

Best Renewable Energy for Hong Kong



WST INTERNATIONAL (HOLDINGS) LIMITED
HOUSEHOLD WASTE TO RESOURCES TECHNOLOGY



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Best Renewable Energy for HK



Definition of Renewable Energy

- Energy sources that are naturally replenishing but flow limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy sources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action and tidal action

(by US Energy Information Administration)



Wind Energy in HK



From the presentation of Dr. Lee Boon Ying, JP (Director of the HK Observatory)
in the 2010 Symposium of E-Management

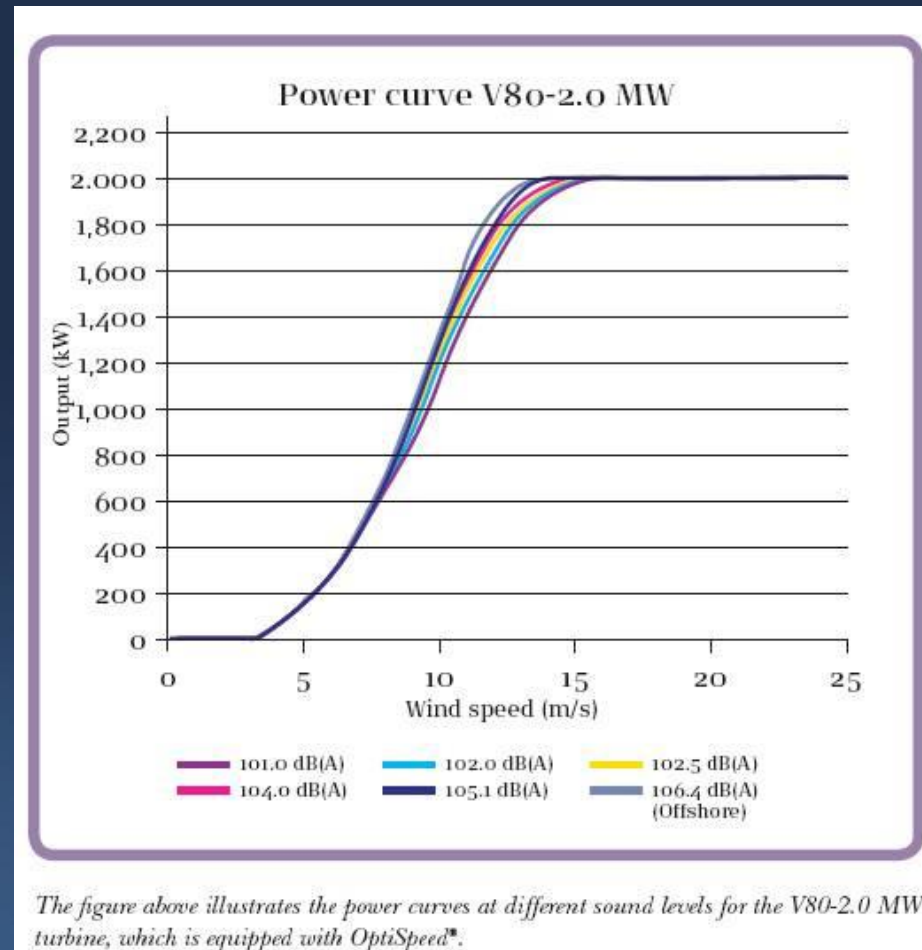
Table 1. Average annual mean wind speed, percentage of time with usable wind speed and mean wind power density at the 16 automatic weather stations

Automatic Weather Station	Average annual mean wind speed (ms ⁻¹)	Percentage of time with usable wind speed	Mean wind power density (Wm ⁻²)
Tai Mo Shan	6.7	83	397
Waglan Island	6.2	84	339
Tate's Carin	6.1	85	283
Ngong Ping	7.4	88	495
Green Island	5.8	81	293
Cheung Chau	5.0	76	204
Kai Tak	3.4	58	73
Sha Lo Wan	3.4	49	119
Lau Fau Shan	3.4	56	80
Tai Mei Tuk	3.5	55	118
Star Ferry	3.2	52	80
Tap Mun	2.7	45	69
Sai Kung	2.8	43	106
Ta Kwu Ling	2.0	26	41
Shatin	2.3	31	39
Tun Mun	2.4	34	47
Tsing Yi	2.3	32	48

Wind Energy in HK



Typical Wind Turbine Power Curve



Wind Energy



- First wind turbine in Hong Kong
 - Started operation in Feb 2006
 - 800 kW, 71m high
 - Average wind speed 5.5 m/s
- Achieving 1% RE for HEC
 - Needs 16 more
 - Where?



