



REPORT ON WASTE MANAGEMENT

23rd November 2013

屹立新界
Resolute in New Territories

關顧全港
Caring for Hong Kong

凝聚共識
Campaigning for consensus

達至大同
Striving for the common goals

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(Revised on 26th November 2013)

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Founded on 4th May 2013, the New Territories Concern Group (“NT Concern Group”) is a non-political party. It acts as a platform, as a pressure group, fostering the views of the people of Hong Kong and lobbies the HKSAR Government. The NT Concern Group aims to monitor the government’s various policies and development projects and hopes to assist the government in developing a more effective and balanced policy direction, so as to relieve the pressure and tensions of different parties and factions.

To that effect, we visited Amsterdam, Rotterdam and London primarily to form a bridge and reach out to overseas born Chinese and advise them about, inter alia, their residency rights in Hong Kong.

In addition, we took this opportunity to better understand different waste management systems by visiting the sites such as an incinerator, gasification plant and gas plasma plant as recently, waste management has been a hot topic in Hong Kong.

Under a two-part report based on the NT Concern Group’s findings from the Mission to Europe, Part 1 is now submitted in relation to waste management with Part 2 in relation to residency rights in Hong Kong to be submitted at a later date.

(II) About the NT Concern Group

On 26th November 2011, the Hong Kong Government announced its revised enforcement policy against unauthorized building works (UBW) in New Territories Exempt Houses (NTEH), which are also known as Village Houses. The new implementation included the introduction of a “voluntary reporting scheme” on unauthorized building structures. The announcement of this new policy fuelled discussions and speculations in society, and also aroused extensive discontent amongst the New Territories residents. The New Territories Heung Yee Kuk, which should be a bridge of communication between the residents and the government bodies, failed to speak up and swayed often in their positions regarding this matter. Many New Territories residents felt frustrated and disappointed by such ineffective representation.

It was against such a backdrop that the NT Concern Group was formed. On 4th May 2013, the NT Concern Group was established with the aim of creating dialogue between different sectors of community and those who are affected by the government’s policies. It aspires to be a voice for the people of the New Territories by conveying their views and suggestions to the Hong Kong Government, so that their traditional and lawful rights would be protected. In relation to the aforementioned policy, the NT Concern Group hopes to bring about the legalisation of minor UBWs that do not seriously contravene the law or pose any imminent danger to life or property. On 25th October 2012, the NT Concern Group applied to be registered as a formal society by the Hong Kong Police Force.

A Aims

NT Concern Group: A body duly registered under the Societies Ordinance Cap. 151 (Licence No. LP/LIC/SO/19/49006) aims: -

- (1.) to apply pressure on the Government in relation to:

- (a). Expansion of the 19 existing items listed in the Guidelines for Exemptions in the application for NTEH UBW exemption certificates;
 - (b). Amendment of the existing Buildings Ordinance by adding a provision that provides a simple reporting mechanism, which would also allow residents to undertake legal alterations to their property;
 - (c). To legalize minor UBWs in NTEHs that were constructed before 28th June 2011, given that such structures are not in serious contravention of the law;
- (2.) to reflect to the government the views and opinions on its policies regarding development in the New Territories, to increase and strengthen communication;
 - (3.) to obtain from the government a reasonable allowance for the New Territories Village Representatives, with appropriate subsidy adjustments;
 - (4.) to obtain amenities or other facilities that would improve the living standards of New Territories residents;
 - (5.) to connect with New Territories residents and various non governmental organisations, in order to improve mutual awareness and to promote liaisons between these factions of the community; and
 - (6.) to coordinate with other villages in creating groups with similar aims and interests.

B **Structure**

The NT Concern Group is led by an Executive Committee, with five specialised teams to handle projects of various nature:

- (1.) **Buildings and Amenities Team:** Responsible for matters regarding Unauthorized Building Works (UBWs) on New Territories Exempt Houses (NTEH), and to advocate for the amendment of the existing Buildings Ordinance;
- (2.) **New Territories Concerns Team:** Responsible for analysing the overall general policy direction of New Territories development;
- (3.) **Rights and Interests Team:** Responsible for dealing with the rights and interests of the village entity, and to strive for the adjustment of wages and subsidies for the Village Representatives;

- (4.) **Community Activities Team:** Responsible for organising cultural activities in the community, protecting the rights of property owners, contacting non-governmental organisations to strengthen community ties, and organising various recreational activities for liaison purposes; and
- (5.) **Operations Support Team:** Responsible for the organisation and logistical support of the other teams' projects.

C Committee Members

D CV of the Delegation and Researchers

(For C and D, please refer to pages 6-7 of the Chinese Version.)

(III) Executive Summary

In 2011, 1.27kg of MSW was disposed of per capita per day and under its Blueprint, Hong Kong government aims to reduce this figure by 40% to 0.8kg by 2022. This would be achieved by implementing the Three Rs and imposing a levy. It is projected that 55%, 23% and 22% of waste produced would be recycled, incinerated and put in landfills respectively.

The current landfills at Tuen Mun in WENT, Ta Kwu Ling in NENT and Tseung Kwan O in SENT occupy an area of 110, 61 and 100 hectares respectively at which the capacity is expected to be saturated by 2019, 2017 and 2015 or earlier. A feasibility study costing HK\$35 million will be carried out at Tuen Mun which would see the area expand by an additional 200 hectares at an estimated construction cost of HK\$9 billion. NENT and SENT would also be extended by 70 and 43 hectares respectively at an estimated cost of HK\$8 billion. The proposed expansions are understandably facing major opposition and outrage.

Government is striving for the operation of its “prized” incinerators capable of processing 3,000 tpd from 2022 on an artificial island off Shek Kwu Chau or less likely, at Tsang Tsui. The reclamation of about 11.8 hectares land is estimated to cost HK\$10 billion and a further estimated cost of HK\$15 billion on construction of the technology. The technology is championed as it will produce EfW, it is clean and it is the best option to tackle Hong Kong’s rising waste problems.

The disadvantages more than outweigh the benefits making this a 3Ls losing strategy. EfW is produced after processing the MSW. However as it burns waste at 850°C in the presence of oxygen, dioxins, toxic fly ash (2%), bottom ash (22%) and carbon dioxide are discharged. The ash also requires to be disposed of carefully in landfill which is adding unnecessary strain. Judicial review proceedings have been initiated which will push the proposed operational date of 2022 back and the total sum for

government's plans on expansion of the landfills and reclamation and construction of the IWMF will cost the taxpayer an estimated eye watering HK\$42 billion. In short, it will cause resentment to the people of Hong Kong, it will further harm the environment and it is an extremely costly feat.

On the other hand, plasma gasification and/or pyrolysis coupled with gasification appear to hold the winning solution to Hong Kong's problem. Naturally occurring plasma is seen in lightning's flash. An electric charge passing through a gas creates this plasma and the electrical energy is converted by plasma torches/arc which is capable of generating temperatures in excess of 5,000°C and thus power the technology.

The technology produces a syngas capable of being converted to electricity and jet fuels and heat and steam being other outputs. Slag being a byproduct can be safely used as construction aggregate. In addition to creating work opportunities, the technology makes it a winning solution for the community. The environment also wins as no residue is required to be dumped in landfills and the technology can in fact back mine current landfill sites. No harmful emissions are discharged.

