



## 1. Introduction

1.1 Over the past decade or so, the Hong Kong Government has launched a number of initiatives to promote waste recovery, including (a) setting up the EcoPark in Tuen Mun in 2007; (b) establishing the Recycling Fund valued at HK\$1 billion to support waste recyclers in 2015; (c) introducing legislations to implement producer responsibility for few waste streams beginning with glass bottles and electronic/electrical products; and (d) improving voluntary waste separation and collection facilities which are accessible to residence of some 80% local households. Yet the recovery rate of municipal solid waste still fell noticeably from 48% in 2011 to 35% in 2015. To a certain extent, the lacklustre recycling performance could be attributable to the sluggish global market for recycled products in recent years. Yet there are also concerns that the local recycling industry did not receive enough support to remain self-sufficient and financially sustainable, compared to their overseas counterparts which are supported by well-established extended producer responsibility systems ("EPRS") covering most kinds of waste.<sup>1</sup> As such, the local recycling industry remained relatively small in size, with about 500 establishments directly employing 4 000 people in 2013.<sup>2</sup>

1.2 At the request made by the Subcommittee on Refuse Collection and Resource Recovery in October 2016 and as a follow-up to the earlier note entitled "Separation and collection of household waste in selected places"

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<sup>1</sup> In those places with good practice of EPRS, producers are held responsible for the environmental impacts of their products from the design to end-of-life phase. This helps relieve the burden of municipal governments and taxpayers in waste management and promotion of recycling. By contrast, EPRS has been implemented on a rather limited scale in Hong Kong. While the Product Eco-responsibility Ordinance setting out the legal framework for producer responsibility system was enacted in 2008, separate legislation is still required for each type of waste added to the system. So far, only two bills covering waste electronic and electrical equipment and glass bottles have been passed.

<sup>2</sup> The figures did not include itinerant waste collectors and scavengers of recyclable materials. The recycling sector is estimated to account for less than 0.2% of both overall business establishments and total employment in Hong Kong in 2013. For details, see GovHK (2013).

published in March 2017<sup>3</sup>, the Research Office has studied how the sorted household waste collected in three selected cities (i.e. Taipei, Seoul and Berlin) is fed into their respective recycling systems. This note focuses on three main areas which are deemed to be more relevant to the public concerns in Hong Kong, namely (a) EPRS operation; (b) treatment of food waste; and (c) incineration of residual waste.

## 2. Waste recycling system in Taipei

2.1 **EPRS** plays a vital role in waste recovery across Taiwan, shifting the financial responsibility of waste treatment from municipalities to "producers" on the ground of "polluter pays principle". Pursuant to the Waste Disposal Act amended in 1997, producers including both manufacturers and distributors in Taiwan have to take back, recycle and dispose of a wide range of 33 "regulated" products and packaging items in 13 categories based on considerations of recyclability and environmental impacts.<sup>4</sup> For this purpose, Taiwanese producers need to declare the amount of such regulated items and pay item-specific levy to a centralized Recycling Management Fund ("RMF") under the Taiwan Environmental Protection Administration ("TEPA").<sup>5</sup> The levy will then be used to subsidize private recyclers in accordance with pre-determined subsidy rates regardless of market fluctuation in the short term.<sup>6</sup> The Fund also supports local governments over household waste collection. This recycling system is called "four-in-one" in Taiwan, signifying the close collaboration amongst local residents, local governments, recycling businesses and RMF in waste management (**Appendix**).

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<sup>3</sup> See Legislative Council Secretariat (2017).

<sup>4</sup> These regulated products include waste aluminium containers, waste paper containers, waste plastic containers, waste dry batteries, waste cars and motorcycles, waste tires, waste lead-acid batteries, waste lubricants and waste home appliances.