Wind Energy



- **CLP Proposes 67 wind turbines in Sai Kung**
- **Facebook group:**
Objection to CLP's wind farm proposal at Clearwater Bay
<http://www.facebook.com/group.php?gid=98033862796>
- **Their key points:**
 - 風力發電會引起強烈噪音, 故很多國家會將之建於人類及其他動物蹤跡渺然之處, 香港並不合適
 - 西貢是香港人的天然後花園, 是我們拋開繁忙工作的好去處, 絕不應讓風車摧毀它
 - 以超過**100**億港幣去建造只有**20-25**年使用期的風力發電計劃, 去換取每年少於**1%**的用電量, 經濟效益極低, 而只能減少**1.4%**的**CO₂**排放
 - 增加資產淨值, 又可以加電費了! (為什麼不增加天然氣作原料? 廢氣排放便可減少了, 但請謹記, 成本會增加, 但資產淨卻不能增加!)
 - 建造風車會引起海水污染, 危害海洋生物. 風車運作亦對鳥類構成嚴重威協

Solar Energy



- EMSD Study on the Potential Application of RE in HK (Stage 1) Dec 2002
 - The potential resource of PV power in Hong Kong has been estimated at 5,944 GWh/yr. It is equivalent to about 17% of the SAR's annual electricity consumption in 1999.
 - Solar heating has also been reviewed and is considered suitable for site-specific applications, such as hotels, hospitals, etc., and its potential in Hong Kong is regarded *insignificant*.



Solar Energy



- EMSD Study on the Potential Application of RE in HK (Stage 2) Dec 2004
 - The best performance achieved \$3.4/kWh (4% discount, 25 years)
- The fact is they never payback



Waste to Energy



- Municipal Solid Waste in Hong Kong (2009)
 - 8,963 MT (metric ton) per day being sent to the landfill
 - 6,015 MT from households (domestic waste)
 - Already excluded the waste separated at source and recycled
- 44.4% organic, very high water contents
- Low heat value, typically 10MJ/kg or less
- Incineration
 - Difficult to recover energy (need to add fuel)
 - Low efficiency due to use of electricity only (heat not used)
 - Community opposition
 - Burning 1 MT of waste emits 1 MT of CO₂

Key to Solving the "Waste Problem"



- Take out all the recyclable materials from the waste, leaving those with no or low value inert materials as the final waste for landfill
- Separate the recyclable materials by type to facilitate the downstream recycling processes



Difficulties in Treating Household Waste



- Household waste mainly contains organic materials (food leftovers with high water contents), paper and plastic packaging materials and small objects made of various types of materials. The huge quantity and complex composition make household waste the most difficult to deal with.

How it works ?



The Concept behind Waste Solutions Technology

Separate the waste components:

- by their physical nature: size, shape, density, solubility. . . .
- with the downstream recycling technology in mind. . .

Minimize:

- secondary pollution
- residue waste for final disposal

Maximize:

- resources derived from the waste





How it works ?

Mixed waste enters the WST system



Using water as the medium



Combined with specially designed mechanical modular devices



Materials are separated into different categories



WST technology utilizes the physical nature of water in combination with unique mechanical devices. The result: more than 80% of waste separated from the system can be recycled and reused.