Capable of processing about 2,000 tpd, at a construction cost of around HK\$7.2 billion, taking up an area of about 30 acres (although this could be reduced), the technology could be housed at Tsang Tsui and is also a winning answer for Government. The pilot plants capable of processing around 400 tpd could be operational within 3 years by 2017, turning Tuen Mun into a functioning green city and assisting in meeting government's aims of addressing the waste problem 5 years earlier than the IWMF would in 2022. The technology which is modular, is not immature as government claims and has been in operation for at least 30 years and used by companies such as New Earth, Solena Fuels, Westinghouse

Plasma Corp, Advanced Plasma Power and Tetronics. It has also been endorsed independently by: R.W. Beck, ENSR | AECOM, AMEC, Golder Associates, Shimadzu Techno Research, Juniper Consultancy and Fichtner Consultancy.

Government is therefore urged to choose carefully, cleverly and sensibly finding a solution which will allow everyone to win. Plasma gasification and/or pyrolysis coupled with gasification could be that answer! It costs about one-sixth of HK\$42 billion, uses decent new technology to produce more energy potentials to benefit locals, avoids dumping residue into landfills and recovers precious land. It is a winning strategy!

1. Introduction

- 1.1 The monumental accumulation of waste around the world is a near unanimous and unruly problem, which is worrisome, especially to the governments of the developed countries. To tackle this problem efficiently and indefinitely, effective waste management strategies and systems must be adopted.
- 1.2 Under the Hong Kong Blueprint for Sustainable Use of Resources 2013-2022 (“Blueprint”), government aims to reduce the waste produced from 1.27kg to 0.8kg by 2022.¹
- 1.3 A primary hierarchy commonly adopted by different countries as well as Hong Kong and can assist in meeting the government’s targets is the “Three Rs” which stands for:
- (a). **reduce:-** from a manufacturer’s point of view and from a consumer’s point of view, use fewer resources from the onset;
 - (b). **reuse:-** before disposal or recycling, considering whether the item can be used again for a different purpose, i.e. a biscuit tin as storage; and
 - (c). **recycle:-** to be sorted, collected and processed for the making of new items from old and used resources.²

Sometimes recovery (of energy from waste “EfW”) and disposal into landfills (being the least preferable) are also used. For the purposes of this report, the Three Rs will also include recovery and disposal.

¹ <http://www.enb.gov.hk/en/files/WastePlan-E.pdf>

² <http://www.nrdc.org/thisgreenlife/0802.asp> and http://www-wds.worldbank.org/external/default/WDSCContentServer/WDSP/IB/2012/07/25/000333037_2012072504131/Rendered/PDF/681350WP0REVISOat0a0Waste20120Final.pdf

1.4 Hong Kong's three landfill sites are estimated to reach capacity between 2015 and 2019.³ The government's proposed solution whilst paying lip service to the Three Rs with pilot projects to extend waste sorting and (after repeated public consultation) introduce waste churning, is in essence to extend the landfills and/or operate one of the world's largest incineration plants ("IWMF") capable of processing 3,000 tonnes per day ("tpd") of MSW which it proposes to make operational by around 2022. However, this is a three-fold losing strategy as the landfill extension is jeopardized since LegCo denied funding earlier this year; the expensive and harmful incinerator proposal is stalled by a judicial review currently going through the courts and it is a technology which is causing resentment in the community.

1.5 The NT Concern Group during its visit to Europe witnessed firsthand the thermal technologies now or imminently operational which seem more appropriate solutions for Hong Kong's waste management. The gasification technology appears to provide 3 key benefits:

- (a). safe, emitting none of the dioxins and other toxins which recent scientific studies have shown are emitted by incinerators in levels hazardous to human health⁴;
- (b). capable of running at a profit, provided they operate at capacities of more than 300 tpd of MSW (whereas the proposed incinerator is projected to run at a steady and significant loss year on year); and
- (c). landfill friendly, whereas the proposed incinerator will require toxic residues to be vitrified and then sent to landfill, gasification produces non-toxic by-product suitable for immediate re-use as construction aggregate.

³ <http://www.enb.gov.hk/en/files/WastePlan-E.pdf>

⁴ http://www.earthisland.org/journal/index.php/elist/eListRead/incineration_the_biggest_obstacle_to_zero_waste/ and <http://www.pvc.org/en/p/pvc-incineration-dioxins>



(vitrified, inert slag)⁵

Indeed, these gasification technologies are now being deployed in Europe⁶ and the US⁷ to reverse landmine and reclaim land for future generations- an application which is all the more appropriate for Hong Kong, where land is an especially scarce and precious resource.

1.6 Based on these findings, which demonstrate that these alternative technologies can produce a Win-Win-Win outcome for Hong Kong in managing its waste, we propose to champion this technology to the government for their further consideration and the trialing of one or more pilot plants to be operational by 2017.

1.7 Win- Environment

1.7.1 Plasma gasification and/or pyrolysis coupled with gasification are better technologies as they do not give off toxic residue. It provides a cleaner solution as the emissions are much lower than incineration. Moreover no residue will need to be disposed of in the landfills and the technology allows for reverse mining of landfills.

⁵ <http://www.httcanada.com/asbestos.html>

⁶ <http://www.theguardian.com/business/2010/oct/11/energy-industry-landfill>

⁷ <http://www.phswastetech.co.uk/blog/Could-landfill-mining-be-the-future-of-recycling.aspx>

1.8 Win- Community

1.8.1 It has a non-repugnant impact as it will take up a much smaller area and at the same time, it will not have a protruding chimney stack some 150 metres in height. The technology will bring employment opportunities to Tuen Mun, where it is hoped the technology will be housed. The EfW produced will also benefit the locals and save on energy bills. Furthermore, the back-mining of landfill will have a resounding result as the land is recovered and greater use could be made in the area.

1.9 Win- Government

1.9.1 Government will see that the technology costs less while achieving more, for example, there is no need to waste billions of dollars on reclamation as it could easily be housed next to the Sewage Treatment Facility at Tsang Tsui or alternatively at the Eco-park in Tuen Mun. The levels of EfW are much higher than incineration. It also addresses the problem of the landfill reaching capacity, relieves the need for the expansion and allows for the recuperation of land being used to dump waste. The technology will bring entrepreneurial and employment opportunities thus stimulating the economy. In addition, the new service base will aid in the investment in the local area as well as Hong Kong in general and therefore afford Tuen Mun the title of a green functioning city, supporting the fact that Hong Kong remains a competitive, innovative and receptive international hub. The technology will also ease concerns over the pollution surrounding the Pearl River Delta.

1.10 We call this the Three Ws strategy- a complimentary strategy to the Three Rs policy- by which Hong Kong can manage its waste more safely, efficiently and profitably and at the same time reclaim the landfill sites (which the government currently insists on extending) for alternative and better use.

1.11 We believe that the Three Rs strategy should be further strengthened by offering Rewards for those who recover waste suitable for recycling or other reuse i.e., payment of small sums for recovery of cans, bottles etc., job creation schemes for home and business waste collection and separation and subvention of businesses which promote waste recycling, re-use and reduction. We therefore believe the Three Rs strategy should be rechristened the Four Rs strategy.

2 Background of this report

- 2.1 We agree in principle with the government's proposal for the fair and reasonable imposition of a levy as there has been so much public consultation on this issue and see no reason for further deferral by way of further consultation. Legislation for a waste charging scheme should be brought before LegCo within the next 6 months and implemented by the end of next year (2014).

- 2.2 We also agree with the government's proposals to extend schemes for the separation of waste. However, we see no reason why these cannot be on a territory wide basis. This government has the power to legislate for mandatory waste separation and has the financial muscle to provide the corresponding infrastructure i.e., free waste bins to every household and an army of waste collectors by the end of next year (2014). Implementation of such territory wide scheme would provide much needed employment to those currently at or below the poverty line which the government's recent report estimates at one-eighth of the population.

