

# Hong Kong





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Evolutions of global environmental awareness  
and consequent evolutions of the tools needed  
to achieve sustainability in the field of waste management

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**For thirty years, Hong Kong has developed a set of sustainable policies in order to be more and more environment respectful. Consequently, the tools needed to achieve sustainability have been improved step by step. All these evolutions will be analyzed through the waste management system**

**Dr. Albert Koenig**, *Department of Civil Engineering, The University of Hong Kong*  
Resource consumption and waste generation in Hong Kong.

**Dr. Ellen Y. L. Chan**, *Assistant Director of the Waste Facilities Business Unit, Environmental Protection Department, The Government of the Hong Kong SAR, representing the local Administration*  
History and report of Hong Kong's way of taking into account environmental issues in general: 1989 White Paper (strikethrough: Agenda 21, SUSDEV), study on sustainable development. Processes implemented in order to manage waste in a sustainable way (economical, social, environmental): Waste Reduction Committee (strike-through), Waste Reduction Framework Plan, implementation of this plan, assessment and evolutions, financing, partnerships...

**Mr. C. M. Lin**, *Hong Kong Productivity Council, representing the local Enterprises*  
How and with which tools can enterprises be encouraged to be more eco friendly. The demands and interests of the enterprises, their oppositions and their evolutions related to the demand for more respect towards sustainability (environment, civil society...). What inputs have enterprises brought to the sustainable process. What evolutions have thus been achieved.

*Chair: Dr. Nola-Kate Seymoar, President and CEO, International Center for Sustainable Cities, Vancouver, Canada.*

*Discussant: Dr. Rebecca Chiu, Associate Professor, Center of Urban Planning & Environmental Management, The University of Hong Kong.*

**Mr. Lionel Krieger**, *Managing Director of SITA Asia*

One Enterprise's point of view : relationships with the local authorities, evolutions of the implemented partnerships, economical aspects and financing. Analysis of the evolutions of the agreements.

**Dr. Gordon T.L. NG**, *Chief Executive, The Conservancy Association, representing an environmental NGO*

Assessment by an NGO on advocating appropriate policies, monitoring government action, promoting environmental education and enhancing community participation.

## **Discussion**





# Resource consumption and waste generation in Hong Kong

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“As the city is renewed each day, it preserves all of itself in its only definitive form: yesterday’s wastes piled up on the wastes of before yesterday and of all its days and years and decades...”  
Italo Calvino, *Invisible Cities*

## Abstract

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The Hong Kong Special Administrative Region (SAR) is a highly developed metropolitan region where technical and economic advances have made it possible to support 6.8 million people on about 120 km<sup>2</sup> of built up land, resulting in one of most compact and most densely populated cities in the world. This population depends on a continual supply of materials, energy and information to function. Since the 1970s, Hong Kong has been transformed from a light industry center to a service based economy, creating enormous economic wealth in this process. This growing affluence has been accompanied by a tremendous increase in the consumption of material resources by 300%, while the population increased by only 50%. The main categories of material resources consumed were foodstuffs, fossil fuel, construction materials, and other goods (consumer and capital goods), which increased by an estimated 110, 225, 525, and 250%, respectively, between 1971 and 1997. Their consumption in 1997 reached approximately 5, 13, 25, and 3.5 million tonnes (Mt), i.e. a total of 46.5 Mt, which corresponds to about 7,000 kg per person. During the same period, the total waste generation jumped from 3 Mt to 13.8 Mt, an increase of 360% (6% per year), corresponding

to about 2,100 kg per capita in 1997. In 1997, the categories of solid waste derived from foodstuffs, fossil fuel, construction activities and other goods amounted to 1, 1, 8.8, and 3Mt, respectively. Lumping together the solid wastes from food and other good consumption (4 Mt) as municipal solid waste (MSW), it can be seen that MSW accounts for about 30% of the total solid waste, with the remaining 70% being mostly construction waste. Without an understanding of the material foundations of modern urban society and the special circumstances of Hong Kong, the challenging issues of sustainable waste management cannot be effectively addressed. The most important issues are:

- Continuous increase in waste generation by about 4% per year;
- Difficulties in locating sufficient sites and space for sustainable final disposal because of scar city and high opportunity cost of land;
- Conventionalwastereductiontechniquesincluding incineration will not significantly reduce the total amount of waste for disposal (20-30%);

Far-reaching changes in consumer behaviour and government policies will be needed to achieve sustainable waste management, e.g. a high degree of recycling of waste materials, development of recyclable buildings, waste-to land conversion by creating new land from the sea, etc.

## Introduction

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Hong Kong is a well-defined, highly developed metropolitan region where technical and economic developments have made it possible to

support 6.8 million people on as little as 120 km<sup>2</sup> of built-up land (excluding open space and vacant development land), making it one of the most compact and densely populated cities in the world (57,000 people per km<sup>2</sup> built-up land). This population depends on a continual supply of materials, energy and information to function, similar to a living organism or an ecosystem. Cities can therefore be analysed in terms of uptake, transformation and storage of materials, and the discharge of waste products. The first pioneering study for Hong Kong was conducted in the late 1970s (Newcombe et al., 1978). Recently, its increased material consumption and waste discharges have attracted renewed attention because of their impact on natural resources and the environment (Koenig, 1994, Barron and Steinbrecher, 1999), raising concerns about how sustainable development could be achieved in Hong Kong. In this paper, the sources and trends in materials consumption and waste discharges in Hong Kong are presented, highlighting the special challenges to Hong Kong's waste management. The material resources consumed are grouped into four categories, according to their main functions in the urban system, namely (i) food for nourishment, (ii) fuel for energy, (iii) construction materials for shelter and roads, and (iv) other goods (consumer and capital goods) (Baccini and Brunner, 1991). Based on available information from various statistical yearbooks and the literature (e.g. CSD, EPD), and applying simple material accounting techniques, a complete materials balance can be established, indicating material resource inputs, transformations, and waste generation.

### Material inputs, transformations and outputs in Hong Kong

In 1997, Hong Kong required a net input of material resources of approximately 46.5 million tonnes (Mt), or 7027 kg per capita. Total input consisted of approximately 5 Mt of food (incl. beverages), 13 Mt of fossil fuels, 25 Mt of construction materials, and 3.5 Mt of other goods and commodities (Table 1). Only 19 Mt (41% of the resources consumed) were of local origin, namely, 0.5 Mt of food (10% of consumption) and 18.5 Mt of construction materials - comprised mostly of aggregates and sand - (74% of consumption). In recent years, the material net input has not changed significantly, but the local contribution decreased even further. The overall solid waste production, including additional waste from construction/excavation and demolition activities, amounted to approximately 30% of the input resources or 14 Mt (2,080 kg per capita), with about 66% as construction and/or demolition waste and 23% as municipal solid waste (MSW). The per capita waste generation shows the typical characteristics of a consumer city with a service-based economy, with almost no livestock, mining or industrial waste.

The organic material resources (food and fossil fuel) have short retention times in the urban system and are mostly transformed to gaseous wastes (carbon dioxide and water), while the predominantly mineral resources (construction materials and other goods) are mostly incorporated

Table 1 - Estimated Material Input, Transformation and Waste Output in Hong Kong in 1997, in Mt

Material Category	Material Input			Transformations			Waste Output
	Import	Local	Total	Stored	To air	To water	
Food	4.5	0.5	5	-	3.7	0.3	1
Fossil fuel	13	-	13	-	12	-	1
New construction material	6.5	18.5	25	22	-	-	3
Excavation/Demolition material	-	-	-	-	-	-	5.8
Other goods	3.5	-	3.5	0.3	-	0.2	3
<b>Total</b>	<b>27.5</b>	<b>19.0</b>	<b>46.5</b>	<b>22.3</b>	<b>15.7</b>	<b>0.5</b>	<b>13.8</b>

Table 2 - Solid Waste Generation and Disposal in Hong Kong in 1997

Type of waste	t d <sup>-1</sup>	kg cap <sup>-1</sup> d <sup>-1</sup>	kg cap yr <sup>-1</sup>
Municipal solid waste	8 680	1.3	487
Domestic	6 760	1.0	379
Commercial	1 220	0.2	68
Industrial	700	0.1	39
Construction & demolition waste to landfill	6 480	1.0	364
Special waste	620	0.1	35
Total waste to landfills	15 780	2.4	886
Construction & demolition waste to public filling area	21 950	3.4	1 232
<b>Total solid waste</b>	<b>37 730</b>	<b>5.8</b>	<b>2 118</b>

into new buildings and road infrastructure, forming our material wealth. However, they will also end up sooner (consumer goods) or later (capital goods, buildings) as solid waste (abandoned goods, demolition waste), after retention times in the urban system between a few months and several dozens of years.

Hong Kong generates 37,370 t of total solid wastes daily (Table 2). Each person now contributes 1.3 kg day<sup>-1</sup> of MSW (domestic, commercial and industrial waste), representing an 80% rise since 1971. Food scraps, plastics and paper constitute the main components of domestic waste, reflecting the greater affluence and «throw-away» lifestyle adopted in the last 27 years. The frenetic cycle of the property market-replacing tall buildings with ever taller buildings on limited land-ensures that construction and demolition wastes comprise the largest portion of solid waste, followed by domestic waste. With Hong Kong's limited land, this translates into an extremely high annual waste generation per unit area: 12 554 t km<sup>-2</sup> for total land area, and almost 114 762 t km<sup>-2</sup> for built-up areas, much higher than in any other city or region of the world.

Through recent recycling programs, Hong Kong has taken steps to address its solid waste problem. Currently, 33% of municipal solid wastes (1.54 Mt) are recycled locally (20%) or abroad (80%). Roughly 50% of the material is paper, and metals account for 34%. Few plastics (11%) are recovered, particularly from post-consumer pack-

aging. About three-quarters of the city's construction waste is reused as public fill material, but the remaining one-quarter still contributes significantly to landfill waste. Hong Kong will run out of landfill space by 2015, and in response, the government is studying environmental impacts and engineering feasibility for building new incinerators with a combined annual capacity of 2 Mt of MSW. Whilst incineration reduces the MSW by about 1.8 Mt, the total quantity of solid waste for disposal would decrease by 13% only from 13.8 Mt to 12 Mt, using the year 1997 as example. Incinerating all MSW would lead to a decrease of about 25%.

### Food

In quantity and quality of diet, Hong Kong is similar to that of most affluent urban societies. Per capita food supply in 1997 was 1.86 kg per day (679 kg yr<sup>-1</sup>, or about 3200 kcal cap<sup>-1</sup> day<sup>-1</sup>), a rise of 20% from 1.55 kg per day in 1971. Since 1971, per capita consumption has risen for meat (+68%), fruit (+53%), sugar (+128%), alcoholic beverages (+56%) and milk (+142%), but has dropped for cereals (-24%) and vegetables (-32%). These changes have had mixed consequences. For example, while greater consumption of dairy products and fat has caused obesity problems, especially in children, average heights have increased. More food waste is also being generated, with 500% more putrescibles found in domestic waste than in 1971. Decreases in local agricultural production have reduced pollution,

especially from livestock wastes, but these environmental impacts have merely been transferred elsewhere (Warren-Rhodes and Koenig, 2001).

### **Fossil fuel**

Over half of Hong Kong's domestic primary energy demand of 14 Mt fossil fuels (472 439 TJ) lies with commercial and residential buildings (about 60%), the remainder is consumed by industry (16%) or for local transport (24%). International transport poses greater energy demands than domestic transport, with an additional energy demand of 30% required. Per capita final energy consumption has more than doubled since 1971 (from 53 MJ day<sup>-1</sup> to 122 MJ day<sup>-1</sup>), largely due to greater development and demands for improved comfort both at home and at work. In 1971, virtually all electricity plants burned fuel oil. By 1982, coal-fired plants generated 70% of Hong Kong's electricity, significantly reducing fuel oil requirements but generating large amounts of pulverized fuel ash as waste product. In the 1990s, pollution concerns prompted a shift from coal to natural gas and a gradual transition to higher quality, low-sulphur coals. Another significant change occurred in 1993, when Daya Bay Nuclear Power Station in Guangdong came online. Since then Hong Kong's electricity imports have grown rapidly. By 1995, less than 50% of the city's electricity was generated with coal, 20% was supplied by nuclear power, and 30% came from natural gas (up from less than 1% in 1995). This resulted in markedly lower air pollution emissions per capita in 1997 (50 kg) than in 1971 (65 kg), despite a doubling in energy consumption (Warren-Rhodes and Koenig, 2001).

### **Construction materials**

Building material consumption more than quintupled during the last 27 years from 4 to 25 Mt, with a similar increase in construction & demolition (C&D) waste. Based on a short mean life span of buildings of 30 years, the percentages of renovation, mixed site clearance, and demolition waste in the total building C&D waste amount to approximately 4%, 29% and 67%, respectively. This shows very clearly that early demolition of buildings contributes the largest portion of building

C&D waste. Extending the lifespan of buildings as well as their regular renovation and maintenance are therefore the most effective means to reduce overall C&D waste reduction (Koenig and Liu, 2000).

