# 6th Market Study
# for Recycling Fund

## Executive Summary

**(HKPC Project Ref.: 10013159)**

**Green Living and Innovation Division**

**Hong Kong Productivity Council**

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## *Background and Objectives*

1. Hong Kong Productivity Council ("HKPC") has been engaged by the HKSAR Government as the Secretariat of the Recycling Fund to assist in the preparation, promotion, management, implementation, and monitoring of activities and projects related to the Recycling Fund. HKPC has been conducting studies on the recycling market since 2015. The 6th Market Study ("the Study") was commenced in May 2022, with aims to continuously review the profile and operation of Hong Kong's recycling industry and to identify the key factors that determine the success of the Recycling Fund. The Study covers current situation of the recycling industry in Hong Kong, the markets/ outlets of recyclables, as well as a review on local recycling industry to adopt smart recycling technologies.

2. The key objective of the 6th Market Study is to obtain the latest market information related to the recycling industry so as to facilitate the implementation of the Recycling Fund and evaluate the potential and need on re-industrialization of recycling industry and move towards circular economy.

3. This Study covers 13 types of key recyclable materials in Hong Kong, including waste paper, waste plastics, waste ferrous-metals, waste non-ferrous metals, waste electrical and electronic equipment ("WEEE"), used clothes /textiles, waste wood, waste glass, waste rubber tyres, food waste, yard waste, used cooking oil ("UCO") and tetrapak.

4. This Study includes two sections as follows:

   (i) To continuously review the current situation, changes and trends of local recycling industry (including scale and profile of the industry, and key issues and constraints faced by the industry) through desktop research and surveys with 155 stakeholders of the recycling industry, as well as the current markets/ outlets for 13 types of key recyclables; and

   (ii) To review the current performance and the further potential of local recycling industry to adopt smart recycling technologies, as well as the challenges faced by the industry to re-industrialize through surveys with 50 recycling companies. The majority of the surveyed companies had 10 or above employees, and their businesses involve processing and/or recycling of different types of recyclables.

## *Key Findings of Section I – REVIEW ON THE STATE OF LOCAL RECYCLING INDUSTRY*

5. The Study reviewed five databases, which include annual applicant lists of Recycling Fund, Hong Kong Collector/ Recycler Directory from Hong Kong Waste Reduction Website, Census and Statistics Department's (C&SD) database, HKPC's in-house database, and a list of waste collectors/ recyclers, charity organizations and recycling programme operators from internet search. Key changes of the recycling industry since 2020 were shown as below:

   (i) A total of 1,996 local waste collectors, recycling and trading companies were identified in the 6th Market Study, which was slightly more than the 1,876 companies identified in 2020;

   (ii) 327 recycling companies were found to cease their operations after 2020; and

   (iii) 447 companies were newly identified, of which 88 companies were found through their application for the Recycling Fund (such as Enterprise Support Programme ("ESP"), Industry Support Programme ("ISP"), One-off Frontline Recycling Staff Support Scheme ("OFRSS"), etc.).

6. 1,030 out of 1,996 companies identified in the 6th Market Study applied for the Recycling Fund. Companies that benefited from the Recycling Fund were collectors/ recyclers of recyclables (such as those that performing collecting, sorting, baling, dismantling, shredding and pelletising etc.) in Hong Kong.

7. Reasons of some surveyed stakeholders that did not apply for Recycling Fund were inquired during the surveys, the key reasons have been summarized as below.

   (i) Did not met eligibility criteria of the Recycling Fund, for example involving only trading activities of recyclable materials, or conducting recycling activities in Mainland China etc.;

   (ii) Applications were rejected before;

   (iii) Did not aware of the Recycling Fund; and

   (iv) Were not interested in or never heard of the Recycling Fund.

8. Local recycling industry is susceptible to market fluctuation. Although the number of local recycling companies increased by about 6% after 2020, around 17% of the 1,876 companies identified in 2020 ceased their business operations. In addition, regarding the 1,996 companies identified after 2020, around 20% of them were newly found.