<sup>5</sup> RMF is set up under government account with stringent supervision. The recycling system comprises of six main bodies, including (a) managing committee; (b) consumers; (c) responsible industries; (d) collection and treatment agents; (e) fee reviewing committee; and (f) auditing agents. Recycling facilities are independently audited to confirm the actual amount of materials recycled and assure that operations meet the regulations.

<sup>6</sup> The levy and subsidy for each regulated waste item is determined by a Fee Rate Review Committee comprising representatives from business, green groups and consumer protection bodies. In fixing the subsidy, the Committee takes into account the recycling volume, the clearance and disposal cost, the amount of bonus paid to waste collectors, treatment capacity, the market value of the recycled materials, inspection and verification cost, and the financial situation of the Fund. The levy collected for a particular item will only be used on that item. The Committee reviews the subsidy when necessary. For instance, it reviewed the rate of subsidies for waste containers three times over the past six years in 2012, 2015 and 2016.

2.2 The RMF's annual levy income rose by a cumulative 30% in 14 years, from NT\$5.4 billion (\$HK1.25 billion) in 2001 to NT\$7 billion (HK\$1.76 billion) in 2015.<sup>7</sup> In 2015, NT\$5.1 billion (HK\$1.28 billion) or 73% of the levy income was paid as subsidy to licensed recyclers<sup>8</sup> who reported their audited amount of recycled waste to the Fund. Analyzed by waste category, waste container recyclers received most subsidy in 2015, accounting for 35% of the total. This was followed by recyclers of waste electrical and electronic equipment ("WEEE"), with a share of 25%. In spite of occasional deficits in individual waste accounts, the Fund managed to maintain an overall surplus after operation of about two decades, with an accumulated surplus of NT\$14 billion (HK\$3.5 billion) recorded at end-2015.

2.3 The "four-in-one" recycling system appears to have provided necessary support to the recycling industry in Taiwan. **First**, the annual quantity of recycled waste under EPRS had surged by 240% to over 980 000 tonne during 1998-2015, accounting for about 30% of all recyclable waste collected in Taiwan in 2015. **Secondly**, the average recycling subsidy per tonne has dropped by 66% over the same period to NT\$6,850 (HK\$1,719) per tonne, indicating improving efficiency of both the Fund and the recycling industry. **Thirdly**, the recycling rates of some waste types considered to be less economical for recycling have also improved. For instance, the average recycling rate of plastic containers has increased from 43% in 1999 to 74% in 2015.<sup>9</sup> **Lastly**, the recycling industry in Taiwan has grown in strength, with its overall receipt increasing by 68% in just eight years to NT\$20.7 billion (HK\$5.1 billion) in 2016.<sup>10</sup> According to TEPA, the subsidy granted by RMF has become a key stabilizing force of the recycling industry in Taiwan, especially amongst the small to medium-sized recyclers.

2.4 That said, there are concerns mainly from producers over the implementation of the "four-in-one" recycling system in Taiwan. As the item-specific levy would have cost implications on production, some producers evaded the levy by under-reporting their product quantity. This free-riding

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<sup>7</sup> As a general rule, at least 80% of the levy will be allocated to a trust fund which is used to subsidize recyclers. The remaining 20% will go to another fund used on publicity, auditing, subsidising local authorities on recyclable collection fleet procurement, and survey and research.

<sup>8</sup> Recyclers have to meet facilities standards and operation regulations before RMF approves and pays the subsidy. To facilitate waste collection, the recyclers may also enter deals with waste collectors on sharing the subsidy.

<sup>9</sup> For PET bottles, the amount collected rose by 187% between 1999 and 2015. In 2012, the recycling rate of PET bottles in Taiwan already reached 96%. The Fund's subsidy is only issued to PET bottle collectors.

