiesel and is collected by a local company which is also actively involved in treating fats, oil and grease (FOGs) as well as odour from the garbage trucks. This programme started with the Seberang Perai Municipal Council (MPSP) but will be replicated in phases throughout the State.
Figure 4: Used Cooking Oil Recycle to Biodiesel Programme Banner

Figure 5: Used Cooking Oil Recycled to Biodiesel Poster
In the Penang Climate & Clean Air Coalition (CCAC) Regional Workshop on Waste Management for Climate Change held on 25-28 October 2016 was part of Penang’s plan for regional sharing and replication of its Best practices with participants in the region.

The Regional Workshop sponsored by the CCAC under its Municipal Solid Waste Initiative (MSWI) in collaboration with UNDP-IETC and the Penang State Government included Field Training Visits to selected best practice sites on both the mainland (MPSP) and on the Penang Island (MBPP). The sites were selected to show case the best practices of involving segregation of waste at source and treatment of organic waste by the various stakeholders from the community, NGOs, schools, hospital, commercial food hub, food outlets and a including a hill resort.

The Field Training Visits and Workshop sessions were designed in a modular format so that participants of the Workshop are able to get more detailed explanation of the best practices sites by the stakeholders during the Workshop phase. This is done so that the participants can absorb the explanation and replicate what they have learned during the Regional Workshop when they return to their respective countries. The Workshop itself provides Penang an opportunity to present itself as a Penang COE (Center of Excellence) to showcase Best Practices on environmental issues for the region and a place to learn about Municipal Solid Waste management.
The following list is an example of the learning modules by different stakeholders and practitioners that have been uploaded onto a website.

**GOVERNMENT AGENCIES, COMMUNITY, NGO, HOSPITAL, SCHOOL, COMMERCIAL HUB BEST PRACTICES**

- Implementing local action by Honourable. Dato’ Maimunah Mohd Sharif, President of Seberang Perai Municipal Council
- Module 1 : Green School Project Programme : Recycling Bank by Ms. Mona Lim Swee Lin, Sekolah Kebangsaan Convent Green Lane, Penang
- Module 2 : Establishing an Environmental Resource Centre & Urban Organic Farming by Mr. Ng Tho Heng, Taman Desa Damai Community
- Module 3 : Establishing a Zero Waste Community by Mr. Lim Chee Keong, Taman Bagan Lalang Community
- Module 4 : Hospital Waste Management Programme by Ms. Cheow Mooy Chew, Lam Wah Ee Hospital, Penang
- Module 6 : Auto-City Food Waste Composting - An Integral Green Practice of Modern Nature by Mr. Gary Teoh, Autocity Management Body
- Module 7 : Recycling for Charity by Mr. Siow Eik Kwang, Tzu Chi Buddhist Merit Society

**PRIVATE SECTOR WASTE OPERATORS AND TECHNOLOGY SERVICE PROVIDERS**

- Saving Costs Transferring Waste by Eurasia Express Sdn. Bhd.
- Operating a Green Landfill by PLB Terang Sdn. Bhd.
- E-Waste Collection Programme by Mr. Foo Kok Beng, Penang Island City Council
- Recycling Electric & Electronic Waste by Shan Poornam Metals, Malaysia / Nomura Kohsan, Japan

The private companies that operate the transfer station, landfill and food machine vendor as well as e-waste recyclers have also been given an opportunity to show case their technologies to the participants of the workshop.

According to UNEP, the purpose is to showcase some of Penang’s best practices. To meet this purpose each operator must prepare an instructional package consisting of a brief write up, PowerPoint Presentation and a short homemade video (non-professional 5-7 mins) of your practice and how they can start off a similar activity when they return to their country.

A document on “Resources for Best practices on Organic Waste Management in Penang” have also been developed alongside a website [http://www.pgcaringsociety.com.my/](http://www.pgcaringsociety.com.my/) to host the Penang Best Practice Site. This website is developed for Penang as a volunteer effort by Quicdata System Development.

The website will show case more selected Best practices online to provide easy access to more information seekers pertaining to solid waste management.
The general implications of the recent Waste Characterisation Study by Infitech Sdn. Bhd. (October 2016) showed that since the introduction of the waste segregation at source regulation on 1 July 2016, the valuable recyclables have already been removed out of the waste stream for recycling and only non-recyclables are discarded for municipal collection. Although waste segregation at source regulation is not fully complied with by the general public, it is evident that less valuable recyclables are being discarded.

A glance at the comparative chart in Table 6 below shows the changes in waste composition between Year 2003 and Year 2016. This is a part evidence that portrays the success of the various best practices implemented by the community based organisations, NGOs, institutions such as schools and hospitals, commercial centres and also the government agencies and the private sector related to solid waste management.