### **Other goods and commodities**

Compared to 1971, households and individuals own more appliances, electronic goods, automobiles and other consumer items. Concomitantly, packaging of these goods has risen, contributing to a 400% jump in plastic consumption since 1971. As a result, more plastics (34% of input, versus 27% in 1971), glass (66% versus 56%) and other materials, are ending up in landfills (see also Table 5).

## **Accumulation of material stock and material waste in Hong Kong**

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Accompanying Hong Kong's rising affluence has been a rapid expansion in accumulated material stock. In 1971, total material stock (buildings, roads, and other infrastructure) was 85 Mt for 4.0 million people, or about 21 t cap<sup>-1</sup> (Boyden et al., 1981). By 1992, material stock had increased to 245 Mt, or approximately 41.5 t cap<sup>-1</sup>, representing a net annual growth rate of 5.2% (Table 6). Of the total 1992 material stock, buildings constituted about 35.6 t cap<sup>-1</sup>, transport infrastructure comprised 5.9 t cap<sup>-1</sup> and less than 1 t cap<sup>-1</sup> existed as personal possessions. Highly developed industrial countries have accumulated much more stock, e.g. Switzerland with 100 tonnes of buildings and 160 tonnes of transportation networks per person. The main differences are due to the much higher residential floor area per person and the more extended transportation networks. For example, the available residential floor area per person amounts to approximately 11, 35 and more than 50 m<sup>2</sup> in Hong Kong, Western Europe and USA, respectively. Therefore, demand for residential space will remain high in Hong Kong resulting in rapid growth of material stock together with increased consumption of construction materials.



Total building area expanded at a net rate of 4.3% between 1971 and 1992, while for residential buildings the net annual growth and demolition rates were 3.5% and 1.5%, respectively. Based on a 3.5% net growth rate, the total material stock by the year 2000 was approximately 320 Mt. Following past trends of population and building growth in Hong Kong and the business-as-usual scenario, it has been estimated that by the year 2050 more than 1000 Mt of building waste alone, without road waste or excavation material, would have accumulated (Koenig and Liu, 2000). Obviously, there is not enough land available for disposal of such large quantities of waste as almost 60 km<sup>2</sup> of area would be covered to a depth of 25 m. Hence present building and waste management practices are not sustainable and need drastic change.

Tremendous inputs are required, in the form of energy, to create and maintain Hong Kong's urban stock. Per capita energy investment in the built environment (excluding roads) in 1992 amounted to 120.4 GJ cap<sup>-1</sup>, up from 74.4 GJ cap<sup>-1</sup> in 1971. In just over two decades the ratio of annual energy required per energy invested in material stock has increased from 0.43 to 0.71, reflecting the ever higher energy demands needed to maintain Hong Kong's urban stock.

## Transformation of land

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### New land formation

Extraordinary quantities of soil, mud, and sand have been excavated for reclamation. In the last 150 years, about 1000 Mm<sup>3</sup> of fill material was used to create 62 km<sup>2</sup> of reclaimed land -more than four times the mass of the Great Wall of China. 82% of this material was removed in the past 10 years. Recently, proposals have been launched to create an additional 107 km<sup>2</sup> of reclaimed land to house 3.6 million people. This would require even larger quantities of fill material, but it remains doubtful whether such alterations of the natural environment will be tolerated.

### Land consumption by waste

Hong Kong is rapidly running out of landfill space. In the last 150 years, 2.95 km<sup>2</sup> (average depth of 25 m) of land has been appropriated to store more than 70 Mt of municipal waste. Over the next 15 years, 2.73 km<sup>2</sup> (average depth 50 m) will be required to dispose of an additional 130 Mt, while even more land is reserved for construction and excavation wastes. Concomitantly, only 7.5 km<sup>2</sup> of land will be made available for residential and commercial purposes to accommodate an additional population of between 1 and 1.5 million people. The only viable long-term option for the disposal of C&D waste seems to be the establishment of public filling areas next to the seashore in order to create new land rather than piling up mountains of waste on scarce land. Or is it possible to imagine the accumulation of more than 1,500 Mt of waste over the next fifty years, enough to cover the built-up land of Hong Kong by 15 metres?

## Material input and waste generation in Asian cities

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How does Hong Kong compare to other Asian cities in terms of material resources input, waste generation and waste composition? No detailed data are available, but reasonable inferences can be made from available data on selected material consumption (e.g. iron and steel as well as paper and paperboard), energy consumption, generation and composition of MSW, GDP per capita as well as economic growth rates, often manifested in construction activities. It should be pointed out, however, that most Asian megacities such as Beijing, Shanghai, Bangkok, Manila, Jakarta and Kuala Lumpur have a city GDP per capita of between two to five times higher than their respective countries. Hence, the per capita material consumption in these cities may greatly exceed the average per capita consumption of their countries and serves as an important factor in attracting migrants from rural areas. Estimates of expected typical values for material consumption rates and municipal waste generation rates are presented in Table 3 (Koenig, 1997).

Table 3 - Estimated Material Consumption and Waste Generation Rates in Selected Asian Cities, in kg cap<sup>-1</sup> yr<sup>-1</sup>

	Material Consumption	Municipal Solid Waste
High-income countries: Hong Kong, Singapore, Tokyo, Taipei, Seoul	6,000 - 14,000	500 - 750
Middle-income countries: Bangkok, Kuala Lumpur	4,000 - 6,000	250 - 550
Low-income countries: Manila, Jakarta, Beijing, Shanghai	3,000 - 5,000	50 - 250
Rural areas in middle - and low-income countries	500 - 2,000	120 - 200

Table 4 presents the MSW generation rates and waste composition of selected Asian cities (Aziz, 1996). The data demonstrate clearly the increasing trend in potentially recyclable materials - mostly of packaging materials - with economic development. However, even with high rates of separate collection of recyclables, about 300 kg cap<sup>-1</sup> yr<sup>-1</sup> will be left for disposal in high income cities as demonstrated by the city of Vienna.

other renewable resources that are consumed inside the city. Obviously, all waste materials associated with the production of these imported resources will accrue outside Hong Kong and cause significant environmental impacts elsewhere. Table 5 provides an initial estimate of the ecological footprint of Hong Kong (Koenig and Warren, 2000) and selected Asian cities as well as a comparison with Baltic cities in Europe (Folke,

Table 4 - Municipal solid waste generation of selected Asian Cities, in kg/per person-year

	Total	Recyclables					Food waste	Ashes, etc.	Sum
		Paper	Plastics	Glass	Metals	Textiles			
Hong Kong (1971)	100	63	17	14	6	n.a.	36	124	260
Hong Kong	233	108	70	13	14	28	181	96	510
Macau (1991)	225	92	47	14	9	62	152	77	514
Singapore	391	207	86	42	35	22	321	17	730
Japanese cities (1993)	257	154	62	10	15	15	180	77	514
Kuala Lumpur	136	55	33	12	30	6	300	35	471
Bangkok	114	44	35	6	6	22	117	90	321
Jakarta	138	67	36	14	11	8	77	59	274
Manila	56	19	17	4	7	9	58	68	182
Bombay	32	20	4	<1	<1	7	40	128	201
Beijing (1990)	81	27	24	18	1	11	165	346	592
Shenyang (1986) <sup>1</sup>	4	1	<1	1	1	1	151	248	407
Shenyang (1986) <sup>2</sup>	6	3	<1	1	1	1	127	14	146
Vienna	129	61	28	16	13	10	111	77	317
separate collection	174								+174

All data refer to 1994 if not otherwise indicated. <sup>1</sup> coal burning districts, <sup>2</sup> gas burning districts

### Impact of Hong Kong's material consumption outside its borders: appropriation of ecologie areas

Hong Kong, like other cities, depends almost exclusively on productive ecosystems outside the borders of the city area to provide the food and

1997). The cities of Guangzhou, Beijing and Bangkok are used to represent the patterns of large Asian cities in middle- and low-income countries so that their values are of an indicative nature only. The simplified estimates are based on consumption and composition of food (plant or animal/ marine origin) as well as on use of paper and wood, assuming subtropical production rates.

Table 5 - Estimated Ecological Area Appropriated by Hong Kong (1997), Selected Asian Cities and Baltic Cities, in km<sup>2</sup> per million inhabitants

	Agricultural area	Forest area	Marine area	Total area	Urban density people/km <sup>2</sup>	km <sup>2</sup> per km <sup>2</sup> city area
Hong Kong	1,800	2,100	20,000	23,900	57,000	1,400
Guangzhou	1,000	700	5,000	6,700	2,400	16
Bangkok	800	300	10,000	11,100	10,000	110
Beijing	600	150	5,000	5,750	20,000	110
Rural areas	500	50	2,000	2,550	n.a.	n.a.
Baltic cities	5,000	1,800	13,300	20,100	10,000	200

Table 5 reflects clearly the high consumption of renewable resources by Hong Kong on a per capita basis, but it also confirms the high material requirements of its urban system on a unit area basis. It can be expected that the rapid economic growth in other large Asian cities will lead to further pressure on the ecosystem to provide more food, especially of animal origin, and other renewable resources. Therefore, the appropriation of ecological areas by Asian cities will increase at a rate faster than the population increase, resulting in high pressures on the remaining natural environment. If no more new ecosystems can be found for appropriation, per capita material consumption may find its natural limits. Economic development, city planning and environmental management have not yet addressed this issue, which requires a radical departure from our present way of thinking.

### Trends in Hong Kong's material consumption

Enormous changes have occurred in Hong Kong since 1971. With each new decade, one million people have been added to the population, bringing with them greater resource needs and waste generation habits. Table 6 reflects the dramatic increases in total inputs, consumption and outputs and trends in selected material flows (Warren-Rhodes and Koenig, 2001). Total non-food material resources consumed (urban material

metabolism, 41.5 Mt yr<sup>-1</sup>) are 8 times larger than food requirements (human metabolism, 5 Mt yr<sup>-1</sup>) and nearly 25 times total material turnover of the natural ecosystem of Hong Kong (Leith and Whittaker, 1975). Fossil fuel energy consumed (urban energy metabolism) is 8.2% of total incoming solar radiation inputs and exceeds somatic energy requirements (human energy metabolism) by 25 times. Fossil fuel emissions of CO<sub>2</sub> are 13 times higher than from human respiration. High material turnover rates can be beneficial to a city's survival. It has been suggested that compact cities with high population densities can achieve extremely efficient land, energy and material use, thus reducing urban sprawl and conserving land for recreational and agricultural purposes ((Jenks et al., 1996). This may be true for Hong Kong relative to other developed economies: (i) it has accumulated lower per capita quantities of stock in buildings and transport networks; (ii) its citizens use less energy and materials; and (iii) it has a high proportion (39%) of its total land dedicated to open space and country parks.

Regardless of the engineering possibilities, the benefits of Hong Kong's high-rate urban system may be outweighed by the environmental costs through systemic overload of the land, air and water within and outside its city limits. These trends are projected to continue as the population expands to 8.9 million by 2016, with direct and indirect energy, materials, water use, and pollution discharges all expected to rise accordingly.

Table 6 - Trends in material flows in Hong Kong in 1971 and 1997

Type of material	Mt yr <sup>-1</sup>			kg cap <sup>-1</sup> yr <sup>-1</sup>		
	1971	1997	% change	1971	1997	% change
Food	2.4	5.0	+ 108	570	680	+ 20
Fossil fuel	4.0	13.0	+ 225	1 000	2 000	+ 100
Construction materials	4.0	25.0	+ 525	1 000	3 800	+ 280
Other goods	1.0	3.5	+ 250	250	530	+ 112
Total solids	11.5	46.5	+ 304	2 920	7 027	+ 141
<b>Total solid wastes</b>	<b>3.0</b>	<b>13.8</b>	<b>+ 245</b>	<b>762</b>	<b>2 086</b>	<b>+ 174</b>

### Issues of sustainable waste management and outlook

Hong Kong probably has one of the highest material turnover rates per unit area of urban systems in the world and therefore faces the most serious problems in maintaining environmental sustainability. The real challenge, however, lies not only in the efficient management of the urban system itself, but increasingly in managing the environmental impact of the generated wastes within and beyond the city boundaries. A careful analysis of the results presented above leads to the following observations:

- The overall annual per capita material consumption and waste production is relatively low for a high-income city because of the service-dominated economy.
- The overall annual material consumption and waste production per unit area is exceedingly high because of the high population density and the small area of Hong Kong.
- Most of the material resources are imported, but almost all the waste remains in Hong Kong.
- Waste associated with the production of imported resources remains outside Hong Kong, lowering considerably Hong Kong's own environmental burden.
- The material stock per capita is still well below that of advanced industrial countries. It will therefore continue to grow and cause increased waste generation in the future, especially of construction and demolition waste.

