# Hong Kong Islands District Association Study Trip to Singapore

*Report by Nick Bilcliffe on behalf of The Green Lantau Association & Living Lamma*

**Introduction**

Notification for this trip stated:

"Due to the current issue of Integrated Waste Management Facilities and its public consultation which introduced by HKSAR government, that is also a key consideration by residents from islands district of HK. The Hong Kong Islands District Association (HKIDA) is now taking the lead to organize a mission study trip to Singapore during 29 May –1 June 2012."

"We hereby invite you to join this trip as a starter to explore the history and current situation of what Singapore has been worked through in Waste Management in both positive and negative way. If you are not available to join, we would like to request your designated representative to participate this trip. HKIDA hopes to have your on-going participation and support to the series of workshops in the islands district afterwards."

This trip allocated 50 places, heavily subvented by the **Environment and Conservation Fund** (ECF) of the **Environmental Campaign Committee** (ECC) [1], for members of the HKIDA, Islands District Council members, Islands Rural Committee members, members of Government Agencies (for example the Productivity Council), representatives of Environmental and Community Concern Groups and a Public Relations and Communications company (Wasabi Creation Public Relations & Communications Ltd)[2].

**Background**

Historically Hong Kong has utilised incineration and landfill to address its waste issues, to date **13 landfills** have been completed and their surfaces restored in order to make the areas reusable. Hong Kong has **three existing landfills** (South East New Territories landfill or "SENT" at Tseung Kwan O, West New Territories Landfill or "WENT" at Tuen Mun and North East New Territories Landfill or "NENT" at Ta Kwu Ling) the first of which is **due to reach capacity in 2014**.

Hong Kong had previously utilised incineration to reduce waste with **four plants** (Lai Chi Kok Incineration Plant – closed in 1991, Kennedy Town Incineration Plant – closed in 1993, Mui Wo Incineration Plant – closed in 1994 and the Kwai Chung Incineration Plant – opened in 1978, closed in May 1997). This policy of incineration was halted as a result of the 1989 White Paper – ***Pollution in Hong Kong - A Time to Act***,[3] which took into consideration the effects of air pollution on the environment and public health. It stated:

"Polluters will also have to pay. Treatment facilities will have to be installed and less polluting processes and fuels will have to be adopted to meet more stringent standards, which may lead to an increase in capital and recurrent cost. Although rapid improvements cannot be expected right away **we must take immediate steps to prevent further deterioration of our environment**, and then gradually improve it over the period of the ten-year plan"

"**Failure to deal effectively with this growing amount of waste can give rise to severe pollution of our air, water and land**, as well as the risk of poisoning by chemical waste and the spread of disease from hospital waste, decomposing carcasses and other organic matter."

"The Government's overall policy objectives for the management of wastes are to ensure:

- The provision, by either the private or public sectors, of **facilities for the cost-effective and environmentally satisfactory disposal of all wastes**;
- The availability of and **proper enforcement of legislation aimed at safeguarding the health and welfare of the community from any adverse environmental effects associated with the storage, collection, treatment and disposal of all wastes**."

The facilities at Kwai Chung, despite ceasing to operate in 1997 were maintained and the contract to demolish and decontaminate (**hydrocarbons, heavy metals, contaminated ash, asbestos and dioxin**) the site was not granted until 26th October 2007 and was slated to last 45 months (3 years 9 months – mid-2011)[4].

**Stated purpose of the Mission Study Trip：**

1. Visit the National Environment Agency, to increase the knowledge in different areas in a city, such as **environmental conservation**, energy saving, and community development 3 areas; in depth understanding;
2. Visit Tuas South Incineration Plant, Senoko Waste-to-energy Plant, Semakau Landfill &Tuas Marine Transfer Station etc, having depth understanding how to integrate the waste management, land usage and it's WTE plan;
3. Meet with Sembawang-Nee Soon (SNS) Town Council and to have a view on **how waste management works in community and its practical and sustainable development**.

The schedule was subsequently amended to replace the Senoko Waste-to energy plant visit with a trip to the most recently built unit, the Keppel Seghers Tuas Waste-to-Energy Plant adjacent to the Tuas South Plant. The Tuas South Marine Transfer Station was omitted from the trip and replaced by a visit to the Hong Kong Economic & Trade Office.

