1st Market and Technological Study (2015/16)

Executive Summary

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Background and Objectives

1. Hong Kong Productivity Council, as the Secretariat of the Recycling Fund, will conduct studies on recycling markets and technologies under the Recycling Fund. The scope of the studies mainly includes the operation of the recycling industry, examination of the challenges and opportunities of the recycling industry, conduction of recycling market survey and identification of recycling technologies applicable for local use. As such, the needs of the recycling industry can be identified and those areas which Recycling Fund can strengthen its support to the industry can be revealed.

2. The first Market and Technological Study was commenced soon after the launch of the Recycling Fund in October 2015. The primary aim of this study is to provide an up-to-date overview of the recycling industry in Hong Kong and to identify the key factors including current state of waste and recyclables generation in Hong Kong, players of recycling industry, and typical/ latest recycling technologies that may affect applications for the Recycling Fund.

3. The present Study covers various key types of recyclables in Hong Kong including paper, plastic, ferrous-metals, non-ferrous metals, waste electrical and electronic equipment (WEEE), textiles / used clothes, wood, glass, rubber tyres, food wastes and used cooking oil (UCO). The aim of this study is to review and updated the current local recycling industry in Hong Kong from these recyclables generation, processing and outlets with a view to updating the general outlook of the industry.

4. The present Study includes four sections as follows:

   (i) To review and update the current state of waste and recyclables generation in Hong Kong.
   (ii) To review the existing waste handling flows, channels and methods in Hong Kong.
   (iii) To look into the previous, current and potential markets/ outlets for various types of recyclables.
   (iv) To review the current typical technologies adopted in the recycling industry and potential new recycling technologies which are able to improve the quality of recyclables for export.

Key Findings of Section I - Current state of waste and recyclables generation in Hong Kong

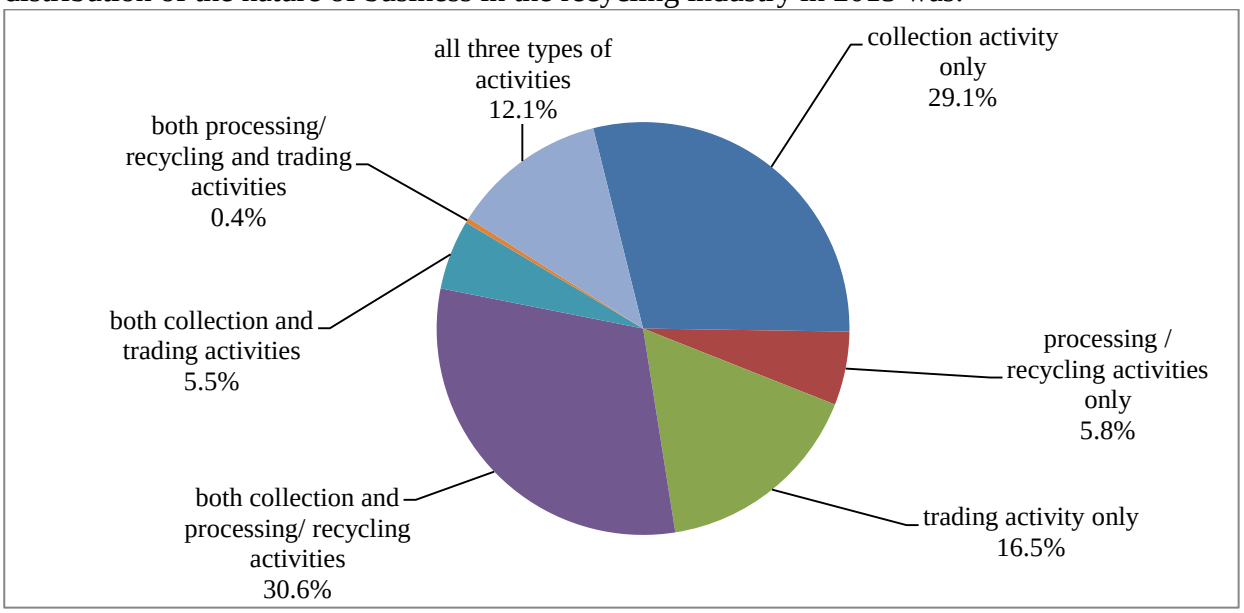
5. This Study reviewed the four databases including the complied Hong Kong Collector / Recycler Directory available the in Hong Kong Waste Reduction Website, Census and Statistics Department's (C&SD) database, Hong Kong Productivity Council's (HKPC) in-house database, and Yellow Page's information. Some 390 companies were found to have ceased their business after 2014 while some 219 companies have newly opened in the same period. The number of waste collection, trading and recycling companies in 2015 was 1,726, representing a drop compared with that identified in 2014 (1,897 companies).