<sup>10</sup> According to a study conducted in 2005, the economic benefits of the recycling industry more than offset the cost. The overall benefit-to-cost ratio of recycling waste was 1.14 in 2001. See Fan, K. (2005).

behavior may have resulted in not only deficit in the account of certain waste products (like plastic containers), but also legal disputes over the levy amount.<sup>11</sup>

2.5 **Food waste** is not covered by EPRS in Taiwan, and hence the Taipei City Government ("TCG") is solely responsible for the treatment of about 170 tonnes of food waste collected on a daily basis. Currently, 22% of the food waste is sold to recyclers located outside Taipei for conversion into livestock feed. The remaining 78% is sent to three incineration plants located in Taipei for temporary storage and pretreatment, before transferring to compost operators.<sup>12</sup> According to TCG, the average treatment cost of food waste was about NT\$1,800 (HK\$450) per tonne in Taipei, including transport cost. To boost its capability to handle the food waste, TCG is planning to build Taiwan's first anaerobic digestion plant with a daily handling capacity of 200 tonnes. Upon completion by 2021, Taipei will be able to treat the food waste on its own and save transport costs.

2.6 **Residual waste** collected from households in Taipei is mostly burnt at three TCG-run incinerators for energy recovery. Despite having a total daily handling capacity of 4 200 tonnes, these facilities have been underutilized in recent years, partly because of the 50% reduction in the amount of residual household waste sent to the facilities between 2000 and 2015. This decrease could be attributable to the success of waste reduction and recycling efforts of the city, as well as public concerns over the air emission from facilities. Although the operation of the incinerators is partly financed by the income from the sale of electricity generated from incineration, 14% of the total operation cost was still not recovered in 2015. Taipei now incinerates about a third of its municipal solid waste.

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<sup>11</sup> See 黃偉倫 (2015).

<sup>12</sup> Taipei used to send most food waste directly to a recycler for composting in neighbouring Yunlin county. This practice was halted after 2000 due to local opposition. The city now first temporarily stores the waste in its incineration plants for pre-treatment. In the meantime, these plants are also testing various methods to recycle the waste, such as the making of bio-ethanol.

### 3 Waste recycling system in Seoul

3.1 **EPRS** was introduced under the Act on the Promotion of Saving and Recycling of Resources in 2003, and it now covers 42 designated items of packaging and product waste mainly disposed of by households.<sup>13</sup> Producers (i.e. manufacturers and distributors) are legally obliged to take back and recycle the designated items to the standards specified by the government. The Korea Environment Corporation ("KECO") is responsible for monitoring compliance by requiring producers to report sales and imports, and the amount of waste collected and recycled. The Ministry of Environment also prescribes annual recycling targets for the items which ranged from 20% to 83% in 2016 for packaging waste,<sup>14</sup> and imposes a financial penalty of up to 30% surcharge for non-compliance.

3.2 Unlike the centralized model in Taiwan, producers in South Korea may join, where appropriate, any of the six industry-based cooperatives (e.g. Korean Packaging Recycling Association) which act on their behalf to fulfill their recycling obligations. These cooperatives are also accredited by KECO to ensure their compliance with the government targets. Producers joining these cooperatives have to pay a product-specific standard fee, ranging from a minimum fee of 30 won (HK\$0.2) per kg for tyres to a maximum fee of 2,649 won (HK\$18.3) per kg of mobile phones in 2015. Each of the six cooperatives will then deploy the fees to support the recycling industry. In the past, about 70% to 90% of the funds was paid to recyclers, while 1% to 5% was spent on publicity. In 2017, it is projected that the Korean Packaging Recycling Association alone will allocate 138 billion won (HK\$952 million) or 85% of its income to recyclers to recycle about 1.2 million tonnes of packaging waste.

3.3 The effectiveness of EPRS in South Korea is reflected in the following indicators. **First**, the annual recycling quantity under EPRS has grown by a total of 62% to 1.5 million tonnes during 2002-2012. **Secondly**, the annual recycling targets for most products have been continuously revised upward over the past decade. For instance, the recycling target for glass bottles was raised from 67.2% to 76.3% during 2005-2016, while that for fluorescent lamps from 18.9% to 35.6%. **Thirdly**, in spite of higher recycling targets, producers

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<sup>13</sup> These regulated products include 27 electronic products as well as tires, lubricant, batteries, fluorescent lamps, styrofoam float, and packaging materials.

