

Analysis by Projects & Policy Research Department | PBIT | Oct 2018



WASTE MANAGEMENT

&

WASTE TO ENERGY

Projects & Policy Research Department

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1. Treating residual waste with various Waste-to-Energy (WtE) technologies is a viable option for disposal of Municipal Solid Waste and energy generation. There are many factors that will influence the choice of technology and every region will have to properly assess its specific context to implement the most reasonable solution.
2. The global WtE market was valued at US\$25.32 billion in 2013, a growth of 5.5% on the previous year. WtE technologies based on thermal energy conversion lead the market, and accounted for 88.2% of total market revenue in 2013.
3. The global market is expected to maintain its steady growth to 2023, when it is estimated it would be worth US\$40 billion, growing at a CAGR of over 5.5% from 2016 to 2023.
4. Europe is the largest and most sophisticated market for WtE technologies, accounting for 47.6% of total market revenue in 2013. The Asia-Pacific market is dominated by Japan, which uses up to 60% of its solid waste for incineration. However, the fastest market growth has been witnessed in China, which has more than doubled its WtE capacity in the period 2011-2015.
5. Biological WtE technologies will experience faster growth at an average of 9.7% per annum, as new technologies (e.g. anaerobic digestion) become commercially viable and penetrate the market.
6. From a regional perspective, the Asia-Pacific region will register the fastest growth over this period (CAGR of 7.5%), driven by increasing waste generation and government initiatives in China and India; and higher technology penetration in Japan.
7. It is estimated that global waste generation will double by 2025 to over 6 million tonnes of waste per day and the rates are not expected to peak by the end of this century. While OECD countries will reach 'peak waste' by 2050, and East Asia and Pacific countries by 2075, waste will continue to grow in Sub-Saharan Africa. By 2100, global waste generation may hit 11 million tonnes per day.
8. The need to increase the share of renewable energy and reduce GHG emissions, along with raising environmental consciousness to protect the environment from polluting and unsustainable practices such as landfilling, will have a positive impact on WtE market development.
9. WtE remains a costly option for waste disposal and energy generation, in comparison with other established power generation sources and for waste management, landfilling.
10. Combustion plants are no longer a significant source of particulate emissions owing to the implementation of governmental regulations on emission control strategies, reducing the dioxin emissions by 99.9%.

CHAPTER 1

- **Global Waste Generation**
- **Global Waste Collection**
- **Global Waste Composition**
- **Energy from waste**



**Globally Waste To Energy
Market Expected to Reach
\$43.9 Billion by 2024**

At a Glance:

MSW generation levels are expected to double by 2025.

The higher the income level and rate of urbanization, the greater the amount of solid waste produced.

OECD countries produce almost half of the world's waste, while Africa and South Asia regions produce the least waste.

Current global MSW generation levels are approximately 1.3 billion tonnes per year, and are expected to increase to approximately 2.2 billion tonnes per year by 2025. This represents a significant increase in per capita waste generation rates, from 1.2 to 1.42 kg per person per day in the next fifteen years. However, global averages are broad estimates only as rates vary considerably by region, country, city, and even within cities. MSW generation rates are influenced by economic development,

the degree of industrialization, public habits, and local climate. Generally, the higher the economic development and rate of urbanization, the greater the amount of solid waste produced. Income level and urbanization are highly correlated and as disposable incomes and living standards increase, consumption of goods and services correspondingly increases, as does the amount of waste generated. Urban residents produce about twice as much waste as their rural counterparts.

