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Introduction

This position paper was produced by the European Chamber of Commerce in Hong Kong in collaboration with the Environment and Energy Business Council and its members. It addresses various issues related to a circular economy: sustainability, commodity pricing and recycling rates, as well as food waste management considerations specific to Hong Kong. Throughout, it touches upon Hong Kong's current situation, opportunities and challenges, in addition to providing a comprehensive comparison between the policy-making and business approaches adopted by Hong Kong and member states within the European Union.

Key Recommendations for Hong Kong

The EEBC suggests that the Hong Kong Government consider the following;

- Improving waste management facilities, specifically in terms of collection and sorting operations, including facilities at disposal sources as well as specialised collection networks.
- Facilitating the introduction of a waste levy or tax in the form of a gate fee at landfills as a clear fiscal incentive for seeking alternate waste management methods. Furthermore, Hong Kong should embrace the economic opportunities associated with creating a green economy.
- Pursuing avenues of engagement to establish trans-border agreements with Mainland China. Doing so in full compliance with the Basel Convention would allow for efficient and controlled trading of waste and recycled materials within the Pearl River Delta region.
- Continuing to build upon the various concepts and initiative proposals outlined in the Hong Kong 2030+ Planning Vision and Strategy¹, specifically "Building Block 3", including: Adopting waste-to-energy conversion technologies, reusing treated sewage effluent, and initiatives such as the extremely efficient large-scale centralised air-conditioning system used in the District Cooling System at Kai Tak.
- Having environmental engineering exemplars such as Eco Park and T-PARK continue to play an essential role in Hong Kong's journey toward the circular economy, especially through facilitating education and awareness of sustainability issues in Hong Kong. There must be a higher level of transparency with regards to the credibility of the recycling process in order to generate enthusiasm among the Hong Kong public.
- The Hong Kong government should seek to engage with firms operating in primary and secondary manufacturing industries within the Pearl River Delta to further help close the loop whilst pushing toward a circular economy.

1

Circular Economy

Unlike the typical linear economy pattern of make-consume-discard, a circular economy presents a sustainable alternative – one that focuses on keeping resources in circulation for as long as possible. Employing linear economic models has been the dominant practice in most of the world’s industrial economies; within this framework, materials and manufactured products lose all value upon disposal.

Countries within the European Union, particularly Germany and Finland, have taken many tangible steps toward promoting and implementing circular economic models. In comparison, Hong Kong, with its high rate of non-recovered waste disposal, lags behind. In an ideal circular economy ecosystem where minimal waste is generated, the value of products, materials and resources is maintained in the economy for as long as is feasibly possible.

1.1. Hong Kong

Enacted in July 2008, the *Producer Responsibility Schemes* (PRS) were introduced by the Hong Kong government, outlining key policies targeting waste management in Hong Kong.² Trail-ing broad public support, the Product Eco-Responsibility Ordinance (Cap. 603) (PERO) was passed by the Legislative Council (LegCo). The PERO is an overarching piece of legislation that outlines the shared core elements of all PRS, as well as the fundamental regulatory requirements with respect to individual product types.

The PRS follow the principle of “polluter pays”, requiring collaboration along the supply chain and shared responsibility for collection, recycling, treatment and disposal of end-of-life products as a means of reducing environmental impact. PRS aims to create a circular economy by providing practicable solutions in source separation, collection logistics, waste treatment and recovery outlets for waste glass materials.

The Environmental Levy Scheme on Plastic Shopping Bags (PSB Levy Scheme) was among the first schemes introduced under the PERO. It sought to reduce excessive use of plastic shopping bags (PSB) through a direct economic disincentive imposed on consumers as a mandatory charge. The first phase of the PSB Levy Scheme was implemented between July 2009 and March 2015, covering over 3,000 retail outlets, including large supermarkets. Upon implementation of the first phase, the amount of PSBs entering landfills from the regulated sectors decreased significantly from some 660 million in 2009 to some 120 million in 2013.³

In 2013, the Hong Kong Government Environmental Bureau released the action blueprint for 2013 to 2022 entitled *Hong Kong Blueprint For Sustainable Use Of Resources 2013-2022*.⁴

The blueprint outlines policies and actions in three key areas: firstly, promoting behavioural change to reduce waste at the source through policy and legislation, including Municipal Solid Waste (MSW) charging and producer responsibility schemes; secondly, rolling out territory-wide waste reduction campaigns, including food waste reduction and glass beverage bottle recycling, and lastly, allocating resources to enhance waste-related infrastructure, such as waste-to-energy plants, including organic waste treatment facilities and waste-to-energy integrated waste management facilities and landfill extensions.

Under the *Hong Kong Blueprint for Sustainable Use of Resources* and *A Food Waste & Yard Waste Plan for Hong Kong*, published by the Environmental Bureau in 2013 and 2014 respectively, the major emphasis of the government's policies is focused on waste management. Furthermore, the government has adopted various schemes to promote waste reduction in household, industry and corporate settings.

With respect to procurement, green public procurement is a further ongoing initiative from the Hong Kong government's Environmental Protection Department. In the early 2000s, the government revised its procurement regulations to require departments to manage environmental considerations when procuring commonly used goods and services.

