



Penang Organic Waste Management Plan: Plan and Policy

Final Report

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. It seeks to further reduce and divert solid waste from the Pulau Burung Sanitary Landfill by firstly by separation at source and then processing the organic waste fraction into useful by-products such as compost, bio-liquid fertilisers, refuse derived fuel (RDF). This will save the State Government cost of transfer and transportation in the long term and eventually, divert all organic waste from the landfill by 2020.

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ACROYNYS

C&D	Construction and Demolition Waste
HDPE	High-density polyethylene
JKKK	Jawatankuasa Kemajuan dan Keselamatan Kampong (Village Development and Security Committee)
LDPE	Low-density polyethylene
MBPP	Majlis Bandaraya Pulau Pinang (Penang Island City Council)
MPSP	Majlis Perbandaran Seberang Perai (Seberang Perai Municipal Council)
OCC	Old Corrugated Cardboard
ONP	Old Newspaper
PEMANDU	Performance Management and Delivery Unit
PET	Polyethylene terephthalate
RT	Rukun Tetangga (Neighbourhood Watch)
PP	Polypropylene
PS	Polystyrene

PENANG'S ORGANIC WASTE MANAGEMENT PLAN

1.0 PURPOSE

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 in other literature. The policy seeks to further reduce and divert solid waste from the Pulau Burung Sanitary Landfill by processing the organic waste fraction into useful by-products such as compost, bio-liquid fertilisers, refuse derived fuel (RDF). This will save the State Government cost of transfer and transportation in the long term. The long-term aim is to eventually, divert all organic waste from the landfill by 2020 as proposed at the PEMANDU Solid Waste Management LAB, 2011. (See Table 1.)

The presence of organics in landfills (considered the biggest pollutant) is notoriously known for the generation of methane which is a major greenhouse gas and also leachate. In view of these, many countries in the EU have already imposed such a ban to their landfill as part of their efforts to mitigate global warming.

European landfill Directive

The European Landfill Directive places targets on Member States to reduce the quantities of biodegradable municipal waste (BMW) going to landfill. By 2016 BMW going to landfill must be reduced to 35% of the total amount of weight of BMW produced in 1995.

Some countries and regions have adopted, or are considering outright bans on the landfilling of the entire biodegradable fraction of the municipal waste stream while others have introduced a taxation system to increase the cost of landfilling as to make recovery options more economically viable.

The Flemish region of Belgium has seen a significant drop in landfilling of BMW and has coincided with a decrease in incineration and an increase in composting and recycling, mainly of paper. The Netherlands has achieved high landfill diversion rates partly through widespread separate collection of food and garden waste.

(Ref. European Environment Agency, Biodegradable municipal waste management in Europe. Available from www.eea.eu.int)

Table 1: Targets for Organic Waste Reduction for Penang State

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Organic waste Reduction (%)	5	10	20	30	40	50	60	70	80	100

Source: PEMANDU SWM Lab, 2011

2.0 BACKGROUND

Waste generated in Penang state-wide; is estimated to be about 1,800 tons/day. From this, about 600-800 tons/day are generated from Penang Island and about 400-600 tons/day from Seberang Perai. Others are from private contractor directly disposing their waste at the landfill. All wastes are transported to Pulau Burung Landfill. The landfill is about 33 hectares in total area and it will last for the next 3 years. The landfill management is now on the process of expanding for another 28 hectares, and it is estimated to last for another 10 years. With this rate of waste generation, landfill will be filled up within 13 years and after that another landfill has to be identified.

From data available for Penang, organic waste constitutes about 40-60 % of total waste and a large proportion of this is from food and garden waste. (See Table 2). In order to expand the life of landfill, it is only prudent to reduce the amount of such waste going to the landfill thereby saving costs in terms of collection, transportation and treatment in the later stage. In order to achieve this, a number of measures must be considered. Composting is one of the measures to be considering reducing waste to landfill. With proper segregation of organic waste at generation point, as such organic waste could be transformed into useful by-products. Besides, other discards can be easily recycled if they do not come into contact with the wet organic waste portion.

Table 2: Waste Composition of Seberang Perai Municipal Council (MPSP) & Penang Island City Council (MBPP), 2003

Item	MPSP		MBPP	
	Metric Tons	%	Metric Tons	%
Food	605.84	50%	206.23	33%
Yard & Garden	148.99	12%	59.86	10%
Paper	54.12	5%	176.15	28%
Plastics	208.10	17%	89.89	15%
Textile/Rubber	38.48	3%	19.02	3%
Metal	43.36	4%	29.09	5%
Hazardous	2.69	0%	1.92	0%
Others	98.42	8%	37.74	6%
Total	1,200.00		619.90	

Source: Satang 2003 EXTRACTED FROM UNDP SWM Study Report 2007

Note: No other comprehensive waste characterisation studies were conducted after 2003.