Region	Waste Generation Per Capita (kg/capita/day)		
	Lower Boundary	Upper Boundary	Average
AFR	0.09	3.0	0.65
EAP	0.44	4.3	0.95
ECA	0.29	2.1	1.1
LAC	0.11		1.1
MENA	0.16	5.7	1.1
OECD	1.10	3.7	2.2
SAR	0.12	5.1	0.45

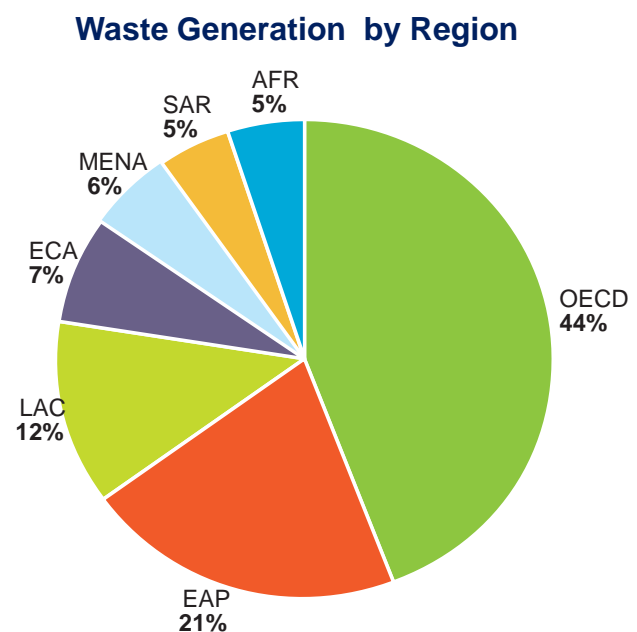
Waste Generation by Region

Waste generation varies as a function of affluence, however, regional and country variations can be significant. Waste generation in sub-Saharan Africa is approximately 62 million tonnes per year. Per capita waste generation is generally low in this region, but spans a wide range, from 0.09 to 3.0 kg per person per day, with an average of 0.65 kg/capita/day. The countries with the highest per capita rates are islands, likely due to waste generated by the tourism industry, and a more complete accounting of all wastes generated. The annual waste generation in East Asia and the Pacific Region is approximately 270 million tonnes per year. This quantity is mainly influenced by waste generation in China, which makes up 70% of the regional total. Per capita waste generation ranges from 0.44 to 4.3 kg per person per day for the region, with an average of 0.95 kg/capita/day (Hoornweg et al 2005).

The OECD countries generate 572 million tonnes of solid waste per year. The per capita values range from 1.1 to 3.7 kg per person per day with an average of 2.2 kg/capita/day. In South Asia, approximately 70 million tonnes of waste is generated per year, with per capita values ranging from 0.12 to 5.1 kg per person per day and an average of 0.45 kg/capita/day.

In Eastern and Central Asia, the waste generated per year is at least 93 million tonnes. Eight countries in this region have no available data on waste generation in the literature. The per capita waste generation ranges from 0.29 to 2.1 kg per person per day, with an average of 1.1 kg/capita/day.

Latin America and the Caribbean has the most comprehensive and consistent data (e.g. PAHO's Regional Evaluation of Solid Waste Management, 2005). The total amount of waste generated per year in this region is 160 million tonnes, with per capita values ranging from 0.1 to 14 kg/capita/day, and an average of 1.1 kg/capita/day. Similar to the high per capita waste generation rates on islands in Africa, the largest per capita solid waste generation rates are found in the islands of the Caribbean.



Waste Generation by Country Income Level

High-income countries produce the most waste per capita, while low income countries produce the least solid waste per capita. Although the total waste generation for lower middle income countries is higher than that of upper middle income countries, likely skewed as a result of China's inclusion in the lower middle income group, the average per capita waste generation amounts for the various income groups reflect the income level of the countries. The high, upper-middle, lower-middle, and low income designations are somewhat inaccurate as these classifications are country-wide, and in several countries average national affluence can be very different from average affluence of the urban populations. Only the affluence of urban residents is important in projecting MSW rates. For example, India and especially China have disproportionately high urban waste generation rates per capita relative to overall economic status as they have large relatively poor rural populations that tend to dilute national figures. boundary and upper boundary for each region, as well as average kg per capita per day of waste generated within each group according to country income level.