![Photo 6: Waste Composition Survey at Ampang Jajar Waste Transfer Station](image)

**Table 6: Composition of MSW, MBPP and MPSP, 2003**

<table>
<thead>
<tr>
<th>Item</th>
<th>MPSP</th>
<th>MBPP</th>
<th>Penang State Overall Average (%)</th>
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<tr>
<td></td>
<td>Metric tons</td>
<td>%</td>
<td>Metric tons</td>
<td>%</td>
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<tr>
<td>Food</td>
<td>605.84</td>
<td>50</td>
<td>206.23</td>
<td>33</td>
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<td>Yard &amp; Garden</td>
<td>148.99</td>
<td>12</td>
<td>59.86</td>
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<td>Paper</td>
<td>54.12</td>
<td>5</td>
<td>176.15</td>
<td>28</td>
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<tr>
<td>Plastics</td>
<td>208.1</td>
<td>17</td>
<td>89.89</td>
<td>15</td>
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<tr>
<td>Textile/Rubber</td>
<td>38.48</td>
<td>3</td>
<td>19.02</td>
<td>3</td>
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<tr>
<td>Metal</td>
<td>43.36</td>
<td>4</td>
<td>29.09</td>
<td>5</td>
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<tr>
<td>Hazardous</td>
<td>2.69</td>
<td>0.00</td>
<td>1.92</td>
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<tr>
<td>Others</td>
<td>98.42</td>
<td>8.00</td>
<td>37.74</td>
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<td>Total</td>
<td>1,200.00</td>
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Paper and paper products discarded at the landfill has fallen sharply from 16.5% (2003) to 2.46% (2016). The plastics category also shows a decline from 16% (2003) to 10.34% (2016). Metals fell from 4.5% (2003) to 1.28% (2016).

In the others category, there was a sharp increase to 39.47% (2016) from 7.0% (2003). This also indicates that there is an increase in non-recyclables collected from households.

The general implications of the study is that since the introduction of the waste segregation at source regulation, the valuable recyclables have already been removed out of the waste stream for recycling and only non-recyclables are discarded for municipal collection. Although waste segregation at source regulation is not fully complied with by the general public, it is evident that less valuable recyclables are being discarded.

There is a need for more awareness of the waste segregation regulation before it is fully enforced with fines. However, after public education and awareness campaigns have been conducted, there needs to be strong enforcement. Deterrent action is needed to tackle recalcitrant members of the public to bring about compliance to cleanliness by-laws.

There should be emphasis on the 3Rs as it involves changing peoples’ attitudes and present practices to minimize waste at the front end so that waste is reduced in the first place rather than treating it later.

Resource Recovery covers a wide array of activities ranging from the itinerant buyers going around neighbourhood in motorcycles, vans and trucks to bigger resource recovery centres even at the Pulau Burung Landfill itself. It is important to have effective policies and department process maps to tackle the cleanliness issues.

To consolidate all the efforts undertaken by the various stakeholders, an Integrated Solid Waste Management Masterplan for Penang heading towards a zero waste management policy should be formulated to provide direction and further action for the present and future. This ISWM Masterplan must also be monitored, reviewed and evaluated over the years to adapt and accommodate changing scenarios as well as to face up to future challenges. The main core goals for the long term are the lowering the social costs and risks of waste, reducing the damage to the environment from waste generation and disposal; and increasing economic benefit by more efficient use of materials.

This Up-Scaleing and Replication Plan which is part of the Penang Organic Waste Policy and Plan is formulated as a dynamic document that requires frequent updates from time to time as policy directions, strategies and action plans change and evolve to reflect new situations that may arise in the future.

With such mechanism and infrastructure in place it is only a matter of time before more resource recovery is achieved in Penang. Penang will continue to move towards achieving its motto “Cleaner, Greener, Safer, Healthier and Happier Penang.”
REFERENCES


GOM- DANIDA, 2008. Recycle Bank in Schools and 3R Activities in Rural Community of Majlis Bandaraya Pulau Pinang (MBPP), Government of Malaysia (GOM) - DANIDA


Waste concern. 1998. Public/Private partnership and community based composting in Dhaka, Bangladesh

APPENDIX 1: OUTPUT BASED PROGRAM TO INCENTIVE SOLID WASTE SEPARATION MAJLIS BANDARAYA PULAU PINANG (MBPP)

GENERAL INFORMATION

1. High-rise Management Committee (HMC) in the program to which this procedure applies shall be informed of the following verification procedure at the commencement of the program.
2. Form B1 shall be in triplicates, one each for the High-rise Management Committee (Form B1a), Collector (Form B1b) and Project Implementation Unit from Majlis Bandaraya Pulau Pinang (MBPP) (Form B1c).