The State should plan to increase its effort to process up to **40% of the organic waste** by 2015, through composting or turning organic waste into useable by-products in phases to divert this waste away from the Pulau Burung Sanitary Landfill. This would save the State Government the cost of transfer and transportation and treatment in the long term.

3.0 TYPES OF ORGANIC WASTE

At least four major types of organic waste (putrescibles) can be deemed significant for Penang. Reducing these types of organic waste would mean significant savings in costs for the two municipal councils. They are broadly categorised into:

1. Food and Kitchen waste
2. Green waste (Garden & yard trimmings)
3. Animal Waste (manure)
4. Bulk waste (organic portion of furniture and household hold fittings)

4.0 SOURCES AND TYPES OF ORGANIC WASTE GENERATION

In the effort to reduce waste to the Landfill, the organic waste fraction from both domestic and non-domestic sources for organic waste in Penang are identified and estimated. The types of organic waste generated and analysis of their characteristics of the various groups are shown in the table below:

Table 3: Sources & Types of Organic Waste Generated and their Characteristics

Groupings	Type of Organic Waste	Characteristics
Group A Residential - High-rise - Low rise - Kampongs - Tamans - JKKKs / RTs	- Food & Kitchen Waste - Garden & Yard trimmings - Bulk Waste	Currently Co-mingled, mixed MSW (Municipal Solid Waste) Maybe separated at source with change in attitude
Group B - Hotels - Hospitals - Institutions with Hostels	- Food & Kitchen Waste - Garden & Yard trimmings - Bulk Waste	Currently Co-mingled, mixed MSW (Municipal Solid Waste) Easily & readily separated at source
Group C Educational Institutions - Schools - Colleges	- Food & Kitchen Waste - Garden & Yard trimmings	Currently Co-mingled, mixed MSW (Municipal Solid Waste) Easily & readily separated at source

Groupings	Type of Organic Waste	Characteristics
<ul style="list-style-type: none"> - Universities - Factories Other Commercial Enterprises	<ul style="list-style-type: none"> - Bulk Waste 	
Group D <ul style="list-style-type: none"> - Restaurants - Food Courts / Complexes - Hawkers - Wet Markets / Fresh Wholesale Markets - 	<ul style="list-style-type: none"> - Food & Kitchen Waste - Fresh crop and animal product waste 	Currently Co-mingled, mixed MSW (Municipal Solid Waste) Easily & readily separated at source
Group E Parks & Gardens	<ul style="list-style-type: none"> - Garden & Yard trimmings 	Easily & readily separated at source
Group F Others <ul style="list-style-type: none"> - Turf Club - Farms - Transfer Station - Landfill - Any Others 	<ul style="list-style-type: none"> - Food & Kitchen Waste - Garden & Yard trimmings - Bulk Waste - Horse Manure - Others 	Easily & readily separated at source

5.0 WASTE GENERATION OF MSW FOR PENANG ISLAND CITY COUNCIL (MBPP)

Table 3 below provides an indication of the amount of waste generation by various sources. Residential areas, wet markets, hawker stalls and hotels are the biggest generators of organic waste. These would be considered “low hanging fruits” that can produce significant changes in the short term if tackled.

Table 4: Estimate of Solid Waste Generation by Source on Penang Island

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

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

Note: There are high proportions of organic and recyclable waste fractions in this estimate.

6.0 OTHER ORGANIC WASTE

Waste Data from the Jelutong Landfill shows that there are about 123 metric tons of bulk waste and about 5 tons of green waste being discarded daily. These organic wastes can be treated and turned into green fertiliser or refuse derived fuel with the aid of minimal mechanisation. Thus, green waste need not be buried as waste but may become a good profitable commercial enterprise which may bring in additional income to the operators of the landfill.

