

Understanding Construction Waste Recycling in Hong Kong: SWOT Analysis of the Government's Prevailing Initiatives

Wendy M.W. Lee^{1*}, Weisheng Lu², Fan Xue³

This is the authors' pre-print version (before peer review) of the paper:

Lee, W. M. W., Lu, W. & Xue, F. (2020). Understanding construction waste recycling in Hong Kong: SWOT analysis of the government's prevailing initiatives. *Proceedings of the 25th International Symposium on Advancement of Construction Management and Real Estate (CRIOCM2020)*, Springer, in press. *Merit Paper Award*.

This file is shared for personal and academic use only, under the license [CC BY-NC-ND 4.0](#) (Non-Commercial, No Derivatives, and with an Attributed citation when you use). The final published version of this paper can be found at: [\[LINK_TO_SPRINGERLINK\]](#). Any uses other than personal and academic purposes must obtain appropriate [permissions from Springer](#) first.



Abstract: The Hong Kong government has implemented the Construction Waste Disposal Charging Scheme since 2006 to promote construction waste recycling among contractors. Under the scheme, in addition to the conventional approach of disposing construction waste at landfills, contractors are given the alternative options of dumping pure inert waste and waste with over 50% by weight being inert materials at public fills and off-site sorting facilities respectively. Yet, the effectiveness of the scheme is questionable. By adopting a mixed-method approach encompassing cross-sectoral learning, attendance of Court hearings and semi-structured interviews, this study aims at understanding the status quo of construction waste recycling in Hong Kong using SWOT analysis, a strategic planning technique from the business sector. Through identifying the inherent strengths and weaknesses of the government's construction waste recycling initiatives, as well as the external opportunities and threats impacting the realization of such initiatives, we have formulated policy recommendations on how construction waste recycling can be boosted in the future. The findings in this paper provide a useful reference for the government's long-term solutions to construction waste recycling in Hong Kong.

Keywords: Construction waste; recycling; cross-sectoral learning; SWOT analysis; Hong Kong

^{1*} Wendy M.W. Lee

Corresponding author, Department of Real Estate and Construction, The University of Hong Kong, Hong Kong Special Administrative Region, China
E-mail: wendy.lmw@connect.hku.hk

² Weisheng Lu

Department of Real Estate and Construction, The University of Hong Kong, Hong Kong Special Administrative Region, China

³ Fan Xue

Department of Real Estate and Construction, The University of Hong Kong, Hong Kong Special Administrative Region, China

1 Introduction

Being a compact city in South China with only 1,106.81 km² of total land area [1], Hong Kong has long been plagued with the issue of scarcity of land [2], and thus has limited space for opening new landfill sites [3]. At the turn of the 21st century, construction waste has constituted a considerable proportion of the solid waste being disposed of at landfills every year. By 2002, nearly half of the landfilled waste was construction waste (48.2%) [4]. Despite that the amounts of construction waste being landfilled per year had declined in the subsequent years, construction waste continued to account for nearly 40% of the waste being landfilled every year until 2005 [5].

In view of the aggravating situation, the Hong Kong government had endeavored to minimize the amount of construction waste generated through implementing the Construction Waste Disposal Charging Scheme (CWDCS) in 2006. The CWDCS had mandated all construction waste not being reused or recycled to be dumped at the government waste disposal facilities. Such facilities include public fill reception facilities (public fills), off-site sorting facilities (OSFs), landfills or outlying islands transfer facilities, depending on their components. The main contractors or other waste producers need to pay a service charge for disposing each ton of waste. The fee scale is:

- HK\$125 for each ton of mixed inert and non-inert construction waste dumped at landfills;
- HK\$100 per ton of mixed inert and non-inert construction waste accepted by OSFs; and
- HK\$27 for each ton of inert construction waste accepted by public fill reception facilities.

The above service charges were later increased to HK\$200, HK\$175 and HK\$71 respectively in 2017 [6]. Premised on the polluter pays principle (PPP) [7], the CWDCS aimed at reducing the amount of construction waste generated through promoting the reuse and recycling of waste among contractors [8].

During the first year of implementation, the CWDCS appeared to be effective in reducing both the amount of landfilled construction waste (from 2.39 million tons in 2005 to 1.51 million tons in 2006) and the proportion of landfilled waste being construction materials (from 37.0% in 2005 to 27.5% in 2006). Such figures were further reduced to 1.22 million tons and 24.8% respectively by 2011. Unfortunately, the decline in the amount of construction waste generated was accompanied by the aggravation of the issue of illegal dumping during the same period. According to the Director of Audit's reports Report No.67 [9], the government only received 1,517 complaints from the public on illegal disposal of construction waste in public areas in 2005. However, such figure was escalated to 6,287 in 2011 [10], and was further increased to 8,225 in 2016 [11]. Worse still, the amount of construction waste being landfilled had rebounded to a high level of 1.62 million tons in 2016, constituting nearly 30% of the total amount of landfilled solid waste in that year [12].

34 The recent intensification of the issue of illegal dumping in conjunction with a rebound in the amount
35 of landfilled construction waste yield two implications: (1) illegal dumping has been increasingly
36 employed by contractors as a means of evading the waste disposal service charges levied on them under
37 the CWDCS; and (2) a considerable proportion of contractors are still reluctant to invest in recycling
38 construction waste. It follows that the CWDCS has failed to meet its initial policy objective - to encourage
39 contractors to recycle construction waste. It is against this backdrop that the following two research
40 objectives have been formulated: (1) to understand the status quo of construction waste recycling in Hong
41 Kong; and (2) to formulate policy recommendations on how construction waste recycling can be promoted
42 in Hong Kong.