9. Amongst the companies with known employment information, almost 90% were small-sized companies with 1 to 9 employees; while about 6% and 3% of the companies were medium-sized companies with 10 - 19 and 20 - 49 employees respectively. On the other hand, around 1% of the companies had 50 or above employees. The figures are similar to 2020 findings. This shows that the recycling industry were dominated by small and medium-sized companies. Amongst the 1,030 grantees of the Recycling Fund, 87% of the companies were small-sized companies with 1 to 9 employees; while about 8% and 4% of the companies were medium-sized companies with 10 - 19 and 20 - 49 employees respectively; plus, around 1% of the companies had 50 employees or more, which shared similar employment size distribution with the overall local recycling industry.

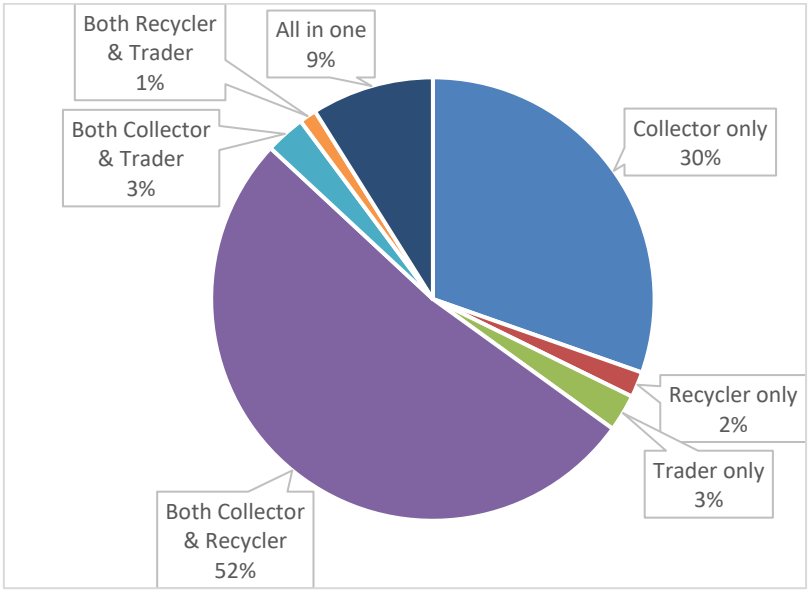
10. Amongst those companies that either ceased or were newly identified, around 90% of them were small-sized companies with 1 to 9 employees. In particular, over 70% of these companies had less than 5 employees. It reveals that small-sized companies might be more susceptible to market fluctuation.

11. Amongst the companies that provided information about their business nature, it was noticed that since 2020, the percentage of companies providing trading service(s) (i.e. being "trader only", "both collector and trader", "both recycler and trader" and "all-in-one company"[1]) decreased, which was particularly noticeable in companies being "trader only" (-34%/ -20 companies). In addition, the most prominent growth was found in companies that being "both recycler and trader" (+17%/ +106 companies).

12. Amongst those companies that either ceased or were newly identified after 2020, the major business nature found were "collector & recycler". Besides, around 16% of the ceased operations were companies with trading activities; while only around 2% of the newly identified companies involved in trading activities.

13. Based on the information found from the consolidated database, the below chart shows the business nature distribution of the local recycling industry after 2020:

[1] "All-in-one company" refers to a company involving in collecting, recycling and trading activities related to recyclable materials.




14. For companies identified after 2020 as "collector only", around 30% of them were mobile recyclers which collected recyclables from different sources and delivered the collected recyclables to downstream recyclers by collection trucks.

15. Most companies targeted recyclables with higher market demand, including waste metals (including waste ferrous-metals and waste non-ferrous metals) (around 1,346 companies), waste paper (around 769 companies), waste plastics (around 602 companies), WEEE (including computers and electrical appliances) (around 420 companies) and used clothes /textiles (around 113 companies). There were a few collectors/ recyclers that handle other recyclable materials with limited and uncertain market demand, such as waste glass, waste wood, waste rubber tyres, food waste and tetrapak (ranging from 51 to 70 companies for each). Within the 1,030 grantees of Recycling Fund, most companies involved in handling waste metals (either waste ferrous metals or waste non-ferrous metals) (735 companies), followed by waste paper (404 companies), waste plastics (307 companies), WEEE (including computers and electrical appliances) (112 companies) and used clothes/ textiles (39 companies); other recyclables with limited and uncertain market demands like waste glass, waste wood, waste rubber tyre and food waste were handled by a small number of collectors/ recyclers (ranging from 18 to 26 for each), which shared a similar distribution of recyclables handling with the overall local recycling industry.