6. Among the companies with known employment size information, 87% of them were small-sized companies with 1 to 9 employees while 6% were medium-sized companies with 10 to 19, followed by 4% of them with 20 to 49 employees. On the other hand, only 3% of the companies have more than 50 employees, which show that the recycling industry was still dominated by small and medium sized enterprises.

7. For both ceased and newly opened companies, over 90% were small-sized companies with 1 to 9 employees, in particular nearly 80% of them with less than 5 employees. It revealed that

small-sized companies might be more easily affected by market fluctuation. The majority of enterprises ceasing their operations after 2014 were companies involved in both collection and recycling activities (37.0%) but the newly opened companies were mainly engaged in collection activity only (57.5%), collecting mostly metals, paper, and plastics.

8. Based on the available information for the nature of business in the consolidated database, the distribution of the nature of business in the recycling industry in 2015 was:



9. Most companies handled more than one type of recyclables in their business[1]. Most companies processed recyclables with readily available market outlets, including paper (~800 companies), metals (~1,000 companies), plastics (~700 companies), textile (~300 companies) and WEEE (including computer product and electrical appliances) (~500 companies). Other recyclables with more specific market outlets like glass, wood, rubber tyre and food waste were handled by fewer collectors/ recyclers (~100 companies).

10. Among those enterprises handling waste paper, the majority (all around 90% for each type of waste paper) of them handled all four major types of waste paper (i.e. magazines, newspaper, cardboard and office paper). For individual type of plastics handled by local recycling enterprises, the top three popular types of plastics are polyvinyl chloride (PVC) (handled by 68.1% of companies), polypropylene (PP) (handled by 61.7% of companies) and polyethylene terephthalate (PET) (handled by 55.3% of companies) and over half of surveyed stakeholders were involved in the recycling process of these plastics. It was observed that PVC was commonly encountered by the recyclers in various product forms such as pipes, advertisement banners, wrapping films, etc. The sources of waste PVC were usually with low-level of contamination and well separated from other recyclables during collection and hence, only simple processing / baling is required before export for recycling. In this regard, despite the relatively low market price of PVC when comparing with those of other plastic types, the handling rate of PVC by the recyclers was revealed to be relatively high among various types of plastics in the recycling industry.

11. Among the ~1,700 companies and organizations engaged in recycling operations in Hong Kong in 2015, roughly 50% of their registered addresses were located on non-ground floor of multi-storey buildings and it was observed that most of them were used as office premises of trading companies, and some were used for the temporary storages of recyclables. Some 34% of the registered addresses were on ground floor (e.g. street-level recycling shops). And more than 15% of addresses were located in open sites. There was also few recyclable collectors/recyclers

[1] As most companies handled more than one type of recyclables, the total sum is greater than 1,726.

operating with mobile collection vehicles, and did not have a fixed operation site.

12. The collection pathway of recyclables were mainly from: (i) imports, (ii) local waste producers and (iii) local supply chain. Among the surveyed companies engaging in recycling operations in Hong Kong, the order of such three sources were: local waste producers (81%), import (11%) and local supply chain (8%). Among recyclables obtained from local upstream of recycling chain, the major way to obtain recyclables was from local collectors (74% of recyclables weight), followed by local preprocessors (17% of recyclables weight) and importers (9% of recyclables weight).

13. Local collectors and recyclers collected recyclables from three main types of sources, namely domestic sources, commercial and industrial (C&I) sources and construction sites. over one third of the companies are involved in the collection/ processing of C&I waste (34%), followed by domestic waste (30%) and then the waste collected through property management companies (7%).