**Funding**

The trip was supported by funds from the ECF, which is controlled by the ECC chaired by Professor David LUNG, SBS, JP, the Vice Chairman is **Professor WONG Woon-chung, Jonathan, MH** (Department of Biology, Hong Kong Baptist University and proponent for an ECF funded trip to Taiwan to look at waste) and the members are Mr. CHAN Wing-hong, Cary; Mr. HUI Yung-chung, BBS, JP; Mr. LAU Ip-keung, Kenneth, MH, JP; Dr. LEUNG Man-fuk, Edward; Mr. MA Ching-hang, Patrick, BBS, JP; Dr. MA Hok-ka, Carol; Dr. NG Cho-nam, BBS, JP; Dr. NG Chui-yiu, Jennifer; Dr. Elizabeth QUAT, JP; Professor SHEN Xu-hui, Simon; Dr. TANG Shuk-ming, Winnie; JP Ms Bernadette; TSUI Mr. WONG Mau-chung, Max; Ms WONG Sau-ying; Dr. YIP Chee-hang, Eric; Dr. YU Yuen-ping, William and Ex-officio members – **Secretary for Home Affairs**, or his representative; Secretary for Education, or his representative; **Director of Environmental Protection**, or her representative; **Director of Health**, or his representative; **Director of Information Services**, or her representative.

Assuming all 50 places (awaiting confirmation of participants) were allocated at a base cost of **HK$6,590** for shared accommodation the gross cost would have been **HK$329,500** (one or two participants, I am aware, did not accept the subsidy offered).

**Visits**

**Semakan Landfill**

The first working visit was to the landfill site created from two islands (Pulau Sakeng and Pulau Semakau) with construction starting in 1995 and finishing in 1997, the island villagers having been relocated during the 1980s and early 1990s to facilitate the construction. The landfill was constructed to predominately receive ash from incineration. The construction method of the landfill consisted of a sand perimeter bund with an impermeable geomembrane coated with clay, geofabric and rocks on the cell (inner) side, geofabric and rocks on the seaward side and an access road on top. The water is pumped out of each cell as it is required and the waste ash is deposited then a layer of soil is placed on top. The area is then allowed to regenerate naturally, although replacement mangroves have been planted outside the perimeter. Interestingly the ash is transferred to the landfill in covered barges to avoid ash escaping, but once at the island is transferred to open trucks to the cells. Regular monitoring is carried out and we were told that to date there had been no registered contamination by leakage or leaching. All waste is **toxicity characteristic leaching procedure** (TCLP) tested – although questions have been asked about the validity of this test as it is based the assumption that organic matter is included in the landfill (Singapore does not have organic waste, just ash and "non-incinerable" materials). Some of the incinerator bottom ash (IBA) is used for roads and in construction.

The landfill occupies 3.5 square miles, has a capacity of 63 million cubic metres and the bund is 7 km long, the expected lifespan is 46 years (1st April 1999 until 2045).

In the presentation at the landfill we were informed that in 2011 Singapore generated 18,899 tonnes per day (t/d) of waste, of that 11,065 t/d (59%) was recycled or reused (predominately building waste used for construction), 557 t/d (3%) was "non-incinerable" waste and 7,277 t/d (38%) was incinerable creating 1,773 t/d of ash – total of 2,350 t/d to landfill.

Levels of waste recover were quoted:

- Paper/cardboard 56% (mostly commercial recycling);
- Food and horticultural waste 37%;
- Plastics 11% ;
- Wood 64% (mostly commercial recycling);
- Over 90% of all recycled waste in Singapore comes from the commercial sector.

Waste collection was privatised in Singapore in 2001, recycling bins are available in Singapore, but the housing blocks operate a chute system and the bulk of domestic waste is not sorted or separated for recycling.

**Tuas South Incineration Plant**

Completed in June 2000, Tuas South is Singapore's biggest incineration plant. It was stated that Tuas South sells 80% of the energy it generates from the incineration process, it operates with a moving grate system (typical of Municipal Solid Waste plants – MSW) and in order to destroy the molecular bonds of compounds such as "dioxin" and "furans" the steady base temperature of 650$^{o}$C must be boosted to reach between 850$^{o}$C and 1,000$^{o}$C for at least two seconds. Electricity is generated by using the hot air and at the same time a variety of cleaning techniques are employed:

- Lime powder spraying – "The high plastic content of today's domestic rubbish means that the incineration process emits Hydrogen Chloride (HCl). It is unacceptable to emit high volumes of HCl into the atmosphere, so plant operators spray lime powder into the process to neutralise the acid gases. This process is over 90% efficient, ensuring that the majority of HCl is neutralised before entering the atmosphere."[10] – excessive use of lime creates other issues;
- Electrostatic precipitators;
- Catalytic bag filters – inefficient for fine particulate matter.