- 2.3 On the government's own statistics, separation of organic waste for alternative treatment e.g., processing through the Stonecutters Island sewage plant will reduce the quantity of waste sent to landfill by 44%. It will eliminate the unpleasant smell associated with the landfill. It will therefore instantly alleviate the current pressure to extend landfill.

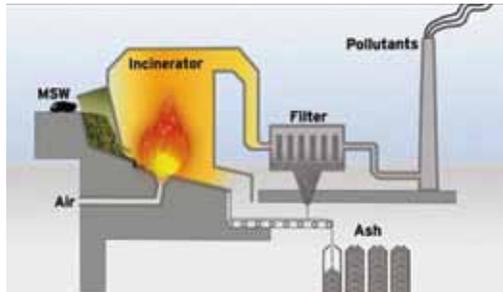
- 2.4 Questions then remain as to how residual waste should be treated and disposed of. The government proposes incineration which requires landfill extension because toxic residues from the incinerator (about a million tonnes over the proposed 30 year cycle) must be treated and then disposed of by dumping in landfills. We

believe there are superior technologies which should now be deployed in preference to incineration because they are clean with no toxic emissions or residues to be dumped in landfills. These technologies will not require landfill extension but will permit landfill reclamation by reverse landmining what is already in the current landfills around Hong Kong and therefore enable the extension of the territory's landbank. They will permit this to be done at no net cost to the government. These technologies therefore represent a Win-Win-Win solution to Hong Kong's current waste crisis - a Three Ws strategy to secure Hong Kong's future. For the sake of convenience, we use the umbrella term 'plasma gas' to describe plasma gasification and pyrolysis coupled with gasification.

2.5 For the differences between incineration and plasma gas (see Annexure 7.1- Incineration vs. Plasma Gasification)⁸ and the following paragraphs:

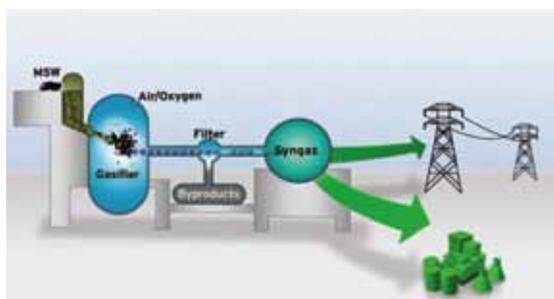
2.5.1 The below figure shows the incineration process in simple terms. MSW and a large amount of air enter the incineration chamber. Only after combustion can pollutants be filtered. A large chimney stack (around 150m in height) is required to catch as much of the impurities as possible before it is released into the atmosphere. Ash is also produced as a by-product which must be disposed of carefully in special landfills. The heat and steam from incineration is used to generate electricity.

⁸ <http://www.futurenrg.net/technology/plasgasification.htm> and <http://www.dovetailinc.org/files/u1/PlasmaGasificationPresentation.pdf> pp12-16.



(General incineration process)⁹

2.5.2 Similarly, a simplified plasma gasification process can be seen. MSW enters the gasification chamber and is broken down to its simplest elements under very high temperatures and little to no air/ oxygen. Using plasma gasification technology, plasma (which is seen naturally in lightning's flash) is produced when an electrical charge travels through gas and the plasma torch/arc generates this into heat capable of reaching temperatures in excess of 5,000°C thus beginning and assisting the gasification system making it an efficient process.¹⁰ Through a filtration system, a synthesis gas is produced.

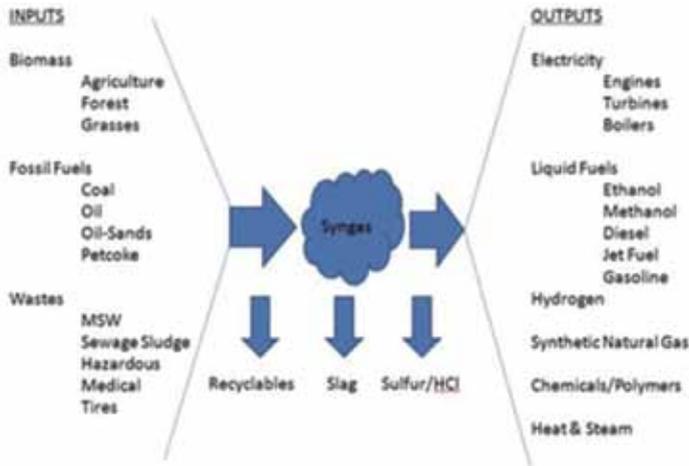


(General plasma gasification process)¹¹

⁹ https://www.gasification.org/page_1.asp?a=87 (taken from video clip)

¹⁰ http://gasification.org/page_1.asp?a=84

¹¹ https://www.gasification.org/page_1.asp?a=87 (taken from video clip)



(Illustration of outputs and by-products of Synthetic gas)¹²

2.5.3 The heat and energy is recaptured and can be used to supply power to the plant. With the installation of (underground) piping, the local community within a 25km¹³ parameter will be able to benefit from lower energy bills such as for heating swimming pools, elderly homes and businesses for instance.

2.6 The way forward for Hong Kong is to use a multi-pronged approach appropriate to Hong Kong's special circumstances and making best use of available technologies and infrastructure.

2.7 In 2011, Hong Kong produced on average 9,000 tpd of MSW¹⁴ and currently produces around 13,400 tpd¹⁵ of waste. Even if this is reduced by waste charging, sorting and alternative treatment of organic waste, it seems likely that there will be residual waste flows requiring alternative disposal if not dumped in landfills.

¹² Reproduced from <http://www.waste-management-world.com/articles/print/volume-10/issue-4/features/plasma-gasification-clean-renewable-fuel-through-vaporization-of-waste.html>

¹³ See below "RAV Water Treatment" section.

¹⁴ <http://www.enb.gov.hk/en/files/WastePlan-E.pdf>

¹⁵ <http://www.info.gov.hk/gia/general/201309/25/P201309250437.htm>

- 2.8 In line with the Three Rs, burying waste into the land, which is a scarce and precious resource in Hong Kong, should only be allowed where other waste management technologies cannot process it (see Annexure 7.2- Three Rs).
- 2.9 13 landfills in Hong Kong have been closed due to high levels of pollution and/or being completely filled up and undergone restoration by 2006. The majority of them, where considered safe to do so, have been converted into recreational facilities. Three landfills remain operational and are situated in West New Territories (“WENT”) at Tuen Mun, North East New Territories (“NENT”) at Ta Kwu Ling and South East New Territories (“SENT”) at Tseung Kwan O, and are said to be quickly reaching its capacity between 2015 and 2019.¹⁶ The respective areas occupied by each landfill site respectively are 110, 61 and 100 hectares.¹⁷
- 2.10 The government proposes landfill extensions to combat the problem but have withdrawn proposals at Tseung Kwan O and have been unsuccessful in passing landfill extension proposals at the remaining two sites due to the levels of opposition. However, ‘Legco’s public works subcommittee voted on July 2 to approve a HK\$35 million study into the feasibility of expanding the Tuen Mun site, which would cost an estimated HK\$9 billion to construct’.¹⁸ If government’s proposals for landfill extensions were approved, this would see an increase of 200 hectares at WENT, 70 hectares at NENT and a total of 43 hectares at SENT¹⁹ with the expansion of NENT and SENT costing around HK\$8 billion.²⁰ To propose extensions of these landfills is a highly illogical position to take when land is at such a premium and could be better used.

