

Sector Report:

Waste Management Market in Taiwan

January 2013

1. Why this sector is promising and why appointed development opportunities for NL

Waste management is one of the most important issues from the environmental protection's perspective. Today, the expenditure in the environmental protection in Taiwan accounts NT\$130 billion (around €3,5 billion) each other: NT\$75 billion from the government, and NT\$55 billion from the private sector. Among all, NT\$45 billion is spent on waste management, NT\$42 billion on water pollution treatment and prevention. Since some water pollution is caused by illegal waste disposal, the total expenditure on over all waste management is estimated to count NT\$50 billion in Taiwan. According to the market report, 80% of the total expenditure is from the government and 20% from private sector.

After 3 decades of development, waste management in Taiwan has achieved to some significant results. According to a report from the EPA, the rate of properly-treated municipal solid waste in Taiwan has reached 99%, with the recycling rate at over 40% and industrial waste recycling rate as high as 84%. Approximately 46% of the municipal solid waste is incinerated at waste-to-energy plants and about 2% is disposed off by landfills while about 52% are recycled (including food waste).

In turning a new era in Taiwan's management of waste resources, Taiwan-EPA looked at how developed nations such as Japan, the Netherlands, and those in the EU and OECD, handle sustainable materials management (SMM) and drawn up the Resource Recycling Policy Plan, which outlines five practical strategies and targets:

- sustainable resource management;
- green design and production;
- green consumption and trade;
- reduction at source and reuse;
- resource final disposal.

Business opportunities in these areas are expected to see significant growth in the near future.

2. Imago Netherlands / competition thermometer (who are already active in the market, there space for Dutch players?)

The development of the waste management in Taiwan is relatively new, comparing with the U.S. and the European countries. Therefore, the industry relies a lot on imported advanced technologies. There are only several local companies that have resources required, especially technologies needed, to handle large scale projects. As a result, the demand of the market is stronger than the supply and competition is relatively low. Some international major players entered the market in the early stage with their technological advantage.

For example, REMONDIS, a major international waste management company from Germany,

started their business in Taiwan since 1989 and now runs 2 plastic recycling factories. MWH Global from the U.S. entered the market with a branch office providing environmental engineering services since 1991. French company, Veolia Environmental Services, joint ventured with Taiwan Cement Corporation in 1992 for the incinerator construction and operation business. Japanese company, Tanaka, also had their heavy metal recycling factory set up in Taiwan in 2005, targeting at the electronic waste produced in the country. World Resource Company from the U.S. has also set up their subsidiary for recycling business, extracting heavy metal from the sludge (industrial waste) in Taiwan since 2006.

As for the most uprising market in soil and groundwater remediation, during the past decade, investigations and monitoring works are mostly done by the local environmental engineering companies. Companies from the U.S. are the most active ones in this subsector, together with their government's active role working with the Taiwanese government, providing assistance in policy and technology advises and consultancy services, such as Environ, Weston, and URS. However, the potential growth of the market has drawn the attention from more foreign market players to Taiwan, such as British and Australian companies. Two U.S. companies that already have their business in China also plan to start their business in Taiwan this year.

Since The Netherlands has a very strong and positive image in the sector and Taiwanese government and companies are keen to learn from The Netherlands, Dutch companies should take the advantage of the initiative and explore the market in the coming future.

3. Business Opportunities for the Dutch companies

Eijkelpark Agrisearch Equipment BV, which offers solutions for soil and water research, is most well-known Dutch company in the soil and groundwater remediation market in Taiwan. They have a local partner working as their agent to promote their products in Taiwan. This is the only Dutch company that is active in Taiwanese market at the moment.

However, The Netherlands' reputation in waste management has continuously attracted Taiwanese government to visit and learn experiences. In 2011, Taiwan-EPA's delegation visited Dutch Road Traffic Agency (RDW), Post Shredder Technology of Auto Recycling Netherlands (ARN), Waardenburg-Rhenoy Autodemontage B.V., Wecycle, G.A.D. in Naarden, and Kringloop winkel in Alkmaar for various types of waste management in The Netherlands.