- Even the best possible practices of waste reduction, recycling and incineration cannot lower by more than 30% the quantity of waste material generated, resulting in further rapid waste accumulation due to increases in per capita waste production and population.

Looking at the special circumstances of Hong Kong, the most challenging issues of sustainable waste management to be effectively addressed are:

- Continuous increase in MSW generation by about 4% per year despite introduction of waste reduction measures;
- Rapid accumulation of large quantities of inert C&D waste materials;
- Difficulties in locating sufficient sites and space for sustainable final disposal because of scarcity and high opportunity cost of land;

Drastic changes in consumer behaviour and government policies will be needed to achieve sustainable material and waste management, e.g. a high degree of recycling of waste materials while minimizing generation of waste for final disposal. Some examples of long-term measures, particularly in the construction sector, are:

- minimize building material consumption and C&D waste generation by extending the life span of buildings through increased renovation and maintenance;
- consider C&D waste as an important reservoir of potential building material and study methods to use of recycled aggregate for building construction;

- design more recyclable buildings through different selection and combination of building materials, e.g. steel instead of concrete;
- waste-to-land conversion by creating new land from the sea using C&D waste. ■



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# Hong Kong's waste management strategy: a sustainable approach

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## Abstract

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Hong Kong is under tremendous pressure to find sustainable ways in meeting the demands of its growing population. Waste reduction is identified as a top priority in Hong Kong's approach to sustainable waste management. A 10-year Waste Reduction Framework Plan (WRFP) was launched by the Government in 1998 to promote waste minimisation and resource recovery. The WRFP integrates a range of measures, ranging from policy initiatives to technological innovation as well as partnership approach to help achieve a waste reduction target of about 60% for municipal solid waste and 84% for construction and demolition waste within 10 years. In accordance with the waste management hierarchy of avoidance, reduction, reuse, recycling, treatment and finally disposal as the last resort, our aim is also to improve and safeguard the environment from adverse environmental effects associated with improper handling and disposal of waste. We achieve this aim by establishing a framework of robust legislative and institutional controls and a system of environmentally sound and cost-effective waste management facilities here in Hong Kong.

## Introduction

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Like many dynamic and populated cities in the world, Hong Kong has to face the pressure and

challenge of finding sustainable ways of meeting the needs and demands of its growing population. Amongst these demands, moving towards a more sustainable way of managing wastes is high on the Government's agenda. It is an unfortunate fact of life that an increasingly affluent and consumer orientated society generates more waste. If the waste produced is not treated properly, then it can lead to numerous environmental and public health problems. Our key role is therefore to safeguard the health and welfare of the community from adverse environmental effects associated with the improper handling and disposal of wastes by planning and providing convenient and cost-effective waste management facilities, proper enforcement of relevant legislation, as well as promoting a sustainable approach to waste management, in which we produce less waste, and reuse or recover value from waste.

## Position in 1989

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In June 1989, the Government published the White Paper on Pollution in Hong Kong - A time to act to tackle the environmental problems in Hong Kong. Based on the policy directive as set out in the White Paper, the Waste Disposal Plan was published in December 1989. The 10 year Waste Disposal Plan gave details of all the existing and proposed waste disposal sites and methods back in 1989 and provided a programme for the development of new facilities and closure of outdated facilities up to 2001.



Traditionally, most solid waste in Hong Kong was incinerated or disposed of at landfills but where these had once been in remote locations, the city had grown up around them, resulting in pollution problems from the three incinerators located in Kennedy Town, Lai Chi Kok, and Kwai Chung and a lack of space for the expansion of the landfills. Furthermore, the incinerators and landfills at that time would not have been able to meet the stringent environmental standards of today.

The strategy in the 1989 Waste Disposal Plan was therefore to phase out existing incinerators and landfills and concentrate on the development of three remote mega landfills to be served by a network of refuse transfer stations strategically located in the urban areas where the waste is generated (Figure 1). Wastes collected in the major urban centres are delivered to the refuse transfer stations where they are compacted in purpose-built containers. The containers are then transported to the remote landfills mainly by sea. At the landfills, the refuse in the container is unloaded for disposal.

### Position by the late 1990's

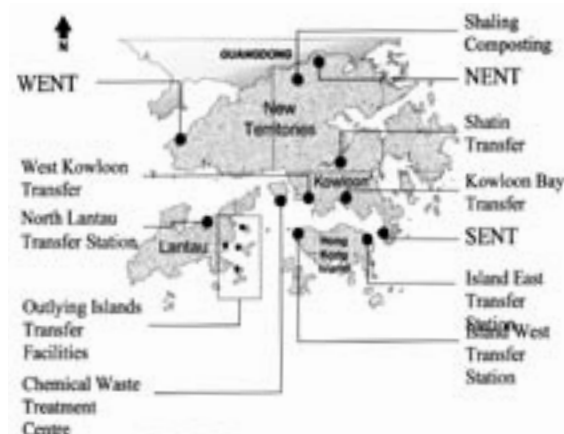
The three landfills known as the WENT (West New Territories) landfill, SENT (South East New Territories) landfill, and NENT (North East New Territories) landfill, are large complex engineering projects by world standards. The WENT landfill, which started receiving waste in November 1993, covers some 100 hectares and will receive up to 61 million tonnes of waste during its lifetime. SENT was commissioned in September 1994 followed by NENT in June 1995. The three landfills will provide a total capacity for about 135 million tonnes of waste which should meet Hong Kong's requirements for 15-20 years. As part of the waste disposal strategy, the refuse transfer stations also came into operation between 1990 and 1997 (Figure 1).

This landfill-refuse transfer station system offers a cost-effective and environmentally acceptable disposal option, compared to the old landfills and urban incinerators which were of the 1960's

design. Operators of these new facilities are employed by the Government through a novel type of Design-Build-Operate contract, which allows maximum flexibility for contractors to propose their own innovative technology and yet comply with the performance requirements and environmental standards set down by the Environmental Protection Department.

By 1997, we have also started a programme to restore all 13 old closed landfills. Although these landfills will not be suitable for building development during the operational period of the restoration due to settlement problems, they can be used for certain temporary beneficial uses such as parks and golf driving range. This is important as these 13 landfills constitute a total area of about 300 hectares or 1.6% of our total urban area.

Fig 1 - Waste Management Facilities in Hong Kong



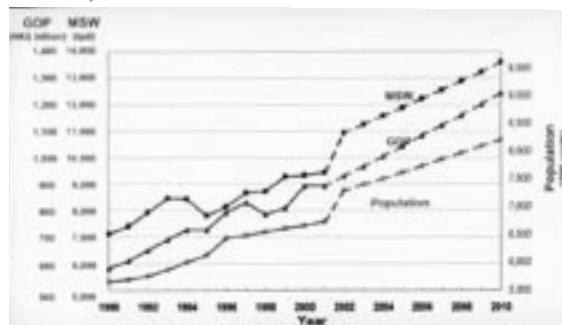
### The Need to Reduce Waste - An Integrated Waste Reduction Plan

However, the three new mega landfills can only last for another ten years or so with the huge increase of waste quantities over the last decade,. It will be extremely difficult and expensive to find new sites. Hence to reduce the quantity of waste requiring disposal and thus prolong our landfill life is clearly a top priority in our approach to sustainable waste management.

Therefore, once we have secured the core waste management facilities to handle the solid waste in an environmentally sound manner, we began to move to the next stage of our integrated waste management strategy - waste minimisation and resource recovery.

In 1998, about 16,560 tonnes of solid waste were disposed of at our three landfills every day. Municipal solid waste (MSW) contributed more than half of this quantity (i.e. 8,730 tonnes). With the projected population of over 8.0 million in the coming 10 years and further growth of economic activities, it is anticipated that the daily quantity of MSW requiring disposal will continue to rise to about 13,000 tonnes in 2011. The corresponding per capita generation rate will rise from 1.30 kg/person/day to 1.55 kg/person/day. In addition, with limited land resources in Hong Kong, we cannot continue to build mega-size landfills for the disposal of our wastes.

Fig 2 - Municipal Solid Waste Growth with GDP and Population

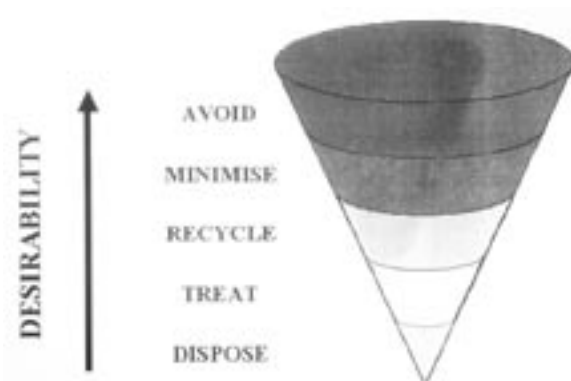


Drawing on overseas experience, we examined and developed waste reduction measures appropriate to Hong Kong. The 10 year Waste Reduction Framework Plan was developed and officially launched in November 1998. The main thrust of the Plan is to promote waste minimisation and resource recovery, to prolong the life of our strategic landfills and to optimise waste management costs (Figure 2).

The Plan integrates a range of measures, from policy initiatives to technological innovation, culminating in an integrated strategy that follows

the waste management hierarchy as shown in (Figure 3). The first priority is waste avoidance, that is avoiding the generation of waste in the first place. If waste production is unavoidable, the quantity of waste generated should be minimised. Then the priority is to maximise recovery, reuse and recycling of suitable materials. Following that the next best option is to reduce the volume of residual wastes requiring final treatment and disposal. The inverted cone in the figure represents the amount of waste that we should deal with at each stage in the waste management hierarchy.

Fig 3 - Waste Management Hierarchy

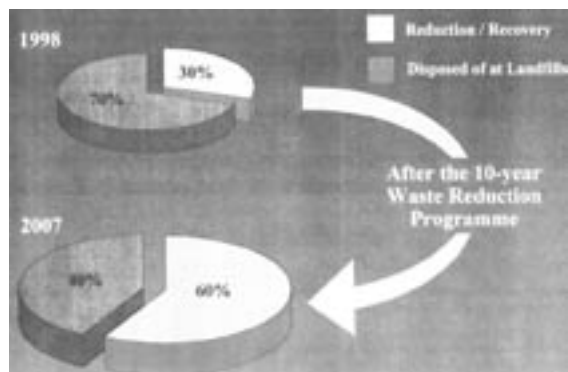


Under the Waste Reduction Framework Plan, we aim to reduce by 40% the municipal solid waste requiring disposal by 2007. Together with the efforts of existing recovery and recycling schemes, we aim to achieve an overall waste reduction level of about 60% for municipal solid waste. Compared with the level in 1997 before the Plan was implemented, the reduction level to be achieved at the end of the 10-year programme would be almost doubled (Figure 4).

To achieve the targets set out in the Plan, an integrated approach for reducing waste is adopted through the implementation of three core programmes over a period of ten years:

- **The Waste Prevention Programme** aims to reduce the amount of municipal solid waste generated at source, and promote the amount of waste material that can be reused, recovered and recycled. A wide spectrum of waste management tools are employed, including «bring» systems,

Fig 4 - Waste Reduction Target - Municipal Solid Waste



changes in building regulations to ensure that adequate spaces are provided for waste recycling in new buildings, demonstration schemes to promote new waste reduction/recycling technologies, education and publicity, environmentally responsible purchasing, land allocation policy for the recycling industry, market-based instruments, materials recovery/recycling facilities, and the Wastewi\$e scheme to promote business participation in waste reduction etc.

- **The Institutional Programme** comprises the setting up of a Waste Reduction Committee which is an independent advisory body to spearhead the implementation of the Waste Reduction Framework Plan in the community. It also includes establishing task forces within various sectors of the community to promulgate and facilitate waste reduction initiatives in a partnership approach.
- **The Waste Bulk Reduction Programme** employs technological tools, such as waste-to-energy incineration and composting of organic waste, to reduce the bulk of waste requiring disposal and to generate energy so as to minimise the depletion of natural non-renewable resources.

## Recovery and Recycling of Municipal Solid Waste

In 2000, about 1.76 million tonnes of municipal solid waste were recovered in Hong Kong. This represented about 34% of the total municipal

solid waste arising in the city. The commercial and industrial waste generators, who contributed about one-fifth of the municipal waste-loads, did a fairly good job in recycling around 50% of their waste but the domestic sector recovery rate was poorer with only about 10% of waste recycled. Whilst the recovery rate of commercial and industrial waste was good when compared with other countries, it was clear that the recovery rate of domestic rate needed much improvement.