Table 5: Waste Data from the Jelutong landfill, 2005-2015

YEAR	BULK WASTE	CONSTRUCTION & DEMOLITION WASTE (metric tons)	EARTHWORK (EXCAVATION WASTE) (metric tons)	GREEN WASTE (metric tons)	TOTAL (Metric Tons)
2005	103,79.62	49,768.22	10,751.59	-	70,899.43
2006	19,500.8	85,107.74	56,384.4	-	160,992.94
2007	702,99.64	91,294.85	50,547.12	-	212,141.61
2008	79,139.77	88,744.06	102,789.64	-	270,673.47
2009	78,763.61	91,346.05	40,693.29	-	210,802.95
2010	17,278.41	180,401.93	155,859.07	-	353,539.41
2011	25,737.47	164,436.4	243,403.16	-	433,577.03
2012	25,089.86	164,436.4	243,403.16	647.61	433,577.03
2013	51,955.83	823,58.83	137,929.51	3,152.31	272,244.17
2014	58,504.78	140,769.73	203,878.43	1,192.8	403,152.94
2015	60,341.84	67,349.16	828,56.74	2,389.66	210,547.74
Yearly Average	45,181.06	109,637.58	120,772.37	1,845.60	275,649.88
Daily average	123.78	300.38	330.88	5.06	755.21
%	16%	40%	44%	1%	100%

Source: Engineering Department, MBPP, 2016

7.0 POLICY

POLICY STATEMENT: 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.

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

Strategy 1.1: Impose separation of organic waste at source

Implement changes for waste separation starting with pilot projects with easy adopters - targets that are easily achievable e.g. Wet markets, hotels, hospitals and schools; food courts under municipal control. These targets are single point sources that are ready to participate in waste separation and are easy to manage with some legislation from the local authorities. Some of the possible approaches for collection are listed in the table below:

Table 6: Types of Organic Waste Generators and Approaches to Collection

Groupings	Approach
Group A Residential <ul style="list-style-type: none"> - High-rise - Low rise (Landed Properties) - Kampongs - Tamans - Village Development And Security Committees (JKKK) / Neighbourhood Watch (Rukun Tetangga) 	<ul style="list-style-type: none"> - Have an effective public education and awareness campaign for separation of food waste to residents, management and staff. - Alternate day collection for house to house collection. Mixed waste will not be collected if not separated at source. - Management corporations of high-rise properties should be provide an area for separate food waste collection.
Group B <ul style="list-style-type: none"> - Hotels - Hospitals - Institutions with Hostels 	<ul style="list-style-type: none"> - Have an effective public education and awareness campaign for separation of food waste to management and staff. - Special arrangements for collection with private contractors should be made. - Organic waste may be processed on site instead of being collected using the Bio-regen Food waste processing

Groupings	Approach
	<p>machine or sent to a centralised facility.</p>
<p>Group C</p> <p>Educational Institutions</p> <ul style="list-style-type: none"> - Schools - Colleges - Universities <p>Factories</p> <p>Other Commercial Enterprises</p>	<ul style="list-style-type: none"> - Have an effective public education and awareness campaign for separation of food waste to management and staff. - Special arrangements for collection with private contractors should be made. - Organic waste may be processed on site instead of being collected using the Bio-regen Food waste processing machine or sent to a centralised facility. - Tie-up with private enterprises or NGOs (such as the Rotary Club e.g. Heng Ee High School) to sponsor on-site processing of organic waste - Collection of used cooking oil into bio-diesel.
<p>Group D</p> <ul style="list-style-type: none"> - Restaurants - Food Court / Complexes - Hawkers - Wet Markets / Fresh Wholesale Markets 	<ul style="list-style-type: none"> - Have an effective public education and awareness campaign for separation of food waste to management and staff. - Special arrangements for collection with private contractors should be made. - Organic waste may be processed on site instead of being collected using the Bio-regen Food waste processing machine or sent to a centralised facility. - Collection of used cooking oil into bio-diesel.
<p>Group E</p> <p>Parks & Gardens</p>	<ul style="list-style-type: none"> - Special arrangements for collection with private contractors should be made for green waste. - Green waste may be processed on site instead of being collected. -
<p>Group F</p> <p>Others</p> <ul style="list-style-type: none"> - Turf Club - Farms 	<ul style="list-style-type: none"> - Have an effective public education and awareness campaign for separation of food waste to management and staff.

Groupings	Approach
<ul style="list-style-type: none"> - Transfer Station - Landfill - Any Other 	<ul style="list-style-type: none"> - Special arrangements for collection with private contractors should be made. - Organic waste may be processed on site instead of being collected using the Bio-regen Food waste processing machine or sent to a centralised facility.