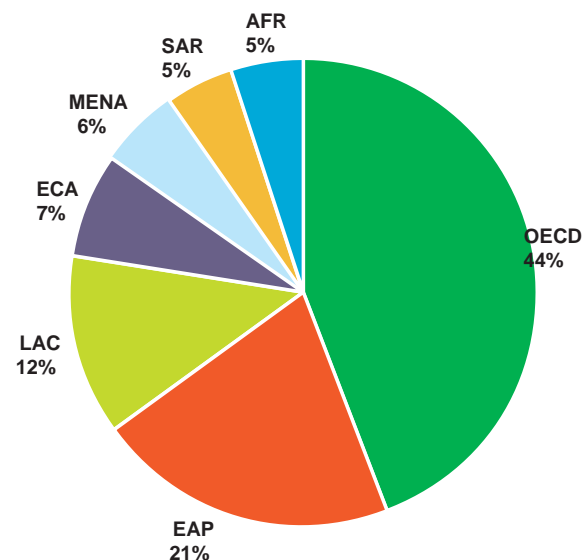
Waste Generation Projections for 2025 by Region

Region	Current Available Data			Projections for 2025			
	Total Urban Population (millions)	Urban Waste Generation		Projected Population		Projected Urban Waste	
		Per Capita (kg/capita/day)	Total (tons/day)	Total Population (millions)	Urban Population (millions)	Per Capita (kg/capita/day)	Total (tons/day)
AFR	260	0.65	169,119	1,152	518	0.85	441,840
EAP	777	0.95	738,958	2,124	1,229	1.5	1,865,379
ECA	227	1.1	254,389	339	239	1.5	354,810
LCR	399	1.1	437,545	681	466	1.6	728,392
MENA	162	1.1	173,545	379	257	1.43	369,320
OECD	729	2.2	1,566,286	1,031	842	2.1	1,742,417
SAR	426	0.45	192,410	1,938	734	0.77	567,545
Total	2,980	1.2	3,532,252	7,644	4,285	1.4	6,069,703

Current Waste Generation Per Capita by Income Level

	Waste Generation Per Capita (kg/capita/day)		
	Lower Boundary	Upper Boundary	Average
High	0.70	14	2.1
Upper Middle	0.11	5.5	1.2
Lower Middle	0.16	5.3	0.79
Lower	0.09	4.3	0.60

Waste Generation by Region



At a Glance:

MSW collection is an important aspect in maintaining public health in cities around the world.

The amount of MSW collected varies widely by region and income level; collection within cities can also differ greatly.

Collection rates range from a low of 41% in low-income countries to a high of 98% in high-income countries.

Waste collection is the collection of solid waste from point of production (residential, industrial commercial, institutional) to the point of treatment or disposal. Municipal solid waste is collected in several ways:

House-to-House: Waste collectors visit each individual house to collect garbage. The user generally pays a fee for this service.

Community Bins: Users bring their garbage to community bins that are placed at fixed points in a neighborhood or locality. MSW is picked up by the municipality, or its designate, according to a set schedule.

Curbside Pick-Up: Users leave their garbage directly outside their homes according to a garbage pick-up schedule set with the local authorities (secondary house-to-house collectors not typical).

Self Delivered: Generators deliver the waste directly to disposal sites or transfer stations, or hire third-party operators (or the municipality).