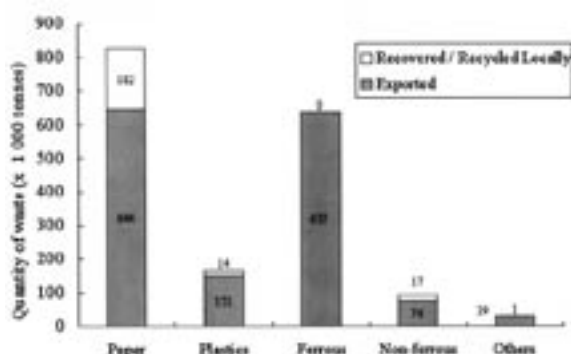
For commercial and industrial waste generators, materials are usually separated at source and sold directly to waste dealers. For domestic waste, cleaners/workers of waste collection services usually separate valuable materials from the waste collected and sell the recovered materials to waste dealers. Organisations such as schools, government departments and community bodies recover materials through waste recovery programmes and the materials recovered are usually given or sold to materials collectors/dealers.

There are a number of general constraints limiting the extent of waste recovery and recycling activities in Hong Kong:

- The environmental awareness of the general public is still relatively low. Promotion of waste recovery and recycling is necessary.
- As costs for collection and disposal services are not linked directly with the quantity of wastes generated through charging, there is no financial incentive for waste generators to reduce waste in order to avoid the disposal cost.
- The built environment in Hong Kong inhibits recycling activities from the domestic waste stream. Small flat sizes restrict source separation and storage practices.
- Low values for recovered materials particularly for glass, textiles, plastic bottles and rubber tyres.
- The high land and labour costs, the predominance of small and medium recovery and recycling enterprises and lack of market demand discourage recovery of marginal materials and investments in waste recovery technology.

The recovered materials were either recycled locally (0.22 million tonnes) or exported to Mainland China and other countries for recycling (1.54 million tonnes). The major materials recovered included paper, ferrous metal, non-ferrous metal and plastics. These accounted for about 80% of the materials recovered. The remaining 20% were rubber tyres, glass, wood and textiles. (Figure 5) illustrates the overall quantities of materials recovered in 2000.

Fig 5 - Major Materials Recovered / Recycled in 2000



Our success in the recovery and recycling of municipal solid waste is not only dependent on the effort we put into the implementation of the Waste Reduction Framework Plan, but also on how quickly we can respond to the changing recycling industry and the growing expectations of the community. Continuous review of the needs of the community and synchronising our work to meet the challenges are equally important. On some occasions, we need to reset the priorities. Despite the achievements made so far, we need to enhance our materials recovery rate, especially in the domestic sector. Whilst the waste recovery and recycling efforts will continue, other supporting measures including landfill charging, support to the recycling industry, materials recovery/recycling facilities, producer responsibility and appropriate legislation will be pursued or considered actively.

## Management of Construction and Demolition Materials

Apart from municipal solid waste, Hong Kong is also facing a great challenge in managing the waste generated from its construction and demolition (C&D) activities. In 2000, the construction industry produced about 13.8 million tonnes (37,610 tonnes per day) of C&D material. More than 11.0 million tonnes (30,130 tonnes per day) or more than 80% of the total C&D materials produced, were reused as fill material for reclamation projects. The remaining 2.8 million tonnes (7,480 tonnes per day) were disposed of at landfills as C&D waste which contributed to over 40% of the total waste disposed of at landfills. If the C&D materials are not properly managed, or if sufficient outlets to reuse inert C&D materials (e.g. land reclamation projects) are not provided, then the surplus material will need to be disposed of at landfills, the life of which will be shortened significantly.

Our strategy to manage C&D materials includes actions to (a) avoid and minimise C&D materials at source through better planning, design and construction management; (b) sort and separate out the useful inert materials that could be reused or recycled; (c) reuse inert materials in reclamation projects; (d) recycle hard inert materials as aggregates or granular materials for concrete production, road sub-base or drainage bedding layers; (e) establish temporary fill banks to tie over temporary mismatch between generation and demand; and (f) introduce landfill charging to provide the necessary economic incentive for waste producers to reduce C&D waste and to reuse/recycle inert materials.

## The Way Forward

Although we have made significant achievements within 10 years in providing Hong Kong with a sound waste transfer and disposal system, we still have many challenges ahead to satisfy exist-

ing and future waste management needs. As the way forward, we are actively pursuing to examine the feasibility of extending the existing landfills and identify new landfill and other waste disposal sites. We will also continue to promote waste reduction and develop new waste management facilities including refuse transfer stations, materials recovery/recycling facilities, bulk waste reduction facilities and facilities for the treatment of special wastes. A new Waste Management Plan (2002-2021) to succeed the 1989 Waste Disposal Plan will be developed. We will continue to encourage private sector initiatives and participation in delivering sustainable and cost-effective services to the community of Hong Kong.

## Acknowledgement

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The author wishes to thank the Director and colleagues in the Environmental Protection Department for their support in producing this paper. The views expressed in the paper are those of the author, and do not necessarily represent the official policies of the Government of the Hong Kong Special Administrative Region.

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# Hong Kong's solid waste strategy: the commercial perspective

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## Abstract

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Over the last twelve years, the Hong Kong SAR Government has been implementing its solid waste management strategy. Features of the strategy include a chemical waste treatment plant, three of the world's largest landfills, eight sophisticated transfer station systems and the restoration of five groups of closed landfills. Government chose to develop each facility by engaging waste management consortia in Design-Build-Operate contracts.

The advantages to Government of selecting the DBO form of contract have been significant. Specified performance standards are achieved at known costs. Unity of responsibility ensures that liability is clearly defined and the ability to impose meaningful sanctions deters contractors from failing to perform. International expertise and keen competition have been attracted to Hong Kong.

For the private sector contractor, there are also benefits. The size, complexity and duration of the projects justify the commitment of skills and resources. The reliance of the contracts upon performance objectives encourages the contractor to be creative and innovative. Control over all aspects of a project reduces risk. The long-term duration of the projects provides stable cash flows. The nature of the relationship with the client is one of partnership and the overall business is predictable.

The mutual benefits to Government and the private sector companies have been key factors in the successful implementation of the solid waste

strategy. The model can be applied to other major cities and to other areas of environmental protection such as sewage treatment.

## Background

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Over the last twelve years, the Hong Kong SAR Government has been implementing its solid waste management strategy. Features of the strategy include a chemical waste treatment plant, three of the world's largest landfills, eight sophisticated transfer station systems and the restoration of five groups of closed landfills. Government chose to develop each facility by engaging waste management consortia in Design-Build-Operate contracts.

The story of solid waste in Hong Kong reveals a certain number of practical examples of what has been achieved, albeit rather quietly, without much trumpeting.

What the Environmental Protection Agency found in the 80s, when it looked at the mechanisms for dealing with solid waste, was really a fragmented situation of different government departments handling different parts of the waste chain, none of whom really cared very much about cost, none of whom cared very much about environmental protection standards, and over whom government had no sanctions whatsoever.

At that time, what became the Environmental Protection Department, really took the rather brave decision to look at the total strategy for a period



of 10 to 20 years ahead, and decided that the private sector had some expertise that was worth bringing into Hong Kong and found that the private sector was somebody over whom they could wave a big stick. So, they embarked upon this policy of developing the hardware, the elements in a total system of solid waste transportation - collection - and - disposal, by use of what they termed Design, Build and Operate contracts, i.e. DBO, or DBTO or various variations on these themes.

## **Advantages to government of selecting the DBO form of contracts**

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### **Objectives and performance requirements**

The central feature of the government's approach was that it set performance requirements, whether it be for a transfer station, whether it be for a landfill. It did not try to dictate how the objectives should be achieved. It simply set out what the objectives were in a contract for operational performance and environmental protection criteria. It then said to tenderers, « OK, you are so clever, you decide how you are going to achieve these objectives and you take all the liability, and we'll evaluate what you are offering and we'll compare and contrast, and we'll pick the best value for money and we'll supervise you for 15 or 20 years. But the responsibility is all yours.» Those features of government's requirements are very important from government's perspective. It means that they can be applied, that they are reasonable performance standards and that they are achievable and measurable. This is quantitative, not qualitative stuff. They are absolute measures and furthermore, the contract means that they are enforceable.

### **Government monitoring**

How does the government monitor performance? First of all, it relies upon the contractor to be self-policing and to report its performance, oper-

ationally and then in terms of environmental protection. The contractor therefore has to install in a facility, whether it is a transfer station or a landfill, elaborate environmental monitoring regimes, to provide laboratory facilities, for example, over a whole range of parameters and to report these. Some of the parameters need continuous monitoring and reporting, some daily, some weekly, some monthly, some annually, but all transparent. There are indeed independent checkers who can monitor, as well as government's own staff of small teams monitoring the contractor's performance. They are not telling the contractor how to do things, but just checking that he conforms with the contract.

### **Penalties**

First of all, where it hurts, in the pocket. Government does not pay or withholds payment for non-compliance. Worse, it could have recourse to the parent company of a contractor through a series of parent company guarantees. Worse again, if it had too, it could call in bonds from banks, which have to be given as part of the contract. So, government has not abdicated responsibility; it still has tight control over the contractor, and clearly that is of benefit to the government. Government knows that it's going to get the high-operating standards that it is set out in its contract and it knows for many years ahead what that is going to cost the public purse. Government also gets the economies of scale associated with these contracts.

### **Unity of responsibility**

Government has unity of responsibility. That means if anything goes wrong, there's only one party to kick. Government does not have to try to trace back through the party that performs the design, the party who performs the construction and then the party who operates and maintains. There's only one, and that party is fully accountable. So, from the government perspective, this has been a good deal and has quietly gone about its affairs almost unnoticed by the public.

## Advantages for the contractor

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### A fair tendering system

The contractors, and there are more than one in Hong Kong, have found it also to be a beneficial arrangement. First of all, and do not underestimate it, it is a fair tendering system. Companies are pre-qualified and know that they are bidding where there are pre-determined evaluation criteria (we do not know what they are but we have every reason to believe that they are well documented) and we also know that the government has gone through a full process of achieving approval for the financial arrangements and that the government will pay once the work is being delivered.

### Benefits

#### A - Total responsibility

What are the benefits of these features to large contractors? This total responsibility for design, build and operate does give control over the breadth of one's responsibility; one's not dependent upon external parties for one's own performance. It means that in the original design and procurement of sub-contractors of equipment, one is able to optimize all the sub-systems, so that overall, the best, the optimal arrangement is provided. Control throughout the project's term, which may be 15 or 17 years for a transfer station, maybe 40 or 50 years for a landfill, maybe 30 years for the restoration and aftercare of some of the dumps.

#### B - Taking one's own decisions

Total control throughout the term, that means that one is making one's own decisions about utilization of plant and equipment, about the refurbishment of it or the replacement of it. It means that one can develop one's own team of people, of managers who can look forward with some security to career development. It means that as an employer, one can put in place all those things that are important in developing

a culture within the workforce providing sensible long-term remuneration and benefits. It means that over that term, the financial aspects are optimized. If necessary, (not necessarily in the Hong Kong context), particularly on a BOT, one can employ innovative financing measures.

#### C - Predictable cash flows

Returning to the Hong Kong model, one has predictable cash flows for a long period of time. And if one has got one's estimates correct at the tender stage, a modest level of profit for a long term. There is no recourse to government if one has got those numbers wrong. You have to be aware that the price is fixed. A construction phase is at fixed price, no escalation, no reimbursement if there should be a change in the value of currency (but this is for a relatively short term). After that, the operating charges are fixed, relative to tonnage, but escalated or perhaps, as we have seen in Hong Kong over the last 2 or 3 years, reduced in accordance with local inflation indexes. But it is predictable and that's valuable to a private sector company.

#### D - Clarity of purpose

Another benefit of that is the clarity of purpose. Focusing on those pre-determined performance objectives, knowing the standards against which the company is going to be measured means that you concentrate on the real responsibilities and not on some imagined objectives. Of course, the financial sanctions available to government tend to focus the mind on behaving properly.

#### E - Clarity of relationship

The clarity of relationship is important too. Knowing that one has a client for 30 or 40 years means that you do not get bogged down in short term, inconsequential issues. You concentrate on a partnership relationship, which has to be sustained for a long term.

## Costs

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### Example of operating costs

Let's take a landfill and what the true disposal cost is in today's money. If I take the capital cost, that is to say all the formation, the site preparation, all the facilities, I take all the operating costs, all the people, all the plant, all the environmental protection measures of gas extraction and treatment and leachate extraction and treatment, all the monitoring costs; if I take also another part of the contractual obligation which is, for a term of 30 years of After care (gas and leachate treatment and all the environmental monitoring), add all that up and divide by the number of tons that are going into the site, it is still only in the order of about HK\$ 80.00 a ton. There is one thing I admit I am excluding and that is the cost, or deemed cost, of the land. But, two points: if you look at the photographs, you probably, like the property developers of Hong Kong, regard this as land which is not otherwise developable anyway. But HK\$ 80 or US\$ 10 a ton is extraordinarily good value for money.