In fact, The Netherlands' reputations in sediment management, ecological risk assessment, agriculture pollution management, and deep well drilling technology are highly appreciated in Taiwan. EPA-Taiwan has already shown great interest in cooperation with the Dutch sectors in these specific areas to introduce the advanced knowledge and products to the Taiwanese market.

In 2013, Soil and Groundwater Remediation Fund Management Board is planning a visit to The Netherlands to learn two major subjects:

1. Sustainable soil and groundwater remediation: site visit + policy making strategies to encourage sustainable soil and groundwater remediation
2. Ecological Risk Management/hierarchical risk assessment: Taiwan only has one factor to decide if the polluted site should be remediated or not. They would like to learn more

sophisticated management approaches, especially for polluted farm land.

However, it's not easy for foreign companies to participate directly in government tender projects in Taiwan due to the fact that few bids are open to international players and networking seems to be an essential element in doing business in this sector. Language barrier and business culture gap issues can make it difficult to maintain a good relation with customers. Therefore, we strongly recommend that finding a good local partner to develop the market together should be a better approach than step into the market directly.

Appendix I

Investment and development plans of local governments

- *Sustainable Development*

Sustainable development has been the government policy in Taiwan in the past decade. In the latest government development scheme, the "Golden Decade, National Visions," announced in 2011, environmental sustainability is listed as the Fifth Vision. According to Taiwan-EPA, resource recycling and pollution prevention are set as the major targets to conserve and protect the ecosystem in Taiwan in the following years, in order to provide a safe and healthy homeland.

In fact, Taiwan-EPA began to implement waste minimization at the source, compulsory garbage sorting, and expanded the scope of waste recycling from July 2002. The average amount of Municipal Solid Waste (MSW) collected for disposal reached 0.520 kg per capita per day in 2008, which dropped by 50.74% from the peak value in 1998. The percentage of MSW that was properly disposed of increased from 60.17% in 1989 to 99.99% in 2008. The recycling rate of MSW increased from 24.01% in 2004 to 41.96% in 2008. The recycling rate of MSW includes the resource recycling rate (32.20%), the kitchen waste recycling rate (9.17%) and the bulk waste recycling rate (0.59%).

It was only in 1984 that Taiwan first began construction of sanitary landfills, and not until 1991 were the first incinerators built. Today, 21 government-owned and three privately-owned waste-to-energy incinerators treat approximately 20,000 tonnes of MSW daily, generating 8000 MWh/day of electricity. All 150 incinerators in Taiwan are gradually being transformed into regional biomass energy centres. The remaining landfills are being shut down after reaching capacity, and future byproducts of incinerators will be used for land reclamation. However, Taiwan's achievements in waste recycling are resulting in over-supply of incineration capacity, and private operators which won contracts based on low bids are seeking other feedstock to replace high-calorific waste like plastic and tyres that are being recycled out of the waste stream.

The final goal is zero-waste in the waste management policy. Taiwan-EPA even plans to excavate old landfills for material and energy recovery, and add bio-energy capacity to its incineration facilities. There are a total of 404 landfills in Taiwan. The EPA says that it plans revitalize the nation's 298 closed garbage dumps by removing untreated or semi-treated materials for recycling, such as recycle glass, metal and flammables, as well as reuse rocks and pebbles for paving roads. The freed-up capacity will be used for cleaner refuse, with the sites eventually turned into parks or green belts. At the moment, Taiwan-EPA is also evaluating the possibility of a new land reclamation project that would make use of solid waste and garbage as part of an effort to help solve the nation's waste disposal problems.