16. When comparing the data collected before and after 2020, there was an overall decrease in the percentage of companies handling waste metals, waste paper, waste plastics and used clothes/ textile. On the other hand, the percentage of companies handling waste computer products, waste electrical appliances, waste glass, food waste, waste rubber tyres and waste wood was slightly increased. Government strengthen its support to the community recycling network and actively promote companies to collect and/or handle different kinds of recyclables could be the possible reasons of the changes. Meanwhile, amongst the 1,030 grantees of Recycling Fund, no companies that joined the recycling industry after 2020 engaged in handling waste glass, waste rubber tyres and food waste.

17. After 2020, around one third of the 1,996 identified companies that engaging in recycling business in Hong Kong were located in open land sites (32%) and non-ground floor of multi-storey buildings (31%), the sites were used for office support and temporary storages of recyclables. Open land sites provided a large space for companies to engage in more than one type of recycling activities and a big storage space. There was a slight rise in the percentage of companies that located in open land sites after 2020, with which over 90% of them were located in Yuen Long district, North district and Tuen Mun district. Additionally, around 19% of the companies were

located on ground floor street shops (for example, recycling shops on road sides). There were some companies with registered address at residential buildings (11%), and some were mobile recyclers with no fixed operational address (7%). The above data was similar to the findings in 2018. For the 1,030 grantees of Recycling Fund, the majority of them were located in open land sites (44%), followed by ground floor street shops (23%), non-ground floor of multi-storey building (17%) and residential buildings (3%), the remaining 13% of the companies were mobile recyclers. Of the 44% of grantees located in open land sites, over 90% of them were located in Yuen Long district, North district and Tuen Mun district.

18. According to the surveyed recycling companies, their recyclables was mainly collected from local waste producers (95%). With less than 5% of recyclables were collected via import or local upstream recycling chain. The major way of obtaining recyclables from local upstream recycling chain was via local collectors (accounted for 75% of recyclables in weight), followed by importers (accounted for 9% of recyclables in weight), re-exporter (accounted for 8% of recyclables in weight) and local processors (accounted for 8% of recyclables in weight).

19. Local collectors and recyclers collected recyclables from six major sources: individual commercial and industrial ("C&I") sector (32%), followed by scavengers (25%), individual domestic sector (20%), property management companies ("PMCs") that collected waste from domestic and C&I sectors (12%), construction site (10%) and government contracts (1%). The percentage of recyclables collected from domestic and C&I sector via PMCs shown an increase after 2020, with a similar percentage of drop in the amount of recyclables collected from scavengers. It implies an increase in recycling facilities in residential and C&I premises, which would also reduce scavengers' reliance in collecting recyclable wastes from these premises.

20. There was two major recyclables collection channels within the recycling industry: direct delivery by waste producers (64%) and collection at source by the recycling companies (30%). The main sources of direct collection of recyclables included scavengers and PMCs of housing estates and C&I premises, while some were from construction sites, cleansing companies, individual commercial companies (including restaurants, hotels, publishers and supermarkets) and schools. Other recyclables collection channels included collection through third party (3%), for example traders, re-processors/ recyclers, government waste management contractors, non-governmental organizations and single block buildings, etc.; also include direct purchase from mobile recyclers (3%). There was a significant increase in recyclables delivered to recycling companies by waste producers after 2020. It implies an increase in recycling awareness amongst local waste producers, which would alleviate the burden on recycling industry in collecting recyclables.

21. According to C&SD's reports about the export figures of recyclables in 2019, 41% of recyclables by weight were exported to Mainland China, followed by other Southeast Asian jurisdictions such as Vietnam (24%), Indonesia (16%) and Taiwan (5%).