### Economies of scale

Another aspect is the economies of scale: it is perhaps challenging for people in the public sector to entrust to one contractor, a large part of infrastructural responsibility, a public service. But, if the sanctions are there, then the savings in costs do become justifiable. Not in Hong Kong, but an example which is just as relevant. Last week, I entered into a contract for waste collection in Brisbane (850 000 people) and an 8-year term. We tendered against other international companies for four zones and the government invited tenderers to provide a permutation for one to four zones, the whole of the city. I was hopeful that we might win two zones. But, after careful evaluation, to my great surprise, we have been awarded all four, simply because the government can see the discount that is available. For example, one can spread overhead costs

and one can buy 71 vehicles (instead of a small fleet) and get better prices. And that all flows through.

### Motives for long-term participation in waste management contracts

We do not simply make more money if more waste is generated. Why not? We do have a reputation to protect, and secondly, it is not true. The structure of contracts is such, as I mentioned, that we get paid a fixed price for the design and construction of the physical assets. After that, we do not benefit whether the facility is over utilized or to an extent under-utilized because it is government property. Nor though do we earn more profit from more tonnage. We price to be competitive, such that the unit price per ton declines as the quantity of tons increases. That is defensive, we are protecting our profit level even if government delivers only one tonne per month. It is unlikely to deliver only one tonne in a month. But if it increases the tonnage, we earn no more profit. In fact, we'd love to see the landfills extended for 20 or 30, 40 years, so we're still here and still in business. We have every motive therefore to participate in waste minimization and the Waste Reduction Plan.

### Charges on polluters

It is inevitable that people generate more and more waste, the richer and richer they get. In Hong Kong, you might not be aware that there is simply no charge on the polluter. The taxpayers, and there are very few of them, pick up the tab. Not the polluter. So, waste generators in Hong Kong are profligate because there is no deterrent. Government has struggled to persuade legislators to impose a charging policy. Hong Kong, I am afraid, is not necessarily altruistic. But if it hits you in the pocket, then you may not create quite as much waste. Even as a private sector contractor, a nasty party that is generally regarded as making money out of other people's waste, we fully support the idea of the implementation of a charging policy. That said, there is a balance to be found.

## **Environmentally sustainable recycling**

Recycling needs to be environmentally sustainable, not a game for the sake of it. I could take you to some of our company's facilities in Holland and in Germany, where there are very high charges for landfills. Frankly, yes they may deter waste from going into a landfill, but they produce some acrobatic ways of dealing with waste, which are not environmentally sound. I could take you to wood treatment plants where large chunks of wood come in at one end and come out as saw dust at the other at, say, USD 99.00 a tonne because it costs 100 USD a tonne at a landfill. That is ridiculous, that is going too far. Do not think that Europe is perfect by any means and Europe is a long way short of perfection in its recycling and resource recovery. But the sooner a charging policy is implemented in Hong Kong, the better.

## **Construction waste**

There is no reason why the Design-Build-Operate approach cannot be applied to construction waste. We can, as the private sector, look a little bit beyond the political boundaries that now limit Hong Kong. Large companies operate quarries in the islands around here, bringing material into Hong Kong. We can go back and fill up those quarries by sensible arrangements with other authorities.

## **Marine waste**

There is an ongoing problem of marine waste in Hong Kong. That's the province of the Marine Department, not of the Environmental Protection Department, and it is not handled terribly well. There is perhaps a way in which the EPD model could be applied to marine waste.

## **Sewage strategies**

Hong Kong is wrestling with its sewage strategies. At the moment, there is a Department, which frankly has behaved in a scandalous way over the last few years in the cost that it has run up in the

civil engineering of sewerage systems to deliver to a treatment plant not yet built, not yet fully operational. But that in itself lends itself to Private Sector Participation in just the way that the Environmental Protection Department has successfully operated for solid waste.

## **Application of the HK model to other major cities and to other areas of environmental protection**

There are examples that can be applied elsewhere. This is a case study which is applicable in other cities in Asia and elsewhere. Providing one looks carefully at the overall costs, at the overall benefits, at the institutional arrangements, and one doesn't dream, but looks at how the system in Hong Kong has worked, then there is a model to follow. ■





# Enterprises and Sustainable Development

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## Abstract

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‘Sustainable development’ has become a much discussed topic in both the environment circle and the business community. Without doubt, business enterprises’ positive attitude toward sustainable development will play a vital role in the future health of our Mother Earth. In 1989 when Ed Woolard became the CEO of Du Pont, he stressed that he was not only Du Pont’s chief executive officer, but was also its chief environmental officer. Another much quoted example about the proactive attitude of business is the famous ‘Pollution Prevention Pays’ concept. The idea was promulgated by the US-based company 3M. So, is sustainable development now fully embraced by the business community? I am afraid not. The experience obtained during my interaction with numerous businesses shows that only very few of them can act in a truly eco-friendly way with a consistent and holistic approach toward environment. These are typically the larger and better managed companies with an environmentally committed CEO who can provide the necessary driving force in a very effective manner. The great majority of companies still need a lot of external motivating forces to move them to the right environmental track. The motivating force can be legislation driven, society driven, market driven, system driven, knowledge driven or stakeholder driven.

The fundamental concern of business is profit and development. It is often said that business development and environment can go hand in hand. While this is theoretically possible I would say that this cannot happen unless there is a

thoroughly understanding management willing to commit efforts and resources to this purpose; and this is still far from a common happening. Without a constant environment focus business.

## Driving force from legislations

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When environmental legislation is comprehensive and enforcement is effective the driving force in making companies comply with environmental requirements will be highly effective. Both large and small companies do not like the idea of being prosecuted by government for violation of environmental legislations and they will pay much attention to comply with the government’s requirements. However although the driving force is effective it cannot drive a company to work out the most ideal result. The reason is that companies under this driving force would tend to spend the minimum amount of efforts to obtain environmental compliance and they seldom give a lot of thoughts to improve the whole business operation as the means to obtain an environmental solution. Companies with a superficial concern for environment would tend to solve the environmental problems in a less than optimal manner.

## Driving force from stakeholders

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Stakeholders of a company include its shareholders and customers and they can exert substantial influence on the environmental performance of a company. Although this is not common in Hong Kong, investors in other countries are beginning



to make use of the environmental performance of a company as a useful indicator to predict business performance. There is good reason behind this approach. Usually companies that excel in environmental performance have good management teams that can also increase the profitability of the company. Therefore companies would want to improve their environmental performance as a way of showing to their investors or customers that the company has good management team that can produce good results for the company. Customer is another source of powerful driving force. The purchasing departments of some companies are beginning to require their suppliers to demonstrate the supplied products are produced in an environment friendly manner. Suppliers will feel the pressure to improve their environmental performance in order to satisfy these customers.

### **Driving force from the market**

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The general public is getting more and more interested in the conservation of environment and there is an increasing demand for environment friendly products. Many places including Hong Kong have set up ECO-label schemes to evaluate whether products are environment friendly. Eco-labels are awarded to those products found to be environment friendly and the general public is now more inclined to purchase these products. More and more companies are trying to capitalize on this inclination and supply products that can satisfy the ECO-label requirements.

### **Driving force by system**

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The ISO14001 system is a management system that can provide a systematic approach for business to manage their environment. Under the ISO14001 approach a company will need to formulate its environmental policy and then design implementation measures in a systematic manner in order to ensure that the environmental policy

has been followed. Companies who have successfully implemented the ISO14001 process can be certified and this certification often signifies that a company is committed to environmental conservation. Many companies find the ISO14001 certification useful in convincing their stakeholders that the company has performed satisfactorily in environmental management. Once a company is enrolled in the ISO14001 process it will be automatically steered towards a systematic approach of managing its environment irrespective of whether its motive is for satisfying its stakeholders or for a genuine concern about environment.

### **Driving force from society**

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As the society becomes more conscious of the importance of environmental conservation companies will also pay more attention to gain recognition from the society that the company indeed gives proper attention to the environment. Companies would want to improve their company image by showing that they have performed satisfactorily in conserving the environment and they would try to devise environment friendly measures in their business operation. Sometimes the motive of adopting the ISO14001 process and the provision of ECO friendly product is merely to respond to the expectation of the society instead of having a genuine concern about the environment. Again it is not necessary to investigate its motive and it is good enough that companies are driven into the environmental management process through pressure from the society.

### **Driving force by knowledge**

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This is the effective driving force that can produce optimal result for a company. When a company understands that it is feasible to improve its operation and at the same time improve its environment it will be willing to invest resources in going



through its operation in a comprehensive manner in order to identify the irrational elements of its operation that can lead to both environmental degradation as well as the loss of business profit. The company will then be able to find out a solution in order to eliminate its environmental impact and wastage. The subsequent result is a reduction in both operational cost and pollution. For example a small electroplating company that has wastewater pollution problem after undergoing a comprehensive study finds out that it can substantially reduce its rinse discharge through simple reconfiguration of its equipment. This reduction of rinse can lead to substantial savings in both chemical and water as well as a reduction of its wastewater discharge. The difficult point here is that companies often lack the will and patience to go for a thorough review of its entire business operation as something necessary to solve a 'minor' problem such as pollution. A lot of education to convey this knowledge to companies is needed. When a company has a committed CEO supported by a team of co-workers who are all committed in environment and equipped with this knowledge, the ideal situation of business and environment going hand in hand can be realized.

The fundamental concern of business is profit and development. It is often said that business development and environment can go hand in hand. While this is theoretically possible it will not happen unless there is a thoroughly understanding management willing to commit efforts and resources to this purpose; and this is still far from a common happening. Without a constant environment focus business can easily stray away from the path of sustainable development. The best path is carved when a company has a committed CEO supported by a team of committed co-workers. This internal motivating force provides the ideal drive in achieving sustainable development. Before we can evolve to this stage external motivating forces are still crucially important to grasp the attention of business to stay on a sustainable development path. ■





# The mobilisation of community resources for waste management in Hong Kong

**Gordon Ting Leung Ng**

Chief Executive, The Conservancy Association, Hong Kong

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## Abstract

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Like many other cities, Hong Kong faces very severe waste problem. This is further exacerbated by the lack of land resources, restricting our waste disposal options. In 1968, The Conservancy Association was established, with one of our focuses on resource conservation and the reduction of all forms of pollution including solid wastes. In the last thirty-three years, the Association has pioneered a number of waste management programmes with the objectives of educating and mobilising the public in waste reduction and recovery. For example, the Association launched the first territory wide waste paper recovery project in 1990 and the first district level scrap plastic bottles recovery projects in nine districts (out of a total of 18 districts in Hong Kong) in 1998. In the last twelve months, the Association has launched a 500,000-citizen signature campaign to reduce plastic bags and established a used clothes recovery programme in 40% of the major housing estates in Hong Kong. In this academic year, the Association is organising the largest scale and most intensive waste segregation education programme which is going to benefit over 100,000 students. In this presentation, these programmes will be used as examples to illustrate the types of community resources which may be available, including volunteers, community leaders, partners such as government and the recycling industry as well as financial resources. The latter part of this presentation will discuss and assess the approach used to mobilise such resources.

## Background

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In 2000, 7,550 tpd of domestic waste was disposed of in landfills. This represents a growth of 70% when compared with the 4,420 tpd of domestic wastes disposed of in 1986. On a per capita basis, the growth in the last fifteen years is 40%. Domestic wastes also have a low recovery and recycling rate, at around 8%, or around 660 tpd. In the last two years, formal recycling schemes have been set up in Hong Kong, recovering 285 tpd of wastes. The remaining is recovered by the informal sector, i.e. the cleaners and scavengers. The informal sector focuses at the most profitable materials such as aluminum cans, old corrugated cardboard and newspaper. They are subject to the market value of the recyclable materials which often fluctuates. They tend not to rely solely on the income from the sales of recyclable materials. They often work at very low wage. In some areas, the formal recycling system can become a competition for materials to the informal sector.

In the last two years, formal recycling schemes have been set up in over 700 housing estates, covering some 1.2 million households. Most housing estates have a set of three bins for newspaper, aluminum cans and plastic bottles. The results of the scheme are not very satisfactory. The recovery rate is about 0.06 kg per day per person, or about 6% of the waste generated in the domestic sector. In addition, the quality of the materials is not high and reportedly contaminants can be up to 50% by weight for plastic bottle bins.

In 1998, the Government announced the Waste Reduction Framework Plan which set a target to reduce domestic wastes by 20% in 2007, i.e. from the current recovery level of 660 tpd in 2000 to 2,400 tpd in 2007. Assuming that the market value of recyclable recovery is already reflected in the quantity of materials currently being recovered by the informal sector, the target is probably from some 300 tpd to 2,000 tpd. The informal sector is not likely to achieve this target if it continues to be market driven. Public participation is needed to help the achievement of the target. Resources is required to mobilise such participation from the community.