43 This study adopts a mixed-method approach comprising cross-sectoral learning, attendance of Court
44 hearings and semi-structured interviews. This paper is structured as follows. Following this introductory
45 section, Section 2 provides an overview of construction waste recycling initiatives in Hong Kong and a
46 review of literature on SWOT analysis, which forms the theoretical foundation of our exploration of the
47 status quo of construction waste recycling in Hong Kong. Section 3 is a description of our research
48 methods. Section 4 reports on the data analyses, results and findings. Section 5 is a discussion of the policy
49 recommendations formulated based on Section 4. Finally, conclusions are drawn in Section 6.

50 **2 Literature Review**

51 **2.1 Construction Waste Recycling Initiatives in Hong Kong**

52 The government has long been playing a leading role in promoting construction waste recycling. Prior to
53 the introduction of the CWDCS in 2006, all construction waste not being reused or recycled ended up
54 being landfilled. Under the CWDCS, apart from the conventional way of transporting construction waste
55 to landfills, two new alternative disposal options were made available:

- 56 1) public fills which accept construction waste entirely made up of inert materials; and
- 57 2) OSFs that accept waste with more than 50% by weight being inert materials [6].

58 The service charges of public fills and OSFs are lower than those of landfills or outlying islands transfer
59 facilities. Thus, contractors who are willing to conduct on-site sorting to separate non-inert materials from
60 construction waste can certainly reduce their disposal charges by using public fills or OSFs.

61 Construction waste being disposed of at OSFs will undergo the processes of mechanical sorting and
62 handpicking. Once the non-inert waste has been segregated from the inert waste, the two types of waste
63 will be transported to the landfills and public fills respectively [13]. Contractors of both public and private
64 projects are entitled to order inert waste from the public fills [14]. In addition, pursuant to a cooperation
65 agreement with the Mainland authorities, the Hong Kong government has been transporting fill materials
66 to Taishan County in Jiangmen for reclamation purpose since 2007 [9].

67 Furthermore, the government had launched the Recycling Fund since 2015 to support the development
68 of the recycling industry in Hong Kong. The Recycling Fund offers funding support to local business
69 enterprises to expand and upgrade their waste recycling operations, as well as non-profit distributing
70 organizations (NPOs) (e.g., professional bodies, research institutes) to launch non-profit making projects to
71 assist the local recycling industry in enhancing their productivity and operational standards [15].

72 **2.2 Overview of SWOT Analysis**

73 Emerged in the 1960s, SWOT analysis is a highly popular strategic management and planning technique
74 employed by business organizations in formulating competitive strategies [16, 17]. SWOT analysis is
75 powerful in optimizing resource allocation [18]. The term “SWOT” stands for “strengths”, “weaknesses”,
76 “opportunities” and “threats”. By “strengths”, it refers to the strong aspects which can add value to an
77 organization [19]. By “weaknesses”, it means negative aspects of an organization that puts it at a
78 disadvantageous position [20]. Both strengths and weaknesses are internal factors and attributes of an
79 organization which can impact on its long-term development [21]. “Opportunities” are the environmental
80 conditions that enable an organization to take advantage of its strengths and overcome its weaknesses [22].
81 “Threats” are environmental conditions jeopardizing the actualization of an organization’s objectives
82 which should be avoided [23]. Both opportunities and threats are external environmental factors and
83 attributes beyond the organization’s control [24].

84 SWOT analysis is conventionally applied by business organizations in evaluating internal
85 (organizational) strengths and weaknesses as well as external (environmental) opportunities and threats.
86 Nevertheless, we consider the cross-learning of this strategic planning technique from the business sector
87 is suitable for this study because business entities and governments share similar rationale in making
88 important decisions. First, in relation to the target of service, while business organizations always endeavor
89 to satisfy the needs of clients, meeting the demands of the public has long been at the top of various
90 governments’ priority. One prominent example is that the Hong Kong government conducts extensive
91 public consultation prior to implementing any new policies, including but not limited to the CWDCS.
92 Second, regarding the guiding principle of operation, both business enterprises and governments seek to
93 achieve cost-effectiveness. In the context of Hong Kong, despite that the government had launched a pilot
94 scheme of installing GPS devices in construction waste collection vehicles to track illegal dumping in
95 2016, the scheme was aborted due to the high administrative costs involved [11]. Another example is the
96 launching of the Recycling Fund in 2015 required prior approval of the Legislative Council’s Finance
97 Committee beforehand [15]. These examples illustrate the indispensable role played by cost-effectiveness
98 in public administration. These two commonalities justify the application of SWOT analysis, a concept
99 commonly applied by the senior management of business enterprises, to explore the current waste
100 recycling initiatives led by the Hong Kong government.

3 Research Methods

This study adopts a mixed-method approach incorporating three methods: cross-sectoral learning; attendance of Court hearings; and semi-structured interviews. Figure 1 gives a summary of the research methods.