Strategy 1.2: Develop relevant policies for different waste generators

Examples of these include introducing a new vacuum waste collection system and static compactors for commercial complexes, wet markets and institutions that have to handle a voluminous amount of waste. Compaction at source makes collection and transfer of waste more efficient and cheaper.

The local authorities must continue to upgrade waste disposal systems for municipal & commercial food complexes. This involves the installation of food processing machines that can turn leftover food scraps and kitchen trimmings into useful products such as compost or bio-liquid fertiliser.

Food waste /kitchen waste, green waste which forms a major proportion of organic waste should also be separated and collected from eating places/food courts, hotels, hospitals and wet markets as these can produce good quality compost or bio-liquid fertilisers with technology that is currently available. Food waste may also be used to produce biogas for cooking purposes for farms, small community halls, hostels etc. A simple prototype is currently in operation at the Environment Resource Centre, Taman Desa Damai Bukit Mertajam. Used cooking oil should also be collected as they are a major source of pollutants in drains and waterways. Used cooking can be used as fuel for boilers, soap making or for biodiesel.

Strategy 1.3: Increase community awareness and understanding of separating organic waste at source

Mindset change is an on-going and time consuming process and local councils should continue and even expand the public education and awareness programme in the communities and institutions such as schools and colleges. Awareness and public education can be carried out through the Environment Resource Centres that have been setup in every district. A good example of such a centre playing an effective role for the community is the one at Taman Desa Damai, Bukit Mertajam that has become a showcase for many other communities to follow suit.

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.

Turn organic waste into useful by-products such as compost, bio-liquid fertilisers, refuse derived fuel (RDF), bio-mass gas production or for conversion of waste to energy. Collection of used cooking oil for conversion to bio-diesel. Some possibilities of which by-products and approaches towards treatment of organic waste are outlined in the table below:

Table 7: Types of Organic Waste Generators and Proposed Treatment

Groupings	Possible By-products	Approach
Group A Residential <ul style="list-style-type: none"> - High-rise - Low rise (Landed Properties) - Kampongs - Tamans - Rural Development And Security Committees (JKKK) / Neighbourhood Watch (Rukun Tetangga) 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer 	<ul style="list-style-type: none"> - Mandating the installation of food processing machines as part of building requirement for new residential areas. - Encourage individual composting at household level - Encourage community composting
Group B <ul style="list-style-type: none"> - Hotels - Hospitals - Institutions with Hostels 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Convert used cooking oil into bio-diesel 	<ul style="list-style-type: none"> - Mandating the installation of food processing machines as part of licensing requirement to operate food places / canteens
Group C <ul style="list-style-type: none"> - Educational Institutions - Schools - Colleges - Universities Factories Other Commercial Enterprises	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Convert used cooking oil into bio-diesel 	<ul style="list-style-type: none"> - Mandating the installation of food processing machines as part of licensing requirement to operate food places / canteens

Groupings	Possible By-products	Approach
Group D <ul style="list-style-type: none"> - Restaurants - Food Courts / Complexes - Hawkers - Wet Markets / Fresh Wholesale Markets 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Convert used cooking oil into bio-diesel 	<ul style="list-style-type: none"> - Mandating the installation of food processing machines as part of licensing requirement
Group E Parks & Gardens	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Refuse derived fuel (RDF) - Bio-mass - Waste to Energy 	<ul style="list-style-type: none"> - Encourage the use of machines to chip and treat green waste into useful by-products - Encourage composting activities to recycle organic material into the nutrient system for maintenance of parks and gardens
Group F Others <ul style="list-style-type: none"> - Turf Club - Farms - Transfer Station - Landfill - Any Other 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Refuse derived fuel (RDF) - Bio-mass - Waste to Energy - Bio-remediation (e.g. landfill cover) 	<ul style="list-style-type: none"> - Mandating the installation of food processing machines as part of licensing requirement to operate food places / canteens

OBJECTIVE 3: To incentivise organic waste treatment by private and community efforts such as Neighbourhood Watch (Rukun Tetangga) 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

Incentives are important instruments to influence behaviour. Good behaviour should be rewarded and bad behaviour penalised. Hence, if recycling is to be promoted, recycling activities should be supported and given incentives, while irresponsible behaviour such as excessive waste generation should be made to pay. The incentive system is part of a polluter pays principle, which translated means that the greater the amount of waste, the higher the amount to pay. Although there is revenue potential in the incentive system, the main purpose is to discipline behaviour.

However, in the case of organic waste reduction, several forms of incentives maybe considered. Not all incentives need not be monetary in nature and more creative forms of recognition may be considered such as the provision of public facilities e.g. play grounds, landscape, tree planting etc.