<sup>14</sup> WEEE is subject to a different EPRS and the responsible cooperative is Korean Electronic Recycling Cooperative. Recycling target is not product-specific and is expressed as kilogramme per capita.

still generally managed to beat the targets. Taking packaging waste as an example, the actual recycling amount was 11% higher than the recycling target in 2015. **Fourthly**, the recycling industry also grew in strength, with the number of recycling businesses surging by 50% to 627 during 2003-2012. **Lastly**, it helped expand the market for recycled products to 3,055 billion won (HK\$21 billion) in 2012, and save landfill space valued at another 2,888 billion won (HK\$19.9 billion). According to the Ministry of Environment, nearly 10 000 jobs were created by EPRS over the same period.

3.4 Products or packaging (e.g. pesticides containers) which are difficult to be recycled and are not included in EPRS may be subject to an "advance disposal fee".<sup>15</sup> The fee may help prompt the producers concerned to improve their product designs to minimize waste. Set at the full waste disposal cost, the collected fee can be used to subsidize local government to set up treatment facilities.

3.5 As the collection and treatment of **food waste** is not covered by EPRS in South Korea, it becomes the responsibility of the municipal governments. In Seoul, about one-third of food waste is processed in five facilities set up by local administrative districts, while the rest of two-thirds are sent to private facilities in neighboring provinces for treatment. Two-thirds of the locally treated food waste are converted into livestock feed and one-third into compost or biogas. According to Seoul Metropolitan Government, the average treatment cost was around 170,000 won (HK\$1,207) per tonne in 2013. Yet, the revenue from the sale of pre-paid bags for food waste could only cover just 30% of the cost. As a result, some district governments on average needed to pay up to 5 billion won (HK\$36 million) each year to make up the shortfall.

3.6 For the **residual waste** collected from households, it is mostly disposed of at the four incinerators in Seoul.<sup>16</sup> Local governments in Seoul could recover part of the incinerators' operating cost from the sale of pre-paid garbage bags, and heat and electricity generated during the incineration process. However, the income generated was not enough to cover the treatment cost averaging at 69,000 won (HK\$476) per tonne in 2012, hence resulting in a loss of 42,000 won (HK\$290) per tonne. Seoul now incinerates about 23% of the municipal solid waste.

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<sup>15</sup> The fee covers containers for pesticides and hazardous chemicals, chewing gum, disposal diaper, cigarettes, and non-packaging plastic not included in EPRS such as PVC pipes, toys and kitchenware. SMEs with annual revenue below 20 billion won (HK\$138 million) are exempted from the fee.

<sup>16</sup> 90% of the daily waste handled by incinerators are from households and small businesses.

## 4 Waste recycling system in Berlin

4.1 **EPRS** was introduced in Germany to meet the requirements of its landmark Packaging Ordinance enacted in 1991.<sup>17</sup> Under the law, while the municipal governments participate in waste collection and recovery,<sup>18</sup> producers or distributors across the country are legally required to assume full responsibility for all packaging waste they create or bring into the country. The German government also prescribes national minimum recycling targets for packaging materials, ranging from 75% for glass to 60% for plastic.

4.2 To meet these mandatory obligations, manufacturers and distributors have to join any producer responsibility organization ("PRO") and pay product-specific licence fees based on the type and weight of the packaging materials.<sup>19</sup> The PRO will then arrange collection and recycle the packaging waste on their behalf. It will disburse the proceeds to waste collectors or recyclers. All PROs are supposed to finance the waste collection and recycling in full. It was estimated that the fee payment under EPRS amounted to about €1 billion (HK\$10.8 billion) in 2011.