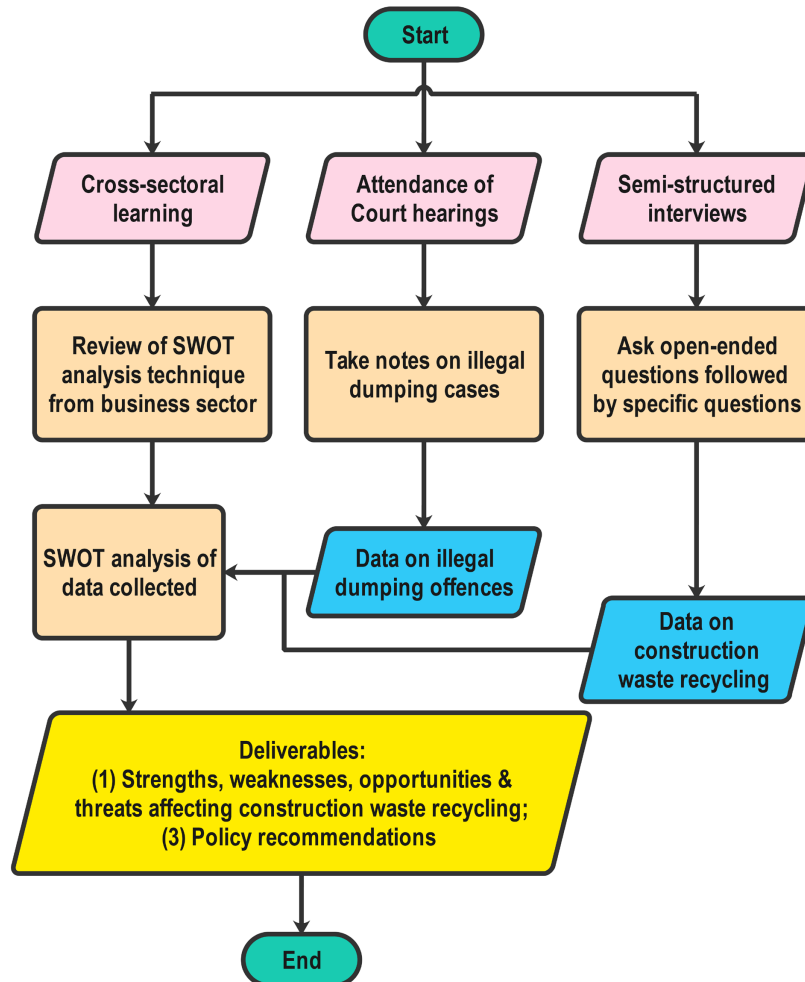


Figure 1. Summary of research methods

3.1 Cross-sectoral Learning

Cross-sectoral learning means discovering the best practices across sectors so as to uncover innovative ideas and to enable creative problem-solving, though it may not be possible to directly transfer the lessons learned from one sector to another [25]. For instance, Vanelslander et al. [26] examined the potential of cross-sectoral learning among different transport sub-sectors. Another more recent example is that Tan et al. [27] had developed a set of Design for Manufacture and Assembly (DfMA) guidelines for the construction industry based on the experience of the manufacturing sector, with a long history of adopting

116 DfMA. In this study, we explore the status quo of Hong Kong’s construction waste recycling initiatives led
117 by the government by conducting SWOT analysis, a strategic planning model which originates from the
118 business sector.

119 In view of the difference in nature between business enterprise and government, for the purpose of
120 this study, the precise meanings of “strengths”, “weaknesses”, “opportunities” and “threats” are refined as
121 follows:

- 122 · “Strengths” refer to strong aspects facilitating construction waste recycling in Hong Kong within the
123 government’s control;
- 124 · “Weaknesses” refer to negative aspects impeding construction waste recycling in Hong Kong within
125 the government’ control;
- 126 · “Opportunities” refer to external environmental factors facilitating construction waste recycling in
127 Hong Kong beyond the government’s control; and
- 128 · “Threats” refer to the external environmental factors impeding construction waste recycling in Hong
129 Kong beyond the government’s control.

130 **3.2 Attendance of Court Hearings**

131 Obviously, contractors’ identification of the low-cost alternative of illegal dumping contributes to the
132 limited effectiveness of the CWDCS in promoting construction waste recycling. Therefore, it is
133 worthwhile to garner a background understanding about the phenomenon of illegal dumping in Hong
134 Kong. It is against this background that we had spent 2.5 months on attending Court hearings of illegal
135 dumping offences being prosecuted in Courts in 2019, and notes were taken for further analysis.

136 **3.3 Semi-structured interviews**

137 To garner in-depth understanding about the status quo of construction waste recycling in Hong Kong, we
138 have conducted a series of semi-structured interviews. As a commonly used qualitative research method
139 [28], semi-structured interviews refer to asking respondents predetermined but open-ended questions [29,
140 30], which is usually succeeded by raising follow-up questions based on the respondents’ initial answers
141 [31]. We had conducted a total of 11 interviews from November 2019 to June 2020. The respondents’
142 backgrounds are highly diversified, ranging from government officials to the senior management of the
143 construction companies and recycling companies (see Table 1 for a summary of the respondents’ profiles).
144 Each interview lasted for one to two hours, all of which were audio-recorded with the prior consent of
145 respondents and transcripts were made for each interview. Thereafter, content analysis was conducted. We
146 then further triangulated the results from the semi-structured interviews with the data collected from Court
147 hearings, as well as the SWOT framework to generate more comprehensive findings.