## Community Resources in Hong Kong

It is important to understand the characteristics of the Hong Kong Community before identifying the types of community resources available. In particular, it is important to understand the attitude of the public towards waste management. A number of surveys have been carried out in the last ten years to look at various aspects of public attitude towards waste management. In a survey in 1998, 75% of the respondents considered waste a very serious or serious problem. In another survey in 1996, 55% of the respondents indicate that household wastes can potentially be reduced by 10-40% and a further 26% indicate that such wastes can potentially be reduced by over 40%. However, it should also be noted that only 10% of the respondents in some surveys indicate that they separate waste and take them to recycling bins on regular basis. The surveys seem to indicate that although awareness of the need and potential for waste reduction is high, there is still not sufficient actions taken by the community in waste reduction. What sort of resources are available from the community to attract more actions in waste reduction?

Generally, five types of community resources are identified for waste management. They include:

- Education resources to raise awareness

- Community resources to mobilise actions
- Logistic resources to transport recyclable materials
- Market/outlet information
- Resources to monitor and provide feedback to community

Education resource is the one that usually receives most attention in many countries. However, it is interesting to note that this is still considered not sufficient in Hong Kong. In a survey of 543 primary and secondary schools (out of a total of 1300 schools in Hong Kong), A number of problems have been identified to have hindered the implementation of environmental education in schools (Table 1). The top two problems reflect the need for capacity building of environmental educators, both in terms of quantity and quality. The lack of teaching materials and expertise has also been identified as the major problems.

Table 1. Problems hindering the implementation of environmental education in schools

	Total serious and very serious
Lack of Time	81%
Teachers are untrained in environmental education	67%
Lack of school environmental education policy	56%
Lack of teaching materials	45%
Lack of cooperation among teachers	28%
Limitation of financial resources	27%
Lack of incentive of school administrators	25%
Unaware of the need of environmental education	24%

Source: Environmental Campaign Committee (2000)

Community resources to mobilise actions is also very inadequate in Hong Kong. Many recycling projects have been launched in communities but many of them are ephemeral, including carnival, competition. There is a lack of systematic and persistent community programmes that can continually induce waste reduction behaviour and high quality community waste management actions. There is also a lack of expertise at community level

as the experience for organising those ephemeral recycling projects cannot accumulate. There is a lack of long-term commitment. In September 2001, the Hong Kong Government has proposed to inject HK\$100 million (about US\$13 million) to subsidize waste reduction initiatives at community level. The results of this injection are yet to be seen. If this is to be used in the next five years to attain the recycling target of 2,400 tpd by 2007, this is equivalent to about HK\$50 per tonne, compared to the cost of HK\$800 per tonne currently used by the Government to dispose of the wastes. This reflects to some extent the inadequacy of government's commitment to reduce wastes.

Logistic resources to transport recyclable materials is also inadequate. Many of the recycling bins (waste paper bins in particular) overflow. This has a bad impression to the residents. The transport of recyclable materials currently relies heavily on the market value of the materials. This is very different from many other overseas communities where the transport of recyclable materials is paid by the local authorities.

Market and outlet information for recyclable materials has become more accessible with the development of the recycler database by the Environmental Protection Department. However, there is still a general mismatch of the expectation of the residents and the recyclers in terms of frequency of collection, types of materials acceptable (particular in the case of plastic wastes) and the level of contaminants.

Resources to monitor and provide feedback to the community are largely missing. Such information should include the participation rate, the setout rate and the reject rate. The information will inform the community on the quantity and quality of their waste reduction programme. Another important aspect is to tie the cost of waste management to their waste reduction initiatives. This is best done through a proper accounting system and facilitated by the introduction of volume based charging scheme, the latter of which is yet to be introduced in Hong Kong.

## Approaches to Mobilise Community Resources

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From the Government's point of view, there are essentially three approaches to mobilise community resources to reduce waste and to manage their waste properly. These are:

- Education and publicity
- Legal (e.g. banning the disposal of recyclable materials)
- Economic (e.g. waste disposal fees, deposit refund)

In Hong Kong, landfill charge was proposed five years ago to reduce waste but has not been implemented yet. Also, the proposal will only cover privately collected wastes. Education and publicity has become the most important approach recently with the rigorous publicity on the recycling bin system but this is lagging behind when considering the original programme in the Waste Reduction Framework Plan. A number of other measures are being proposed, mostly voluntary approaches to encourage waste reduction, including:

- Producer responsibility schemes for selected wastes such as packaging, electronics appliances, batteries, tires
- Waste wise scheme to encourage companies to reduce wastes
- Allocation of land to assist the recycling industry

These approaches are outlined in the WRFP but the details of implementation is lacking. It is also unclear as to the amount of resources which are being allocated for the implementation of WRFP. One approach is that the government threatens to use mandatory measures if these voluntary approaches fail. Yet it is unclear how determined the government is.

The mobilisation of community resources to achieve public participation is an important way to the achievement of the reduction targets. The remaining of this section will describe the educa-



tional approaches used by an NGO to mobilise the resources from the community. It should be noted that the approaches available to NGOs are fairly limited when compared with the Government and focus mostly on the educational aspects.

In the last three years, The Conservancy Association has launched a number of waste reduction campaigns which help to reduce wastes. The Association currently has 15 full time staff, with two of them dedicated to waste management due to budget limitation. This paper will look at three programmes which the Association has organised. They are:

- Green Challenge
- Quality Education on Waste Segregation for Recycling
- Used Clothes Recovery for Protecting the Environment

The target of Green Challenge is to reduce plastic bag waste. In Hong Kong, plastic waste is about 18% by weight and possibly 35% by landfill volume in the waste stream. It is the highest among many developed economies such as UK, US, Korea, Australia, France, both in terms of proportion of plastics in the waste stream and in terms of the total quantity. About 1 billion plastic bags are disposed of in landfills every year and the main sources include newspaper vendors, supermarkets, department stores and wet market. The first phase of the project is to solicit public support to reduce plastic wastes. A signature campaign was launched and over half a million signatures were gathered. The second phase was to persuade newspaper vendors to agree not to distribute bags proactively. The third phase is to work with the retail industry to find ways to persuade customers to say «NO» to plastic bags. The Campaign has been quite successful in soliciting support from the public and the various stakeholder groups such as newspaper vendors, retailers and supermarkets.

The Quality Education on Waste Segregation for Recycling project helps schools to take part in raising the quality of waste segregation and reduc-

ing the reject level in recycling bins. Students from 100 primary and secondary schools have been trained to organise education programmes in their schools to increase both the quantity and quality of their current recycling programmes. The emphasis is on accumulating the experience of the participants in waste management and recognising the importance of recycling.

The Used Clothes Recovery programme is an ongoing project covering 320 housing estates which have about 20% of households in Hong Kong. District councils and estate management were contacted to assist the recovery of the waste textile materials. A total of 150 green workers are to be deployed to assist in publicity and education in these housing estates, each of them working for around 10 hours each week for five months. In the last twelve months, about 900 tonnes of used clothes were collected, representing a recycling rate of around 20%.

## An Assessment

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In the WRF, the Government has set an interim target to reduce waste by 10% in 2001, or a total quantity of 356,000 tpa (around 1,000 tpd), in addition to the quantity of materials already recovered by the market driven recycling industry (including the informal sector). The data in 2000 shows that only a total of 660 tpd has been recovered from the domestic sector, of which 57% is estimated to be by the informal sector. The interim target is unlikely to be met. Only a few measures have been adopted in the last three years and not sufficient resources have been deployed to mobilise community participation.

Where resources were deployed, focus has been on ephemeral and top down waste reduction projects. The government has recently adopted a different approach, as announced in September 2001, to encourage community based waste reduction activities. However, the details of such approach are yet to be announced.

One of the main achievements of the Government is probably the formation of the Waste Reduction Committee which advises the Government on waste reduction initiatives. Due to its advisory nature, there are limitations to its effectiveness.

Environmental NGOs such as The Conservancy Association have initiated a number of waste reduction activities including those being described. Such activities have involved local communities and volunteers to organise their own recycling projects in their respective organisations, through cooperation with the local groups. Yet, some of the Association's projects are also subject to the same limitation as being ephemeral due to the lack of financial resources. Another important drawback is the poor documentation of the experience learnt in these projects. This inhibits monitoring and the provision of feedback to the communities. The cost effectiveness of these projects is also poorly evaluated and costs information is also lacking.

More systematic evaluation of the projects by the Government and the NGOs are required. Priority, however, should be given to the compilation of the monitoring and feedback information which are essential step to the analysis of the cost effectiveness of these initiatives.

## Summary

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To develop successful community resources for waste reduction, we need persistent programmes, accumulation of expertise and knowledge that would help to analyse the needs of the local community, and the building of community awareness to reduce waste and manage our waste properly. Hong Kong is going to launch community-based programmes to mobilise public participation. We are yet to see how Hong Kong is achieving and our experience in mobilising community onto a sustainable waste management path.

## References

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# Hong Kong

## Discussion

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### Introduction

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#### **Dr. Rebecca Chiu**

To Albert: my first question is about unit of measurement. It is good to know that on per capita basis, the waste generation of Hong Kong is similar but not greater than other services economies. But once the measurement is on a unit measurement basis, then it seems to be different. To me, it seems that Albert does not really seem to have a clear and firm argument, on whether the statistics shown are on a unit area basis. Is it something good or not? Let me elaborate: you use the unit area as the basis of measurement for waste generation, for the appropriation of ecological areas and materials turnover in Hong Kong, and then you find it extraordinarily high. Although it is extreme, if you use the compact city concept, probably it is a good thing because if you have a high material turnover measured by the unit area that would mean that we are utilizing the land resources very well. It is a phenomenon inevitable for any compact city. So, why is it necessary to use the unit area as a unit of measurement?

In an extremely compact city like Hong Kong, a high rate of waste generation, appropriation of ecological areas and material turnover, in terms of unit area, is it inevitable and are they signs of compact cities development?

How would this research (the paper) contribute to the compact city debate?

Materials stocks: Albert's finding is that the materials stocked in Hong Kong are much lower than that of highly industrialized economies. Based on this finding and also on the past building growth rate of Hong Kong, Albert argues that Hong Kong's materials stock will grow very quickly. I am not too sure I will agree with that because if you look at the socio-demographic structure, the trends and also the housing demand trends, I think this rise will go down in the coming years. The growth

in the building rate will not be as high as in the past, and therefore the picture projected by Albert may not be as gloomy as he may think. About the space standard of Hong Kong, in the paper you point out that it is low and therefore there is a lot of room for improvements and therefore again, it will cause a high rate of building growth. That, I do not quite agree because given the physical topography structure of Hong Kong, I do not think we will ever be able to come up with a space standard, which is, let's say, about 20 square meters per person. So I do not think that a direct comparison of what it is now in the West and in Hong Kong, and then assuming Hong Kong is striving for the same standard, I do not think this is the case. As a matter of fact, the government has no space target set for Hong Kong.

On Albert's conclusions, I agree on his first three suggestions to reduce waste, but here I would like to emphasize that the housing management profession and industry potentially commit a great contribution to lengthening the life of buildings and the profession is getting more and more important in the community. About the use of recyclables in buildings, about using recycled building materials, I think that would require a joint effort of government and enterprises. So, again I think the government needs to provide incentives, like what the Building Department is doing at the moment to encourage Green Design. About the last point, regarding land conversion by creating new land from the sea to house construction and demolition waste, maybe it is a big problem ecologically. Maybe it is easy to create more landfills, but I do not think it is a simple matter because of the ecological problem.



## Discussion

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### Albert Koenig

I am no housing expert at all, so I did not want to interfere with your expertise there. All I did was to make a very simple calculation that population increase in Hong Kong is about 1.5% per year and individual space would also increase by 2% per year, which are very low figures. So, I came up with 3.5% growth of building mass, which does not seem to me extraordinarily large. If you extrapolate 2% building space per year over the next 50 years per person, that may end up in 20 square meters or so. I know that this is based on past trends and we cannot extrapolate the future, but for the sake of showing where this would lead us, I used those figures. In fact, we also used a low estimate of 1.5%, and a high estimate of 5%, which were not realistic at all. About the 3.5% annual growth rate in building mass, we checked with the building waste and it turned out that the annual growth rate of building waste over the last 15 years was actually much higher, it was 4.5%, so the 3.5% growth rate looks almost like a low estimate.

### Waste reduction, recovery and recycling

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#### Dr. Rebecca Chiu

Waste reduction: Can the reduction target be achieved? So far progress are not bad, but not good enough to reach a sustainable standard. So what can we do?

Recovery and recycling: the recovery of domestic waste is more difficult, and I think that probably the housing management profession can help and I wonder if the government is interested in pursuing a partnership approach with the housing managers, for example, by providing incentives to the companies that are certified by the ISO 14000 series or linking the charge of cost for waste collection disposal and services with the quantity of waste.