¹⁶ http://www.epd.gov.hk/epd/english/environmentinhk/waste/waste_maincontent.html

¹⁷ <http://www.legco.gov.hk/yr05-06/english/sec/library/0506in37e.pdf>

¹⁸ <http://www.scmp.com/news/hong-kong/article/1349309/government-press-plans-expand-two-landfill-sites>

¹⁹ <http://www.legco.gov.hk/yr12-13/english/panels/ea/papers/ea0527cb1-1079-1-e.pdf>

²⁰ <http://www.scmp.com/article/996194/incinerator-bigger-landfills-cost-hk23b>

2.11 Whether the government will eventually get approval for its landfill extension proposals (which will cost around HK\$17 billion in total), is just one matter. Part and parcel to landfills and their extensions are government's biased steps towards a slowly yet surely, spear-headed proposals of a mega-incinerator at a construction cost of an estimated HK\$15 billion²¹ over at least a 7 year period to build and to be housed at Shek Kwu Chau (on an artificial island occupying about 11.8 hectares²², 10 meters offshore in a designated conservation area and at a cost of around HK\$8-10 billion²³).



(Photo of proposed site of incinerator at Shek Kwu Chau in yellow banding)²⁴

It is proposed that the operational date will be 2022 and will cost around HK\$353 million a year to run.²⁵ However, the incineration proposal is currently subject to judicial review proceedings. It has also been rejected by LegCo's Environmental Advisory Panel when submitted last year for approval.

²¹ <http://www.scmp.com/news/hong-kong/article/1317862/families-could-pay-hk74-month-dump-waste-says-consultation-paper>

²² http://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/files/Booklet_IWMF_English.pdf

²³ <http://www.scmp.com/article/997235/costly-incinerator-will-be-waste-money> (based on the figures for the assumed cost of reclamation of 16 acres of land).

²⁴ http://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/WFdev_IWMF.html

²⁵ <http://www.scmp.com/article/996194/incinerator-bigger-landfills-cost-hk23b>

2.12 Moreover, the government has also considered Tsang Tsui Ash Lagoon in Tuen Mun to house the incinerator next to the current site where the Sewage Treatment Facility is situated. Nearing completion²⁶ it adopts incineration technology, is designed to process 2,000 tonnes per day, occupying approximately 7 hectares²⁷ and cost \$5billion to construct.²⁸



(Photo of proposed site of incinerator at Tsang Tsui in yellow banding)²⁹



(Photo of proposed site of incinerator at Tsang Tsui in yellow and proposed landfill extension of 200 hectares in red)

²⁶ http://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/WFdev_TMSTF.html

²⁷ <http://www.epd.gov.hk/eia/register/profile/latest/esb169/esb169.pdf>

²⁸ <http://www.scmp.com/article/996194/incinerator-bigger-landfills-cost-hk23b>

²⁹ http://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/WFdev_IWMF.html

- 2.13 Regardless of location, the government's strong support for incineration and what appears to be an inclination to house the incinerator at Shek Kwu Chau or alternatively but less likely at Tsang Tsui Ash Lagoon, is based on findings from the end of 2009.³⁰ There have been substantial advances in alternative technologies since then, such as gasification and plasma gasification, which will not require the disposal of around 22% of bottom ash (as a by-product of incineration)³¹ into landfills and thus negate the need for landfill extensions and indeed allow for reverse landfill mining.
- 2.14 It is government's championed fact that incineration of MSW will not require pre-treatment or pre-sorting of the waste which, by that account, means that all waste will be processed by the incinerator, whether it is recyclable or not. So too could plasma gas technology process unsorted waste; however, the energy such as power, hydrogen and jet fuels produced would not be as high although the levels of slag would be greater³² which would reduce the amount of construction aggregate currently imported³³ (as we understand that there is a heavy reliance³⁴ of importing aggregate and the practice is of more economical benefit than it is to produce it)³⁵. It also bypasses the 2nd and 3rd Rs i.e., reuse and recycle and jump straight to the less preferred recovery and disposal.

³⁰ Advisory Council on the Environment- "Integrated Waste Management Facilities Technology Review and Associated Facilities"- ACE Paper 22/2009

³¹ See "Annexure 7.3- Data" (although gasification will produce around 12% ash).

³² <http://www.futureeng.net/technology/plasfaq.htm>

³³ http://www.edb.gov.hk/attachment/en/curriculum-development/kla/pshe/references-and-resources/geography/article-geological_resources.pdf

³⁴ [http://www.epd.gov.hk/epd/SEA/eng/files/Quarry%20Study%20Brief%20\(Part%20Version%20coverin g%20SEA\).pdf](http://www.epd.gov.hk/epd/SEA/eng/files/Quarry%20Study%20Brief%20(Part%20Version%20coverin g%20SEA).pdf)

³⁵ http://www.academia.edu/800697/The_Application_of_recycled_aggregate_for_the_urban_sustainability_of_Hong_Kong_construction_industry

- 2.15 The Environment Bureau of the government has recently published the Blueprint which sells the concept of Use Less, Waste Less. Essentially it sets out the government's vision and identifies challenges and opportunities, it provides an action plan and targets to be met by 2022 and lastly it provides a waste management structure.
- 2.16 Whilst this Blueprint is helpful, the government is failing to embrace new concepts and thus cannot grasp the bigger picture. Adamant that incineration is the only way of efficiently moving forward, the government does not want to recognize any other innovative and plausible EfW methods which will enhance the sustainable use of resources. Plasma gasification is not a technology in its infancy and to demonstrate its merits, Tuen Mun could be used to house a pilot plant, potentially within 3 years from 2014 and will have the necessary feedstock to process from the landfill sites already in existence. It would not disrupt government's plans and time-scales under the Blueprint, unlike the mega-incinerator which is currently subject to judicial review and thus delaying construction plans by at least a year.

3 Inspection

- 3.1 From the fact-finding mission to Europe, the NT Concern Group was able to witness firsthand, the various facilities in operation and spoke to the different managers and directors to ascertain facts and figures about their plants.

- 3.2 WSS Infocard System (“WSS”)³⁶
 - 3.2.1 Having begun operations in the Netherlands in 2003, the waste separation business has adopted the model such that the units are supplied with most of the services thereafter being contracted out.
 - 3.2.2 The units are buried underground with its head above the ground. The units are powered by solar energy and technology akin to the “Octopus Card” is used. Users tap their card against the reader on the unit and the appropriate waste can be disposed according to the separation unit. Monitoring the data, WSS sends letters to the local residents at the end of each month to encourage or educate users about waste separation practices.
 - 3.2.3 The delegation visited a residential area in Rijswijk where they saw the separated waste being collected from the WSS units. Using a mechanical claw, the unit which is underground is lifted up and flaps spring up preventing any unsuspecting passerby from falling in. Once the unit is suspended above the waste collection truck the bottom flaps are then released allowing the depositing of the waste into the truck. The flaps on the unit are then returned to its original closed position and the unit is carefully maneuvered into the ground. The whole process took about 10 to 15 minutes.

³⁶ WSS Infocard Systems at Rijswijk, the Netherlands with Managing Director, Mr. Paul van Alphens. Visited 18/09/13.