1.2. Macao

Since 1999, the Macao government's Civic and Municipal Affairs Bureau (IACM), has run the Waste Separation and Recycling Programme to promote waste reduction and the efficient use of natural resources. Initially focused on promotion and education in schools, the programme was later expanded to include local organisations, commercial institutions and government departments. Public collection points were also established around Macao. As recycling rates and volumes continued to rise, IACM launched its community programme, the Domestic Waste Separation and Recycling Programme, in 2005. The programme provides households with more convenient access to waste recycling, with an ultimate goal of further improving recycling rates and building green homes through combined efforts.⁵

1.3. The European Union

Europe's status as a net importer of raw materials adds further incentive to support recycling and the reusability of goods. In December 2015, the European Commission produced an action plan entitled *Closing the Loop* as the framework for a circular economy that strives to achieve a sustainable, low carbon and resource-efficient economy by 2030.⁶ The plan defines a circular economy as one "...where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste [is] minimised"

The action plan provides a framework for stimulating a circular economy in Europe, including a practical programme with strategies to be implemented through close monitoring of every stage of the product cycle. This includes product design, production and production process, as well as consumption to waste management and the market for secondary raw materials.

Regarding production, the Commission recommends maximising used materials in terms of the reparability, upgradability, and recyclability of products. Furthermore, it proposes implementing a form of economic incentive for producers to design products that are easier to recycle by introducing end-of-life costs for products. With regards to the production process, the Commission provides guidance for best practices for industrial sectors with respect to resource usage, waste generation and management.⁷

There is a focus on enhancing consumers' access to information regarding consumption. One of the priorities is to improve the reliability of eco labels and environmental claims. Achieving this calls for more robust enforcement of the penalties against unfair commercial practices and testing of a product's environmental footprint. Additionally, when goods within the legal guarantee period fail to meet specifications set out in the guarantee statement or relevant advertisement, consumers are advised to exercise their right to have products replaced or repaired without charge.⁷ Such measures protect consumers from defective products and contribute to a product's durability and reparability, reducing the overall disposal rate of defective products. In doing so, the producer may utilise these products for recycling purposes to ensure full utilisation of resources.

To further improve waste management, the Commission is introducing expanded general requirements for producers' responsibility schemes. With respect to pricing, the relevant environmental councils within the European Parliament are mandated to ensure that the incentives and costs, such as energy transportation and resources taxes, better reflect environmental costs.⁹ Imposing tax incentives on the various process stages within in a circular economy has proved to be very effective for many EU countries, including the United Kingdom, Finland and France. Clear examples of effective waste management schemes may be drawn from Europe through the usage of mandatory legislation instead of non-enforced voluntary schemes.

The "Closing the Loop" action plan establishes an ambitious programme, with measures covering the complete product life cycle, from production and consumption to waste management and the market for secondary raw materials. Additionally, several policies and monitoring schemes have been adopted to comply with and reinforce the global commitments outlined by the UN's *2030 Agenda for Sustainable Development*, as well as the *G7's Alliance on Resource Efficiency*. This clearly demonstrates that in recent years, the EU has reflected the importance of sustainable development within a broad range of its policies. Particular focus was placed on the EU taking the lead in the fight against climate change and the promotion of a low-carbon economy. Within its 7th *Environment Action Programme* (EAP), in 2010, the

European Commission appointed a new Directorate General for Climate Action in order to better address issues related to climate change. One of the European Commission's priority objectives was outlined in *Sustainable Cities: Working Together for Common Solutions*.

The overall objective of this policy drive is to enhance the sustainability of EU cities such that by 2050 all Europeans are living in environments driven by innovative, circular economies in which nothing is wasted, natural resources are sustainably managed, and biodiversity is protected, valued and restored in ways that enhance society's resilience. Specifically, the Action Programme states that by 2020 "...a majority of cities in the Union are implementing policies for sustainable urban planning and design" and that the Commission should develop "a set of criteria to assess the environmental performance of cities, taking into account economic, social and territorial impacts."¹⁰ The project also aimed to set long-term recycling targets for municipal and packaging waste, while reducing reliance on landfills. In the future, more than 50 key actions will be included in the *EU Action Plan for Circular Economy* and a progress report will be made five years after adoption in order to monitor and fine-tune the effectiveness of the current scheme.

1.4. The Circular Economy in Finland

Finland has one of the world's highest national plastic bottle recycling rates, having achieved an admirable 98.7% in 2003.¹¹ Finland also has ambitions to become a global leader with respect to circular economy implementation by 2025.¹²

Households have demonstrated high levels of participation in recirculating goods and materials through the economy via rental services, sharing schemes and second-hand goods. Households may further contribute to the Finnish circular economy through the Textile Project, where the Technical Research Centre of Finland collects old clothes for their reusable fibres and produces new fabric goods for various fashion outlets in the country.¹³

Currently, Finland's food producers and distributors are aiming to develop alternative energy resources. For example, firms in the energy industry are pioneering the production of bio-fuel from food industry residuals,¹⁴ while farmers are encouraged to recycle organic waste instead of importing fertilizers.¹⁵

1.5. The Circular Economy in Germany

During the 1980s, there was a growing awareness in Germany of the need for resource reuse in its economic cycle. Throughout the 1990s, there was a noticeable shift in waste management policy approaches toward the model of circular economy. This led to producers being required to design their products using three criteria: minimisation of the amount of waste arising from production, the capacity for maximum high-quality waste recovery, and the feasibility of environment-friendly disposal of unusable waste. The term "waste" was also

re-categorised as a resource and rebranded as “waste property” to support and promote waste avoidance. Furthermore, a paper produced by the Federal Ministry for the Environment outlines that since landfilling of untreated waste was prohibited in 2005, more than 70% of municipal waste and 90% of construction and demolition waste now enters the recycling process.¹⁶

With regard to waste treatment, waste incineration and mechanical-biological treatment has been implemented throughout the country. Outputs of the waste treatment process re-enter the economic cycle -- for instance, ash from incineration is used in road construction, while energy is produced by incineration plants.