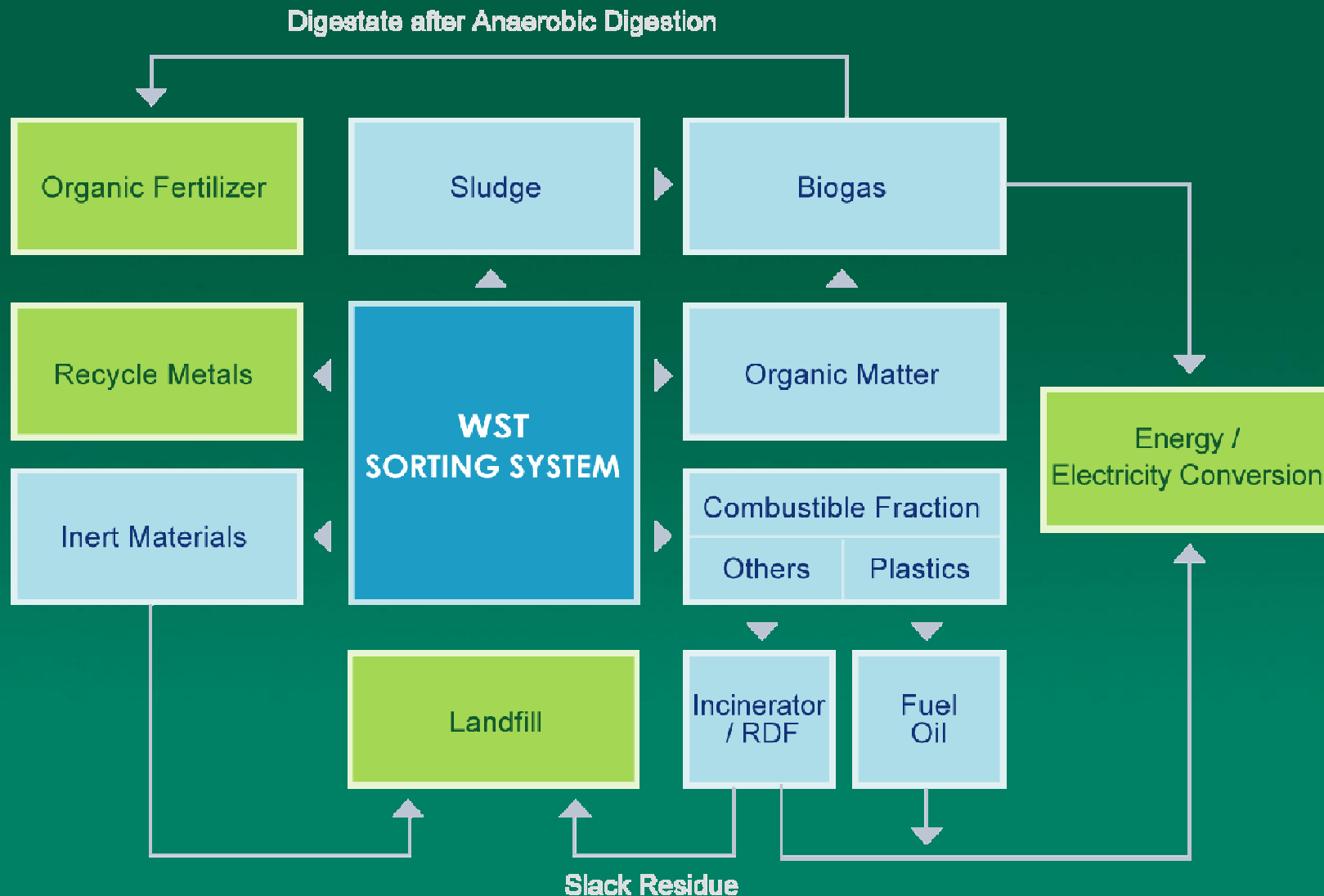
How it works ?



<http://www.youtube.com/watch?v=rB8Qth56lul>

<http://www.youtube.com/watch?v=pfwfxYCQ5eM>

Ideal Recycling Combination



Turning Waste to Resources



1. Organic Matter and Sludge

- Separation precision is above 90%
- Washed and cleaned by the system
- Unfavorable substances are removed (batteries, metals, plastics, glass, etc.)
- Also sludge and scum from the wastewater treatment
- For **biogas production**



Organic matter after sorting



Organic Slurry



Sludge from wastewater



Biogas Tank

Turning Waste to Resources



1. Organic Matter and Sludge (cont.)

- The organics to biogas process (anaerobic digestion) does not emit Landfill Gas (LFG) or methane. Biogas is also a clean energy source for heat or electricity generation.
- The methodology is a candidate for Clean Development Mechanism (CDM) under Kyoto Protocol and could generate Certified Emission Reductions (CERs) for trading.
- WST technology has attracted investment interests from various financial institutions including the World Bank and the Asian Carbon Fund.
- The residue after biogas production is used for organic fertilizer production