Table 1. Profiles of respondents

No.	Role	Experience in construction waste management
1	Senior Inspector of Works, Civil Engineering and Development Department (CEDD)	>20 years
2	Senior Maintenance Surveyor, Housing Department (HD)	>30 years
3	Former Building Services Inspector, Housing Department (HD)	>30 years
4	Chief Property Services Officer, Architectural Services Department (ASD)	>35 years
5	Senior Engineer, Environmental Protection Department (HKEPD)	>20 years
6	Senior Engineer, CEDD	>20 years
7	Director and Registered Architect of an architectural firm	>35 years
8	Director of a construction waste recycling plant	>12 years
9	General Manager of a construction waste recycling plant	>20 years
10	Director and Registered Structural Engineer of a construction company	>15 years
11	Senior Building Surveyor of a construction company	>20 years

150

4 Data Analysis, Results and Findings

151

4.1 Strengths Facilitating Construction Waste Recycling

152

4.1.1 Provision of Economic Incentives

153

154

155

The government has provided various economic incentives to facilitate the development of the construction waste recycling industry in Hong Kong. Interviewee 5, who takes part in administering applications for the Recycling Fund, explained:

156

157

158

In fact, the government has not formally set any precise quota limiting the number of successful applicants. From my experience, so long as the criteria of application has been met, it is very likely that the application for Recycling Fund will be approved.

159

Interviewee 5 added:

160

161

162

163

Except housing projects launched by the Housing Department, all public projects are entitled to order fill materials from the public fills for free. As for private projects and the Housing Department's housing projects, only a very low administrative fee will be levied for collecting fill materials from the public fills.

164

165 *To boost the development of construction waste recycling in the private sector, the government has*
166 *been operating the EcoPark since 2007, which provides long-term land for recycling companies at*
167 *affordable rent.*

168 Interviewee 11 reflected:

169 *In recent years, it is common practice for the government to use contractual clauses to require*
170 *contractors undertaking public projects to carry out waste recycling. The government pays*
171 *additional costs to contractors for incorporating such additional requirement.*

172 **4.1.2 Pioneer in Conducting Recycling Initiatives**

173 In addition to provision of economic incentives, the government itself has been practising various waste
174 recycling initiatives in public projects. One prominent example is that the design team of each public
175 project (i.e. a team of architects from a government department) must formulate a “Construction and
176 Demolition Material Management Plan” (C&DMMP) with particulars on how the construction waste being
177 generated at each project phase will be stored, reused, recycled and/or disposed of at the design stage. As
178 explained by Interviewee 4:

179 *The C&DMMP is subject to the approval of a committee, the members of which comprise all senior*
180 *officials of the relevant department. Once the committee has decided that the plan is infeasible, then*
181 *the plan will be sent back to the design team for further revision.*

182 Also, on-site recycling has long been conducted in public projects. Interviewee 4 emphasized:

183 *In public projects, it is common to use hydraulic breakers to crush inert waste such as rocks and*
184 *waste concrete into smaller pieces for future use in road construction.*

185 Interviewee 6 added:

186 *The government has long been practicing on-site sorting and on-site crushing in tunneling projects.*

187 In the event where the waste generated cannot be reused in the same project, public projects have long
188 been relying on a “matching” mechanism to resolve the problem. As explained by Interviewees 4, 5 and 6:

189 *If not all inert waste from the excavation stage of a project can be applied at the site formation stage,*
190 *contractors would liaise with other public construction sites to see if there is any demand for inert*
191 *waste. The waste will then be shared with site(s) with such need.*

192 To promote the development of the construction waste recycling industry, the government pioneered in
193 using green building materials. As reflected by Interviewee 5:

194 *In recent years, the government’s technical circulars have been promoting the use of green building*
195 *materials (e.g. green paving blocks) in government buildings.*

196 **4.2 Weaknesses Impeding Construction Waste Recycling**

197 **4.2.1 Prevalence of Bureaucracy**

198 Bureaucracy is the major obstacle to construction waste recycling, especially on-site recycling. As stressed
199 by Interviewee 9:

200 *The use of on-site recycling equipment would cause nuisance to the residents nearby, and it is*
201 *necessary to apply to the HKEPD for the relevant licence(s) beforehand. Although it is easy to*
202 *purchase an on-site recycling equipment, the process of obtaining the relevant licence(s) can drag on*

203 *for six to twelve months. This accounts for the reluctance of private projects to conduct on-site*
204 *recycling.*

205 The stringent requirement on the size of inert materials accepted by public fills is another example
206 illustrating how bureaucracy impedes construction waste recycling in Hong Kong. As explained by
207 Interviewee 6:

208 *The public fills only accept inert materials with diameters not more than 250mm. Thus, contractors*
209 *may need to break inert waste materials into smaller pieces before disposing them at public fills.*
210 *Many contractors, especially those undertaking private projects where waste recycling is not*
211 *compulsory, are reluctant to spend extra time and resources on meeting such stringent requirement.*
212 *They would rather dump the inert materials in landfills.*

213 Interviewee 2 added:

214 *The public fills' requirement of only accepting inert materials with diameters not exceeding 250mm*
215 *also poses a challenge to public housing projects – Many recent public housing projects are small*
216 *projects of constructing a few residential blocks at the border areas of existing public rental housing*
217 *estates. It is difficult to place crushers in such compact sites for the purpose of breaking inert*
218 *materials into smaller pieces.*

219 **4.3 Opportunities Facilitating Construction Waste Recycling**

220 **4.3.1 Emergence of New Local Projects**

221 Since 2007, Taishan has been a stable demander of Hong Kong's inert waste accumulated in public fills.
222 However, throughout the years, many worried about the difficulties associated with opening up new
223 outlet(s) for inert waste upon completion of Taishan's reclamation project. Fortunately, in recent years,
224 some new local projects in need of fill materials have been started, which can temporary relief the pressure
225 on the public fills. As explained by Interviewee 5:

226 *It is expected that the Three-Runway System project (commenced in 2016) will be completed by 2024.*
227 *Being a demander of the inert materials in public fills, this project can continue to relieve the*
228 *pressure on the public fills in the next couple of years.*

229 *Similarly, the Tung Chung New Town will continue to be expanded in the coming decade. Since*
230 *housing development, which is a predominant component of the project, requires fill materials for*
231 *land levelling, it is unlikely that the public fills will reach their full capacity in the next few years.*

232 **4.3.2 Recycling Companies' Intimate Waste Collection Services**

233 Despite the government's stringent requirements on the content and size of waste accepted by public fills
234 and OSFs, private recycling companies have set much lower thresholds and provide more intimate service,
235 thereby providing alternatives for contractors. Interviewee 9 said:

236 *As a social enterprise, we do not charge contractors any fees for disposing their waste at our*
237 *recycling plants.*

238 Interviewee 8 added:

239 *We only accept inert waste, and contractors must sort their waste into different categories (e.g. red*
240 *bricks must be separated from waste concrete) before handing over to us. In comparison to the*
241 *government's public fills which stringently require inert particles to be not more than 250mm in*
242 *diameter, we accept inert particulars with diameter not exceeding 500mm, and our service charges*
243 *are lower than the public fills.*

244 *We understand that many contractors are reluctant to use the government waste disposal facilities*
245 *due to their long distances from the construction sites. In view of this, we also send trucks to collect*
246 *waste from contractors.*

247 **4.4 Threats Impeding Construction Waste Recycling**

248 **4.4.1 Mentality of Profit Maximization and Time is of the Essence in Private Sector**

249 Profit maximization, a deep-rooted mentality among contractors and developers, is a long-standing threat
250 impeding construction waste recycling in Hong Kong. As emphasized by Interviewee 3:

251 *In demolition projects, contractors are only willing to recycle metal waste (e.g. copper wires), waste*
252 *PVC and paper boxes due to their high economic values. However, inert materials (e.g. waste*
253 *concrete, rocks and soil), which constitute a significant proportion of overall construction waste in*
254 *most projects, cannot be resold at high prices. Thus, many contractors prefer incurring higher*
255 *disposal costs of dumping inert waste at landfills rather than allocating resources in conducting on-*
256 *site sorting and recycling.*

257 The views of Interviewees 4, 5 and 7 echoed with that of Interviewee 3.

258 Interviewee 11 added:

259 *Contractors of public projects can perform waste recycling because the government will cover the*
260 *additional expenses incurred in construction waste management. However, in the case of private*
261 *projects, developers tend to award construction contracts to contractors submitting the lowest bids. It*
262 *is impossible for such low contract sums to cover the costs of on-site recycling, which is not a*
263 *contractual requirement. Together with the significant increase in labor costs in recent years, both*
264 *developers and contractors only opt for means of completing the projects at the lowest possible costs.*

265 *It should be noted that time is of the essence in Hong Kong's construction industry. If a contractor*
266 *fails to complete a project within the deadline, then it needs to pay liquidated damages.*

267 *Thus, no contractor undertaking private projects cares about how to manage waste in a proper*
268 *manner.*

269 Also, based on the data collected from the Court hearings, about one-third of the illegal dumping offenders
270 were contractors. This illustrates that contractors have a relatively high tendency to evade the service
271 charges of disposing construction waste at government waste disposal facilities.

272 **4.4.2 Underutilization of Government's Economic Incentives and Services**

273 It is worth to be noticed that the government's waste recycling initiatives failed to gain popular support
274 from the industry players. Obviously, the public fills' service of supplying fill material to projects at zero
275 or extremely low costs (depending on the nature of project) has been underutilized. As emphasized by
276 Interviewee 5:

277 *Very few contractors choose to collect fill materials from the government's public fills. According to*
278 *our internal statistics, only 80 projects (both public and private projects inclusive) had collected fill*
279 *materials from the public fills during the past five years.*

280 Similarly, the government's OSFs are also underutilized. As explained by Interviewee 1:

281 *In contrast to the landfill sites which are overutilized and with long queues at the entrances, the*
282 *OSFs are underutilized. According to our internal statistics, each OSF has slightly more than 200*
283 *users per day.*

284 Interviewees 11 and 5's views were confirmed by Interviewees 10:

285 *I have neither used the OSFs nor public fills before. Although their service charges are considerably*
286 *lower than that of the landfills, much time and resources are required to conduct on-site sorting to*
287 *fulfil their inert waste content requirement. Therefore, I only instruct my employees to dispose all*
288 *construction waste at landfills.*

289 *Also, I have never heard of the government's service of allowing us to order fill materials from their*
290 *public fills before.*

291 Another major threat which should be noticed is that although the government has been trying to
292 encourage industry players to set up construction waste recycling plants by launching the Recycling Fund
293 and opening the EcoPark, such supportive measures are lacking in popularity. As explained by Interviewee
294 5:

295 *Due to the huge initial capital investment involved, there are only two construction waste recycling*
296 *companies in Hong Kong, one of which is just a division of a developer's subsidiary construction*
297 *material manufacturer. Indeed, we receive very few applications for the Recycling Fund every year.*

298 Interviewee 5's observation is confirmed by Interviewee 9, who is the general manager of the recycling
299 division of the developer's subsidiary construction material manufacturer referred by Interviewee 5:

300 *Our company produces construction materials, including both materials made from virgin resources*
301 *and green building materials. Our division currently operates two recycling plants, one of which is*
302 *situated in EcoPark. A recycling plant does require huge initial capital investment. Our employer*
303 *initially set up the recycling plants as a matter of "corporate social responsibility". Most clients still*
304 *prefer using virgin materials. Our division's green building materials are mainly consumed by public*
305 *projects and new developments of our holding company. Without sound financial background and*
306 *stable outlets for end-products, it is really difficult to enter the waste recycling industry despite the*
307 *availability of Recycling Fund.*

308 4.4.3 Compacted Sites of Private Projects

309 Furthermore, although the government has been pioneering in conducting on-site recycling and stockpiling
310 inert waste materials for use at later stages, it appears that the private sector is unwilling to follow due to
311 an array of practical constraints. Interviewees 5, 6, 7 and 11 reflected:

312 *Most construction sites of private projects are so small that there is insufficient space for housing on-*
313 *site recycling equipment. Additionally, due to the lack of space to stockpile treated/recycled waste,*
314 *the public projects' common practice of using excavated waste generated at an earlier stage for*
315 *landfilling at subsequent stages can hardly be applied to private projects.*

316 Such views were confirmed by Interviewee 10:

317 *Being the director of a construction company predominantly undertaking small private projects in*
318 *highly compacted sites, I have neither arranged on-site recycling in my sites nor stockpiled waste for*
319 *future use before.*

320 The lack of space for stockpiling of inert waste also hindered the sharing of inert waste among different
321 private projects as in the case of public projects. Interviewee 2 explained:

322 *The practice of sharing inert waste among different sites only exists in the case of public projects.*
323 *But such arrangement seldom exists in private projects.*

324 Interviewees 10 and 11 added:

325 *Our project sites do not even have enough space for stockpiling, not to mention finding potential*
326 *users of stockpiled waste and waiting for their collection.*

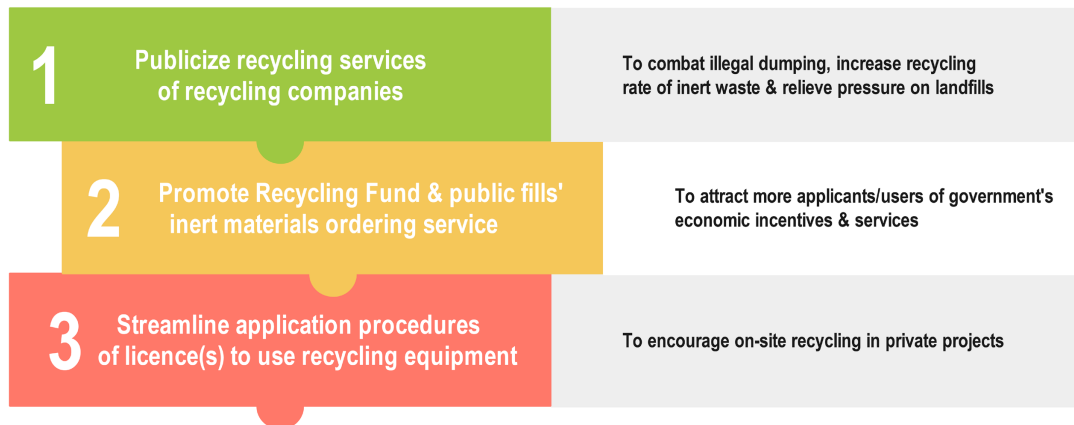
327 **5 Discussion**

328 Admittedly, the government has endeavored to promote construction waste recycling in Hong Kong via a
329 wide range of incentives throughout the years. Prominent examples include: (1) Not setting precise quota
330 to limit the number of successful applicants of the Recycling Fund; (2) Allowing contractors to collect fill
331 materials from the public fills at extremely low or zero costs, depending on the nature of project; (3)
332 Establishing the EcoPark which provides rental concessions to recycling companies; and (4) Mandating
333 contractors to carry out waste recycling in public projects by paying higher contract sums. Meanwhile, the
334 government also pioneers in conducting waste recycling in public projects as illustrated by the following
335 examples: (1) formulating C&DMMP at the design stage; (2) carrying out on-site recycling; (3) matching
336 sites in need of inert waste with sites with surplus supply of inert waste; and (4) attracting new entrants
337 into the recycling industry by pioneering in using green building materials. Nonetheless, some prevalent
338 incentives or initiatives are bureaucratic in nature (e.g. lengthy process of obtaining licence(s) to use on-
339 site recycling equipment, stringent requirement on the size and content of waste disposed at public fills and
340 OSFs), thereby weakening their strengths.

341 The government's economic incentives and recycling initiatives also failed to gain popular support
342 from the private sector. The major threats to their success include: (1) private sector's long-standing
343 mentality of profit maximization, cost minimization and time is of the essence; (2) underutilization of the
344 government's services and economic initiatives; and (3) compacted sites of private projects. It appears that
345 such threats cannot be directly offset by the new opportunities emerged in recent years, including the
346 demand for inert waste arising from the two large-scale local new development projects, as well as the less
347 stringent requirements on the size of waste accepted by private recycling companies.