1.6. The Circular Economy in The Netherlands

The Netherlands has recently strengthened its waste reuse legislation to promote a circular economy. The country has established a series of regulations governing the collection of household waste, e-waste and regulated car demolitions. Their preliminary target is to reduce the waste-to-incineration ratio by 50%. Moreover, the Netherlands has also set a target of separating 75% of waste at the source, which would significantly reduce landfill dependency in the near future. As for waste incinerators, the Netherlands is aiming to ensure that all facilities maintain high operational standards and are built according to high standards for rates of recycling and energy recuperation.¹⁷

1.7. Recommendations

- The Environmental Protection Department of the Hong Kong government should impose relevant taxes and tax incentives on households as a means of promoting the circular economy.
- The Hong Kong government should refer to relevant schemes in the EU for best practice examples. These include: plastic bottle recycling schemes and recirculating systems in Finland; construction waste management, waste incineration and mechanical-biological treatment in Germany; household recycling and waste reduction schemes in Denmark; and waste-sorting and separation approaches in the Netherlands.
- Further awareness of sustainability topics should be developed through education and community campaigns, including classroom-level programs to help boost Hong Kong’s household sorting and recycling rate.
- As outlined in the Hong Kong 2030+ Plan, the Hong Kong government should ensure that the relevant actions and processes are in place to meet the report’s 2017 target (no more than 1.0 kg of the per-capita MSW disposal rate, and 20% reduction in waste disposal over 2011 levels).

2

Commodity Pricing and Recycling Rate

Recycling the majority of commonly used goods is realistically achievable. Therefore, it is economics rather than advanced scientific knowledge that is a determining factor for recyclability. Specifically, a material is recycled only if a market value can be clearly identified for its collection, sorting and recycling. For money to be made in the context of a green economy based on recycled materials, much depends on the price manufacturers are willing to pay for materials to be used as secondary raw materials. Manufacturers will determine the price they are willing to pay for the virgin material that the secondary raw material can replace.

At present, secondary raw material prices have been dropping as prices for virgin materials have been largely reduced due to falling oil and commodity prices.¹⁸ Since virgin materials are now cheaper than recycled raw materials, many manufacturers prefer to purchase virgin materials. This leads to difficulties for frontline recyclers. As the price paid for waste falls, there is less incentive for recyclers to collect disposals. Many recycling firms are understandably unwilling to bear the burden of logistical costs in the face of decreasing profit margins due to reduced prices for recycled goods.

The price of plastic (both virgin and recycled) is proportion (positively correlated) to the price of oil, since plastic is primarily derived and refined from oil. Hence, the plunge in oil prices in recent years has severely damaged the plastic recycling industry, as the price of virgin plastic becomes low enough to push manufacturers to buy virgin plastics, as well as other virgin commodities.

Similar to the current influences of commodity prices on recycling rates, the gradual increase of glass commodity prices reflects an overall increase in glass recycling. However, the increase in recycling rates may also be the result of individual government legislation governing glass recycling initiatives.

2.1. Waste Transportation in the European Union

The control and supervision of waste transport in the EU is a matter of high importance for member states. To drastically stem the problem of uncontrolled movement of waste, Regulation (EC) No 1013/2006 of 14 June 2006 on waste shipments outlines procedures for trans-boundary waste shipment (transportation). The regulation enshrines implements the provisions of the *Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and Their Disposal*, as well as the OECD Decision, into EU Law.¹⁹ Included within the regulation is a ban on the export of hazardous wastes to non-OECD countries, known as the Basel Ban, as well as a prohibition on the export of waste for disposal.

Since the use of virgin material is preferred by manufacturers and large corporations, another objective of the EU Action Plan is to increase the use of secondary raw materials, recycled nutrients and treated wastewater. This may be achieved through improving knowledge of material stocks and flows, ensuring quality standards for secondary raw materials, enforcing the EU regulation on fertilisers and legislating minimum requirements for reused water.

Furthermore, as of July 2016, EU customs officials were able to harness new methods in aiding the identification of waste illegally crossing EU borders as non-waste. The tool that was introduced involves goods with customs headings that may be checked and verified against a waste code, thus serving as an alert for customs that waste may be illegally crossing EU borders. This authentication mechanism (Regulation (EU) 2016/1245 of 28 July 2016) is expected to curb the amount of illegally exported waste, as well as prevent the leakage of raw materials out of the EU.²⁰

Another successful labeling mechanism used in the EU is the “EU Ecolabel”. The Ecolabel identifies products and services that have been deemed by a licensing body to have a reduced environmental impact throughout their life cycle, from the extraction of raw material, production, use and disposal. Labeled products are evaluated by independent experts to ensure they meet sustainability criteria. Although a voluntary scheme, the public popularity of the EU Label scheme is well demonstrated, enabling consumers to easily verify a product’s environmental commitment.²¹

2.2. Hong Kong

Price changes for virgin materials also effect recycling mechanisms in Hong Kong. Furthermore, there is a lack of incentive for the private sector to enter the plastics and glass recycling markets without the persuasion of government bodies. Means of interventions considered for implementation should include subsidies on purchasing recycled material from local sources and providing suppliers and producers with tax incentives for using recycled materials in their production and supply chain.