4.3 Unlike South Korea, EPRS in Germany is a market-led scheme, with 10 PROs currently competing against each other. These PROs may not own or operate any recycling facilities, as they can outsource recycling operation to private companies. Hence, there are limited publicly available information on their charges to producers and the financial viability of the overall system.

4.4 EPRS in Germany is generally considered as effective in supporting recycling. **First**, the recovery rate of overall packaging materials in Germany has gone up from 39% in 1991 to 98% in 2014. **Secondly**, the cost of recycling has gone down significantly. According to Duales System Deutschland GmbH ("DSD") which is the oldest and largest PRO in Germany with a market share of 46%, the cost of plastic recycling dropped by a total of 95% to €19 (HK\$157) per tonne during 1997-2015, while the cost of sorting lightweight packaging also dropped by 76% during 2003-2011. **Lastly**, the annual cost of running the system has decreased by more than a half from €2 billion (HK\$14.4 billion) during 1995-2000 to €960 million (HK\$10.4 billion) during 2008-2011, due to increased competition among PROs.

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<sup>17</sup> There are two EPRS in Germany, one for packaging waste while another for WEEE.

<sup>18</sup> In Berlin, the public waste disposal authority either owns or runs directly or indirectly sorting facilities, recycling depots, an incinerator and a bio-gas plant in Berlin.

<sup>19</sup> The fee level is determined by the type of packaging materials and the estimated amount of the materials put into the German market by individual producer.

4.5 However, EPRS in Germany also encountered problems such as free riding by non-complying producers in early implementation years. For example, it was estimated that up to 45% of the packaging waste collected by waste recyclers had not received the respective licence fee payment in 1993, leaving a huge debt of DM 800 million (HK\$3.74 billion) by the end of year.<sup>20</sup> The problem has so far not been eliminated, with an estimated free riding ratio of 23% in 2011.<sup>21</sup>

4.6 **Bio-waste** (mostly food waste) treatment is not covered by EPRS and is the sole responsibility of the Berlin government. In 2015, about 87% of the 67 000 tonnes bio-waste collected annually was sent to a bio-gas plant for energy recovery.<sup>22</sup> The waste was transformed into gas through an anaerobic digestion process at the facility with an annual handling capacity of 60 000 tonnes. The gas produced is fed into the natural gas network and used by the waste collection fleet of BSR, a public entity owned by the Berlin government, which owns and finances the plant and is tasked with bio-waste collection.

4.7 For **residual waste** collected from households, there are at least three treatment facilities in Berlin. A majority of them were directly sent to a modern waste-to-energy facility where electricity and heat is produced. A small part is sent to two mechanical treatment plants where the waste will be turned into solid fuel for combustion in power and cement plants. Three plants are owned and operated by BSR and partly financed by the waste collection fees.

## 5. Concluding remarks

5.1 While producer responsibility system appears in different forms in Taiwan, South Korea and Germany, they all play a key role in waste recycling in the respective places. Not only does EPRS supplement the mandatory quantity-based charging scheme on and mandatory separation of household waste, it also improves the financial sustainability of the recycling industry. Yet it is noted that EPRS could give rise to additional cost to producers, resulting in non-compliance problems such as free riding.

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<sup>20</sup> See OECD (1998).

<sup>21</sup> Apart from free-riding, there were also problems of under-capacity of recycling facilities, poor quality of waste collected, and short lead time before introduction in the early years of EPRS implementation. In recent years, the German EPRS for packaging waste was also found to be more costly than similar systems in neighbouring places like Belgium. See Grocery Manufacturers Association (2012).

<sup>22</sup> The rest of the collected waste is sent to other composting facilities.