22. Amongst the 155 interviewed recycling companies, over half of the respondents considered high labour cost (53%) as the major reason that constraint their businesses. Additionally, around one third of the respondents faced difficulties in staff recruitment (36%), high land cost and inadequate land supply for recycling industry (35%) and high logistic cost (33%) in their business operations.

23. Based on the responds from the 155 surveyed recycling companies, the top five most desired support from Recycling Fund were: staff increment (39%), increase recycling facilities (36%), facility upgrade (25%), subsidies for consumable expenses (e.g., water and electricity fee) (21%) and enhancement of logistic and collection process (21%). The findings was different from that in 2020 with the top five most desired support from Recycling Fund were subsidies from consumable expenses (30%), staff increment (27%), increase recycling facilities (26%), enhancement of logistic and collection process (17%) and upgrade facilities (15%). It implies that the industry which composed of mainly small and medium sized-companies, had increasing

awareness of the deployment of machines or by enhancing the processes to make up for staff insufficiency and to reduce manpower cost.

24. Similar to the findings in 2020, the majority of respondents expressed no interest to expand their business scale in the future (87%). For companies considering business expansion, 55% respondents would consider to expand their workplace area, 50% respondents would consider to recruit more staff, 20% respondents would consider to increase recycling facilities, 15% respondents would purchase vehicles for recyclables collection and 10% respondents would consider to collect or handle multiple recyclables. The major challenges for these companies to expand their business scale were staff recruitment (42%), inadequate clean recyclables due to poor source separation practice (30%) and lack of capital for adding recycling facilities (19%).

25. Over 95% of the 155 surveyed companies heard of Recycling Fund before the interview. Amongst them, 38% of them thought there is a need to enhance the assistance by Recycling Fund. Some companies provided recommendation for the improvement, for example, provision of subsidy for renting operational sites, provision of subsidy for staff recruitment cost (covered wage and other fringe benefits for staff (e.g., insurance, etc.)) and provision of subsidy for logistic cost (e.g., car park rental fee, etc.).

26. Regarding the employment relationship adopted by the 155 surveyed companies, around 60% of them employed only full-time employees; around 25% of them employed both full-time and part-time employees; around 8% of them employed only part-time employees; while the remaining around 7% of the companies did not employ any employee (i.e. the companies were operated by the owners only). For the around 85% companies employing full-time employees, the majority of them offered wage on monthly basis (78%). For the around 33% companies employing part-time employees, the majority of them offered wage on daily basis (69%).

27. The monthly rate offered to full-time employees was generally higher than that offered to part-time employees. Around one third of the recycling companies offered monthly rate to full time employees in the range of "HK$10,001 to HK$15,000" (37%), "HK$15,001 to HK$20,000" (28%) and "more than HK$20,000" (36%). Meanwhile, the monthly rate offered to part-time employees was less than HK$7,100 (100%).

28. The daily rate offered to part-time employees were similar to that offered to full time employees. For part-time employees, the daily rate mainly ranged from "HK$601 to HK$700" (26%) to "more than HK$700" (71%). Similarly, for full time employees, the daily rate mainly ranged from "HK$601 to HK$700" (27%) to "more than HK$700" (68%).

29. For the around 33% companies employing part-time employees, around one fourth of them provided wage on hourly basis (26%), which was mainly in the range of "HK$50.1 per hour to HK$70 per hour" (58%) and "HK$70.1 per hour to HK$90 per hour" (25%). On the other hand, there were around 85% companies employing full-time employees, only a small fraction of them provided wage on hourly basis (2%), which was "more than HK$90 per hour" (100%).

30. In general, full-time employees had longer work hours than part-time employees. Regarding the working pattern, amongst the 85% surveyed companies with employing full-time employees, around 70% of them arranged full time employees to work "6 days per week" (73%) and with daily working hours in the range of "between 9 hours per day to 12 hours per day" (65%). For the 33% companies employing part-time employees, over half of them offered part-time employees with working pattern of "3-4 days per week" (55%); in the meanwhile, around one fifth of them arranged their staff to work "1-2 days per week" (20%) and "5-6 days per week" (20%). Also, around three fourth of the companies arranged their part-time employees to work "4-9 hours per day" (76%).