(WSS waste container being lifted out the ground)

3.3 RAV Water Treatment (“RAV”)³⁷

3.3.1 RAV which has been in operations since the 1970s, is part of the AVR-AFVALVERWERKING B.R. (“AVR”) group, recently purchased by Li Ka Shing’s Cheung Kong Holdings Ltd.³⁸ It has two sites in the Netherlands, one in Rozenburg and the other in Duiven, both using incineration, biomass to energy technology and water treatment or composting.

3.3.2 The incineration plant operates between temperatures of 850°C and 1,000°C³⁹ and in the presence of oxygen. Notwithstanding, the need for oxygen is one cause for dioxin emissions, which is at its highest on start-up and shut-down of an incinerator thus there is a need to process feedstock on a continual basis. As a direct result, rubbish from within the Netherlands is collected by truck and processed at one of the two sites. Rubbish is also imported

³⁷ RAV Water Treatment at Rozenburg, the Netherlands with the Director. Visited 16/09/13

³⁸ <http://www.scmp.com/business/companies/article/1262719/li-ka-shing-buy-dutch-waste-firm-us126b>

³⁹ http://europa.eu/legislation_summaries/environment/waste_management/128072_en.htm.

from Europe by shipping cargo such as from Ireland. The site is therefore located in a port with good road links. As there are not many residential areas close by, the various numbers of chimney stacks do not have much of an immediate visual impact.

- 3.3.3 Besides dioxins, furans and CO₂ emissions, toxic fly ash and bottom ash are also produced as by-products. RAV, knowing that fly ash is heavily polluted, requires the fly ash produced to be disposed of in special landfill sites using concrete to contain and minimize any leaching. Metals are further extracted from the bottom ash and this ash is then used for reinforcement of soil, railways and supplement concrete.
- 3.3.4 The heat and steam can be used to generate electricity or can be distributed to the local community within a 25km radius.



(Members of the NT Concern Group, friends from Netherlands and staff of RAV)



(RAV Incinerator chimney stack)

3.4 Advanced Plasma Power (“APP”)⁴⁰

3.4.1 Based in Swindon in the South West of England, UK, APP is a two-stage plasma gas plant which uses graphite electrodes. It functions as a test plant for users to test their pre-sorted waste (or refuse derived fuel (“RDF”)) and provides a detailed analysis of the output. Its visual impact is relatively low, with the exterior looking like a warehouse.

3.4.2 It operates at 1,500°C in the oxygen-deprived furnace and the plasma which is intense heat and ultraviolet (“UV”) reaches a peak temperature of around 5,000°C or 5,273 Kelvin (the

⁴⁰ Advanced Plasma Power at Swindon, UK with Sales Director, Mr. Steven Gill and Sales Consultant, Ms. Vicky Jones. Visited 19/09/13.

Sun's surface is 5,504°C or 5,778 Kelvin). The UV is utilized to break down the harmful gases/emissions and produces a very clean gas (cleanliness measured at 'parts of a billion').

3.4.3 Using plastic and rubber which is shredded to 10mm and dried along with the RDF, the calorific value is higher. It goes through the gasifier using a fluid bed operating at 850°C which produces ash and gases. This is then put through the plasma converter which utilizes graphite electrodes to crack and polish the gas creating a super clean synthesis gas which can be used as jet fuel⁴¹, LPG or cooking gas, etc. The ash produced is vitrified and turned into Plasmaroc, a slag/ slack which is harder than granite and used for construction, load bearing and/or on roads. As the Plasmaroc comes out in a molten state, it can be molded into materials required.

3.4.4 The plant is efficient and self-sustaining once operations have begun.



(Picture of APP plasma gasification cycle)⁴²

⁴¹ <http://www.solena fuels.com/index.php/projects>

⁴² <http://www.advancedplasmawater.com/solutions/process-overview/>

3.5 New Earth⁴³

3.5.1 The site is located at Avonmouth, also in the Southwest of England, UK. The plant uses pyrolysis and gasification technology, a two-stage process, with a focus on the production of electricity. Phase 1 was operational as of February 2013 with Phase 2 still being constructed. It is located next to a supermarket's warehouse with agreements in place for New Earth to receive the waste and the energy produced is returned to power the supermarket. New Earth itself also has a low visual impact, looking like a warehouse with an air condenser stack just 30m in height.

3.5.2 The pyrolysis uses New Earth Advanced Thermal ("NEAT") technology which allows for the processing of unrecyclable RDF in a controlled combustion environment, thus there are no dioxins produced. A carbon rich char is produced which enters the gasifier and steam and air are injected which releases energy to get a pyrolysis and synthesis gas. A cyclone chamber is then used to clean the synthesis gas.

3.5.3 The plant requires an initial input of energy but is self-sustaining thereafter.

3.5.4 For every 1MW produced, the plant is able to claim double Renewable Obligation Certificates (ROCs) from the UK government which 'are ultimately used... to demonstrate that they have met their [renewable] obligations'⁴⁴ and worth between £40 to £46.⁴⁵ Samples are taken several times a week which requires to be tested to ensure the consistent meeting of renewable obligations.

⁴³ New Earth at Avonmouth, UK with Business Development Director, Mr. Graham Lockyer and Technical Director, Mr. Scott Edmondson. Visited 20/09/13.

⁴⁴ http://www.biomassenergycentre.org.uk/portal/page?_pageid=77_20190&_dad=portal&_schema=PORTAL , <http://www.bloomberg.com/news/2013-02-13/u-k-sets-renewables-obligation-buy-out-price-at-42-02-pounds.html> and <https://www.ofgem.gov.uk/environmental-programmes/renewables-obligation-ro>.

⁴⁵ <https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/the-renewables-obligation-ro>



(New Earth units)⁴⁶

3.6 Air Products⁴⁷

3.6.1 The “world’s largest renewable energy plant in the UK using advanced gasification ... EfW technology”⁴⁸ will comprise of Tees Valley Phase 1 and Phase 2 (“TV1” and “TV2” respectively) is estimated to be completed and operational by 2014 and 2016 respectively. Due to the unfinished construction works, the delegation visited the Air Products UK HQ in Hersham in the Southeast of England, UK. The plasma gas plants at TV1 and TV2 will use a single stage process to convert the unrecyclable RDF to electricity. The brownfield industrial site where both plants are being constructed is reclaimed land using materials such as vitrified slag. Its external appearance looks like a warehouse.

3.6.2 With the use of petroleum coke (“coke”) in the oxygen deficient chamber, the torch will ensure complete conversion of inorganic materials to synthesis gas or melting of inorganic material to slag and is self-sufficient. The synthesized gas is cleaned and put through a gas turbine and electricity is

⁴⁶ <http://www.waste-management-world.com/articles/2013/06/13-mw-rdf-pyrolysis-gasification-plant-starts-up-in-avonmouth.html>

⁴⁷ Air Products UK Headquarters at Hersham, UK with Regional Manager-EMEA, Mr. Duncan Snelling, Business Manager, Ms. Lisa Jordan and Principal Research Engineer, Dr. Andrew Shaw. Visited 20/09/13.

⁴⁸ <http://www.airproducts.co.uk/teesvalley/>

produced.

3.6.3 TV1 and TV2 have the backing of the UK government⁴⁹ with various agreements signed. Air Products receives a 30% subsidy from the UK government which is guaranteed for 20 years as well as double ROCs for every 1MW produced.



(Air Products plasma gasification process)⁵⁰

3.7 To that end, different data was acquired from the various waste management sites visited (see Annexure 7.3 - Data). This has greatly assisted the NT Concern Group to compare the statistics of adopting plasma gas technology against the government's champion, incineration technology (Annexure 7.1 – Incineration vs Plasma Gasification).