## Key features of extended producer responsibility system ("EPRS") in selected places

		Taiwan	South Korea	Germany
1.	<b>Legislation on EPRS</b>	<ul style="list-style-type: none"> <li>Waste Disposal Act amended in 1997.</li> </ul>	<ul style="list-style-type: none"> <li>Act on the Promotion of Saving and Recycling of Resources enacted in 2003.</li> </ul>	<ul style="list-style-type: none"> <li>Packaging Ordinance enacted in 1991.</li> </ul>
2.	<b>Waste covered</b>	<ul style="list-style-type: none"> <li>33 items.</li> </ul>	<ul style="list-style-type: none"> <li>42 items.</li> </ul>	<ul style="list-style-type: none"> <li>All sales packaging.<sup>23</sup></li> </ul>
3.	<b>Scheme design</b>	<ul style="list-style-type: none"> <li>Centralised Recycling Management Fund, with contribution from producers and funds allocated to eligible recyclers and collectors.<sup>24</sup></li> </ul>	<ul style="list-style-type: none"> <li>Six "cooperatives" formed and joined by industry stakeholders for collective recycling of waste and products.</li> </ul>	<ul style="list-style-type: none"> <li>10 competing producer responsibility organisations ("PRO") formed by industry stakeholders for collection and recycling waste.</li> </ul>
4.	<b>Recycling targets</b>	<ul style="list-style-type: none"> <li>No recycling target.</li> </ul>	<ul style="list-style-type: none"> <li>Annual quotas ranging from 20% to 83% in 2016.</li> </ul>	<ul style="list-style-type: none"> <li>Target ranging from 60% to 70% for different packaging in 2015.<sup>25</sup></li> </ul>
5.	<b>Resources available to support recyclers</b>	<ul style="list-style-type: none"> <li>NT\$7 billion (HK\$1.76 billion) in 2015.</li> </ul>	<ul style="list-style-type: none"> <li>At least 138 billion won (HK\$952 million) (packaging waste only) in 2017.</li> </ul>	<ul style="list-style-type: none"> <li>About €1 billion (HK\$10.8 billion) in 2011.</li> </ul>
6.	<b>Strength of the recycling sector</b>	<ul style="list-style-type: none"> <li>Registered recycling business up from 317 in 2002 to 741 in 2013.</li> </ul>	<ul style="list-style-type: none"> <li>During 2003-2012, recycling businesses surged by 50% to 627.</li> </ul>	<ul style="list-style-type: none"> <li>Operators of PRO rose from one<sup>26</sup> in 1991 to 10 as at 2017</li> </ul>
7.	<b>Recycled amount under EPRS</b>	<ul style="list-style-type: none"> <li>Increased from 288 000 tonnes in 1998 to 984 000 tonnes in 2015.</li> </ul>	<ul style="list-style-type: none"> <li>Increased from 938 000 tonnes in 2002 to 1.5 million tonnes in 2012.</li> </ul>	<ul style="list-style-type: none"> <li>From 6.1 million tonnes in 1991 to 17.3 million tonnes in 2014.</li> </ul>
8.	<b>Issues and concerns</b>	<ul style="list-style-type: none"> <li>Free-riding.</li> <li>Increase in recycling levy.</li> </ul>	<ul style="list-style-type: none"> <li>Free riding.</li> <li>Lack of competition.</li> </ul>	<ul style="list-style-type: none"> <li>Free-riding.</li> </ul>

<sup>23</sup> Products made from any materials for the purpose of reception, protection, handling, delivery or presentation of goods which may range from the raw materials to the processed products and are passed on to the distributors or final consumers by the manufacturers. See section 3 of the Packaging Ordinance. WEEE is subject to another legislation which also requires mandatory take-back and recycling.

<sup>24</sup> About 20% of the Fund is set aside for procurement of machinery for local cleaning teams, publicity and education, and administrative cost.

<sup>25</sup> Glass (75%), paper and cardboard (70%), tinsplate (70%), aluminium (60%), composites (60%), and plastics (60%).

<sup>26</sup> DSD used to be the only PRO until 2005 when competition was introduced to the market.

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24 May 2017  
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