Residue after fermentation can be turned to fertilizer by simple processes

Refined organic fertilizers

Turning Waste to Resources



1. Organic Matter and Sludge (cont.)

- 6,015 MT domestic waste per day, 44% organics = 2,647 MT organics per day
- 1 MT organic generates 150 CBM of biogas, giving 396,990 CBM of biogas (at around 65% to 70% methane)
- 1 CBM biogas generates 2.04 kWh of electricity, giving 809,860 kWh
- Equivalent to 296 Million kWh per year or 2.71% of HEC's annual electricity sold

Turning Waste to Resources



2. Non-organic Fraction

- Ferrous Metals – To recycling factories
- Inert Materials – To landfills or sent to brick production plants



Ferrous Metals



Inert Materials

Waste Reduction through WST



Inert Materials to Landfill for Final Disposal

- About 5-15% in volume of incoming waste to be sent to landfill.
- These inert objects are mainly rocks, glass, ceramics that can be handled easily in the landfill process.
- There is only a very small percentage of organic objects such as bones and fruit cores left in this category. Their secondary pollution (odor and leachate) in landfill is minimal.
- Land resources and construction costs for landfills are significantly reduced.



Actual landfill volume is reduced to 5-15% of the original volume



Amount of waste to be landfilled after the WST sorting process.

Turning Waste to Resources



3. Plastic Fraction

- The WST system can sort out different types of plastics, depending on the waste composition and specific recycling needs.
- High quality plastics (mainly bottles) can be further separated (PET, HDPE) and then recycled. Low quality plastics can be used for RDF production or as a feedstock for Plastic to Fuel process.

Plastics obtained after sorting



Plastic Bottle



Styrofoam



Plastic Membranes



Packaging Materials

Turning Waste to Resources



3. Plastic Fraction (cont.)

- Low quality plastics can be converted into fuel oil through a catalytic pyrolysis process and the residue (carbon black) is also a valuable material for recycling factories.
- The fuel oil obtained meets GB252-2000 standard of light diesel.
- The process operates under atmospheric pressure at around 240°C.
- The higher quality plastics can be processed into plastic pellets that is high-valued in the market

Plastic to Fuel Technology



Pyrolysis Chamber



Fuel oil



Carbon black



Recycled plastic pellets

Turning Waste to Resources



3. Plastic Fraction (cont.)

- 6,015 MT domestic waste per day with 18.7% are plastics giving 2,647 MT of plastics per day
- With Plastic to Fuel technology at a yield of 50%, giving 675 MT of diesel fuel per day
- Equivalent to 246,332 MT of diesel fuel per year or 3.54% of retained import of fuel oil in Hong Kong

Turning Waste to Resources



4. Combustibles Fraction

- These are mainly textiles, leather, composite materials and other miscellaneous items that have no recycling value.
- There is no organics, metals, inert items in this group of materials. Hence they are suitable for producing RDF (Refuse Derived Fuel) which can be used for co-combustion with coal in power stations, cement factories, etc.



Soft & Long Materials

Combustible Materials

Composite materials
(with aluminium foil)



Incinerator



RDF (Refuse
Derived Fuel)

Turning Waste to Resources



4. Combustibles Fraction

- 6,015 MT domestic waste per day with 28.8% combustible materials (paper, textile, wood, etc.) giving 1732 MT of combustibles per day
- By drying, shredding, grinding and cubing, turned into Refuse Derived Fuel at a yield of 80% giving 1,386 MT per day
- Equivalent to 505,890 MT of coal replacement or 4.1% of retained import of steam coal in 2009

Emission Consideration



- No organics to landfill, no methane emission, qualified for Clean Development Mechanism (CDM), estimated CO₂ reduction 560,000 MT per year
- Electricity from biogas is carbon neutral, giving a reduction of 207,200 MT of CO₂ emission (0.7 kg/kWh) per year
- Reduce import of diesel fuel by 246,332 MT per year
- Reduce import of coal by 505,890 MT per year