31. Amongst the 85% surveyed companies with full-time employees, the majority of them offered paid annual leave in the range of "7-10 days annually" (47%), followed by "7 days annually" (28%) and "11-14 days annually" (18%). Besides, slightly less than half of them (49%) provided other fringe benefits to full-time employees, for example, medical insurance (72%), accommodation allowance (15%), study/ training subsidy (8%), etc.

32. For the around 33% companies with part-time employees, 80% of them did not provide contribution in Mandatory Provident Fund ("MPF") schemes for their part-time employees because of their short employment period (i.e. less than 60 days) (78%) and part-timers being exempted from contributing in MPF schemes (22%).

33. Cash payment was the most commonly adopted wage settlement method by surveyed companies which employed full-time and/or part-time employees, but it might poses burden on their cashflow. For the around 85% companies employing full-time employees, about 60% of them paid full-time employees by cash (58%), and around 20% - 30% of them paid via bank transfer (29%) and/or via cheque (22%). Besides, near 60% of them settled wage monthly (57%); near one fourth of them settled wage semi-monthly (24%); while around 10% of them settled wage weekly (9%) or daily (8%). For the about 33% companies which employed part-time employees, over 70% of them paid part-time employees by cash (74%) and less than 20% of them paid wages via bank transfer (11%) and/or cheque (17%). Besides, over half of them settled wage daily (51%); near one third of them settled wage weekly; while around 6% - 11% of them settled wage monthly (11%) and/or semi-monthly (6%).

34. Around 85% of the surveyed companies recruited staff via job referral, for example by family and friends (62%) and/or existing employees (25%).

35. Near 90% of the surveyed companies were aware of the implementation of Municipal Solid Waste ("MSW") Charging in the future. Over 40% of them perceived positive impacts brought by MSW Charging (45%), for example by increasing the local supply of recyclables, increasing public awareness on recycling and improving the quality of locally generated recyclables, etc. On the contrary, over 20% of them perceived negative impacts brough by MSW Charging (24%), for example by increasing the cost for sorting/ processing of recyclables, increasing labour demand for sorting/ processing of recyclables, increasing the demand for machinery/ equipment for sorting/ processing of recyclables, etc. Meanwhile, for companies which considered positive and/or negative impacts brought by MSW Charging, less than one third of them would consider taking mitigation measures (28%), for example by hiring more staff, increasing facilities/ equipment for sorting/ processing of recyclables, increasing/setting up mobile recyclables collection vehicles, etc.

36. In 2022, no export of waste paper and food waste was recorded by C&SD, which might be resulted from a tightened import control on waste paper in different jurisdictions, as well as an increase in the use of locally collected waste paper for manufacturing recycled paper products for sales and re-use.

37. In 2022, Vietnam topped the major markets for waste plastics (87%) and waste ferrous metal (45%); while Mainland China was the major markets for waste non-ferrous metals (87%) and overtook Malaysia to be the major export for waste glass (100%). For WEEE, the major market of waste batteries and electrical parts of machinery or apparatus remained to be Korea (66%), with Mainland China (25%) and Thailand (9%) being the emerging markets. Additionally, Macau became the major markets of waste wood (100%) and yard waste (100%); meanwhile, Macau was no longer the major market of waste rubber tyres, with Thailand (25%), Vietnam (14%) and Korea (10%) becoming the top three major markets of these recyclables. For UCO, Malaysia overtook Spain to be the major export market (71%).

38. Via desktop research and stakeholders' interview, it was found that the recycling industry experienced a small impact from the fluctuating trading prices of recyclables and experienced a stable supply of locally generated recyclable waste in 2022. Besides, several bottlenecks and limitations of the local recycling industry were revealed, which included manpower shortage, high land cost and poor source separation of wastes. Further investigation in the employment situation in recycling industry revealed that workforce in recycling industry generally faced low wage and long working hours. Moreover, recycling companies generally paid wage by cash and settled wage payment to part-time employees at a higher frequency than to full-time employees, which implied the potential difficulty faced by some recycling companies to employ staff while maintaining positive cashflow. In the light MSW Charging, some respondents also expressed concern about the potential cost increase associated with the addition of manual labour and machinery for waste sorting.