Some examples are provided in the accompanying table below:

Table 8: Types of Organic Waste Generators and Proposed Incentive Schemes

Groupings	Proposed Incentives
Group A Residential <ul style="list-style-type: none"> - High-rise - Low rise (Landed Properties) - Kampongs - Tamans - Rural Development And Security Committees (JKKK) / Neighbourhood Watch (Rukun Tetangga) - 	<ul style="list-style-type: none"> - Provide community facilities through waste diversion savings - Possible reduction of assessment fees - Green practice recognition - awards
Group B <ul style="list-style-type: none"> - Hotels - Hospitals - Institutions with Hostels - 	<ul style="list-style-type: none"> - Possible reduction of assessment fees - Ease of license renewal - Green practice recognition - awards - Reduction in licensing fees -
Group C Educational Institutions <ul style="list-style-type: none"> - Schools - Colleges - Universities Factories Other Commercial Enterprises	<ul style="list-style-type: none"> - Possible reduction of assessment fees - Ease of license renewal - Reduction in licensing fees - Green practice recognition – awards
Group D <ul style="list-style-type: none"> - Restaurants - Food Courts / Complexes - Neighbourhood Watch (Rukun Tetangga) - Hawkers - Wet Markets / Fresh Wholesale Markets 	<ul style="list-style-type: none"> - Possible reduction of assessment fees - Ease of license renewal - Reduction in licensing fees - Green practice recognition - awards
Group E Parks & Gardens	<ul style="list-style-type: none"> - Green practice recognition - awards
Group F Others <ul style="list-style-type: none"> - Turf Club - Farms 	<ul style="list-style-type: none"> - Possible reduction of assessment fees - Ease of license renewal - Green practice recognition - awards

- **Transfer Station**
- **Landfill**
- **Any Other**

Strategy 3.2: Set the stage for future voluntary carbon offset schemes

Carbon offset schemes are part of the carbon trading process in the international market place. A carbon offset is a reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for or to offset an emission made elsewhere.

Carbon offsets are measured in metric tons of carbon dioxide-equivalent (CO₂e) and usually represent six primary categories of greenhouse gases. The categories include: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulphur hexafluoride (SF₆). One carbon offset represents the reduction of one metric ton of carbon dioxide or its equivalent in other greenhouse gases.

There are two markets for carbon offsets. In the larger, compliance market, companies, governments, or other entities buy carbon offsets in order to comply with caps on the total amount of carbon dioxide they are allowed to emit. This market exists in order to achieve compliance with obligations under the Kyoto Protocol, and of liable entities under the EU Emissions Trading Scheme. In 2006, about \$5.5 billion of carbon offsets were purchased in the compliance market, representing about 1.6 billion metric tons of CO₂e reductions.

In the much smaller, voluntary market, individuals, companies, or governments purchase carbon offsets to mitigate their own greenhouse gas emissions from transportation, electricity use, and other sources. For example, an individual might purchase carbon offsets to compensate for the greenhouse gas emissions caused by personal air travel. Many companies offer carbon offsets as an up-sell during the sales process so that customers can mitigate the emissions related with their product or service purchase (such as offsetting emissions related to a vacation flight, car rental, hotel stay, consumer good, etc.). In 2008, about \$705 million of carbon offsets were purchased in the voluntary market, representing about 123.4 million metric tons of CO₂e reductions.

The usual conversion rate for food waste is 0.9:1; i.e. every 1000kg of food waste is equivalent to 0.9 metric ton of carbon offset or CO₂e. This formula can easily be applied to Penang's situation where 1 metric tons of organic waste diverted from the landfill will result in cost savings for the local authority. E.g. for the case of MBPP the average cost savings is RM132.20 From this cost savings, say RM20 is attached as the monetary value for 1 CO₂e which can be used to redeem when proof is provided

Fixing the mechanism for a local "Penang Carbon Credit (PCC)" scheme is not difficult but the mechanism needs to be carefully worked out by the two local authorities. It needs

proper documentation and verification processes preferably done by a third party body engaged or authorities by the state.

Participants who wish to take part in the voluntary PCC scheme must first register their participation with the two local authorities and adhere to a list of stipulated regulations and procedures. PCCs can only be awarded if these are fully complied and will be recognised by the two local authorities. This is somewhat similar to the present incentive schemes for recyclable items currently practiced by MPSP.