- *Waste to Energy*

Green energy and carbon reduction are the issues that have been on the government's agenda these years, due to the fact that more than 90% of the energy in Taiwan is imported. Taiwan's management of waste has evolved from originally relying upon tail-end treatment to the current zero waste policy. How to turn waste into energy has always been an item on its agenda. To this end, the EPA is currently evaluating a refuse incinerator district heating

and cooling (DHC) system. The EPA estimates that installing this system on all of Taiwan's incinerators could increase total heat efficiency of the nation's incinerators by over 30% just by utilizing waste heat from power generation.

Taiwan currently has 24 large-scale refuse incineration plants that annually burn a total of 6.35 million tonnes of household and general waste. As well as going a long way to solving Taiwan's waste disposal problem, these incinerators also produce high-temperature steam that drives steam turbines to generate electricity. Statistics show that in 2011 Taiwan's 24 incineration plants produced 3,070 gigawatt-hours of electricity, of which 2,360 gigawatt-hours, or 76.87%, was sold. Revenues of NT\$4.51 billion were generated from the sale of the electricity, making it the incinerators' most important side benefit.

However, in terms of heat efficiency, incinerators — the primary purpose of which is to incinerate refuse — have a heat efficiency of just 20% on average. This means that 65-80% of excess heat escapes into the atmosphere via air-cooled condensers. Incinerators are thus a suitable target for heat reuse projects and the installation of demonstration systems as the margin for improving recovery is so large. The EPA estimates that taking advantage of the latent heat capacity of steam could lead to at least a 30~45% increase in the heat efficiency of Taiwan's refuse incinerators.

Furthermore, Taiwan-EPA recently announced that it has planned to work with local governments to build two biogas plants in five years to generate electricity with livestock waste. Taiwan currently has 6.17 million pigs, mainly in six counties and cities south of Changhua on the country's west coast, and the waste they produce accounts for over 20% of the river pollution in the country. With the establishment of the two bio-energy plants, pig manure could be processed as biogas and converted into electricity for industrial and household use, according to the EPA, and the residue could be used as soil conditioners and fertilizers. They are now looking at countries such as Denmark, the United Kingdom, Germany, Australia and New Zealand, to provide some experiences and biofuel technologies as models for Taiwan's design of the plants.

- ***Soil and groundwater management***

After years of development in waste management, the major challenges for Taiwan come from the soil and groundwater pollutions caused by both primitive landfills and continuous illegal dumping sites. Both primitive dumping sites and illegal dumping contaminated with toxic industrial wastes often leave heavy metals and chemicals in the soil and groundwater. Gas stations are another major source of soil and groundwater pollutions. These pollutions have made headlines in the news and the pressure from the general public has pushed the government to start the remediation works.

After 10 years of practices and experiences in a nationwide soil and groundwater investigation and remediation, Taiwan-EPA found the management in soil and groundwater pollution should be more comprehensive than they thought. As a result, they have drawn up a 4-year (2011~2015) plan with a total budget of NT4.35 billion (around €116 million) focusing on the following tasks:

- ✓ Apart from a more thorough investigation to be continued, the government also find the monitoring job important. Therefore, a nationwide network of monitoring wells and setting up alert systems for monitoring wells and irrigation systems to detect

pollution in time.

- ✓ Sediment from rivers, reservoirs, and irrigation canals are included into the soil and groundwater monitoring system starting from 2013. This is a brand new area where Taiwanese industry is rather lack of experiences and knowledge with.
- ✓ The government also needs to learn more about polluted-land management, such as environmental impact and health risk assessment management, in order to complete a decision-making support system. A strategic approach is in need for polluted-land use in the coming future, especially for farm lands.
- ✓ The government will lead the industry to upgrade the soil and groundwater remediation technologies, including sampling and testing technologies, and to introduce the most updated remediation technologies into the market, such as green remediation strategies to promote more energy-effective and environmental friendly remediation methods.
- ✓ 10 years of practices and experiences have made Taiwan a successful story among Asian countries. Therefore, Taiwan initiated a Working Group on Remediation for Soil and Groundwater Pollution of Asian Countries as a platform for administrators, researchers, and environmental engineers from Asia and other countries, in order to maintain the leading role in the field. This should make Taiwan an ideal partner for Dutch companies to enter Asia market.