No mention was made of on-site monitoring, although Singapore-wide monitoring was referred to, we were told that both particulate matter 2.5 and 1.0 (PM 2.5 & PM 1.0) were filtered out

using a one nanometre filter and regular testing was done based on a milligrams per Newton metre cubed ($mg/Nm^3$) – concern has been expressed about the validity of a mass measurement for PM 1.0 and below due to the relationship between mass and surface area as size decreases.

No mention was made of the explosion and subsequent fire that occurred on the 6th May 2012, although it was only three weeks prior to our visit. It caused the evacuation of the plant and considerable damage to the control room.

**Keppel Seghers Tuas Waste-to-Energy Plant**

Completed in 2009 Keppel Seghers Tuas Waste-to-Energy Plant is the newest, smallest and only private/public incineration plant in Singapore (800-900 t/d against 3,000 t/d at Tuas South). It is essentially a smaller version of the Tuas South Plant and most of the basic principles and figures are the same or comparable.

Keppel Seghers uses air-cooled tumbling grates, rather than a traditional moving grate for carrying and handling the waste within the incinerator and a number of cleaning techniques:

- A reactor;
- Activated carbon dosing;
- Baghouse filters.

Interestingly at Keppel Seghers we were told the technology is still being developed to capture PM 1.0 and below – Tuas South stated it existed.

Keppel Seghers are involved in a number of incineration projects in Asia and Europe including the Shenzhen Bao'an Plant and a variety of other waste projects including Anaerobic Composting in Qatar and Sludge Drying Plants.

The consultant at Keppel Seghers provided the following additional information:

- Singapore became aware in the 1970s that ordinary landfill use was not sustainable due to the limited land area;
- Viable options were baling (reduces volume by 20-30%), composting (40-50%) or incineration (85-90%);
- Because Singapore doesn't separate its waste it has "wet Asian waste", lower calorific value than segregated "European" waste and wet because of the organic matter (food and vegetation);
- Singapore considered that incineration was more able to cope with the "wet Asian waste" than other systems;

- Composting was tried, but was unsuccessful due to the smell and lack of an end market;
- Gasification is a similar process to incineration, but the temperatures are higher **4,000-10,000$^{o}$C**, the plant sizes smaller (300 t/d) and in his view the system less tolerant of variable waste (good in Japan where they separate waste);
- Gasification reduces volume by 95-97%;
- Keppel Seghers use gasification for treating sludge;
- Asked if chimneys were necessary for incineration plants he said you could use underground or undersea sequestration, but the cost is high, with chimneys **"by the time the pollutants hit the ground they don't harm you"** – pollutants spread over a greater area if falling from a greater height!

**Hong Kong Economic & Trade Office, Singapore**

A visit with no research value.

**Sambawan-Nee Soon Town Council**

Sambawan-Nee Soon Town Council is the largest council in Singapore incorporating over 129,000 housing units. The waste collection from domestic premises is facilitated by chutes within the buildings and a compactor, recycle bins are available one for every five housing blocks (towers), but are infrequently used. Domestic waste separation appears to be the exception rather than the norm.

**Concerns**

1. There is a real risk, in view of the following comments, that **the trip is seen as a request to endorse rather than evaluate solutions**.
2. Singapore has adopted a singular approach to the issue of waste management based on assumptions made that are not necessarily applicable to Hong Kong. The report by Reginald B. H. Tan and Hsien H. Khoo of NUS addresses this issue and the strategy adopted.[11]
3. The decision to locate, and relocate, waste facilities to an entirely industrial area creates a **dislocation between waste creation and disposal**, thereby **hampering both education and motivation for waste reduction, reuse and recycling**.
4. With a party of this size (approximately 50 people) from a variety of backgrounds if guidance and structure is not provided the returns are likely to be minimal. There was **no briefing paper or lecture** prior to or even after the trip with the exception of the meeting on the 19$^{th}$ June 2012.
5. **At no stage were the participants asked to consider alternatives to the option chosen in Singapore – which is the same option chosen by the Hong Kong Government.**