### Manfred Giggacher

I have been hearing a lot of these messages presented today, 20 years ago. I was 100% for the 3 Rs: Recycling, Reduction and Reuse. I am beginning to change my views these days because I see so much effort (as I see over here with some of the other presentations) about recycling, recycling, and recycling but not sustainable or ongoing benefit. But ultimately, I am a market person. I agree with what you said, CEOs coming in with DuPont and this fantastic message on not only the CEO but also the environmental officer. They are great messages, but ultimately the problem is that there are a lot more smaller-sized industries out in the market: the SMEs, the small medium enterprises. And when you add up the small contributions from the SMEs that's where the waste is coming from. Our focus is wrong, it is great what the CEOs are saying and delivering these messages, but I think our focus is wrong. Ultimately, we need to focus on those SMEs and you highlighted a good example with the electroplating industry. Unfortunately, a lot of SMEs cannot introduce the type of measures to improve their processes, So, I think our focus needs to change a little bit there.

The other focus, I think, is that recycling is good, we cannot avoid that. But I do not see any operations in the world where it is viable, first of all. Secondly, what is the maximum amount we can recycle? What is the upper limit? You're talking about 8% here, what is the upper limit here? I think the best in the world is something like 30%. What about the other 70%. We have to be able to reduce the other 70%, and that is, I think, what I have been hearing from you this morning - about the education. This education process, we educate our children, that is fantastic and that's for the future generation, but what about now? What about the people that are actually using the products today? That is where, I think, the education process needs to be focused a little bit more. Because people today have to start reducing and demanding less wastage in consumer products they buy. If the demand is there for such products, then the industries and the private sector will be economically

challenged to be environmentally market-oriented. And they will deliver to the new market because the demand has changed. And I cannot see any messages here about making the demand change. Maybe someone can clarify this. Does anyone have an idea on how to increase that awareness in the consumer marketplace, to increase the demand for an economically sustainable type of product that they actually buy on a daily basis?

**C. M. Lin**

I think the answer really lies in education. About SMEs, I entirely agree with you that they are difficult to reach and particularly to convince and make them change their minds, probably because of the lack of knowledge. I am not saying that they are not well educated. I think SMEs have very little resources and running business is not easy nowadays. So they are to spend a lot of efforts in getting business, in sorting out personnel problems and a lot of things. Environment is simply not at the top of their agenda. Unless there is a change in mindset, unless they were told since they were young about the importance of the environment, then, there will be a chance for them to react in the proper way.

Having said that, I would like to address your point about what can be done. I think at this stage, the economics are not working right. The factor of the environment is not taken into account in the pricing of our products. I think environment is taken for granted. Even though people say they care about the environment and they want to conserve it, few have done a proper environmental accounting exercise. Probably the entire spectrum for economics, for the products, for the operations of governments, for a lot of systems, including the landfills, simply will have another entirely different picture that tells us our existing modus operandi is economically not justified when environment is taken into account. Before this is realized, I have little optimism in thinking that we can really become a sustainable development society. This is why I am saying that education is important. In the short run, I think we still have to carry on to broadcast this message about environmental importance to everyone. In the longer run, I think we really need

to have a very drastic change in mindset, not only the big companies, not only the SMEs, but also everybody in society. Environment is one big problem and energy is another big problem and people should focus their mind on renewable energy. Otherwise how long can our energy supply last? People are simply not taking in this message. They think that renewable energy is not economical, but if you have a longer time horizon, you will find that the economies, the picture will completely change. There is a need for a mindset change.

To answer what government can do, I think it is really to educate our next generation, to bring to them the proper knowledge.

**Ms. Lye Lin Heng**

We see many similarities between Hong Kong and Singapore. My question is: Why is not Hong Kong looking at incineration? You have closed 3 incinerators; do you have plans to build new ones that are more state-of-the-art? What we do in Singapore is that we used to have landfills sites but the latest one is a different landfill site because it is sited in an offshore island. I liked Rebecca's point, which is that apart from the actual cost that went into building this new landfill site; we have to also take into account the real cost which includes the loss to the ecology and that is something you can never assess in dollars and cents. Under our Green Plan, that island was highlighted as one of 19 nature sites but it became a landfill. Having said that, this new landfill is different in the sense that it only contains ash from incinerated waste, as well as non-incinerable waste such as construction waste. So what goes into the landfill is non-putrefiable and there is no smell.

**Peter Wong**

To answer the question why Hong Kong has no incinerator, I think it is simply because Singapore has democracy but it is a dictatorship and people shamefully listen to the dictators. In Hong Kong, we have no democracy but the government does listen to the people. In this particular case, Greenpeace has a high ground talking about dioxins and the EPD is now in a funk and they do not know what to do. But I think everybody agrees

that incineration is probably the right answer for Hong Kong. But the problem is how do we get it through our very undemocratic legislative council. And Hong Kong government does listen to this very undemocratic bunch of legislators, which I was one once upon a time. We really must do something. I work on the assumption that 10% of the people would do the right thing all the time, 10% would never do the right thing and 80% would probably go along if you persuade them one way or the other or demonstrate that they have advantages. I think this is where the government would come in, how to persuade those 80% that it would be best for them. Do not consider what is right for them, consider what is best. This is where the government has to provide the right infrastructure first of all, so that they can do what is the right thing. And then, you have to provide some particular advantages; at least they think they are advantages in some way. I went on a tour to Europe in August, and we were particularly attracted by a Parisian company, in the way they approached tackling this question, of how to persuade the people this is the best thing to do. I think this is something our government has to learn, they are not God, and they do not know all the answers. In France, in Paris, they had to site an incinerator and it was part of the conditions, that even if the contractor won the bid, they will not get any money, they will not do anything unless they somehow manage to persuade the population that this is the right thing to do.

**Ms. Lye Lin Heng**

Lastly, I just want to make a comment about a major problem in Singapore in relation to recycling. Despite the fact that statistics show that Singapore is recycling 40% of its waste, it is mainly from industrial waste because domestic recycling at a national level has not quite taken off. We only started promoting it this year, after paying for an international consultant to see why we are not recycling. But the main reason is the way our high-rise apartments are constructed. About 92% of Singaporeans live in high-rise apartments, of which 86% are in public housing. In every apartment, there is a garbage chute in

the kitchen or in the back utility area and everybody just dumps his or her waste down the chute. So, even if you have a law mandating separation, you can never enforce that law because you cannot catch them breaking the law. Now we have started recycling the same way as the people in Hong Kong. Bins are placed for different types of refuse in public areas and in the common areas of public housing estates. It is interesting to see whether this is going to work or not, because people are just lazy - they have the chutes right in their own homes so why bother to take the garbage out for disposal? . The new housing board apartments now have done away with the individual garbage chute, so you have a common garbage chute. But still you still have the one chute, and instead of separating them for different types of waste, they just have the one chute. So, this is something they really need to think about.

**C. M. Lin**

You mentioned about waste oil being a problem. I think treating waste oil on an island is not easy at all. I just want to let you know that in Hong Kong, we have good recycling technology that can enable the waste oil producers to recycle their waste oil in a commercial manner. So if anyone is interested, I would be very happy to help you with the Hong Kong technology.

## **Under-utilization of waste facilities**

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**Dr. Rebecca Chiu**

One of the RTS, in Mount Davis is not operated at full capacity so the government will certainly have to pay the loss.

**Dr. Ellen Y.L. Chan**

Under-utilization of waste facilities: yes, Rebecca Chiu is right to point out that some RTSs are not yet up to their full capacity. But in terms of planning for waste facilities, it is also important for us to plan for the future. So, if we take the Island West RTS as an example, it is currently underutilized, but then for the whole central and western district, particularly the western district, we have to take into

consideration the long-term urban redevelopment programmes. So in planning for waste facilities, we do not just plan them now and perhaps five years from now but for a more long-term basis.

### **Lionel Krieger**

To get back to the landfill situation: if, as a Contractor, we had failed to install appropriate long-term containment systems, if we had failed to calculate the quantity of leachate that needed to be treated and the gas that needs to be dealt with, and our contract were terminated after ten years then, wonderful, we walk away! But this is not life. We have to retain responsibility for our decisions for another 50 years. So there is no escape and there are no hiding places. And I do not think that's anything an experienced company should be afraid of. On the other hand, it is not something that civil servants should be afraid of either.

In terms of the utilization of the facilities, let us recall that they need to be flexible, not only to accept in these facilities municipal waste, (i.e., waste that is publicly-collected, in the jargon). The facilities were designed and they were sized to deal with all that waste which is privately collected, and which at the moment travels in 5-tonne trucks all the way through the streets of Hong Kong to the landfills. The implementation of a charging policy, when it comes, will cause companies which collect waste to deliver it to the RTS's and then the RTS's will be fully utilized. The fact that this has not happened yet does not mean that an RTS is going to be demolished after 5 years. The Island West station, for example, which has been referred to by Ellen Chan, is built under the ground in a cavern, and the contract sets out that it has a design life of 100 years. So let us not worry over much whether it is fully utilized in the first couple of years.

## **Use of construction waste**

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### **Peter Wong**

Solid waste management in Hong Kong: I am wondering where does the source of the material come from? In Taiwan, the excavation of sand and

rubbles is causing severe damage to the riverbed and the nature.

To Albert: What is the percentage of the construction material that is from Hong Kong? Is it causing a negative impact on the nature?

### **Albert Koenig**

That is a tough question. I am not very keen on the construction sector. A lot of our resources have been created in Hong Kong. I think that in the recent years, most of the material has come from outside Hong Kong. Sand has been mined mostly from the seabed, but in recent years more than half of the aggregates used in Hong Kong have come from the outside.

### **Lionel Krieger**

I could be a bit provocative as usual and say that construction waste has not properly been utilized in land reclamation, for institutional reasons. It was never the province of the Environmental Protection Department to manage land reclamation. It has been that of the Civil Engineering Department. And they do not care where the materials come from and they have very short-term goals. What was proposed some years ago was to designate sites which could be filled with construction waste, properly graded, over a long period of time. On the contrary, what actually happened was that the land for the airport, Disneyland and the Exhibition Center Extension (right behind us) has been formed hydraulically. If you look at the reclamation for Disneyland now, there is just a constant procession of dredgers in the Lamma channel. We lost the opportunity to use construction material to reclaim land because projects always needed to be completed in a hurry. The land needed to be formed, consolidated, and dewatered in a hurry. We never set aside areas for construction waste reception over the long term.

### **Dr. Ellen Y.L. Chan**

Actually, the approach it is changing. We did have a lot of difficulties in the past with major public works projects. It is true that, as Lionel Krieger said, every project has to be done quickly. So, they do not have the luxury to use inert C&D

waste material. For example, not much was used in Disney, Stage 1. But for Stage 2, they have to submit the waste management plan to the Government's «Public Fills Committee» which is chaired by the Civil Engineering Department. So, there are very stringent controls. The project contractor cannot just say, «I do not want to use any inert C & D material as fill». They have to explain why, so they have to use more C&D material in the project. The new reclamation of the extension of the Convention Center is an example.

## Government's subsidies, collection charges

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### Dr. Rebecca Chiu

Could the government subsidize the prices of recovered materials and also the recycling companies? In doing so, would the cost of the subsidy be lower than that involved in having to build more landfills. Landfills are expensive, but subsidizing the recycling companies would also cost money. Have there been any comparisons between the costs involved between the two methods of coping with waste? Why is it not imposing charges for disposing waste at landfills? Why can we not impose cost?

### Dr. Ellen Y.L. Chan

About Government's subsidies for the recycling trade: No, because it is against government's general policy as a whole and not just in terms of waste management. The government cannot subsidize any particular industry, because by doing so we may be hampering or hindering the progress of the trade. However, we recognize that the recycling trade is working on a very narrow profit margin and has to compete with the market fluctuations of the virgin materials. If the virgin material is cheap than nobody will want to buy the recycled materials. So, we try to help them, not through direct subsidies, but indirectly through land allocation. Land is very expensive in Hong Kong, so we help them to acquire these sites at a more competitive rate. They do not have to com-

pete with the other trades when bidding for certain sites offered to them. We are also planning to establish a recovery park. In addition, we are trying to help them with new technologies.

A lot of them are still working as some kind of «two-man band», in very small workshops with old equipment. We want to improve the situation by helping them to apply for funds to upgrade their technology. We work very closely with the trade. We understand that the ones who have been in Hong Kong for more than 30 years do not want any money from the government, they just want other forms of assistance such as some help in terms of getting long-term land and better technologies. That is what they need, not just direct handouts from the government.

To address the issue of charging, why is it something that we cannot get into place? We have been talking about since 1995. We tried once to put charging into place in 1995. We failed. We faced blockades by waste haulers at our landfills and RTSs. I think all of us, here, appreciate the importance of charging as a very important incentive for people to reduce waste and recycle waste. But we also have to convince the general public to understand that as well and this will include legislators and politicians. Unfortunately the whole issue is perhaps getting very politicized, but it is an issue we have not forsaken. I think the government is still planning to propose charging. I hope in the coming months, the government will be putting forward a proposal for the legislators to consider again.