Appendix II

Investment and development of local businesses

- *Industrial Waste*

As a global ICT product manufacturing base, the demand for industrial waste treatment and recycling in Taiwan is large, while the number of legal and large scale waste treatment and recycling companies is limited. These Taiwanese ICT companies are very good at developing new technologies for new products but very limited knowledge and technologies for these ICT wastes. For example, the total production value of LCD displays in Taiwan already reached NT\$1.615 billion in 2008. However, how to treat the wastes produced during and after the production, especially toxic chemicals, remains a big challenge for the industry.

The business in waste management can be divided into waste clearance, waste treatment, and resource recycling and reuse. In the past a large number of industrial wastes were exported to the neighbouring countries, especially China. Since the Taiwanese government decided to comply with Basel Convention in 2005, import and export of industrial hazardous wastes is limited. For this reason, the demand for technologies of waste reduction, and recycling and reuse of industrial wastes started to boom. According a market report, the production value of the waste management industry in Taiwan grew 39% annually between 2005~2008. The total production value of recycling and reuse of industrial waste grew from NT\$24,9 billion in 2002 to NT\$65,6 billion in 2011.

The effectiveness of the government's zero-waste policy has resulted in 84% of industrial wastes being recycled, and the remaining 16% treated by the waste generators themselves, or through contracted professional services. Proper treatment of hazardous wastes is now at 60%, and the EPA and MOEA are evaluating ways to improve this rate. Based on statistics reported by Taiwan EPA, a total of about 16.8 million tons of general industrial wastes from these designated industries was reported in 2010. The top three types of wastes by volume were coal ash, blast furnace slags, and electric arc smelting furnace slag, comprising 55.3% of all reported wastes.

As for the treatment of industrial wastes, government and corporate promotion of clean production and resource recycling has resulted in the recycling of approximately 84% of industrial wastes (approximately 14.2 million tones in 2010). Industrial wastes that were not recycled were properly treated either by the generators or through contracted professional services, which accounted for 15% of industrial waste (approximately 2.6 million tones in 2010).

As for hazardous industrial wastes, 0.89 million tones of hazardous industrial wastes was reported in 2010. The types of hazardous industrial wastes by volume were 229.500 tones of electric arc smelting furnace ash, 126.700 tones of copper sludge, 112.000 tones of waste solution, 97.900 tones of waste acid, and 71.200 tones of electroplate water treatment sludge. Reuse was the most common management method for hazardous industrial wastes. Recycle account for 38% of all hazardous industrial waste (approximately 340,800 tones) in 2010. Environmental sound treatment either by the generators or through contracted services accounted for 60% of hazardous industrial waste.

Currently, in the waste management market in Taiwan, the demand seems still to be larger than the supply. According to “The Specific Environmental Protection Service Industry Survey, 2011” published by Taiwan-EPA, altogether there were 3,436 businesses in the specific environmental protection service industry at the end of 2010. Among all, 2,550 businesses are in the waste clearance and treatment, 794 businesses are in resource recycling, 92 businesses are in environmental analysis and testing. 70% of these business are private companies with small business scale (1-5 employees) accounted for the main part (around 60%). The total revenue from the environmental service industry was NT\$108.76 billion and the total expenditure was NT\$89.87 billion in 2010.

One of the major reasons why these businesses are limited in a small scale is the difficulty of acquiring the land needed to operate the business. Taiwan is a small country with high density of population. Due to the negative images in the past, especially pollutions from toxic industrial waste, local residents often object to have a waste disposal or treatment plant nearby. And since they are small scale businesses, they often don't have enough resources needed, financially and technologically, to invest in pollution prevention at their sites, which results in even worse image for the general public. This is a real challenge that the waste management industry in Taiwan is facing. Among 2,550 businesses in the waste clearance and treatment, only 22 businesses hire more than 100 employees.