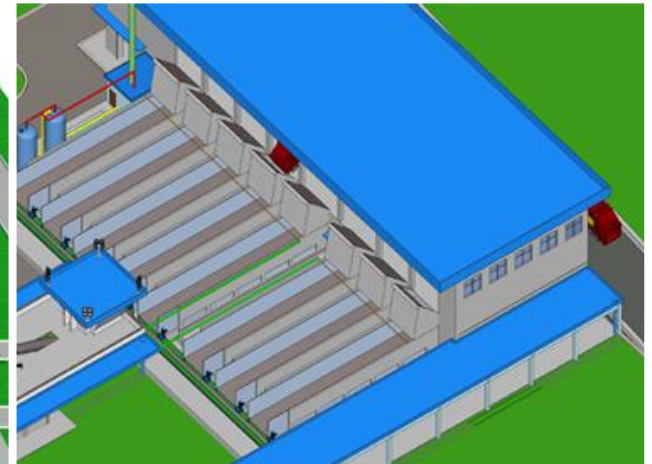
WST Standard Treatment Plant (500T/D)



Overall View



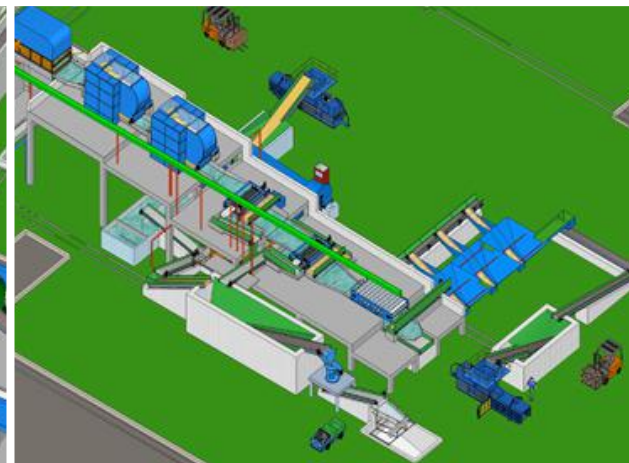
Interior overview of Water Sorting System