348 Based on the inherent strengths and weaknesses of the prevalent government waste recycling policies
349 and the external opportunities and threats beyond the government's control, we propose the following
350 policy recommendations (see Figure 2 for a summary of the recommendations). Firstly, it is recommended
351 that publicity of recycling companies' waste recycling services should be reinforced to combat contractors'
352 reliance on illegal dumping as a means to evade legal disposal charges and preference for recycling metal
353 waste (with higher economic value) rather than inert waste. Knowing that private recycling companies
354 provide more flexible and intimate services (e.g. transportation services), contractors who initially prefer
355 landfills to OSFs and public fills might be attracted to use the recycling companies' services instead. In
356 turn, the pressure on the landfills can be relieved. Secondly, the government should allocate more
357 resources to promote both the Recycling Fund and the public fills' fill material ordering service to the
358 industry players to tackle the issues of few applications for the Recycling Fund despite the high success
359 rate, and underutilization of fill materials in public fills. This suggestion is justified by the fact that the
360 director of a small construction company being interviewed is unaware of the service of ordering fill

361 materials from public fills and there are only two construction waste recycling companies in Hong Kong at
362 the moment. Thirdly, it is of crucial importance for the government to streamline the application
363 procedures of the relevant licence(s) to encourage private projects to adopt on-site recycling.



364

365 **Figure 2. Summary of policy recommendations**

366 **6 Conclusion**

367 During the past two decades, the Hong Kong government has devoted a multitude of resources to promote
368 construction waste recycling. Nevertheless, the effectiveness of its initiatives is far from satisfactory. By
369 cross-learning the strategic planning technique of SWOT analysis from the business sector, conducting a
370 series of semi-structured interviews and attending Court hearings of illegal dumping offences, this study
371 had identified the strengths and weaknesses of the government's prevailing construction waste recycling
372 policies, as well as the external opportunities and threats beyond the government's control. Based on the
373 findings of the study, we have proposed three policy recommendations to combat the threats hindering the
374 long-term realization of the government's construction waste recycling objectives. This study is novel in
375 that it is the first study evaluating the status quo of construction waste recycling in Hong Kong using a
376 strategic planning technique from an entirely different industry. Despite that the policy recommendations
377 put forward in this study targets at the government, it is believed that the collective efforts of different
378 stakeholders, including the government, contractors, and construction practitioners ranging from frontline
379 staff to senior management, are of utmost importance to the long-term development of construction waste
380 recycling in Hong Kong.

381 **Acknowledgement**

382 This research is supported by the Policy Innovation and Co-ordination Office of the Hong Kong Special
383 Administrative Region Government (Project Numbers: 2018.A8.078.18D and S2018.A8.010).

References

- 385 [1] Lands Department of The Government of the Hong Kong Special Administrative Region (LandsD).
386 (2020). *Total Land and Sea Area of Hong Kong*. Available at
387 <https://www.landsd.gov.hk/mapping/en/publications/total.htm> [Accessed 1 August 2020].
- 388 [2] Wang, H., Zhang, X., & Skitmore, M. (2015). *Implications for sustainable land use in high-density*
389 *cities: Evidence from Hong Kong*. Habitat International, 50, 23-34.
- 390 [3] Hao, J., Hills, M., & Tam, V. (2008). *The effectiveness of Hong Kong's Construction Waste Disposal*
391 *Charging Scheme*. Waste Management & Research, 26(6), 553-558.
- 392 [4] Environmental Protection Department of The Government of the Hong Kong Special Administrative
393 Region (HKEPD). (2002). *Monitoring of Solid Waste in Hong Kong 2002*. Available at:
394 <https://www.wastereduction.gov.hk/sites/default/files/msw2002.pdf> [Accessed 2 August 2020].
- 395 [5] HKEPD. (2020). *Waste Data & Statistics*. Available at:
396 https://www.wastereduction.gov.hk/en/assistancewizard/waste_red_sat.htm [Accessed 20 July 2020].
- 397 [6] HKEPD. (2017a). *Construction Waste Disposal Charging Scheme*. Available at:
398 <https://www.epd.gov.hk/epd/misc/cdm/scheme.htm> [Accessed 3 January 2020].
- 399 [7] HKEPD. (2017b). *Problems & Solutions*. Available at:
400 https://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/background.html
401 [Accessed 3 July 2020].
- 402 [8] Lu, W., Peng, Y., Webster, C., & Zuo, J. (2015). *Stakeholders' willingness to pay for enhanced*
403 *construction waste management: A Hong Kong study*. Renewable & Sustainable Energy Reviews, 47,
404 233-240.
- 405 [9] Audit Commission of the Government of the Hong Kong Special Administrative Region (HKAC).
406 (2016). *Director of Audit's reports Report No.67. Chapter No.4: Management of abandoned*
407 *construction and demolition materials*. Available at: https://www.aud.gov.hk/pdf_e/e67ch04.pdf
408 [Accessed 1 April 2019].
- 409 [10] HKEPD. (2013). *Measures to tackle fly-tipping of construction and demolition waste and illegal land*
410 *filling*. Available at: [https://www.legco.gov.hk/yr12-13/english/panels/ea/papers/ea0225cb1-569-6-](https://www.legco.gov.hk/yr12-13/english/panels/ea/papers/ea0225cb1-569-6-e.pdf)
411 [e.pdf](https://www.legco.gov.hk/yr12-13/english/panels/ea/papers/ea0225cb1-569-6-e.pdf) [Accessed 25 March 2019].
- 412 [11] HKEPD. (2018). *Enforcement Against Illegal Land Filling and Fly-tipping of Construction Waste*.
413 Available at: <https://www.legco.gov.hk/yr17-18/english/panels/ea/papers/ea20180326cb1-703-3-e.pdf>
414 [Accessed 28 March 2019].
- 415 [12] HKEPD. (2016). *Monitoring of Solid Waste in Hong Kong 2002*. Available at:
416 <https://www.wastereduction.gov.hk/sites/default/files/msw2016.pdf> [Accessed 3 June 2020].
- 417 [13] Lu, W. (2013). *Construction Waste – Hong Kong Style*. Available at: [https://waste-management-](https://waste-management-world.com/a/construction-waste-hong-kong-style)
418 [world.com/a/construction-waste-hong-kong-style](https://waste-management-world.com/a/construction-waste-hong-kong-style) [Accessed 1 April 2019].