PCCs can also be traded for environmentally conscious companies or individual who wish to practice their CSR or offset their carbon footprint.

Such a move will see Penang initiate another first for the State and may be adopted by other states at later stages.

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.

All of our organic waste streams contain vast quantities of nutrients and trace elements which aid in crop development, growth and health. Organic by-products such as compost, bio-liquid fertilisers, and bio-fertilisers move nutrients through the full circle and back into agriculture and in doing so develop closed loops. Instead of just depleting earth's natural resources, such nutrient cycles put backs and replenishes the top soil of the earth thus enabling and ensuring a sustainable nutrient cycle as opposed to mining the resources in arterial industries (defined as industries that mine natural resources from the earth in an exploitative and non-renewal manner).

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

Maintaining food producing soils and continuing food production in proximity to urban areas like major towns in Penang is becoming increasingly important to ensure a reliable supply of food close to market. Within the context of potential rises in energy and transport costs, expanding urban populations, water scarcity and demand for agricultural lands for other land uses, there is an emerging need to produce more with less. Expanding peri-urban food production will require innovative methods of food production and soil management in these locations, such as greater use of recycled water and comprehensive mapping to identify existing and potential agricultural clusters.

8.0 CONCLUSION

The State needs to further coordinate, harmonise or streamline approaches to waste management across jurisdictions and derive at categorisations, definitions and standards used to manage waste between and within the different levels of government so that they are effective and appropriate. This ensures the delivery of an effective regulatory framework which will provide an appropriate suite of approaches to address waste and resource recovery issues especially that of organic waste.

The Penang Organic Waste Policy should work effectively in conjunction with planning and other environmental legislation and not as a standalone solution to address the mitigation of worldwide issues such as climate change and global warming.

The State authorities must also provide the right incentives to manage materials, products and waste sustainably and holistically. It has also to look any aspects of waste management that could be improved or streamlined through adopting standards. Whatever changes that could be made to improve management of the municipal waste stream and those of the commercial and industrial sector and the construction and demolition sector must be done in a timely and appropriate manner.

Reducing the amount of organic waste sent to landfill has the potential to contribute to reducing greenhouse gas emissions as well as other potential environmental and economic benefits. What benefits and opportunities, costs and disadvantage of increased diversion and / or recycling of organics wastes must be continually studied.

Conventional wisdom appears to be driving us to bury all organic waste, collect landfill gas and produce green electricity. The Policy should also be used to encourage the diversion of organic waste away from landfills (e.g. introducing green waste / organic waste collections) and to utilise the organic waste to generate a beneficial by-products. Why can we not use reduction and conversion of organic waste to earn carbon offsets? Why are these efforts not considered to be carbon sequestration? The Policy should be changed to include the benefits of composting for carbon sequestration and for the reductions in greenhouse gas emissions. A compulsory requirement to utilise organic by-products and compost for carbon sequestration with agricultural activities could be introduced under this policy. Utilising organic fertilisers will reduce the need for chemical fertilisers that are currently being used as an easy cheap short term unsustainable option.

Diverting green waste and organics from the waste stream can potentially divert up to 40 to 50% of the waste from landfill and thus provide substantial cost savings. There is huge potential not only in the domestic / residential waste stream but also in the commercial and industrial sector (e.g. food manufacturers, food processors etc.).

The Penang State Government has set June 1, 2016 for enforcement of the Waste Segregation at Source Policy throughout the state.



Figure 1 : Penang's Waste Segregation at Source Poster

Waste separation at source is the process of separating solid waste produced at source in accordance with the composition of solid waste, namely recyclable waste (paper, plastic, aluminium cans) and general waste or garbage (gross waste, and food waste).

The main objectives are:

- To reduce environmental pollution and to maintain ecological balance.
- To reduce the cost of waste management.
- To reduce increasing volume of waste generation to landfill.
- To prolong the lifespan of Pulau Burung landfill.

The schedule for Recyclables Collection are:

- *Landed Properties - every Saturday by MBPP (2pm-5pm) / MPSP (8am-4pm).
- *Strata Premises - will be decided by Joint Management Board/ Management Body.

For high-rise houses, the Joint Management Body (JMB) has to dedicate a space for bins for residents to bring down their recyclable items. As for landed property, residents can leave the segregated trash beside the garbage bins

General waste is collected three times a week by MBPP and twice a week by MPSP for residential areas. Collection for commercial areas and wet markets may be daily depending on the specific need of each location.



Figure 2: The Two Waste Streams for Segregation.