14. The major collection channels in recycling trade are through scavengers and property management companies of housing estates and C&I premises, from where recyclables were sorted at source. Other channels include the purchase of recyclables from local collection companies / cleansing companies, local trading companies, and from overseas sellers. Some of them expressed that they collected recyclables directly from construction sites, cleansing companies, individual commercial companies (including restaurants, hotels, publishers, supermarkets), schools and via online platforms. Moreover, companies also collected recyclables through other channels including government contracts, non-governmental organizations and single block buildings. Among the recyclables collection operations, over half of them collect recyclables by the delivery from waste producers (54%), nearly one-third of these respondents collect recyclables at source in person.

15. According to the exportation figures of recyclables from the report of Census and Statistics Department (C&SD) in 2015, around half of recyclables by weight were exported to Mainland China, followed by other Southeast Asian jurisdictions such as Vietnam and Taiwan. The proportion of recyclables being exported to Mainland China dropped from 67.8% in 2013 to 50.4% in 2015. Due to the tightening policy of importing recyclables of Mainland China, the countries for export of recyclables shifted to Southeast Asian jurisdictions such as Vietnam, Taiwan, Indonesia, Thailand, etc and the proportion of export recyclables increased for all of the above Southeast Asian jurisdictions from 2013 to 2015.

16. Among the surveys of 155 companies engaging in recycling operations in Hong Kong, 77% of the respondents regarded high logistic cost as the major limitation and restrictions in local recycling business operation, followed by the fluctuation of recyclables' prices (74%) and high land cost (47%). Among different employment size groups, companies with 20 to 49 employees had distinctively high percentage in choosing high logistic cost (100%) as their major limitation in business operation. Small-sized companies were more affected by fluctuation of recyclables' prices (78%).

17. Operation cost (mainly labour cost) was still the most desirable item for respondents of the survey in seeking support from the Recycling Fund in 2015. 45% of the enterprises chose treatment cost in 2015, followed by "increase in number of staff" (34%) and "increase in number of facilities" (33%). Only 15.5% of the interviewees expressed that they would consider expanding their companies mainly.

18. After conducting the desktop review and engaging the stakeholders of the recycling industry to gauge their views, several bottlenecks and constraints including unstable market situation, high operation cost, manpower shortage, inadequate land for operation, contamination and improper

sorting of recyclables in the "recycling chain" were revealed to limit the development of local recycling industry.

Key Findings of Section II - Existing waste handling flows, channels and methods in Hong Kong

19. In Section 2, the existing waste handling flows, channels and methods in Hong Kong was reviewed. The recycling rate for paper, plastic and metal in Hong Kong in 2014 are 57%, 12% and 92% respectively. Quality of sorted recyclables is one of the factor affecting the recycling rate. To improve sorting process, the recyclables should be further sorted at the source, especially plastic, for example, sorted separately as plastic bags and plastic bottles. However, further sorting for metals at source are not recommended as metals can be sorted in the downstream easily. For paper, it can be easily sorted in the C&I sector as the variety of paper is limited. However, further sorting by waste paper types was hard to carry out in the residential sector due to the large variety of paper and the difficulty in distinguishing, separating and storing different types of paper. And by referencing to other counties, it is not necessary to further categorise metals and paper.

20. The suggestions on the enhancement of waste handling flows, channels and methods in Hong Kong are as follows. To enhance the collection at the source, recycling bins equipped with Radio Frequency Identification (RFID), balance and iCloud service can be used. It will enable the tracking of recyclables amount on the spot for a better arrangement on the collection frequency by the property management companies and recyclers. To further enhance the logistic flow of collection by recyclers, level sensors could be installed in the recycling bins. These sensors could be connected to relevant management software systems which can detect the bin's fill-level for monitoring the bin status. By using this technology, the recyclers can flexibly optimise the collection routines and reduce the labour cost and the transportation cost. Apart from installing level sensors at the bins, the garbage and recycling trucks can also install Radio Frequency Identification (RFID) readers which enable the planning of collection routines. Details on these technologies will be further discussed in Section 4.

21. To enhance the collection of recyclables at source for recycling, it is important to enhance the information exchange in order to facilitate the collaboration between different relevant parties among the recycling industry and to build up their connection and networks. With exchange on market information, the recyclers / collectors could identify the upstream clients / downstream buyers with wider choice of supplies and better price offered, leading to higher profits from the trading of recyclables in the recycling chain. In this regard, we suggest the Recycling Fund could support relevant projects under the Industry Support Programme.