Nevertheless, Hong Kong faces the hurdle of small geographical size coupled with high urban population density. Therefore, to establish a stable and sustainable recycling industry, collaboration in the form of transportation and facilitation methods between the Hong Kong, Macao and Chinese Governments is greatly needed.

2.3. Recommendations

- The Hong Kong government should be aware of how price developments for virgin commodities impact recycling rates. To offset them, the government should look toward

subsidising the use of recycled materials, providing tax incentives for using recycled materials, and imposing tariffs on virgin and non-recycled materials.

- The Hong Kong government should consider facilitating the trade and transport of recycled materials collected in Hong Kong to other countries in the region who demonstrate an established production and manufacturing base.
- The Hong Kong government should support the development of a market for products derived from secondary raw materials.
- Looking toward the future, environmental and sustainability legislation should clearly encompass supporting the importation of goods into Hong Kong that would complement and boost a circular economy.

3

Glass Recycling

Of the 9,000 tonnes of MSW daily waste produced in Hong Kong, at approximately 290 tonnes, waste glass accounts for only 3%. Because glass waste is such a small percentage of the overall waste amount, the recycling procedures and regulations relating to glass have not been prioritised. Despite this, waste glass disposed of at landfills inevitably accumulates and contributes to the capacity of Hong Kong's only three landfills. These are estimated to reach full capacity before 2019.²²

In addition, reuse of waste glass can save up to 25 mega joules of energy per 1 kg when compared to the process of manufacturing glass from raw materials.²³ There are also applications which convert glass into building materials, concrete and paving applications, replacing sand and other natural resources.

Encouragingly, Hong Kong's private sector provides positive examples of innovative glass recycling methods. In the area of concrete and paving applications, some eco-glass block manufacturers have harnessed air pollution removal technologies. Technologies are implemented using titanium dioxide, which serves as an excellent air-purifying element to reduce nitrogen oxide on pedestrian walkways, in some cases by up to 20%.²⁴ Eco-glass blocks are also much cheaper than imported, non-environmentally friendly pavers.²⁵ This provides opportunities for local construction companies to purchase higher quality materials at a lower cost, thus increasing cost efficiency.

3.1. Hong Kong

The waste glass in Hong Kong that is recycled by the government and NGOs such as HK Recycles is delivered to Eco Park for waste management.²⁶ Some private sector waste management

companies located in Eco Park use waste glass as a raw material for conversion to eco-pavers.²⁷ The technology effectively uses recycled glass as a major material, reducing the need for waste glass disposal while preserving valuable natural resources (e.g. river sand).

Currently, Hong Kong implements a deposit-and-return system for recycling glass beverage bottles. Grocery stores and similar vendors charge customers a fee as a deposit for using the glass bottles, which can then be redeemed upon return after finishing the beverage.²⁸ Recently, this system has been somewhat in decline as a result of local re-bottling operations relocated out of Hong Kong, as well as the increasing use of other packaging materials.

However, in 2010, the Environmental Protection Department cooperated with the Hong Kong Housing Authority to establish glass bottle collection points in housing estates, residential buildings and government facilities to promote glass bottle recycling by the public.²⁹ There are 1,200 glass bottle collection points over the territory, reaching 70% of Hong Kong's population. Furthermore, the Environmental Protection Department has designed a mobile application "Waste Less" to show the location of nearby collection points.³⁰

Additionally, after a public consultation was well received in 2013, the EPD drafted the necessary legislative proposals for the mandatory PRS on glass beverage containers, entitled the *Promotion of Recycling and Proper Disposal (Product Container) (Amendment) Bill 2015*³¹. The bill proposed a legislative framework for the implementation of the mandatory PRS on glass beverage containers and was presented to LegCo in July 2015. LegCo passed the legislation, which came into effect in May 2016. EPD is carrying out other preparatory works for the implementation of the PRS, including drafting the necessary subsidiary legislation and preparing for the open tender for glass management contractors, with a view to implementing the scheme as soon as practicable.

3.2. Macao

In 2011, the previously-mentioned IACM of Macao introduced the Glass Container Recycling Programme to promote the sorting and recycling of recyclable waste, while increasing the types of recyclables accepted for sorting and recycling in Macao.³² The programme has been an effective method of further reducing the amount of solid waste produced while increasing the local waste recycling rate. To further heighten recycling awareness and participation in the local community, IACM has placed public recycling bins for glass bottles in various districts citywide to make it convenient for members of the public to participate in the recycling programme. The glass bottles collected through the Glass Container Recycling Programme undergo further processing to be transformed into glass sand. Glass sand may be used in many applications, such as the manufacture of eco-floor tiles, as raw materials in the manufacturing asphaltic concrete, or as road construction backfill material.

3.3. The European Union

The 28 member states of the EU generate approximately 80 million tonnes of packaging waste yearly per inhabitant, of which 20% (16 million tonnes) is waste glass.³³ Between 2005 and 2015, the generation of waste glass decreased by 1.2% while the recycling rate increased. Figure 1 (right) shows that, as of 2013, the EU-28 averaged a 65.3% recycling rate, ranging from 78.7% (Belgium) to 36.1% (Poland).