The Penang state government has delayed the implementation of the summon action to June 2017 and is currently educating the public regarding the matter.

Since the introduction of the waste segregation at source policy, the landfill has seen a decrease in the amount of recyclables and an increase in the non-recyclables component. This is because the more valuable recyclables are already taken off stream at source and is no longer discarded into the residential bins during door-to-door collection.

Table 9: Summary for MBPP, MPSP & Overall Waste Composition at the Pulau Burung Landfill

Type of Waste	MBPP	MPSP	PENANG OVERALL AVERAGE
Organic Waste	52.3%	43.9%	48.1%
OCC	3.4%	3.4%	3.4%
ONP	1.0%	0.2%	0.6%
GW + Woody C&D	4.1%	3.0%	3.5%
Ferrous	0.9%	0.9%	0.9%
Non-Ferrous	0.1%	0.1%	0.1%
Plastics			
PP	1.1%	0.8%	0.9%
LDPE	9.6%	8.4%	9.0%
PET	0.5%	0.5%	0.5%

Type of Waste	MBPP	MPSP	PENANG OVERALL AVERAGE
HDPE	0.2%	0.3%	0.3%
HP (Hard Plastic)	0.2%	0.3%	0.2%
Others (Non-recyclables)	26.6%	38.3%	32.5%
Total	100.0%	100.0%	100.0%

Source: Waste composition Survey (October 2016), Infitech Sdn Bhd. 2016.

The remaining general waste stream that ends up in the landfill comprises dirty contaminated plastic waste (mainly LDPE used as garbage bags), wet corrugated cardboard, food waste and a small proportion of green waste.

Table 10: Composition of MSW, MBPP and MPSP, 2003 compared with 2016 Survey Results

Item	MPSP		MBPP		Penang State Overall Average (%) 2003	Penang State Overall Average (%) 2016	+/-
	Metric Tons	%	Metric Tons	%	%	%	%
Food	605.84	50	206.23	33	41.5	45.20	3.70
Yard & Garden	148.99	12	59.86	10	11.0	0.24	-10.76
Paper	54.12	5	176.15	28	16.5	3.46	-13.04
Plastics	208.1	17	89.89	15	16.0	10.34	-5.66
Textile/Rubber	38.48	3	19.02	3	3.0	0	-3.00
Metal	43.36	4	29.09	5	4.5	1.28	-3.22
Hazardous	2.69	0.00	1.92	0	0.0	0.23	0.00
Others	98.42	8.00	37.74	6	7.0	39.47	32.47
Total	1,200.00		619.9				

Source: Satang 2003 quoted by UNDP SWM Study Report 2007

The recent Waste Characterisation Study by Infitech Sdn. Bhd. (October 2016) ; when compared with 2003 Satang Report showed that 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. Table 11 below shows that the State Recycling rates have been rising steadily from 2005 – 2015 and it also illustrates the effect of Penang’s Best Practices and replication of such practices to other areas within the state contributing the success of resource recovery from waste.

Table 11: Waste Disposed at the Pulau Burung Sanitary Landfill, 2005-2015

Year	Waste Disposed at Landfill Per Year (metric tons)			Recycling Per Year (metric tons)			Total Waste Generation Per Year (metric Tons) C=(A+B)	Recycling Rate (%) B/C
	MBPP	MPSP	Total	MBPP	MPSP	Total		
			A			B		
2005	280,489	416,254	696,743	57,178	96,032	153,210	849,953	18.03%
2006	295,498	463,750	759,248	82,210	119,964	202,174	961,422	21.03%
2007	216,490	490,729	707,219	80,351	125,504	205,855	913,074	22.55%
2008	218,440	472,005	690,445	33,775	124,121	157,896	848,341	18.61%
2009	216,456	428,563	645,019	61,307	132,039	193,346	838,365	23.06%
2010	213,591	426,152	639,743	63,756	129,804	193,560	833,304	23.23%
2011	209,701	401,663	611,364	72,341	144,682	217,023	828,387	26.20%
2012	205,972	370,989	576,961	82,405	157,286	239,691	816,652	29.35%
2013	207,968	427,706	635,674	80,050	207,849	287,899	923,573	31.17%
2014	214,609	434,175	648,784	80,233	233,791	314,024	962,808	32.62%
2015	221,576	440,460	662,036	84,100	289,259	373,359	1,035,395	36.06%

Source: MBPP/MPSP 2016

The recycling rate for Municipal Solid Waste (MSW) achieved the highest recycling rate in the country of 36% compared with 18% when we first started in 2005. This 36% recycling rate achieved far exceeds the current national recycling rate of 10.5% and the 2020 target of 22% recycling rate. Penang also aims to reduce our Waste Generation from 1.3 kg/capita/day to half this amount by 2020.