- 419 [14] Civil Engineering and Development Department (CEDD). (2020). *Management of Public Filling*.
420 Available at: [https://www.cedd.gov.hk/eng/public-services-forms/fill-management/management-of-](https://www.cedd.gov.hk/eng/public-services-forms/fill-management/management-of-public-filling/index.html)
421 [public-filling/index.html](https://www.cedd.gov.hk/eng/public-services-forms/fill-management/management-of-public-filling/index.html) [Accessed 2 February 2020].
- 422 [15] HKEPD and Hong Kong Productivity Council (HKPC). (2020). *Recycling Fund – Overview*.
423 Available at: <https://www.recyclingfund.hk/en/overview.php> [Accessed 20 April 2020].
- 424 [16] Gürel, E. (2017). *SWOT Analysis: A Theoretical Review*. The Journal of International Social
425 Research, 10(51), 994-1006.
- 426 [17] Shinno, H, Yoshioka, H, Marpaung, S, & Hachiga, S. (2006). *Quantitative SWOT analysis on global*
427 *competitiveness of machine tool industry*. Journal of Engineering Design, 17(3), 251-258.
- 428 [18] American Institute For Chartered Property Casualty Underwriters. (2013). *Conducting a SWOT*
429 *Analysis*. Available at: [https://armstudygroup.com/wp-content/uploads/2013/08/ERM-57-Chapter-5-](https://armstudygroup.com/wp-content/uploads/2013/08/ERM-57-Chapter-5-QA.pdf)
430 [QA.pdf](https://armstudygroup.com/wp-content/uploads/2013/08/ERM-57-Chapter-5-QA.pdf) [Accessed 20 July 2020].
- 431 [19] Yilmaza, O., Mansuroglub, S., & Yilmazc, R. (2013). *Swot Analysis of Ecotourism as a Tool for*
432 *Sustainable Development: A Case Research in North-west Black Sea Coastal Zone of Turkey*. Journal
433 of Environmental Protection and Ecology, 14(2), 786–798.
- 434 [20] Taylor, D. (1994). *Strategic Planning, Russian Style*. Cornell Hotel and Restaurant Administration
435 Quarterly, 35(1), 82-89.
- 436 [21] Säynäjäkangas, M. (2019). *Service Development For Äspö Hard Rock Laboratory*. Available at:
437 [https://www.theseus.fi/bitstream/handle/10024/263259/Saynajakangas_](https://www.theseus.fi/bitstream/handle/10024/263259/Saynajakangas_Mari.pdf?sequence=2&isAllo)
438 [Mari.pdf?sequence=2&isAllo](https://www.theseus.fi/bitstream/handle/10024/263259/Saynajakangas_Mari.pdf?sequence=2&isAllo)
[wed=y](https://www.theseus.fi/bitstream/handle/10024/263259/Saynajakangas_Mari.pdf?sequence=2&isAllo) [Accessed 2 July 2020].
- 439 [22] Harrison, J., & St. John, C. (2014). *Foundations in strategic management* (6e. ed.). Mason, OH:
440 South-Western Cengage Learning.
- 441 [23] David, F., Creek, S., & David, F. (2019). *What is the Key to Effective SWOT Analysis, Including*
442 *AQCD Factors*. S.A.M. Advanced Management Journal (1984), 84(1), 25.
- 443 [24] Sammut-Bonnici, T., & Galea, D. (2014). *SWOT analysis*. Wiley Encyclopedia of Management. 12,
444 120103.
- 445 [25] Lu, W., Lee, W., Bao, Z., Chi, ., & Webster, C. (2020). *Cross-jurisdictional construction waste*
446 *material trading: Learning from the smart grid*. Journal of Cleaner Production, 277, 123352.
- 447 [26] Vanelslander, T., Chomat, G., Roumboutsos, A., & Bonnet, G. (2014). *Cross-sectoral comparison of*
448 *concessions in transport: Urban, road and port pre-fuzzy assessment*. Built Environment Project and
449 Asset Management, 4(1), 22-39.
- 450 [27] Tan, T., Lu, W., Tan, G., Xue, F., Chen, K., Xu, J., Wang, J., & Gao, S. (2020). *Construction-Oriented*
451 *Design for Manufacture and Assembly Guidelines*. Journal of Construction Engineering and
452 Management, 146(8), 4020085.
- 453 [28] Kallio, H., Pietilä, A.-M., Johnson, M., & Kangasniemi, M. (2016). *Systematic methodological*

454 review: *Developing a framework for a qualitative semi-structured interview guide*. Journal of
455 Advanced Nursing, 72(12), 2954-2965.

456 [29] Given, L. (Ed.). (2008). *The Sage encyclopedia of qualitative research methods*. Sage publications.

457 [30] Bao, Z., Lee, W. M., & Lu, W. (2020). *Implementing on-site construction waste recycling in Hong*
458 *Kong: Barriers and facilitators*. Science of The Total Environment, 747, 141091.

459 [31] Rubin, H., & Rubin, I. (2004). *Qualitative Interviewing*. Los Angeles: SAGE Publications.