	RECOVERY RATE	RECYCLING RATE
EU-28 ⁽¹⁾	79.2	65.3
Belgium	96.6	78.7
Bulgaria	66.0	65.7
Czech Republik	74.7	69.9
Denmark	85.6	64.8
Germany	97.7	71.8
Estonia	77.7	58.4
Ireland	88.1	70.2
Greece	52.8	52.4
Spain	73.1	66.6
France	75.4	66.4
Italy	58.8	58.8
Croatia	76.5	66.7
Cyprus	56.6	56.6
Latvia	54.5	51.0
Lithuania	53.9	53.5
Luxembourg	91.8	62.8
Hungary	60.3	49.2
Malta	38.2	38.1
Netherlands	93.9	70.5
Austria	96.1	66.6
Poland	50.4	36.1
Portugal	64.8	61.5
Romania ⁽²⁾	57.4	56.8
Slovenia	92.5	69.0
Slovakia	69.5	65.9
Finland	93.2	58.0
Sweden	87.4	71.9
United Kingdom	72.7	64.6
Iceland ⁽²⁾	56.5	41.8
Liechtenstein	90.9	50.3
Norway	93.2	54.5

(1) Estimate. (2) 2012 data.

Source: Eurostat

Figure 1: Recovery and Recycling Rate for Packaging Waste, 2013 (%)

Various factors contribute to Belgium's particularly elevated and successful levels of glass recycling. Various private-sector member-based companies lead the region in the promotion, coordination and financing of sustainability-related activities and initiatives. These include campaigns to boost awareness of collection, sorting and recycling of household packaging waste, both in schools and the public sphere. In line with the effectiveness of financial incentives, companies that bring packaged products into the Belgian market pay a contribution to said firms, which is then allocated to suitable household packaging collection, sorting and recycling programs. Elsewhere, a regulatory framework such as the *EU Waste Legislation & Building Glass Recycling* provides limited financial or other incentives for recycling packaging glass and no incentive for building glass.³⁴

As clearly demonstrated in Belgium and other EU member states, recycling and sustainability practices flourish when they are underpinned by legislation and an enforceable benchmark or minimum standard. Although school and grassroots level campaigns are effective, overall recycling involvement and contributions are undoubtedly benefitted by legislative enforcement.

3.4. Recommendations

- As the Hong Kong glass recycling industry is still in its infancy, the Hong Kong government should provide subsidy incentives and administrative assistance to businesses that are interested in entering or engaging in a joint venture within the glass recycling market.
- The Hong Kong government should seek to clearly define avenues of governance regarding the sorting, crushing and export of glass to the Pearl River Delta region. This should be outlined in environmental legislation through the harnessing of Hong Kong's reputable legal system.
- Through its Environmental Protection Department, the Hong Kong government should fortify and expand on the currently implemented glass recycling programmes, including "Clink, Drink then Recycle" and "Glass Container Recycling Programme for The Hotel Sector".

4

Food Waste

Food waste in high-income countries is usually a result of supply chain surplus, and leftover or expired goods. To reduce food waste, European Union countries have adopted various measures, including legislation, the imposition of fees and voluntary disclosure schemes. Meanwhile, Hong Kong's Environmental Protection Department has established a plan to achieve a 40% reduction in food waste entering landfills by 2022, using 2011 as the baseline year.

Approximately 40% of Hong Kong's 9,000 tonnes of daily municipal solid waste is putrescible waste, of which 90% is food waste. In 2011, Hong Kong residents disposed of approximately 3,600 tonnes of food waste daily³⁵ – two-thirds from households and one-third from commercial and industrial sources. The Environmental Protection Department of the Hong Kong government has initiated plans to build three Organic Waste Treatment Facilities (OWTFs) between 2016 and 2021. These facilities would turn organic waste into reusable organic material and alternative energy, such as biogas, thus reducing greenhouse gas production by 25,000 tonnes while also reducing fossil fuels usage.³⁶

The current goal is to reduce total disposals at landfills by 40% by 2022. Most waste is comprised of food waste. However, the total daily capacity that the three proposed organic waste treatment facilities can handle is only 800 tonnes, which is equivalent to approximately 22% of total food waste produced every day. In addition, unlike many EU countries, Hong Kong has yet to enforce a charge on waste disposal.

4.1. Food Waste Management in Hong Kong

The majority of food waste in Hong Kong originates from households and commercial establishments (supermarkets and restaurants). About 98% of food waste is sent to landfill despite its recyclability, with only a small amount of food waste recycled as fertilizer. It is also important to note that Hong Kong's shift to a service-based economy means that most of the recycled waste cannot be reproduced locally and go back to the local community. As a result, this waste must be exported to Guangdong Province and to other parts of Asia.³⁷

Despite the EPD having set a target of reducing food waste by 40% by 2022, this may prove to be overly ambitious.

The government has planned to achieve food waste management goals via four main channels:

- At-source reductions: Food waste management reforms in restaurant kitchens via the “Food Wise Hong Kong” campaign. “Food Wise Hong Kong” was launched in 2013 and some programmes and activities have been implemented with an objective to reduce food waste by 5 to 10% by 2017-2018.
- Food donation promotion: The Government has funded 18 NGO projects, collecting more than 2,000 tonnes of surplus food over the two-year project period. However, this figure remains underwhelming when compared to the amount of food waste entering landfills each year.³⁸
- Food waste recycling: Food waste is composed of many useful materials that can be reused and recycled. The Hong Kong Research Institute of Textiles and Apparel (HKRITA) has harnessed technologies to break down food waste materials through a fermentation process so they can be polymerised, spun and woven into new fabrics.
- Turning Food Waste into Energy: As Hong Kong has large demands for energy, turning food waste into energy should be a priority in the efforts to solve the food waste issue. Anaerobic digestion of food waste could create biogas, providing a more sustainable alternative energy source to fossil fuels.