⁴⁹ <http://www.letsrecycle.com/news/latest-news/energy/work-starts-on-2018world2019s-largest2019-gasification-plant>

⁵⁰ http://www.airproducts.co.uk/teesvalley/industrial_gas_facility.htm

3.8 Whilst the incinerator can potentially process more MSW by weight, it also costs approximately HK\$34 billion more than what the plasma gas technology would cost, taking into account of the landfill expansion. Furthermore, plasma gas facilities can operate profitably above parasitic load (the point at which energy extracted from the processed MSW exceeds the energy required to keep the facility running). The parasitic load for current plasma gas technologies is lower than incineration. The championed incinerator, by the government's own projections, will operate at approximately HK\$353 million per year.



(Air Product's gasification unit)⁵¹

⁵¹ <http://premierconstructionnews.com/2013/09/24/a-breath-of-fresh-air/>

4 Analysis/ Issues

- 4.1 The delegation agrees in principle with the government's Blueprint and does not in general, take issue with its proposals. However, the government in making its decision in combating the waste management in Hong Kong must have a range of options which can be considered on a balanced footing. All bias for one method must be put aside for the sake of the public which it serves - for their health, the environment and their best interests.
- 4.2 The government has adopted an almost scare-mongering tactic by emphasizing that the waste situation must be urgently tackled. Yet with the barriers faced and opposition to government's proposals, Hong Kong is actually lagging behind in its technological advances. It proposes to operate the mega-incinerator by 2022 at the earliest which is some 9 years in the future. By then, the current landfills are indeed likely to be saturated and require extension.
- 4.3 The Environmental Protection Department ("EPD") argues that only incineration can process 3,000 tpd of MSW; however they fail to acknowledge that the incinerator requires a continuous input of unsorted MSW; thus there will be a gradual need to import waste from other countries to appease the incinerator's hunger, entirely by-passing any recycling which can be reasonably carried out. Burning unsorted waste directly contradicts the government's 'philosophy of sustainable use of resources'.⁵² The unsorted waste will definitely contain food content and therefore a high moisture rate (as high as 90%), requiring a greater percentage of energy to burn essentially what is water⁵³- therefore not a directly analogous fact which the government can use to compare with other countries such as those in the European Union where the wet content of waste could be as low as 15%.⁵⁴

⁵⁴ <http://www.wtert.eu/default.asp?Menu=13>

⁵² <http://www.scmp.com/comment/letters/article/1347824/sticking-shek-kwu-chau-incinerator-best-option>

⁵³ <http://news.newclear.server279.com/wp-content/uploads/2013/10/SomefoodforthoughtUpdated.pdf>

- 4.4 The EPD also fails to make public that on start-up and shut-down of an incinerator, the highest levels of emissions such as dioxins and furans are produced. The residual output of toxic fly ash [is] listed as an absolute hazardous substance in the European Waste Catalogue⁵⁵ and causes harmful effects if not carefully treated, resulting in an expedited and unwarranted death sentence to all those who live nearby affected by its leaching into the water table and eco-system. The fly ash, post-treatment (vitrification, an essential process⁵⁶ which inevitably increases its mass and volume from the estimated 10% to 30%) will therefore have to be disposed into special landfills at additional cost and will even then represent a (potential) risk to Hong Kong's eco-system of catastrophic proportions, compared to the existing 'normal' landfills.⁵⁷
- 4.5 Plasma gas technologies use thermal energy at a very high temperature and a gasifier which is an oxygen deprived vessel; feedstock, such as non-recyclable RDF, is broken down into its basic elements i.e. hydrogen, carbon monoxide and water. Organic compounds are converted into synthetic gas and inorganic compounds (such as metals) are melted in the reactor with residual inert, non-toxic, granite-like output which can be safely used i.e. as aggregate for construction works. Dangerous dioxins and particulates are removed in the process, unlike incineration.
- 4.6 Plasma gas technology has already been used in the commercial industries for at least 30 years with demonstration plants operating at volume throughout the globe.⁵⁸ The technology is already successfully⁵⁹ used in China, Japan, the US and the UK to neutralize toxic byproducts of incinerators.

⁵⁵ http://www.ecomed.org.uk/content/IncineratorReport_v3.pdf

⁵⁶ http://www.ecomed.org.uk/content/IncineratorReport_v3.pdf

⁵⁷ <http://www.scmp.com/comment/insight-opinion/article/1305807/delay-disclosing-toxic-run-makes-landfill-expansion-harder>

⁵⁸ Such as Westinghouse Plasma Corp., Advanced Plasma Power, Tetronics, Solena Fuels, Air Products and New Earth Advanced Thermal to name but a few

⁵⁹ <http://www.airproducts.co.uk/teesvalley/technology.htm>

- 4.7 The government preys on the fact that the ‘... only commercial size plant operated to treat mixed MSW was the Eco Valley facility at Utashinai, Japan, which commenced operation in 2003 to treat 165 tpd of a 50/50 mixture of MSW⁶⁰, consequently ceased operation in December 2012. Whilst there were initial teething problems with the technology, this was soon resolved. The reason why operations were ultimately halted was because of the lack of source of specific feedstock required.⁶¹ This alone encompasses the notion of waste separation and best use of resources; the same cannot be said about incineration which will seek to burn unsorted waste- a fact which government champions, against its own goals of the ‘Three Rs. ‘Burning waste can seem easier and less expensive than sorting, diverting and recycling it. But once it’s burned, it can never be used for anything else – it’s gone!’.⁶²
- 4.8 The UK government has agreements in place with Air Products who estimates that TV1 will be operational as of 2014 for the processing of up to 1,000 tonnes of waste a day, producing up to 50MW (gross) of renewable electricity generation and electricity for up to 50,000 homes in each year and will have industry investment in the area for at least 20 years. The UK government is so confident in the technology, which meets and surpasses strict UK and EU environmental standards, that it has signed another agreement for the installation of TV2.
- 4.9 The government dismisses plasma gas technology by saying any working scale at present can only process 300 tpd. The EPD fails to acknowledge that plasma gas technology is modular, which essentially means that the plant capacity can be expanded by installing additional units in series with relatively little difficulty by comparison to landfills and incinerators.

⁶⁰ Letter to NT Concern Group dated 19th August 2013 and signed by the Director of Environmental Protection Department, P.H. Lui.

⁶¹ Independent Waste Technology Report of The Alter NRG/ Westinghouse Plasma Gasification Process published in 2008 by Juniper Consultancy, p.40.