ROLES AND RESPONSIBILITIES

1. High-rise Management Committee (HMC)
   The High-rise Management Committee (HMC) shall:
   • record the first reading of the water meter of the Bio-regen machine.
   • record all subsequent meter readings on a periodical basis, amount of slurry collected and amount of bokashi used in Form B1 when collection is made.
   • ensure both HMC and collector sign the form when every collection is made.
   • keep the records of HMC and residents that participated in the program.

2. Verification Agent (VA)
   The Verification Agent (VA) shall:
   • conduct field checks from time to time.
   • request a schedule of collection from the either the HMC or Collector.
   • Impromptu field checks shall be made periodically on the chosen date and time of collection.
   • counter check and verify the total quantity of food waste using the formula in Form B1.
   • Counter check and verify the authenticity of the field data records.
   • keep records of HMC and residents that participated in the program.
   • prepare verification report and submit to Urban Service Department for review and approval by end of every month.

3. Project Implementation Units (PIU)
   The Project Implementation Units (PIU) shall:
   • compile data and check field data record in B1 for participating High-rise dwellings by end of every month.
   • prepare calculation of scores and incentive amount for participating High-rise dwellings every month.
   • prepare evaluation report and submit to Urban Service Department for review and approval by end of end of every month.
VERIFICATION PROCEDURE

1. High-rise Management Committee (HMC) shall record the amount of water used from installed water meter readings every time the collection is made. Form B1 shall be filled in by HMC and signed by the Collector.

2. HMC should keep and maintain accurate records for auditing and verification purposes.

3. The high-rise dwellings that participate in the program would be verified every month by the Verification Agent (VA).

4. VA shall check the records (eg. Form B1 and other related documents) and current water meter readings.

5. If the data recorded cannot be verified, another site verification with the collector and HMC shall be arranged within 7 days. Any tampering with the weighing machine or falsifying of records by either the collector or HMC will automatically disqualify the HMC from the program.

6. If the data recorded can be verified, VA shall chop and sign Form B1b. PIU and VA shall take a copy of the Form B1b for record. PIU shall submit the original signed copy of B1b for claiming incentives.
## FOOD WASTE COLLECTION FORM B1
MAJLIS PERBANDARAN PULAU PINANG

### A. HIGHRISE DWELLING DETAILS

<table>
<thead>
<tr>
<th>Name of Highrise Dwelling</th>
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<tr>
<td>Address</td>
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<td>Contact Person</td>
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<td>Food Waste Collector</td>
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### B. FIELD DATA

<table>
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<tr>
<th>No.</th>
<th>Date</th>
<th>Current Water Meter Readings</th>
<th>Volume of water used (litres) (W)</th>
<th>Amount of slurry collected (litres) (N)</th>
<th>Amount of bokashi used (litres) (B)</th>
<th>Collected by Contractor (Name and Signature)</th>
<th>Verified by HMC (Name and Signature)</th>
<th>Remark</th>
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**TOTAL**

**TOTAL OF FOOD WASTE, A=0.85 (N-W-B)**

Checked by PIU, MPPP: (Name)  
Signature:  
Date:  
Remark:

Verified by Verification Agent: (Name)  
Signature:  
Date:  
Remark:

37
APPENDIX 2: OUTPUT BASED PROGRAM TO INCENTIVE SOLID WASTE SEPARATION MAJLIS PERBANDARAN SEBERANG PERAI (MPSP)

GENERAL INFORMATION

1. High-rise Management Committee (HMC) in the program to which this procedure applies shall be informed of the following verification procedure at the commencement of the program.

2. Form B1 shall be in triplicates, one each for the High-rise Management Committee (Form B1a), Collector (Form B1b) and Project Implementation Unit from Majlis Perbandaran Seberang Perai (MPSP) (Form B1c).

ROLES AND RESPONSIBILITIES

1. High-rise Management Committee (HMC)

The High-rise Management Committee (HMC) shall:

- record the weight of the food wastes collected.
- record all subsequent weights on a periodical basis in Form B1 when collection is made.
- keep the records of food waste collected by the Collector.
- ensure both HMC and Collector sign the form when every collection is made.
- keep the records of HMC and residents that participated in the program.

2. Verification Agent (VA)

The Verification Agent (VA) shall:

- conduct field checks from time to time.
- request a schedule of collection from the either the HMC or Collector.
- Impromptu field checks shall be made periodically on the chosen date and time of collection.
- counter check and verify the total quantity of food waste recorded in Form B1.
- counter check and verify the authenticity of the field data records.
- keep the records of HMC and residents that participated in the program.
- prepare verification report and submit to Community Department for review and approval by end of every month.