## *Key Findings of Section II – REVIEW ON LOCAL RECYCLING INDUSTRY TO ADOPT SMART RECYCLING TECHNOLOGIES AND MOVE TOWARDS CIRCULAR ECONOMY AND RE-INDUSTRIALIZATION*

39. Amongst the 50 surveyed companies, 90% of them were based only in Hong Kong; while the rest of them had production sites in Hong Kong and other jurisdictions, for example Mainland China, Macau SAR, Vietnam, etc. Meanwhile, 90% of the surveyed companies encountered one or more problems with their current production sites. The top three problems raised by the 90% companies include insufficient storage area (raised by 69% companies), insufficient space for installing smart production line (56%) and limitation in existing building structure (24%).

40. Besides, around one third of the companies already set up smart production line (36%); while the same percentage of companies did not have smart production line and would not consider it (36%). Less than one third of the companies did not set up smart production lines but would consider it in the future (28%). They faced challenges such as needs for a larger operational space, with the majority of them (79%) requiring operational sites of at least 10,000 sq.ft. Financial constraint was another challenges, as companies planning for smart production lines were expected to pay a lower rent than those who had already implemented such production lines, with 28% companies expected the rent of below HK$10 per sq. ft. (71%). But in fact, 36% companies which already set up smart production lines paid HK$10 per sq. ft. or above (75%). Furthermore, companies with plan to set up smart production lines anticipated a rental contracts of at least 10 years (62% of the 28% companies) to justify the investment, compared to the majority who currently had rental contracts of 1 to 5 years (accounted for 69% of the 36% companies). These findings highlight that the recycling industry faced space and financial constraint to adopt smart technology in their business operations.

41. The top six types of recyclables considered with the potential to achieve circular economy locally were waste paper (suggested by 40% of the companies), waste ferrous metals (suggested by 38% of the companies), waste non-ferrous metals (i.e. suggested by 34% of the companies), food waste (suggested by 30% of the companies), waste wood (suggested by 24% of the companies) and waste glass (suggested by 24% of the companies). On the contrary, the top five types of recyclables considered with no potential to achieve circular economy locally included waste paper (suggested by 12% of the companies), ferrous metals (suggested by 10% of the companies), waste non-ferrous metals (suggested by 8% of the companies), tetrapak (suggested by 8% of the companies) and UCO (suggested by 8% of the companies).

42. While 62% of surveyed companies understood the concept of smart recycling, only 2% of them integrated it into their operations, and 42% of them would need to understand more about the smart recycling before incorporating it into their business operations. Despite this, 96.8% of the surveyed companies believed smart recycling could bring a positive impact to their business by

increasing efficiency (provided by 87% of the surveyed companies), reducing operational costs (provided 65% of the surveyed companies), improving customer services (provided by 58% of the surveyed companies), improving product quality (provided by 52%), etc.

43. Understanding on Industry 4.0 ("I4.0") technologies was rather limited amongst the surveyed companies, with 40% to 65% of them considering I4.0 unimportant to their business operations. However, some companies adopted or planned to adopt technologies like sensors (36%), cyber security (23%), and Internet of Things ("IoT") (20%), etc. There were discrepancies that the number of companies that had implemented or planned to implement I4.0 technologies were more than those who considered I4.0 important, indicats a knowledge gap on the integration of smart recycling technologies.

44. About 40% of the surveyed companies had no plans to adopt smart recycling technologies, and 26% of the surveyed companies considered to implement related technologies five years later. Hence, it is anticipated that there will be no rapid development about the integration of smart recycling in the recycling industry.

45. For the around 60% companies that considered to adopt smart recycling, the majority of them planned to rely on internal research for implementation (63%), while others considered to seek support from the government (38%) or private consultancy firms (13%). Around 80% of the 60% companies concerned that the adoption of smart recycling would have difficulties, including insufficient capital, insufficient land/space and difficulty in measuring the associated economic benefits.