Despite the positive steps taken by the government, there remain unexploited opportunities for improvement. The participation rate of “Food Wise Charters” still remains low. Moreover, some voluntary plans suggested by the government, including the “Green Lunch Practices”, as well as food-waste recycling trial schemes in public rental housing, are not widely adopted by all schools and households in Hong Kong due to a lack of enforcement. This clearly demonstrates that implementing voluntary schemes in Hong Kong are largely ineffective without corresponding government enforcement.

Furthermore, public awareness of recycling and separation of food waste is still very limited in Hong Kong. By way of comparison, successful instances of public awareness initiatives and campaigns in various EU countries can serve as valuable reference points for Hong Kong. For example, Germany and Belgium have had great success through their education system by employing specific environmental teachers and specialists in classes beginning in kindergarten.³⁹

4.2. Food Waste Management in Europe

An estimated 88 million tonnes of food are wasted annually in the EU, with an associated cost of approximately 143 billion euros.⁴⁰ Food waste management directives are an integral part of the European Commission's abovementioned Circular Economy Action Plan, with the plan also containing related legislative proposals on waste management.

To assist in reaching the Sustainable Development Goals (SDG) food waste reduction targets in the EU, the European Commission will implement various actions targeting food waste. These will include: taking measures to clarify EU legislation related to waste, food and feed, facilitating food donation and the use of former foodstuffs, and using by-products from the food chain for feed production without compromising food and feed safety, as well as creating a new platform involving both EU member states and actors in the food chain in order to help define measures needed to achieve the food waste SDG, facilitating inter-sector co-operation, and sharing best practices and result achievement.

4.2.1. France

Through legislative means, France has recently prohibited supermarkets from discarding any unsold food. It is now compulsory for such establishments to donate the unsold goods to charities. On July 12, 2010, the French Parliament passed Bill 2010-788 through the National Commitment for the Environment, also known as the Grenelle II Law. This Law serves as a clear blueprint for France's future objectives on environmental and sustainable development dating back to the 2008 Grenelle I Law (Title III Energy and Climate), which states that the future target of decreasing energy consumption and carbon emissions is to be achieved by clear indication on the product label of a given item's energy-CO₂ performance. It also maintains France's leading position among the EU countries in the production of renewable energy, and explores the potential of developing new fuels made from plants, wood, and other organic waste.⁴¹

4.2.2. The United Kingdom

In the UK, supermarkets make food waste data available to the public. Many large retailers in the UK take initiatives to publish food waste data online for public access. Additionally, expiration of "best-before-date" accounts for approximately 55% food waste from households. Besides household waste, a large proportion of waste is produced from the supply chain, including production residuals and industrial waste. The HM Revenues & Customs of the United Kingdom also applies a standard tax charged by weight for landfill disposal, with the standard rate being £ 84.40/tonne.⁴² Hong Kong is no exception when it comes to food waste disposal, with most of the perishable and putrescible waste originating from households.

4.2.3. Germany

Each German resident discards more than roughly 82 kg of food waste every year, mainly due to expiration dates. Fruit and vegetables account for more than half of the total disposal. In 2016, the Minister of Food and Agriculture announced plans to abolish the practice of displaying a best-before-date (BBD) on some perishable food, replacing it with a more current and reasonable expiration date.⁴³

4.2.4. The Netherlands

Every year in the Netherlands, the average household throws away more than 50 kg of food, accounting for approximately 2.5 billion euros in losses. On the industrial side, food suppliers, wholesalers, the hospitality industry and supermarkets combine for a further total of 2 billion EUR due to food disposal.⁴⁴ Similar to Germany, agricultural products and consumable seasonings such as sauces, oil and fats are the main contributors of food waste.

Despite this, the waste management systems of the Netherlands are generally highly regarded worldwide owing to high recycling rates, energy efficient waste incineration plants and minimal landfill disposal.⁴⁵ In May 2013, a statement of intent on waste management collaboration between Hong Kong and the Netherlands was signed. Under the Statement of Intent, both parties will co-operate on waste issues through the interaction of government, industry, education and research institutions. Agreement was also reached in the exchange of scientific studies and technological developments, as well as sharing expertise and strategies to maximise resource recovery and to minimise waste disposal.

4.2.5. Finland

Finland's National Waste Plan outlines various waste reduction methods and initiatives, as well as promotes alternative energies, helping to significantly reduce food waste generated in households, supply chain, and other areas including farming and the hospitality sector. This is despite the fact that Finland does not have a separate plan for treating food waste. Finland's Waste Legislation/Waste Tax Act (1126/2010) advocates for the sensible use of natural and organic resources and endeavours to reduce or halt the production of more unrecyclable waste.⁴⁶ For instance, a waste tax is levied against landfill waste that cannot be recycled, recovered, or reused on technical and environmental aspects, such as chemical processing or biotechnology. Final disposal of waste onto or into land on a landfill site is subject to tax. Starting from 2016, organic waste disposal at landfills is completely prohibited and hefty fines apply if found violating the law.