### Yong Jaan Lee

From Ellen's presentation: the program shows that when the GNP grows, the problem of municipal waste also grows. It reminds me of a joke in Taiwan that says: when the GNP grows, another form of GNP grows, garbage, noise, pollution. I think the situation in Hong Kong is quite similar to that of the city of Taipei and I think the charge system will also be very useful for compact cities like Hong Kong and Taipei. Let me just give you a brief history of Taipei city. We did collect the garbage fees but we collect it from the wrong target. We would check how much water they use and

collect a garbage fee, so we were definitely collecting from the wrong target. We did also use the economic incentives, like a deposit refund. It is not very successful either. So the government tried to build 3 incinerators. Since last July, we collect per bag trash collection fees and it reduced one third of the municipal waste and recycling volume was increased by 400%. I think it is really a very successful charging fee compared to the incentive system. And now the government tries to collect the food waste for treated waste. This may be a good example: you have to target the right thing. I have a question for Dr. NG: how do you get funding for NGOs during economic recession?

### **Gordon Ng**

That is my daily headache, getting funds. Ever since I have joined the association, I have started a partnership approach to problems and we are in good partnership with the Environmental Protection Department, with businesses, schools and the community. Now we have one third of our funding from the community through public funds raising. One third of our funding is from the government including the Education Department, the Environment and Protection Department and the Social Welfare Department. Environment, as we look at it in a sustainable way, concerns many areas. This is why we talk to departments and tell them we need to do things in these areas. And of course, we get one third of our funding from companies. All this, at the moment, is not very satisfactory. One of the comments I have is that many of our projects are short-lived. It is not persisting, it is not regular. Why? Because it is project-based, and it lasts for one year, half a year, that's the problem. If you do not have a persistent project, then the public may get OK, and in the next 6 months, who is going to follow. We are trying to secure more persistent funding and that is the test or the challenge to us.

### **Dr. Ellen Y.L. Chan**

Collection charges: At the moment there is no charge for domestic/household waste and the relevant government department, the Food and

Environmental Hygiene Department is collecting waste from households. The department goes to both public and private housing estates with their refuse collection vehicles and collect the waste free of charge. When these vehicles go to the refuse transfer stations or landfills, it is also free of charge. So we do not collect any waste disposal charge from residents here. But for industrial and commercial establishments, for example, hotels or convention centers, they have to hire their own cleaners and cleaning company to collect the waste and deliver it to refuse transfer stations or landfills. In doing so, they have to pay at the refuse transfer station, not a lot, but they have to pay. If they go directly to the landfill, they do not have to pay because there is no landfill charge

## **Partnerships**

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### **Dr. Rebecca Chiu**

I think Mrs. Chan's paper gave us quite a good overview of what Hong Kong has done and there is certainly some good experience that we can share. On the waste disposal, I think that the partnership with the business sector is something that is certainly useful and could be a good experience for other places. But I would like to say that the contract is a long-term one (and M. Krieger said it was a good thing for planning...) but in some way, it is a monopoly?

And what if there are problems, what if the contractor does not perform?

### **Perelini S. Perelini**

American Samoa with a total population of about 60,000 people generate about 40 tons of solid waste a day, private companies collect the solid waste and deliver to one sanitary landfill, pump 9 million gallons of drinking water a day, and consume about 7 million gallons per day. 100% of our drinking water is from the ground that is why managing of the solid and sewer waste is very important for us from the health aspect, because we rely on the ground for drinking water. Protection of ground water is critical, that is why solid

waste, scrap metal, and waste oil are collected and disposed off in accordance with Environmental Protection Agency requirements. American Samoa like all the island countries in the Pacific rely on the ocean resources such as fish for their livelihood and economic based industry for employment, this is why we will condemn any form of ocean dumping handling of the waste oil, dumping of scrap metal is very important to any small island community. Promote anti-liter awareness campaign in schools and public, and sponsored anti liter enforcement legislations to fine those who violated legislations. Government used to subsidize solid waste operation, now government is no longer subsidizing solid waste operation, total cost for operation is generated from solid waste rates charged to residential, commercial and industrial customers.

To E. Chan: You talked about privatizing solid waste and management construction, and I admire the idea. Is it the government's plan to get out of it completely and leave it to the private sector (to also set up the tariffs for the customers?)? In the Samoa, the government got out of it completely. The operation is totally funded by the customers and also the businesses. We also privatized the collection and we are in the process of privatizing the management of the landfills and also the compaction of the scrapped metal and the disposal thereof.

#### **Dr. Ellen Y.L. Chan**

You mentioned this idea of partnership approach with big waste management companies, they design, build, and operate the waste facilities for us. Do we have any problems with this sort of monopoly situation? Everything we do has to be completely transparent and fair, so everything we do is through open tendering, we do not favor any company. Of course, multinational companies sometimes have an edge on smaller companies, simply because of their experience and their financial backup. We are not afraid we are going into a monopoly situation because M. Krieger's company is not the only company, which is operating the facilities in Hong Kong. We do encourage other parties to come in and like every company,

they have to go through very stringent pre-qualification and tendering procedures. And if they have parent companies, the whole structure has to be made known to us and we may have to require bonds, guarantees from the parent companies as well. So, if the contracting company is not fulfilling the performance requirements and has problems, then we can approach the parent company if necessary. Fortunately, we have never been into that position. There have been cases where the parent company has changed, so they have to let us know. But then that may be a part of international business.

#### **Lionel Krieger**

The term monopoly: there is only one monopolist and that is the government! I can tell you emotionally how it feels to have all your eggs in one basket in Hong Kong. Ellen Chan has pointed out that there is bitter competition to secure a contract in the first place. After that, though, the performance criteria are very clearly set out, the sanctions for failure to perform are very clearly set out, the charges are very clearly set out. One cannot, during the life of a contract, reduce standards or increase the prices, it is just not possible. The long duration of a contractor's responsibility is a deliberate choice of government, but it also allows a contractor to take a long-term view. It is not a disadvantage at all to be a client of the government.

What makes a partnership workable? I think I may be repeating points that separately have been brought out earlier. First, the clarity of the pre-qualification and the tender procedures, and clean government. Second, the breadth and length of responsibilities such that a ring fence is drawn around one's responsibilities, such that one is wholly responsible for the obligations in the contract. And third, the clarity of the contract in terms of the risk sharing, the performance criteria, and the payment terms. I think also it would be nice to know that government has the means to pay what is set out in the contract. There are parts of the world where that is not always the case and sometimes we have to live with that. We also have to live with the risk of currency exchange issues



and interest rate fluctuations, but these are not within the control of any individual government, and it would at least be nice to know that budget approval has been secured for the charges in the contract.

**Dr. Ellen Y.L. Chan**

Maybe I was not too clear on the subject. Our facilities are not yet privatized. They are all owned by the government. We simply employ contractors to design, build and operate them. Now, whether we will go for privatization for new facilities, we do not know. We are always open-minded and would always want to improve what we've got. At the moment, we have already started to review the DBO contract system. With 10 years of very successful DBO management of these facilities, we want to know: can we do it better? What about new facilities? Is it still the way to go? Should we have a revised version or a modified version? Or indeed, can some of them be totally owned and operated by the private sector? One obvious stumbling block now is the fact that we do not have any landfill charging by the government. We need to put in place a charging policy first.

**Lionel Krieger**

I am not necessarily an advocate for privatization. There is a world of difference between government contracting out to the private sector and government stepping aside and allowing there to be a contract directly between waste generators and waste collectors. It is, actually, in a geographical location like Hong Kong, very difficult to implement true privatization. Singapore has just come a cropper in this and Malaysia had a disaster. Both thought they could privatize, that means, sell off a facility or invite the private sector to build a new facility, but it ignored (in the case of Singapore) the issue of flow control. How do you organize the privatization of one facility while you either keep control of the other ones as a government or sell them off at different prices to other parties? A person, a company that is interested in buying and operating these facilities needs to be able to build a business model. The business model needs to include predictions of how much

waste is going to come into that facility as well as to estimate the cost per ton. If the bidder does not know what is happening to the other facilities, which are after all but a few miles away, or a few minutes away, you have no idea of what the future holds.

Malaysia failed for an entirely different reason. It tried to let the whole country as three concessions, where the concessionaire would take on the responsibility currently held by the municipalities: it would collect waste, it would build facilities to treat and then dispose of waste and it would derive all its revenues from every household and every business. But such an ambitious scheme was always doomed to failure because there were so many arrangements already in place, except for one: the householder does not directly pay for waste disposal. He pays (a bit like the gentleman from Taipei was saying) as part of the assessment, as part of the rate linked to the water bill. There is no way you can say, unlike the delivery of water or electricity: if you do not pay, we'll turn off the tap. The joke is: if you do not pay, what can we do? Bring you double your garbage back? It does not work.

**Manfred Giggacher**

My comments: what I have been hearing this morning seems to be reiterating the message I actually delivered yesterday in relation to another model, a concession model and the confusion within many governments' mind and markets. In fact, there is a confusion between privatization and effectively long term contracts. With concession contracts, a service is actually contracted out. We do not own the existing assets, we have the right of usage of an existing asset but we do not own the asset whereas privatization is when you buy the asset from the beginning. It is a completely different story. For those of you who were here yesterday, remember the right and left side of my slide (Slide 10 - Types of Private Sector Involvement).

But the overall message I am hearing today is first of all, there seems to be some successes within the Hong Kong environment in relation to certain models, the DBO model, as you mentioned. But I

am also hearing another message here, and I do not know if anyone is picking it up, again, that a complementary relationship needs to be established. Just because you have a contract with the private sector does not mean that all the problems are solved. The contract itself has to have the enabling environment around it, functioning, and that is where the complementary nature or the linkages come into place. If the government washes its hands of the enabling environment around the contract, the contract itself would be self-limiting ultimately. So, that is a very important message here. I think we have some very good tools for the future to solve the problems, whether it is the concession for the water industry, the DBO for the waste management, I mean we have some very good tools as long as we continue to establish those linkages and make sure the complementary nature actually does work.

## Silent majority

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### Dr. Rebecca Chiu

How do you think the silent majority or the less educated can be reached? What is the most effective way to raise their environmental consciousness?

### Gordon Ng

At the moment, we have a kind of a standard one-program for everybody. I suggested in my presentation that we should have community-based programs and the request is «What about the elderly, the low income group, the deprived groups?» How can we mobilize them? There are a lot of problems like space problems, time problems. They do not have the time, they have other things to attend to. They are not necessarily the targets. Most of these lower income groups are actually quite good in resource conservation. Most of the waste being generated, that is recyclable at the moment, the sector that needs to look at waste reduction are the people who can afford it. From my economic point of view, if you spend 10 000 \$ (we have limited resources) whether we try to

reduce the easiest 10% first or the recycled easiest 10% first, through some housing estates that are already ready, that are better educated and so on. Gradually, because when we move to the last 10 or 20% of the materials we try to recover, to retrieve from the highest cost materials, that is a typical economic problem. There is one problem with that, because if we do that, the deprived community may feel they are being deprived again, become they do not become part of the community if the program is not targeted at them. To that extend, this needs to be addressed. I do not have a really good solution to that. Typically, we have programs for both the easy targets and also for all the districts. But we do not put very much resource into those programs.

### Perelini S. Perelini

Dr. Seymoar, you mentioned that you have projects related to solid waste management in other parts of the world, please can you do one for the Pacific. The reason is because we have very small land-masses, we are all atolls (Marshall islands...) and we all face the same problems.

### Nola Kate Seymoar

I am going to make a few comments. The organization I work with does waste management in about 8 cities in the world. Hong Kong is a very special case. Where my organization is working, there are a lot of waste pickers and junkers, who are living on rivers of garbage. If some of you know the open dumpsites in the Philippines or in Thailand or in Indonesia, you know there is another side to this solid waste management issue. They go on the less developed part of Asia and other parts in the world. I am anticipating the presentation from Bangkok will address some of those issues, which are different from the ones we heard of this morning. If our experience is applicable, it is that we have really recruited, we talk about all the stakeholders within the waste management sphere and that includes the mayor, the city councils...etc and it also includes the waste pickers and the waste pickers' children who are living on the dumpsite. So we actually build schools on dumpsites and inoculate kids and do

what needs to be done to build alternate lifestyles, so that when you get a sanitary landfill, then you do not have 150 people out of work, so to speak. Junkers are private enterprises, they are small businesses. We organize junkers' cooperatives in the Philippines that set up their own lending and credit schemes, just as you would do with any poverty program. This is small enterprises development. We get the University of the Philippines to train them. About changing people's consumer behavior, there is a tremendous amount known about social marketing, and again Thailand has got some of the best social marketing programs for solid waste management and influencing children, who then influence their parents' behavior. But two things that are common throughout the world: if you have to develop campaigns that change people's behavior, the way of doing is making it fun. It is those campaigns that are funny, that attract people, that you saturate the airwaves with for a short period of time. You should overwhelm people's consciousness with a new message that is so unusual that it compels them to reconsider what they are doing. After they have reconsidered, then you need the long-term messages to be consistent. Those have been our experiences in other places that I think are complementary to what Hong Kong is presently doing. ■