3. Project Implementation Units (PIU)

The Project Implementation Units (PIU) shall:

- compile data and check field data record in B1 for participating High-rise dwellings by end of every month.
- prepare calculation of scores and incentive amount for participating High-rise dwellings every month.
- prepare evaluation report and submit to Community Department for review and approval by end of every month.
VERIFICATION PROCEDURE

1. The High-rise Management Committee (HMC) shall record the quantity of food wastes every time the collection is made. Form B1 shall be filled in by HMC and signed by the Collector.
2. HMC should keep and maintain accurate records for auditing and verification purposes.
3. The high-rise dwellings that participate in the program would be verified every month by the Verification Agent (VA).
4. VA shall check the records (eg. Form B1 and other related documents).
5. If the data recorded cannot be verified, another site verification with the collector and HMC shall be arranged within 7 days. Any tampering with the weighing machine or falsifying of records by either the collector or HMC will automatically disqualify the HMC from the program.
6. If the data recorded can be verified, VA shall chop and sign Form B1b. PIU and VA shall take a copy of the Form B1b for record. PIU shall submit the original signed copy of B1b for claiming incentives.
## A. HIGHRISE DWELLING DETAILS

<table>
<thead>
<tr>
<th>Name of Highrise Dwelling</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Person</td>
<td>Food Waste Collector</td>
</tr>
</tbody>
</table>

## B. FIELD DATA

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Weight of Food Waste at Highrise Dwelling (kg)</th>
<th>Transported by MPSP/Contractor (Name and Signature)</th>
<th>Verified by HMC (Name and Signature)</th>
<th>Weight of Food Waste at Composting Plant (kg)</th>
<th>Weighed by Contractor (Name and Signature)</th>
<th>Verified by Collector (Name and Signature)</th>
<th>Remark</th>
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<td>1</td>
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APPENDIX 3: PENANG’S ORGANIC WASTE POLICY (POWP) IN A NUTSHELL

The Penang Organic Waste Policy seeks to encourage the separation and treatment of organic waste at source in order to divert such away from the landfill prolonging its lifespan and reducing municipal cost. This is part of Penang’s local action towards a global commitment to mitigate the effects of global warming and climate change.

In any natural system the organic outputs of any natural process become the inputs for another natural process. In this regard, Penang’s Organic Waste Policy will seek to emulate nature and return all organic outputs to food production, parks and gardens and energy production.

POLICY OBJECTIVES

OBJECTIVE 1:
To divert the amount of organic waste (putrescibles) from the PulauBurong Sanitary Landfill and moving towards a total ban in the long term.

    Strategy 1.1: Impose separation of organic waste at source
    Strategy 1.2: Develop relevant policies for different waste generators
    Strategy 1.3: Increase community awareness and understanding of separating organic waste at source

OBJECTIVE 2
To reduce the costs of collection, transfer and treatment of organic waste for the local authorities by treating organic waste at source.

    Strategy 2.1: Encourage treatment of organic waste into useful by-products at source where possible.

OBJECTIVE 3
To incentivise organic waste treatment by private and community efforts through costs savings by local authorities.

Strategy 3.1: Develop incentive systems to reward efforts such as Neighbourhood Watch (RukunTetangga) that treat and process organic waste at source
Strategy 3.2: Set the stage for future voluntary carbon offset schemes.
**OBJECTIVE 4**
To emulate nature and return all organic outputs to food production, parks and gardens and energy production thereby completing the nutrient cycle to ensure a sustainable food supply and security.

**Strategy 4.1:** Develop and promote new linkages to return organic outputs to the food production process in agricultural, horticultural and agro-forestry sectors.

**Strategy 4.2:** Encourage a food waste to food policy to maintain food security through urban and peri-urban agriculture

<table>
<thead>
<tr>
<th>Groupings</th>
<th>Type of Organic Waste</th>
<th>Possible By-products</th>
<th>Strategies</th>
<th>Remarks</th>
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<tr>
<td><strong>Group A</strong></td>
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<tr>
<td>Residential</td>
<td>- Food &amp; Kitchen</td>
<td>- Compost</td>
<td>- Public Awareness</td>
<td>In areas where people have little personal income or not viable to install food waste processing machines it may be possible to distribute plastic compostable bags and to bring the bags to a central location with such facilities.</td>
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<td>Waste</td>
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<td>- Garden &amp; Yard</td>
<td>fertilizer</td>
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<td>- Bulk Waste</td>
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<td>- Individual composting</td>
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<td>Other Commercial Enterprises</td>
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<p>| <strong>Group D</strong> | - Food &amp; Kitchen Waste | - Compost | - Public Awareness | - Separation at Source |
| - Restaurants | - Fresh crop and animal product waste | - Bio-liquid fertilizer | - Individual composting | - Community composting |
| - Food Courts / Complexes | | | - Regulatory | - Licensing |
| - Hawkers | | | Requirement - Food | |
| - Wet Markets / Fresh Wholesale Markets | | | | |</p>
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- Turf Club
- Farms
- Transfer Station
- Landfill
- Any Other
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