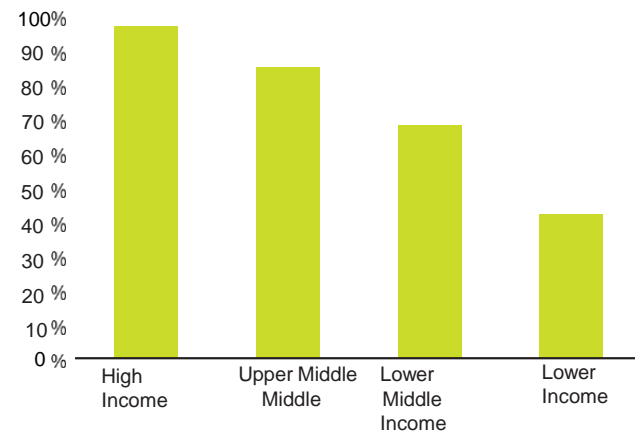
Contracted or Delegated Service: Businesses hire firms (or municipality with municipal facilities) who arrange collection schedules and charges with customers. Municipalities often license private operators and may designate collection areas to encourage collection efficiencies.



MSW Collection by Income

The data show that the average waste collection rates are directly related to income levels. Low-income countries have low collection rates, around 41%, while high-income countries have higher collection rates averaging 98%. shows the average collection percentage by income.

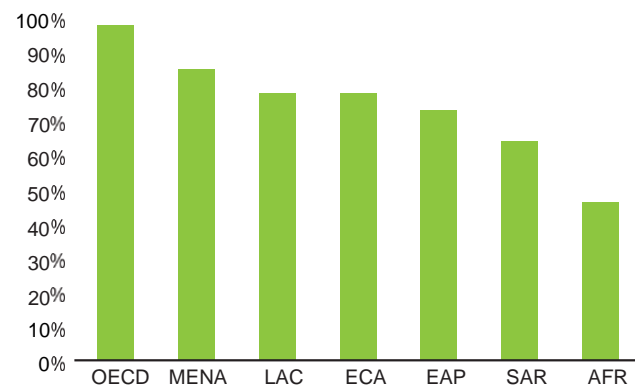
Waste Collection Rates by Income



MSW Collection by Region

MSW collection efficiency by region. Regions with low-income countries tend to have low collection rates. South Asia and Africa are the lowest with 65% and 46% respectively. Not surprisingly, OECD countries tend to have the highest collection efficiency at 98%.

Waste Collection Rates by Region



At a Glance:

Waste composition is influenced by factors such as culture, economic development, climate, and energy sources; composition impacts how often waste is collected and how it is disposed.

Low-income countries have the highest proportion of organic waste.

Paper, plastics, and other inorganic materials make up the highest proportion of MSW in high-income countries.

By region, EAP has the highest proportion of organic waste at 62%, while OECD countries have the least at 27%, although total amount of organic waste is still highest in OECD countries.

Although waste composition is usually provided by weight, as a country's affluence increases, waste volumes tend to be more important, especially with regard to collection: organics and inerts generally decrease in relative terms, while increasing paper and plastic increases overall waste volumes.

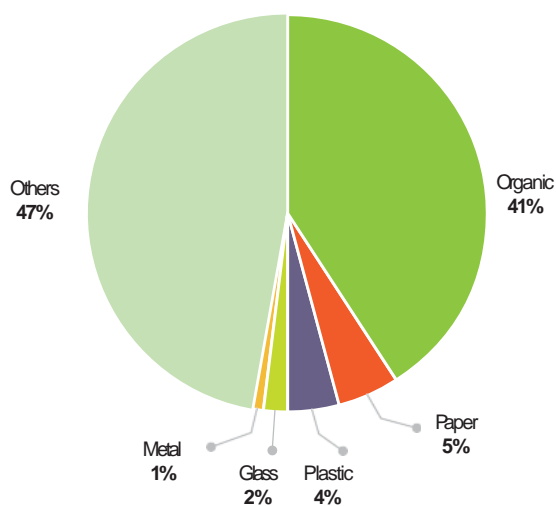
In the municipal solid waste stream, waste is broadly classified into organic and inorganic. Waste composition is categorized as organic, paper, plastic, glass, metals, and 'other.' An important component that needs to be considered is 'construction and demolition waste' (C&D), such as building rubble, concrete and masonry. In some cities this can represent as much as 40% of the total waste stream. However, C&D waste is not included unless specifically identified. A separate case-by-case review is recommended for specific cities. (ICI) waste also needs further local refinement. Many industrial processes have specific wastes and by-products. In most cities this material, with its relatively easier flow and quality control, is the first material to be recycled. Some industrial process waste requires specific treatment. For most MSW management plans industrial by-products are not included in waste composition analyses, however household and general waste should be included since it is usually disposed at common facilities, and in most cities waste from the ICI sector represents the largest fraction of the waste collected.