4.3. Food Waste Management in the Pearl River Delta Region

The Pearl River Delta Region is heavily polluted due to millions of tonnes of untreated food waste being directly deposited into the sea and river. Recent collaborations between universities and the PRD region have aimed at treating food waste pollution. For example, Guangxi Province has produced a low-cost, feasible waste management model which separates waste into various fractions and, in so doing, facilitates the recycling of organic waste for future utilisation as compost. This practice reduces landfill space needs (which are already greatly limited). It also prevents the illegal dumping of MSW onto agricultural land, as well as prevents the subsequent adverse impact on food quality, which was previously normal practice in Mainland China for most of the industrial waste. A similar approach will be further tested in two different sites in Guangdong to reconfirm the feasibility of the waste management models in-country at the rural level. Harnessing facilities in the PRD region will be a key focus to further contribute toward building a sustainable future for Hong Kong.

4.5. Recommendations

- The Hong Kong government should look to invest in waste collection and sorting facilities, especially for newly-built projects and commercial buildings, including collection networks for food and organic waste.
- More environmentally-friendly and central waste management designs for collecting sorted waste should be considered for new buildings, especially given the number of high-density residential buildings in Hong Kong. This may be expanded to include the retrofitting of densely developed urban areas and optimising the new development areas as outlined in the Hong Kong 2030+ Plan.

Regarding food waste, liaison between the relevant government departments and entities in the food and beverage industry is needed to introduce legislation obliging restaurants, markets and supermarkets to separate and collect food waste. This should include mandatory collections (or donation) of food waste from restaurants, supermarkets and food markets, which should be enforced by the relevant authorities, in a similar manner to the Grenelle II Law in France.

The Hong Kong government should look to implement education and communication campaigns, in collaboration with restaurants, food markets and supermarkets.

5

Waste to Energy

The signatory countries to the United Nations Framework Convention on Climate Change (UNFCCC) must submit national inventories of greenhouse gas emissions. The Intergovernmental Panel on Climate Change (IPCC) has a set of guidelines for calculating greenhouse gas emissions, which countries use to report their emissions. Mainland China is a signatory country, whereas Hong Kong and Macao are considered as sub-national Special Administrative Regions. The two regions are required to submit their greenhouse gas emission inventory to the Central People's Government, per the IPCC guidelines for overall national emissions inventory.⁴⁷

In using the IPCC guidelines for calculation, Hong Kong's annual greenhouse gas emissions ranged from 33.3 to 43.1 million tonnes of carbon dioxide from the period of 1990 to 2012. Hong Kong's greenhouse gas emissions on a per capita basis ranged between 5 to 7.4 tonnes of carbon dioxide on a sub-nation basis or 0.021 to 0.044 calculated at the national level. In the year 2013, electricity had the major share of energy for end-uses with 54%. In 2009, the fuel mix for electricity generation was divided: 54% Coal, - 23% Natural Gas, and - 23% Nuclear power imported from the mainland. Therefore, 77% of electricity is produced from climate gas generating resources. Following the 2015 Paris Conference, the Hong Kong government set targets to promote low-carbon living in communities. The aim is to reduce the carbon intensity by 2020 by 50-60%, taking the 2005 level as the baseline (44.8 million tonnes of GHG were emitted). Further, energy efficiency shall be enhanced and the development of renewable energy is to be promoted. In this area, the waste management sector can play a vital role. In its blueprint, the government made clear that in the waste management hierarchy, waste recovery in the form of energy generation is a lower step in the waste hierarchy, whereas prevention, reuse and recycling take higher priority. However, the energy produced from waste is in fact a viable source for renewable energy and can provide a sustainable solution for the use of waste.

5.1. Hong Kong

In Hong Kong, one large-size waste facility is already in operation (i.e., T-PARK – the world's biggest sewage sludge incinerator) and the implementation of additional waste treatment plants are planned (e.g. "Integrated waste management facilities" and "organic waste treatment facilities"), all of which will make use of the corresponding waste treatment to produce energy (mainly electricity).

In 2010, total greenhouse gas emissions in Hong Kong amounted to about 41.5 million tons of CO₂ equivalents, whereas electricity generation contributed about 66% of the total

greenhouse gas emissions. Furthermore, the Hong Kong electricity market is dominated by two companies: The Hong Kong Electric Company, Limited (HKE) supplies electricity to Hong Kong Island, Ap Lei Chau and Lamma Island. CLP Power Hong Kong Limited and Castle Peak Power Company Limited (referred to collectively as CLP) provide electricity to Kowloon, the New Territories and some outlying islands.

Electricity generation operations are currently governed by Scheme of Control Agreements (SCAs). SCAs are bilateral agreements signed between the Hong Kong SAR Government and both of the local utilities, Hong Kong Electric (HKE) and CLP Power (CLP) to regulate the economic aspects of the electricity supply.

The Hong Kong government is considering continuing the implementation of additional new Waste-to-Energy plants. These include the current Sludge Treatment Facilities (STF / T-PARK) and another that is currently being implemented is the Organic Waste Treatment Facility - Phase 1 (OWTF Phase 1). However, there are more to come. The planning anticipates several OWTF Phases. A current in-tender process is the Integrated Waste Management Facility - Phase 1 (IWMF, i.e. MSW incinerator). However, there may be an IWMF - Phase 2 as the Government has indicated that it may be necessary to implement at least two plants to treat the MSW in Hong Kong, despite all other efforts of waste avoidance, reduction and recycling.