Key Findings of Section III – Review of Current and Potential Market for Recyclables and their Import/ Export Policy and Control

22. The historical, current and potential markets/outlets for 11 types of recyclables, including paper, plastic, ferrous-metals, non-ferrous metals, WEEE, textiles / used clothes, wood, glass, rubber tyres, food wastes and UCO were reviewed. Over 90% of the recyclables export were concentrated in paper, plastics, ferrous metals and non-ferrous metals in 2015. Hong Kong's recyclable export were concentrated within Asia. In 2015, the top five jurisdictions for Hong Kong's recyclables export in terms of weight are in descending order were: Mainland China, Vietnam, Taiwan, Indonesia and Thailand. Mainland China was a major market for export of recyclables from Hong Kong in 2015, accounted for 50.4% in weight among all export jurisdictions.

23. Mainland China was the major market of paper, plastics, non-ferrous metal, textiles / used clothes and wood recyclables. Vietnam was the major market of ferrous waste and scrap, which had a nearly 50% share of all ferrous metal waste and scrap exported from Hong Kong. For non-ferrous metal, besides Mainland China, Korea was the market with second highest of percentage share, which accounted for about one-third respectively. For WEEE, major home appliances such as television, air conditioner, refrigerator, washing machine / dryer and computer products had been refurbished before export to jurisdictions such as Mainland China and Southeast Asia. For glass, the export quantity of glass scrap was relatively low in the past five years, which shows that glass scrap is unfavourable to be exported and the demand in export market is limited. Similar was for waste tyre, its recycling rate was low and local retreaded tyres for export were limited. Local market should be explored for consuming the glass scrap and waste tyre generated. For food waste, it was exported in the product form of flours, meals and pellets made of meat of meat offal (unfit for human consumption) and greaves. Taiwan was the major export market in 2015, which accounted for 80% of the total export quantity. For UCO, it was exported to Mainland China, Spain, Korea and Netherlands in 2015. With consideration in geographical advantage and selling price of UCO, Korea is suggested as a potential market for UCO in the coming years.

24. In general, decreasing price trends of paper, plastics and non-ferrous metal are identified. Between 2012 and 2016 in Mainland China, the average price of different kinds of waste paper dropped 19%; and for plastics, the price of PVC, PET and HDPE recyclables dropped dramatically to almost a half, in 50%, 48% and 40% respectively; for non-ferrous metals, nickel and copper scraps had a significant drop in unit trading price, which dropped 50% and 41% respectively.

25. Mainland China's Operation Green Fence (OGF) environmental policy affects the trading business of plastic scrap to the greatest extent among different types of recyclables. For the recyclers to export recyclables to Mainland China, they are encouraged to generate high quality recyclables locally by introducing shredding machines and washing machines to upgrade the sorting and treatment process before export. With such reason, some local recyclers preferred to sell collected materials to Southeast Asia counties with less restricted standard on the recyclables, such as Vietnam, Indonesia, and Malaysia, as an alternative market of recyclables. The estimated affecting factors include processing cost, relative supply and demand of nearby jurisdictions and transportation cost.

Key Findings of Section IV – Review of Local and Overseas Typical and Latest Recycling Technologies for Recyclables

26. In Section 4, the technologies starting from logistic of collecting recyclables, preliminary processing of recyclables are reviewed and introduced. This section also covers the followings:

    - The typical and representative recycling technologies applied in Hong Kong
    - The local and overseas higher-end and latest recycling technologies in collecting, handling or processing different types of recyclables into secondary raw materials/ recycled commercial products
    - The potential types of recycling technologies that can be applied in Hong Kong recycling industry

27. The typical technologies which could be potentially applied for collection and logistics of recyclables in Hong Kong include Reverse Vending Machine, fleet management and RFID. Reverse Vending Machine is an application with value added in form of electronic rebate is rewarded by donating the bottles. If Reverse Vending Machines could be placed in the public or private housing estates, it will not only increase the collection network of beverage bottles but also raise the incentive of people to recycle the bottles. Fleet Management System is a technology to manage their trucks, collection routines and disposal processes. It includes a global positioning system (GPS) and a 3G/4G device for accessing mobile network. The purpose of the fleet management is to monitor the vehicle status in anywhere and anytime. By monitoring the vehicle location, speed, idling and engine ignition, it can achieve fuel saving and optimize the collection routes.