- ***Soil and Groundwater Remediation***

Business in soil and groundwater investigation and remediation in Taiwan is rather new development and still relies a lot on imported experiences and technologies from other countries, mostly from the U.S. Because of the technological obstacle, the number of businesses in the sector is still rather small. According to the statistics from Taiwan-EPA, there are 50 businesses registered providing engineering services for soil and groundwater remediation; 43 businesses registered providing soil and groundwater analysis and testing services; 16 registered businesses providing soil and groundwater pollution investigation and remediation equipment/technologies.

The increasing investment in the sector from the government, especially in the sediment management, has attracted several international players to step in the market this year. New regulations on the sediment management require the responsible authorities of water bodies, such as rivers and reservoirs, to monitor the sediment regularly and report to the authorities when results exceed the index. This means there will be investment in both local and central government level for related engineering services and equipment/technologies. Since the sector in Taiwan lacks of experiences and knowledge in this field, they will be keen to look for solutions from those countries that have high reputations on it, such as the U.S. and The Netherlands.

Appendix III

DESTEP factors (demographic, economic, political, ecological, socio-cultural and technological factors)

Location:	Eastern Asia, off the south-eastern coast of China, between Japan and the Philippines.
Area :	36,000 square kilometers
Population:	23 million
Capital :	Taipei City
Language :	Mandarin Chinese (official), Taiwanese & Hakka dialect. English is the most common foreign language in business practice.
Religion :	Mixture of Buddhism, Confucian, Taoism, Christian, Catholic & Others.
Terrain:	Eastern two-thirds mostly rugged mountains; flat to gently rolling plains in west.
Climate:	Tropical; marine; rainy season during southwest monsoon (June to August)
Government:	Multiparty democratic regime headed by popularly elected president (the recently president election was on 20 March 2008)
Infrastructure:	Railways 2.481 km, highways 36.698 km. International seaports (harbours) - Keelung, Hualien, Kaohsiung, and Taichung
GNP per capita:	US\$ 18,588 (2010)
Currency:	New Taiwanese Dollar (average is accounted NT\$37.5 = Euro€1)

- Cross Strait Relation

Over the past six decades, the societies on either side of the Taiwan Strait and relations between them have undergone momentous transformations. In 1949, as a result of civil war on the Chinese mainland, the government of the Republic of China relocated to the island province of Taiwan to advance the ideals on which the Republic was founded. Since then, the two separately governed territories have evolved in different directions politically and economically: The ROC(Taiwan) has become a thriving democracy with a well-developed free-market system, while mainland China, though gradually adopting free-market mechanisms, has remained authoritarian.

The relationship between the two has changed over the past two decades from one of estrangement and military confrontation to one characterized by extensive people-to-people and economic exchanges and semi-official consultations. While the possibility of armed conflict across the Taiwan Strait remains a matter of international concern, the resumption of institutionalized cross-strait talks in mid-2008 and signing of agreements on a variety of practical issues offer hope that steady progress can be made toward building a framework for advancing mutual trust, peace and prosperity.

- ***Economics***

The biggest contributor to GDP, at 67.08%, was the service sector, which employed 58.84% of the work force. Industry (manufacturing, construction, utilities, mining and quarrying), comprising 35.92% of the work force, contributed 31.34% of GDP. Agriculture, with 5.24% of workers, made up the remaining 1.58%.

Small and medium-sized enterprises (SMEs) play a critical role in the economy. According to the Ministry of Economic Affairs (MOEA), SMEs in Taiwan numbered about 1.25 million at the end of 2010, accounting for 97.68% of all enterprises. They employed 8.19 million workers, or 78.06% of the total work force. SMEs' sales of goods and services comprised 29.55% of all sales and made up 16.88% of total export value in 2010.