46. Only 8% of surveyed companies established Research & Development ("R&D") teams, with teammates came from various educational background ranging from Associate degrees to Doctoral degrees. Also, 75% of them expanded their teams in the past three years, typically employing 5 to 10 staff members. Besides, investment in R&D varied, with two-thirds of these companies spending less than HK 1,000,000 annually. To facilitate R&D within local recycling companies, they believed that providing rental subsidies, nurturing local R&D talents and offering R&D subsidies in the future are crucial factors.

47. Almost 90% of the surveyed companies applied for Recycling Fund. The majority of them were satisfied with the funding amount of the Recycling Fund (96%) and recognised the role of Recycling Fund in promoting smart recycling (71%).

48. Meanwhile, nearly half of these companies (49%) suggested Recycling Fund diversifying its funding types to enable an efficient adoption of smart recycling technologies, for example, purchase of smart recycling technologies, talent recruitment, logistic arrangement, battery recycling, etc.

49. Five key challenges ahead of transitioning to smart recycling and re-industrialization were identified and summarized in the following. First, many recycling companies lacked understanding of I4.0 technologies, which would potentially hinder their ability to integrate these technologies into their operations and benefit from advancements of IoT, human-machine interface ("HMI"), data analytics & artificial intelligence, and sensors. Second, there was a gap in the implementation of smart production lines within the industry, with many companies lacked the relevant knowledge or experience, resources and/or expertise, such may hinder their future plans on developing smart production lines. Third, land scarcity and high land costs were the big obstacles for recycling companies to set up smart production lines, which would potentially force companies that would like to adopt smart production lines to relocate their businesses outside of Hong Kong. Fourth, recycling companies faced financial burdens from the purchase of smart recycling technologies, recruitment of skilled personnel, and R&D investment, which was compounded by the industry's relatively low profit margins. Fifth, the cost of manufacturing products from recycled materials was comparable or even higher than that from raw materials,

which would potentially lead to higher prices for recycled products and reduced consumer preference for products made of recycled materials.

## *Conclusion*

50. The recycling industry in Hong Kong has been transitioning to provide more recycling services and adapting to market changes and government support initiatives.

51. The industry needs to address challenges related to manpower, land, source separation, and knowledge of smart technologies to move towards circular economy and re-industrialization. Regarding manpower shortage, relatively low wage and long working hour might be the root causes.

52. The future implementation of MSW Charging is expected to draw a positive impact on recycling volume and attention amongst the recycling industry, though there was also concern about its effect on the quality of recyclables.

53. This Study also explore the adoption of smart recycling technologies, with many recycling companies recognizing its potential benefits, but they were in the meantime facing knowledge and capacity gaps. Therefore, this Study highlights the needs to strengthen promotion and education, to facilitate the industry to transit to smart recycling and move forward a circular economy.

54. The Recycling Fund played a crucial role in supporting the sustainable development of local recycling companies. It enabled recycling industry to keep abreast with the development of local environmental policy (e.g., MSW Charging) and so to support recycling companies to transit towards re-industrialization and circular economy. Recycling Fund could consider to provide the following supporting initiatives to the recycling industry:

- to subsidize the manpower expenses for recycling companies to recruit sufficient manpower to support sorting/ processing of recyclables or to establish R&D team to expand their capacities in implementing smart production lines.;
- to support the recycling industry to purchase facilities for sorting/ processing the recyclables;
- to incorporate the concept of I4.0 in theme-based schemes of ESP, which would enable recycling companies to upgrade their operational facilities and efficiency through the adoption of technologies such IoT, robotics and automation, data analytics and artificial intelligence, sensors, HMI, and cyber security;
- to increase the proportion of funds for expenditure related of smart recycling technologies in the future;
- to support various pilot projects to enhance waste separation at source. Conduct active outreach programmes and improve collection systems/ machineries such as reverse vending machines in different pilot projects so as to engage the public/ recycling industry in clean recycling and waste separation; and
- to subsidise recycling related operations or NGOs in conducting trial outreach programmes which could facilitate the collection or recycling of recyclables, especially for recyclables with low market values, this could create new business trends within the industry, and to motivate the community to separate these recyclables at source.

***- End of Executive Summary -***