28. RFID technology has also been adopted for logistics monitoring in recycling industry. Implementing RFID together with data logging systems in recycling of confidential materials could keep track of every step in processing for ensuring secured destruction. By installing the RFID readers on the trucks equipped with GPS and the tags on the bins, the collection status can be traced and tracked continuously in real-time basis. Normally, RFID tags have internal memory for information storage. Once the information is uploaded to the monitoring center, the information can be analyzed for further planning of the collection routines and the policy making so as to optimize the logistic arrangement for reducing of operating cost.

29. Based on cost consideration, local policy and special situation in Hong Kong, we have identified the following technologies that could be suitable to be adopted by the local recycling industry. As various waste management initiatives will be implemented in Hong Kong soon, the demand for collection of glass bottles in the districts will be increased. In considering that space will be one of the major problems in storage of bottles at collection points, hence glass imploders should be one of the potential processing equipment that producers and collectors of waste beverage containers may find them useful in enhancing the storage and collection efficiency. Glass imploder can be installed in the collection points where the large amount of glass bottles can be converted to cullet by saving storage space prior to delivery for recycling. It costs around HKD270,000, with output 2.5 tonnes of glass per hour.

30. The second technology is Automatic Plastics Sorting System. Different types of waste plastics are usually mixed during the collection from different sources in Hong Kong. In the local plastics recycling industry, the collected waste plastics are sorted into different types manually. This labour intensive and time consuming process increases the operating, and hence affects the profitability of the local recyclers. Therefore, a fully automatic sorting system with small spatial requirement could be useful for the local recyclers so as to lower the operating cost and to increase the selling price with sorted plastics. When mixed plastic wastes pass through the

sensors, the sensors will send out the signal to activate corresponding air valves, then the air valves will eject the targeted material. The sorting system is able to identify up to 6 types of plastics. It costs around HKD900,000, with output 0.7-1.2 tonnes of plastics per hour. However, the recycler should reserve a space of around 15m(L) x 1m(W) x 2m(H) in their workshop to install the system. The enhancement of source separation and collection and the improvement of labour's qualification and capability are the main two major supports can be considered by Recycling Fund to address needs of the industry.

Conclusion

31. The current situation and profile of recycling industry in Hong Kong from recyclables generation, processing and outlets have been reviewed through this study and survey to key stakeholders to update the outlook of the recycling industry as well as constraints and needs encountered by the recycling chain where support to the trade is needed most. Bottlenecks in unstable market situation, manpower shortage and cost issues were revealed as the key factors limiting the development of local recycling industry.

32. To address part of the needs and bottlenecks faced by the recycling industry, various measures are recommended for further considerations and discussions, including, promoting source separation through outreach programmes and collaboration with collectors; setting up logistic systems to enhance waste collection efficiency; increasing the level of automation for waste separation and sorting to reduce manpower requirement and improve quality of recyclables; installing new facilities to enhance waste separation / collection; developing and offering training and certification programmes on enhancing occupational health and safety and environmental knowledge for frontline workers; providing trainings or formulating certification schemes for the industry to enhance the overall operational standards and productivity, etc.

33. The existing waste handling flows, channels and methods in Hong Kong was reviewed. To enhance the collection flow, recycling bins, garbage and recycling trucks could be equipped with different type of technologies (e.g. RFID, balance and iCloud service and level sensors) to enable better arrangement in collection and inventory control. Moreover, it is also important to enhance the collaboration between different relevant parties in the recycling industry for improving their operational effectiveness.

34. In 2015, the top five jurisdictions for Hong Kong's recyclables export in terms of weight are in descending order were: Mainland China, Vietnam, Taiwan, Indonesia and Thailand. The proportion of recyclables being exported to Mainland China dropped from 67.8% in 2013 to 50.4% in 2015. In general, decreasing price trends of paper, plastics and non-ferrous metal are identified and the estimated affecting factors include processing cost, relative supply and demand of nearby jurisdictions and transportation cost. The recyclers to export recyclable to Mainland China are encouraged to generate high quality recyclables locally before export through upgrading the sorting and treatment process.

35. In view of the typical and representative recycling technologies as well as higher-end and latest recycling technologies in Hong Kong or other jurisdictions in collecting, handling or processing for major types of recyclables, glass imploder and automatic plastics sorting system are identified which are suitable to be applied in Hong Kong in glass and plastics recycling sectors respectively so as to improve the collection efficiency and expand the treatment capacity.

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