Waste composition is influenced by many factors, such as level of economic development, cultural norms, geographical location, energy sources, and climate. As a country urbanizes and populations become wealthier, consumption of inorganic materials (such as plastics, paper, and aluminium) increases, while the relative organic fraction decreases. Generally, lower and middle-income countries have a high percentage of organic matter in the urban waste stream, ranging from 40 to 85% of the total. Paper, plastic, glass, and metal fractions increase in the waste stream of middle- and high-income countries, organics make up 64% of the MSW stream for low-income countries

and paper only 5%, whereas in high-income countries it is 28% and 31% respectively. The IPCC uses its own classification of MSW composition based on region .

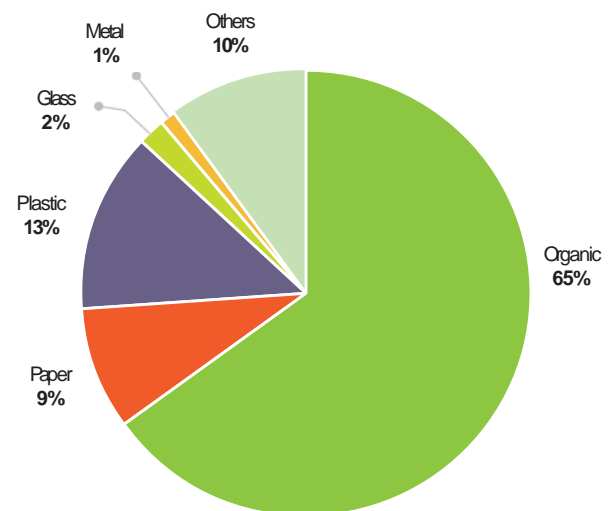
In high-income countries, an integrated approach for organic waste is particularly important, as organic waste may be diverted to water-borne sewers, which is usually a more expensive option. Geography influences waste composition by determining building materials (e.g. wood versus steel), ash content (often from household heating), amount of street sweepings and horticultural waste. The type of energy source

Population Using Coal



Source: Hoornweg 2005

Population Using Gas



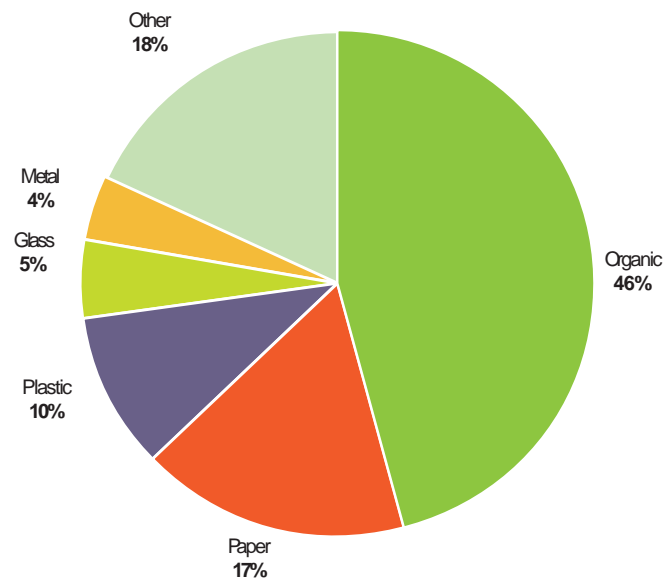
Municipal Waste Generated from Population Using Coal for household heating = 49,500,000 tons Municipal Waste Generated from Population Using Gas for household heating = 100,500,000 tons Total Municipal Waste Generation in 2000 = 150,000,000 tons