⁶² <http://www.davidsuzuki.org/blogs/science-matters/2013/09/incinerating-trash-is-a-waste-of-resources/>

- 4.10 It would be unfair and wholly unjust that facts from the 2009 paper are cherry-picked in favor of incineration by the government and to the disadvantage of plasma gas when the current technological advances of the latter have improved immensely yet are ignored to this date in 2013. The plasma gas technology has been endorsed by at least 6 different independent industry experts such as: R.W. Beck, ENSR|AECOM, AMEC, Golder Associates, Shimadzu Techno Research and Juniper Consultancy.⁶³ In addition, Fichtner Consultancy has also endorsed the technology.⁶⁴
- 4.11 A 150,000 tpy pilot plasma gas plant, occupying up to 10 acres, could potentially be on-stream as early as 2017, at no monetary cost to the government (subject to agreements entered) to demonstrate its technological merits and capacity for loads of 400 tpd or more. What are the downsides for the government facilitating one or more such pilot plants? Two full-scale plants processing 700,000 tpy (2,000 tpd) would potentially take around 30 months to build, at a saving to government of about 4 years and at least HK\$10 billion.
- 4.12 The government is not offering a pilot incineration plant, notwithstanding the EPD concedes that 18% of particulates emitted from incinerators were highly toxic.⁶⁵ Instead, the government puts forward this costly mega-incinerator, in terms of time and money, as the 'pilot plant'. The government is therefore taking a huge risk and gambling with the taxpayers' money and confidence in the knowledge that incinerators are unsafe- Hong Kong use to have 4 incinerators which were all closed down by 1997.⁶⁶

⁶³ <http://www.westinghouse-plasma.com/wp-content/uploads/2013/04/WPC-SoQ-March-2013-NDA-Not-Required-Final.pdf>

⁶⁴ <http://www.advancedplasmapower.com/solutions/proven-technology/>

⁶⁵ http://www.epd.gov.hk/epd/english/resources_pub/policy/files/White_Paper-A_time_to_act.pdf

⁶⁶ <http://www.drmartinwilliams.com/environment/waste-incineration-alternatives-including-plasma-arc-gasification.html>

5 Local community

- 5.1 Local communities in Tuen Mun, Cheung Chau and Lantau, potentially affected by the prospective siting of an incinerator in their vicinity have protested vigorously. A Cheung Chau resident is the lead applicant for the judicial review currently on appeal through the courts. These local voices have been joined by NGOs concerned about the ecological and health impacts of the proposed incinerators which they say will affect the entire territory of Hong Kong and have potentially yet broader negative impacts.

- 5.2 In addition, with the Eco-Park, Tsang Tsui and a landfill site currently situated in Tuen Mun, it could potentially be a candidate district to house an operational pilot plant or full-scale plant. With this innovative technology in Tuen Mun's back garden, a trend of being a technologically advanced district could be set, whilst providing employment to the local residents and stimulating the local economy. If this district municipality recognizes all the advantages of this wonderful waste management system and knows that it will be turned into a green city, of what then is central government so afraid? The site is ready, the technology is ready and feedstock of 6,000 tpd of MSW will be readily available. A pilot plant will evidence the efficiencies, cost-effectiveness and merits within a small area and could easily be expanded as the technology is modular in nature.

6 Recommendations and conclusion

- 6.1 From the research undertaken and from the fact-finding mission to Europe, the government should implement the Three Rs head on without further delay and educate Hong Kong's population as it goes. We believe the policy will be more palatable if appropriate rewards are included to make it the Four Rs policy.
- 6.2 Whether incineration or plasma gas technology is adopted, these in themselves provide no encouragement to Hong Kong's population to separate and reduce waste. The population's concept of creating waste will be just as great as it currently is. The population could be motivated to separate waste via a waste-disposal charge which will see the reduction of waste build-up.⁶⁷ This is the stick approach. A carrot approach of incentivizing waste reduction and recycling through appropriate rewards is desirable as a complementary method. To implement the requisite infrastructure will provide employment for those who currently most need it - the relatively unskilled and impoverished groups within Hong Kong's current community.
- 6.3 The delegation concludes that Plasma Gasification and/or gasification coupled with pyrolysis technology is a much cleaner alternative which encourages waste separation from the outset and therefore encourages second chance recycling. It is likely to incentivize the population to reduce waste by the fair imposition of waste-disposal charges and there is no continued contribution to the dumping of landfills as there is no ash, toxic or otherwise, produced. As well as the production of cleaner energy there are no dioxins produced and the by-product, inert slag is successfully used in the likes of construction work with no harm caused to the environment.

⁶⁷ <http://www.scmp.com/news/hong-kong/article/1317862/families-could-pay-hk74-month-dump-waste-says-consultation-paper>

- 6.4 The plasma gas technology is one-sixth cheaper than the proposed IWMF and is not in its infancy. It has been used for many years and will provide a strong workforce from the local community. Adopting plasma gas technology will allow for the sell back of energy, production of clean fuel, encourage landfill mining and ultimately land reclamation.
- 6.5 In assisting the government by suggesting an alternative, Tuen Mun's Eco-Park and/or Tsang Tsui should be considered for the housing of the plasma gas pilot plant which will be affordable, operate in a feasible time-frame and will not delay in addressing Hong Kong's waste issue. As a pilot, it would only make a small dent in the reduction of MSW but it will serve as working proof that the technology is successful and will avoid the requirement of landfill extensions and allow for the eventuality of reverse landmining, after all, seeing is believing. Not only will this address the issue of location, but it will also make Tuen Mun a functional, innovative and modern green district. This will create a positive synergy involving the government, the private sector, NGOs and the community.
- 6.6 In addition, Green Tuen Mun, a status which the district should already have but is currently lacking, should be treated accordingly - a district where the green environment is heavily promoted and the technology developed. The government should cease using Tuen Mun as a "convenient" dumping ground for waste it does not want in its back garden. The government should be incentivizing the development of alternative waste management technologies which will eventually address the landfill problem and subsequently be meeting waste reduction targets as set out in its Blueprint.
- 6.7 It perhaps appears that the government is motivated to build this mammoth sized incinerator at Shek Kwu Chau to solely deal with the enormous amounts of MSW produced by its population and

not for actual waste management reasons- forgetting its objectives as set out in the Blueprint and potentially missing its earlier goals which were also missed in 2005. It does not directly deal with the issue of using resources optimally.

- 6.8 As government is convinced that incineration is the way forward, it should keep to its own time-frames whilst considering and implementing other feasible technology such as plasma gas. Tsang Tsui has been identified as a potential IWMF site with an EIA already completed. Government's actions are costly in time, money, health and to the environment. Instead, the area could be used to test plasma gas and alternative technology and potentially expand the units since it is modular in nature. Transparency is required and fair consideration of alternative waste management systems is respectfully requested. Government has maintained continual dialogue with experts in the incineration field; experts from the plasma gasification and pyrolysis coupled with gasification industry should also be afforded the equal opportunity to be extensively interviewed by the administration and have their technologies seriously considered.
- 6.9 Based upon the above data retrieved from NT Concern Group's investigation to Europe and from their understanding of other literature and sources, the recommendations are as follows:-
- 6.9.1 the Blueprint is not a concept with which we disagree with in principle, be that as it may by imposing levies and providing a reward scheme to encourage, incentivize and motivate the people of Hong Kong to practice waste separation in line with the Three Rs of Reduce, Reuse and Recycle;
- 6.9.2 we disagree with shutting out alternative technology. Is incineration the best and only available technology for Hong Kong? No. Plasma gasification technology and other advanced thermal technologies should be given a chance. A pilot plant or plants could be operational by 2017 and should

be housed in Tuen Mun as the site is ready (Tsang Tsui), the technology which is modular is ready and the logistics of being next to the landfill means there is a readily available supply of around 6,000 tpd of MSW;

6.9.3 the landfills should not be expanded but instead, technology should be employed to recuperate the land by back-mining the waste, a process which plasma gasification can carry out, allowing for better and greater utilization of a premium and lack of resource to Hong Kong;

6.9.4 Tuen Mun should not be seen to be like the sacrificial kamikaze by conveniently dumping waste in its backyard but instead should be turned into a useful, functioning, green city which can process the waste produced and latterly back mine; and

6.9.5 Hong Kong should take the lead in advancing this technology in the Pearl River Delta region. In adopting this approach, the acutely problematic pollution and harm to the environment could be lessened. Hong Kong should take back the initiative and influence others on the merits of plasma gasification.