6. Tuas South stated that they can capture PM 1.0 and below with filters, Keppel Seghers say the technology is in development, but not yet available.
7. Recent research has shown that both **PM 2.5 and PM 1.0 (and below) are rare in nature so humans have developed few defences to them**, they pass deep into our lungs and from there even into our bloodstream. PM 1.0 and below being smaller penetrate further into our bodies carrying toxins.
8. Talk of "no smoke" meaning "no pollution" is clearly misleading to say the least, but without data this type of comment is likely to be accepted by many participants.
9. Despite clear links between PM 1.0 and major health issues the methodology for calculating quantities is more appropriate to much larger particles where mass rather than surface area is a significant factor.
10. The views expressed by some industry experts on the incidence and mitigating the effects of PM 1.0 are much like those of the tobacco industry who said smoking wasn't linked to cancer. **Denial is the standard tool used when hazardous practices are employed**.
11. Despite requesting details no information has been published regarding the attendees and their affiliations, nor has any notification been given of when all the reports will be assimilated into a single volume and published with an abstract for ease of reference for this ECF (government) funded trip.

**Conclusions**

1. As a study trip to consider the future of waste management in Hong Kong it is **fatally and completely flawed** by the fact that only one solution was considered.
2. Any conclusions drawn from the bulk of responses are likely to be uninformed, based on a fraction of the available data and tainted by selective funding.
3. **Singapore has decided that it will not compost, reduce, recycle or reuse domestic waste** and that everything will be incinerated.[11]
4. The pattern exhibited in **Singapore is increasingly the exception rather than the rule** as countries adopt innovative waste solutions around the world that incorporate comprehensive **recycling, reduction and reuse programmes**.
5. No information was provided to participants about **World Health Organisation** guidelines, the bi-annual **Environmental Performance Index**[12], research on **dioxins** and **furans**, the relative impacts of **particulate matter** categories (PM 10, PM 2.5 and PM 1.0 and below, thus severely impairing any evaluative processes.
6. The dangers of incineration have long been documented[13], from the first monitoring in Germany in the 1960s through to the current day, yet we continue to focus on this as our only viable option in Asia's World City. Is this because the Hong Kong government

fears to step outside the box and embrace new technology, preferring to stay with precedent and the comfort derived from familiarity?

7. Science has throughout history fought to catch up with the problems it creates (nuclear fuel – radiation poisoning; vehicle fuel – lead poisoning; catalytic converters – benzene poisoning; irresponsible landfills – methane, carbon dioxide and other greenhouse gases), the list is endless.[14]
8. The Hong Kong government has sat and watched while the landfill position has deteriorated to a point where urgent action is required, talked about recycling, but paid lip service to facilitating it.[15]


1. http://www.ecc.org.hk/english/index.html
2. http://www.wasabic.com.hk/about_wasabi.html
3. http://www.epd.gov.hk/epd/english/resources_pub/policy/files/White_Paper-A_time_to_act.pdf
4. http://www.kcip-ema.com/Main.htm
5. http://www.scientificamerican.com/article.cfm?id=plasma-turns-garbage-into-gas
6. http://www.gasification.org/page_1.asp?a=85
7. http://www.gasification.org/page_1.asp?a=87&b=85
8. http://www.gasification.org/uploads/downloads/Final_whitepaper.pdf
9. http://www.epd.gov.hk/epd/english/resources_pub/policy/files/White_Paper-A_time_to_act-2nd_review.pdf
10. http://www.procal.com/kittiwake_procal_wins_tender_for_tuas_south_incineration_plant_in_singapore.htm
11. http://www.ncbi.nlm.nih.gov/pubmed/16573187
12. http://epi.yale.edu/sites/default/files/downloads/2012-epi-full-report.pdf
13. http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/3809.PDF
14. http://www.ecomed.org.uk/content/IncineratorReport_v3.pdf
15. http://www.cleanbiz.asia/blogs/hk-government-pulls-slow-one-air-pollution


Additional reference papers:


1. http://www.thestandard.com.hk/news_detail.asp?we_cat=4&art_id=123430&sid=36714648&con_type=1&d_str=20120614&fc=7
2. http://www.rijksoverheid.nl/nieuws/2012/05/30/subsidie-voor-schoonste-trucks-en-bussen.html
3. http://www.airclim.org/sites/default/files/acidnews_pdf/AN2-12.pdf?utm_source=Acid+News+212&utm_campaign=d65c1435f8-New_issue_of_Acid_News_now_available3_23_2012&utm_medium=email
4. http://www.ehjournal.net/content/10/1/53