Geography influences waste composition by determining building materials (e.g. wood versus steel), ash content (often from household heating), amount of street sweepings (can be as much as 10% of a city's waste stream in dry locations), and horticultural waste. The type of energy source in a location can have an impact on the composition of MSW generated. This is especially true in low-income countries or regions where energy for cooking, heating, and lighting might not come from district heating systems or the electricity grid. The difference in waste composition in China between a section of the population that uses coal and another that uses natural gas for space heating. The 'other' category is clearly higher: 47% when coal is used, and an ash residue is included, as opposed to 10% when natural gas is used for home heating. Climate can also influence waste generation in a city, country, or region. For example, in Ulan Bator, Mongolia, ash makes up 60% of the MSW generated in the winter, but only 20% in the summer (UNEP/GRID-Arendal 2004). Precipitation is also important in waste composition, particularly when measured by mass, as un-containerized waste can absorb significant amounts of water from rain and snow. Humidity also influences waste composition by influencing moisture content.

Waste Composition in China

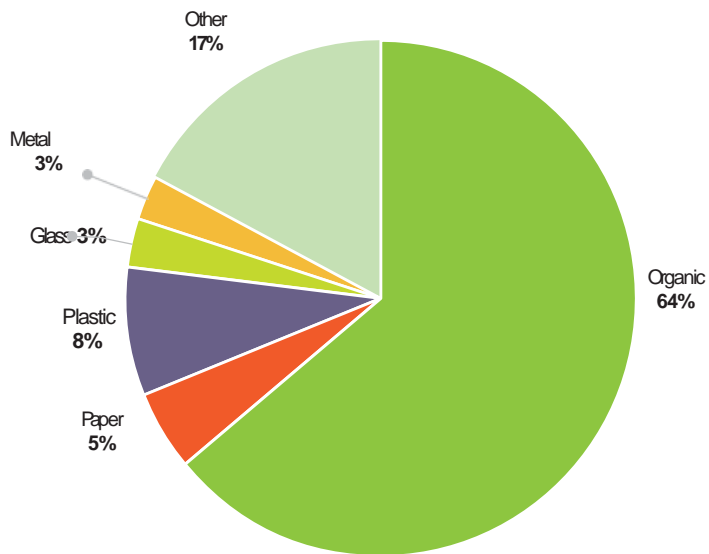
Type	Sources
Organic	Food scraps, yard (leaves, grass, brush) waste, wood, process residues
Paper	Paper scraps, cardboard, newspapers, magazines, bags, boxes, wrapping paper, telephone books, shredded paper, paper beverage cups. Strictly speaking paper is organic but unless it is contaminated by food residue, paper is not classified as organic.
Plastic	Bottles, packaging, containers, bags, lids, cups
Glass	Bottles, broken glassware, light bulbs, colored glass
Metal	Cans, foil, tins, non-hazardous aerosol cans, appliances (white goods), railings, bicycles
Other	Textiles, leather, rubber, multi-laminates, e-waste, appliances, ash, other inert materials