Additionally, the focus of the waste-to-energy plants is the generation of electrical power, where different plants still could provide other types of energy, for example, generating cooling and other forms of useable energy from the heat produced from building air conditioning units. Therefore, it seems that the focus of the waste treatment plants is disposal rather than energy recovery, which can be seen as a missed opportunity to provide sustainable renewable power.

5.2. The European Union

Recent developments in Europe concerning waste management have also focused on energy efficiency. The Directive 2006/12/EC on waste has been revised to include additional requirements. Among these, the terms “recovery” and “disposal” were clarified. The revised directive also clarified when the incineration of municipal solid waste is energy efficient and may be considered a “recovery operation” or a “disposal operation”. The new EU Directive 2008/98/EC on Waste includes Annex II, which defines the R1 criterion.

The EU Directive 2008/98/EC in its Annex II defines recovery as where waste or by-products can replace other materials in its function (*R1 Criterion*). This also includes the use of waste as a fuel to generate energy, e.g. in waste incineration plants where waste is the sole fuel source. However, to be deemed “recovery”, the energy efficiency of the facility must be higher than the threshold as laid out in the formula of the R1 Criterion as mentioned in Annex II – Recovery Operations.

The corresponding Guidelines of the Directive 2008/98/EC explain that the calculated result of the formula is a performance indicator for the plant, in which it expresses the level of energy recovery capabilities for a given plant. As such, it necessarily must exclude several aspects of waste-to-energy plant from the overall system for the calculation of the performance indicator according to the R1 criteria formula of Annex II. This is necessary to clarify the system boundaries arising from the fact that additional incineration processes lower energy efficiency. Therefore, the R1 criterion focuses on the incineration process itself and the resulting or required energy only. Pre-treatment of waste, e.g. crushing, mixing, or shredding is excluded. These are considered separate processes that are covered by Criteria R12. The same applies to any post-treatment, e.g. of bottom ash, which can be covered by Criteria R4 or R5.

The Confederation of European Waste-to-Energy Plants (CEWEP) is the umbrella association of the owners and operators of Waste-to-Energy Plants, representing some 400 Waste-to-Energy Plants from 22 countries. They make up more than 80% of the Waste-to-Energy capacity in Europe.⁴⁸

CEWEP has analysed and investigated energy efficiency of European Waste-to-Energy plants in reports over a period from 2001 to 2004 and from 2004 to 2007. In the report covering the period from 2007 to 2010, it continued this work and analysed energy data from 314 European waste-to-energy plants from 17 European countries and regions, including Spain, Southern Italy, Central Europe, Eastern Europe, as well as Sweden and Finland. The simplified results of the investigation showed that plants with a low result for R1 are small plants (throughput < 100,000 Mg/a) producing electricity only, and the highest results are related to large-sized plants (throughput > 250,000 Mg/a) with combined heat and power production.

Although it would be possible for smaller plants or plants producing electricity only to achieve the R1 criteria, it is more difficult. This highlights the importance of a sound and comprehensive energy concept to underpin such facilities to provide sufficient opportunities to make good use of the energy contained in the MSW.

The R1 criterion in Europe is currently only applied against waste-to-energy plants, however it is a comprehensive benchmarking tool for energy efficiency. In particular, planners and regulating authorities are aided by this criterion as it greatly aids in evaluating designs and building methods for their energy efficiency prior to initiating construction. It would also enable the Hong Kong Administration to evaluate existing plants.

In principle, the criterion aims to maximise energy efficiency, including power generation and use, helping society to move toward low carbon footprint, as mentioned by the Hong Kong government in the policy address in 2016.

5.3. Recommendations

- The Hong Kong government should look to take example from the R1 criterion in Europe, as it is an excellent benchmarking and comparison tool for energy efficiency for waste-to-energy and comparably focused waste management facilities.
- European companies across all environmental industry segments should be encouraged to consult on carbon emission reduction measures and provide sustainable solutions in collaboration with the Hong Kong government and local corporate entities.
- Overreliance on landfill for solid waste disposal is unsustainable, especially in geographically restricted cities such as Hong Kong. Industrial Environmental facilities such as Eco Park and T-PARK should continue to be harnessed for the conversion of waste to energy. Particular focus should be placed on the need to build additional organic waste treatment facilities (OWTFs), and sizable integrated waste management facilities (IWMFs) with sufficient capacity to turn waste into energy and deal with MSW that has not been removed from the waste stream.

Abbreviations

BEEO	Building Energy Efficiency Ordinance
CEWEP	Confederation of European Waste-to-Energy Plants
China	People's Republic of China
EAP	Environment Action Programme
EPD	Environmental Protection Department
EU	European Union
IACM	Civic and Municipal Affairs Bureau (Portuguese: <i>Instituto para os Assuntos Cívicos e Municipais</i>)
IWMF	Integrated Waste Management Facility
IPCC	Intergovernmental Panel on Climate Change
LegCo	Legislative Council
MSW	Municipal Solid Waste
NGO	Non-Governmental Organisations
OECD	Organisation for Economic Co-operation and Development
OWTF	Organic Waste Treatment Facilities
PERO	Product Eco-responsibility
PRS	Producer Responsibility Schemes
PSB	Plastic Shopping Bags
SCA	Scheme of Control Agreements
SDG	Sustainable Development Goals

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European Union Business Information Programme in Hong Kong & Macao

Room 1302, 13/F, 168 Queen's Road Central, Hong Kong
info@eubip.eurocham.com.hk
Tel: +852 2511 5133 · Fax: +852 2511 6833



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