6.10 On a final note, failure to manage rubbish and people well will lead to a catastrophe and result in a waste of talent and opportunity. Give Hong Kong a chance. Give ourselves a chance. Give our future generations a chance.

NT Concern Group

23rd November 2013

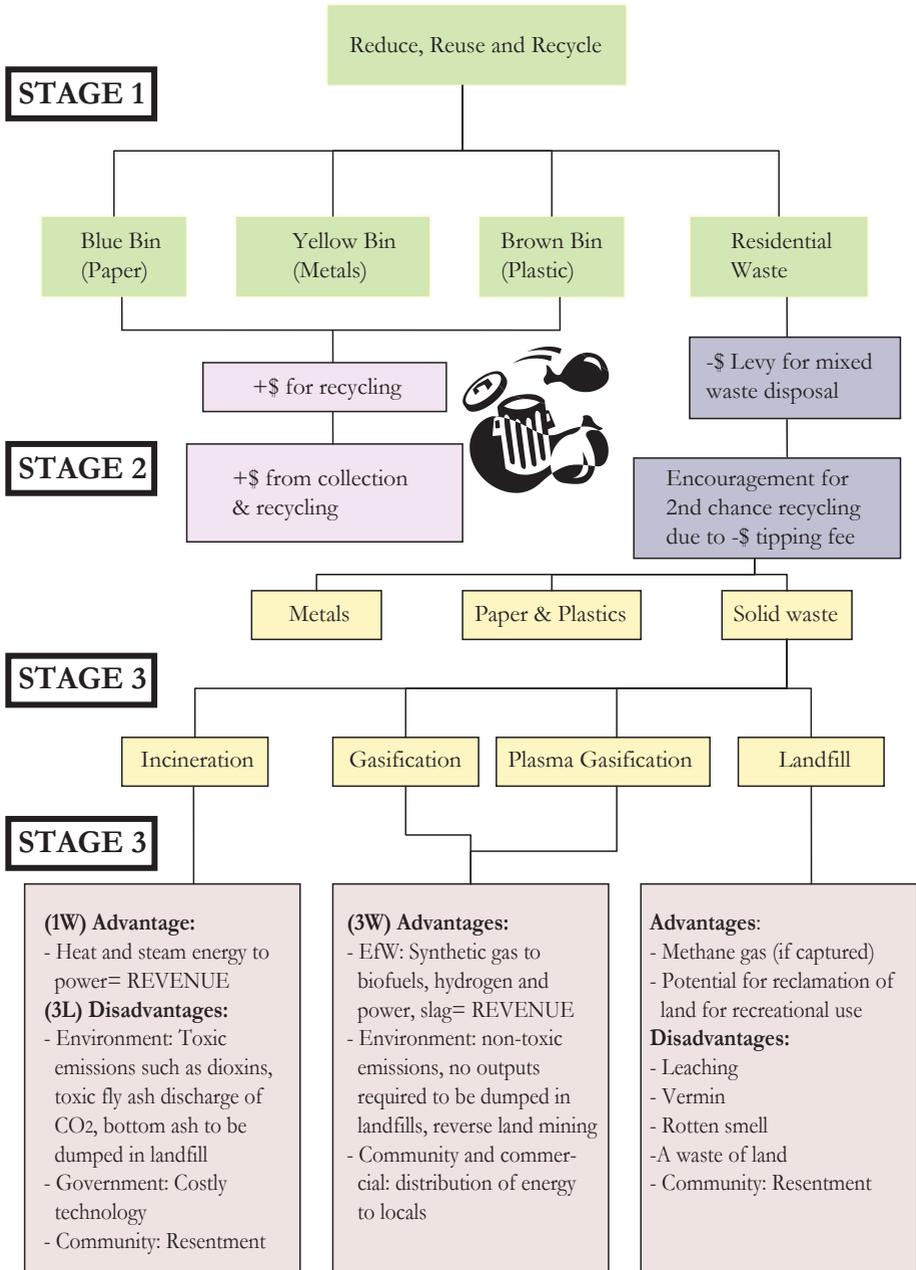
Annexure 7.1 - Incineration vs. Plasma Gasification

INCINERATION	PLASMA GASIFICATION
Total cost: HK\$42 billion*	Total cost: HK\$7.2 billion#
3,000 to 4,000 MSW processed (tpd)	2,000 MSW processed (tpd)
Does not support reverse land mining, as the ash requires to be dumped into landfills	Supports reverse land mining, as any ash produced is vitrified and turned into inert slag. Nothing is dumped into landfills
Fly Ash and Bottom Ash as by-product with as much as 30% requiring careful disposal	Slag as by-product with as much as 15% of waste becomes inert slag which can be safely used and reduce the requirement to import aggregate
Any potential energy is converted to heat	Gases are collected and used to produce a variety of energy forms such as heat, hydrogen, synthetic gas and jet fuels
Operates between 700°C and 1,000°C	Operates between 1,200°C and 10,000+°C
Requires hydrocarbon fuel or fuel gas to start burning of waste	Requires initial input of electricity but becomes self-sufficient when the plant produces electricity itself
Air is required for complete combustion	Little to no oxygen is required therefore no combustion
Greater emissions of greenhouse gases, pollutants and toxic ash	Lower emissions

* Will likely increase by the time the final judicial review appeal decision is made (possibly end of 2014 or later) with costs estimated to have jumped to around HK\$18 billion. The total amount includes the estimated construction costs of the IWMF at 15 billion; reclamation at 10 billion; landfill extension in Tuen Mun at 9 billion and Ta Kwu Ling and Tseung Kwan O at 8 billion.

Based on capital investment used for TV1 and to be used for TV2 (cost not including land reclamation as the land was already reclaimed by the time Air Products began construction- the figure for land reclamation was not made available).

Annexure 7.2- Three R's



Annexure 7.3 - Data

	1. Size (acres)	2. Input	3. Output	4. Waste processed (t/yr), Discharge (t/yr) and Environmental Standards	5. Construction time	6. Modular?	7. Workforce	8. Initial Costs and Operational costs	9. Internal Rate of Return	10. Future development?
1. RAV Water Treatment (Rotterdam)	TBC	60MW for entire site including incinerator, biomass and water treatment	41.5MW from incineration	-1.3k tonnes incineration -2% fly ash and 20-22% bottom ash -EU 0.1mg TEQ/m ³	1 year	No	270	TBC	TBC	TBC
2. WSS (Amsterdam)	660 litre containers x 10,000+ units	Solar power	TBC	-14% incinerated -2% landfilled -84% processed/ recycled	1 to 2 hours per 660 litre container	Yes	3 per 500-1,000 containers of 660 litres	TBC	TBC	2nd chance recycling
3. Advanced Plasma Power (Swindon)	10	4MW	16-20MW	-150,000 per line -12,000 Plasmarok (slag)	2 years	Yes	50	TBC	TBC	2nd chance recycling and Reverse Land Mining
4. New Earth (Avonmouth)	11 for entire site of which energy plant sits on 2	120kt RDF	13MWe	-120 kt -12% ash	18 months	Yes	7 in Operations at energy recovery plant per shift and over 120 for New Earth/ NEAT Group	TBC	Estimated to be 20% in an unlevered project	Gas to engine technology
5. Air Products (Teesside)	30 (can be reduced)	13MW	Gross output 50MW	-TV1 350,000 and TV2 350,000 -87,500 slag	27 to 30 months	Some components	50 700 during construction	GBP 300 million	TBC	2nd chance recycling and Reverse Land Mining