Taiwan plays a dynamic role in the global economy. According to World Trade Organization statistics in 2010, it was the world's 16th-largest exporter and 17th-largest importer of merchandise, while ranking No. 24 and No. 28 in export and import of commercial services, respectively. One of the most powerful players in the global information and communications technology (ICT) industry, it is also a major supplier of other goods across the industrial spectrum, from chlorella health food supplements to powered wheelchairs.

In the 2011 World Competitiveness Yearbook issued by Switzerland's International Institute for Management Development, Taiwan moved up two places to No. 6 overall to achieve its best ranking in over a decade. It retained the third spot in the "business efficiency" category, attributable in part to its companies' adaptability and its stock market efficiency, ranking first and second, respectively, in these categories.

Taiwan ranked 13th in the World Economic Forum's (WEF) Global Competitiveness Report 2010-2011, earning high marks in the categories of health, higher education, personnel resources, market efficiency and innovation. In its April 2011 Business Risk Service report, U.S.-based Business Environment Risk Intelligence again rated Taiwan as having the fourth-lowest-risk environment out of 50 nations surveyed.

- ***Science & Technology***

Global surveys have consistently given Taiwan high scores in their S&T-related indices. It is in sixth place in the category of technological infrastructure among the 59 top economies surveyed in the 2011 World Competitiveness Yearbook, compiled by the International Institute for Management Development. And among the 139 economies surveyed in the World Economic Forum's Global Competitiveness Report 2010-2011, it is ranked No. 1 in the sub-index of new utility patents per million population, No. 6 in quality of math and science

education, No. 8 in availability of scientists and engineers, No. 8 in Internet access in schools, and No. 9 in company spending on R&D.

Collaboration between sectors is producing valuable fruits. They range from powerful next-generation computer processors and nano-scale computer memory units to pharmaceutical and radiological therapies for cancer, and from satellites that boost the accuracy of meteorological and climatic analyses to advances in wireless and broadband Internet communications that greatly expand vistas for e-learning and access to valuable software resources.

For many years, Taiwan has ranked among the top five countries for the number of patents issued by the U.S. Patent and Trademark Office. It was the No. 4 recipient of all types of U.S. patents over the period 1986 to 2010. In terms of out-put of scientific papers, Taiwan ranked 16th worldwide in 2009 for the number of papers published in journals tracked in Thomson Reuters' Science Citation Index, and ninth for those published in journals tracked in the organization's Engineering Index.

- ***Social-cultural***

Taiwan is a multi-ethnic society, where waves of settlement and encounters with other civilizations have bequeathed it a diverse cultural heritage. The settlers from southern mainland China centuries ago, the 17th-century Dutch and Spanish presence, Japanese colonial rule from 1895 to 1945, and the influx of 1.3 million people from various parts of mainland China in 1949 all helped shape the culture. Millennia-old customs and rituals of its indigenous peoples continue to be observed in Taiwan today, while cross-cultural marriages involving more than 400,000 new immigrants have further enriched the island's cultural tapestry, making Taiwan an incubator of diverse art forms that not only coexist, but blend with or influence each other.

Taiwan's population of some 23 million is graying, and its fertility rate fell to 0.895 per woman in 2010, the lowest in the world. Policy measures have been enacted to encourage young people to marry and have children. Taiwan became an aging society as defined by the World Health Organization when its elderly population (65 or older) crossed the 7-percent threshold in 1993. At the end of 2010, 10.74% of the population (or 2.49 million people) were elderly, and the old-age dependency ratio—the ratio of elderly people to the work force under 65—stood at 14.59%. According to the Council for Economic Planning and Development, Taiwan's elderly will amount to more than 40% of the population by 2060, making long-term care for the elderly a pressing public policy issue.

Appendix IV

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TAIWAN ENVIRONMENTAL ENGINEERING ASSOCIATION

<http://www.teea.org.tw/index.asp>

Taiwan Association of Soil and Groundwater Environmental Protection

<http://www.tasgep.org.tw/>

Working Group on Remediation for Soil and Groundwater Pollution of Asian Countries

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