Automatic Feeding Device



Multi-function drum screens

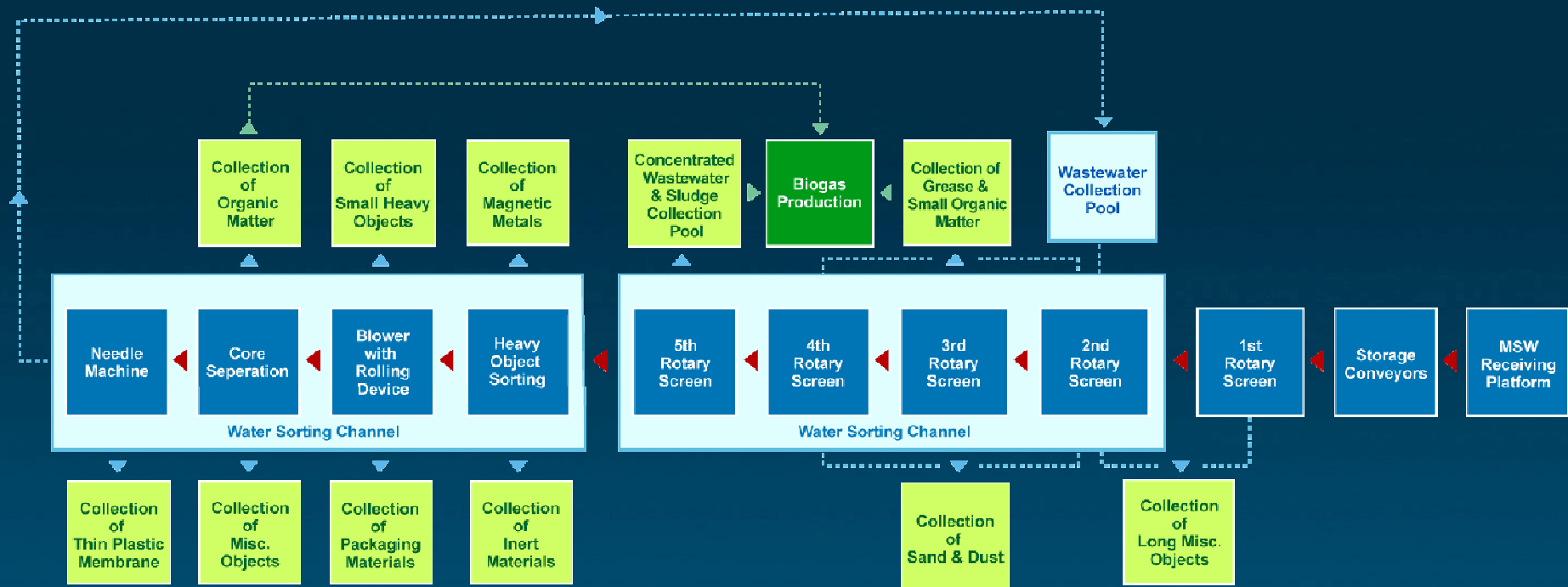


Water Sorting Section



Wastewater Treatment System & Biogas Production System

WST Technology Flowchart



The WST Innovation



Country	Title of invention	Patent No.
PCT (Patent Cooperation Treaty)	<ul style="list-style-type: none"> · Apparatus & method of separating small rubbish and organic matters from garbage for collection · Apparatus & method of separating plastic films from garbage for collection · Apparatus of piercing garbage bags and classifying garbage · Apparatus and method of separating medium-sized materials from garbage for collection · Apparatus and methods of separating heavy materials in garbage from light ones and classifying the heavy garbage for collection 	<ul style="list-style-type: none"> · PCT/IB2004/001451 · PCT/IB2004/001452 · PCT/IB2004/001453 · PCT/IB2004/001455 · PCT/IB2004/001463
U.S.A.	<ul style="list-style-type: none"> · Waste Disposal Apparatus · Apparatus of piercing garbage bags and classifying garbage · Apparatus and method of separating medium-sized materials from garbage for collection · Apparatus and method of separating plastic films from garbage for collection · Apparatus and method of separating small rubbish and organic matters from garbage for collection · Apparatus and method of separating heavy materials in garbage from light ones and classifying the heavy garbage for collection 	<ul style="list-style-type: none"> · US6,193,178 B1 · US6,955,265 B2 · US6,962,255 B2 · US6,994,221 B2 · US7,017,752 B2 · US7,017,753 B2
China	<ul style="list-style-type: none"> · Waste Disposal Method & Apparatus · Apparatus of piercing garbage bags and garbage screening · Apparatus of piercing garbage bags and garbage screening · Apparatus and method of separating small rubbish and organic matters from garbage for collection · Apparatus and method of separating medium-sized materials from garbage for collection · Apparatus and method of separating heavy materials in garbage from light ones and classifying the heavy garbage for collection · Apparatus and method of separating plastic films from garbage for collection · Apparatus of piercing garbage bags, collection of soft & long materials, dust & sand 	<ul style="list-style-type: none"> · ZL 98117498.1 · ZL02129187.X · ZL03102224.3 · ZL03102220.0 · ZL03102221.9 · ZL200420006679.7 · ZL03102222.7 · ZL200410037535.2
Taiwan	<ul style="list-style-type: none"> · Waste Disposal Method & Apparatus · Apparatus of piercing garbage bags and classifying garbage · Apparatus and method of separating heavy materials in garbage from light ones and classifying the heavy garbage for collection · Apparatus and method of separating small rubbish and organic matters from garbage for collection · Apparatus and method of separating medium-sized materials from garbage for collection · Apparatus and method of separating plastic films from garbage for collection 	<ul style="list-style-type: none"> · 139019 · I242474 · I228059 · I230100 · I230097 · I230099
Singapore	<ul style="list-style-type: none"> · Apparatus of piercing garbage bags and classifying garbage · Separating small rubbish and organic matters from garbage 	<ul style="list-style-type: none"> · 200506949-7 · 200506956-2



WST INTERNATIONAL (HOLDINGS) LIMITED

明日环保科技控股有限公司

**Unlocking an endless resource supply...
bringing new hope to the world**