Continuous awareness campaigns are needed to encourage Penangites to either compost at home or participate in the local government’s green waste / organics collection schemes (both kerbside and outsourced haulage to the waste management facilities). The campaign should also encourage the use of compost on gardens, lawns, farms etc. instead of using chemical fertilisers. Market

development is needed for organic by-products to ensure that there are sufficient processors for the amount of organic waste material being generated and to ensure that there will be sufficient end uses for the product (e.g. compulsory carbon sequestration in the agricultural industry) to ensure a ready and sustainable market. This will further ensure that more resource recovery in the coming years as food/organic waste is being separated and do not contaminate items that are recyclable.

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.

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Appendix

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 Pulau Burung 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 (Rukun Tetangga) 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

Groupings	Type of Organic Waste	Possible By-products	Strategies	Remarks
Group A Residential <ul style="list-style-type: none"> - High-rise - Low rise - Kampongs - Tamans - JKKKs / RTs 	<ul style="list-style-type: none"> - Food & Kitchen Waste - Garden & Yard trimmings - Bulk Waste 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer 	<ul style="list-style-type: none"> - Public Awareness - Separation at Source - Individual composting - Community composting - Regulatory (Incentives) - Food processing machine (where applicable) 	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.
Group B <ul style="list-style-type: none"> - Hotels - Hospitals - Institutions with Hostels 	<ul style="list-style-type: none"> - Food & Kitchen Waste - Garden & Yard trimmings - Bulk Waste 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Convert used cooking oil into bio-diesel 	<ul style="list-style-type: none"> - Public Awareness - Separation at Source - Individual composting - Community composting 	

Groupings	Type of Organic Waste	Possible By-products	Strategies	Remarks
		-	<ul style="list-style-type: none"> - Regulatory (Licensing Requirement - Food processing machine (where applicable)) - Voluntary Carbon Credit Schemes 	
<p>Group C</p> <p>Educational Institutions</p> <ul style="list-style-type: none"> - Schools - Colleges - Universities <p>Factories</p> <p>Other Commercial Enterprises</p>	<ul style="list-style-type: none"> - Food & Kitchen Waste - Garden & Yard trimmings - Bulk Waste 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Convert used cooking oil into bio-diesel 	<ul style="list-style-type: none"> - Public Awareness - Separation at Source - Individual composting - Community composting - Regulatory (Licensing Requirement - Food processing machine (where applicable)) - Voluntary Carbon Credit Schemes 	
<p>Group D</p> <ul style="list-style-type: none"> - Restaurants - Food Courts / Complexes - Hawkers - Wet Markets / Fresh Wholesale Markets 	<ul style="list-style-type: none"> - Food & Kitchen Waste - Fresh crop and animal product waste 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Convert used cooking oil into bio-diesel - 	<ul style="list-style-type: none"> - Public Awareness - Separation at Source - Individual composting - Community composting - Regulatory (Licensing 	

Groupings	Type of Organic Waste	Possible By-products	Strategies	Remarks
			Requirement - Food processing machine (where applicable) - Voluntary Carbon Credit Schemes	
Group E Parks & Gardens	<ul style="list-style-type: none"> - Garden & Yard trimmings 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Refuse derived fuel (RDF) - Bio-mass - Waste to Energy 	<ul style="list-style-type: none"> - Public Awareness - Separation at Source - Individual composting - Community composting - Regulatory (Licensing Requirement- Food processing machine (where applicable)) 	
Group F Others <ul style="list-style-type: none"> - Turf Club - Farms - Transfer Station - Landfill - Any Other 	<ul style="list-style-type: none"> - Food & Kitchen Waste - Garden & Yard trimmings - Bulk Waste - Horse Manure 	<ul style="list-style-type: none"> - Compost - Bio-liquid fertilizer - Refuse derived fuel (RDF) - Bio-mass - Waste to Energy 	<ul style="list-style-type: none"> - Public Awareness - Separation at Source - Individual composting - Community composting - Regulatory (Licensing Requirement – 	

Groupings	Type of Organic Waste	Possible By-products	Strategies	Remarks
		<ul style="list-style-type: none"> - Bio-remediation (e.g. landfill cover) 	treatment of Green Waste)	