Global Solid Waste Composition

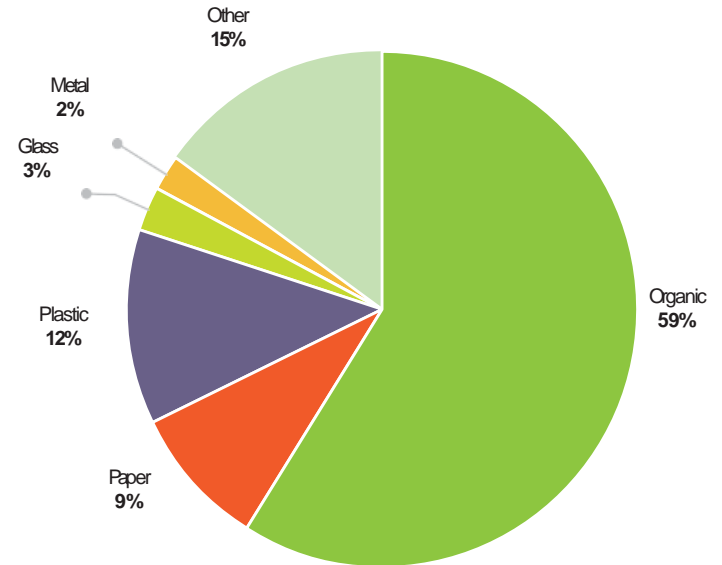


Waste Composition

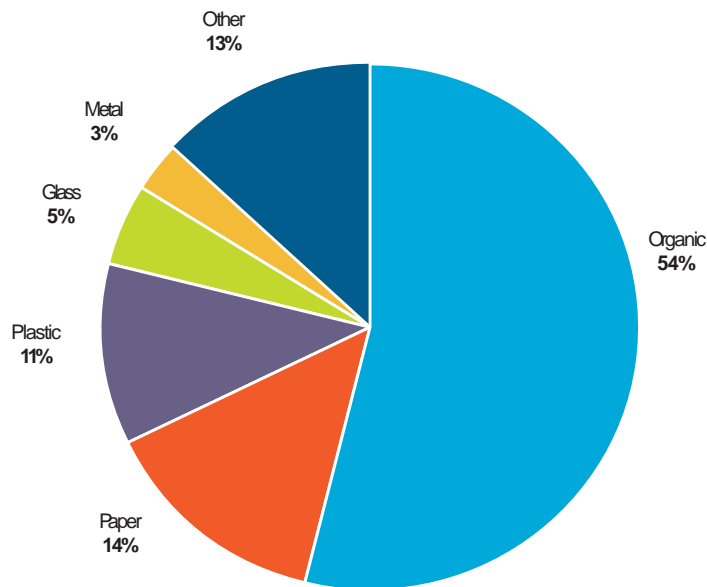
Waste Composition in Low-Income Countries



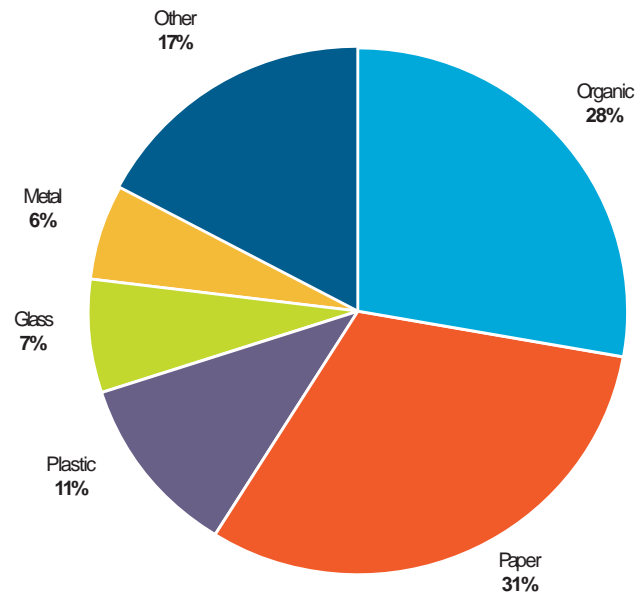
Waste Composition in Lower Middle-Income Countries



Waste Composition in Upper Middle-Income Countries



Waste Composition in High-Income Countries



CURRENT ESTIMATES*

Income Level	Organic (%)	Paper (%)	Plastic (%)	Glass (%)	Metal (%)	Other (%)
Low Income	64	5	8	3	3	17
Lower Middle Income	59	9	12	3	2	15
Upper Middle Income	54	14	11	5	3	13
High Income	28	31	11	7	6	17

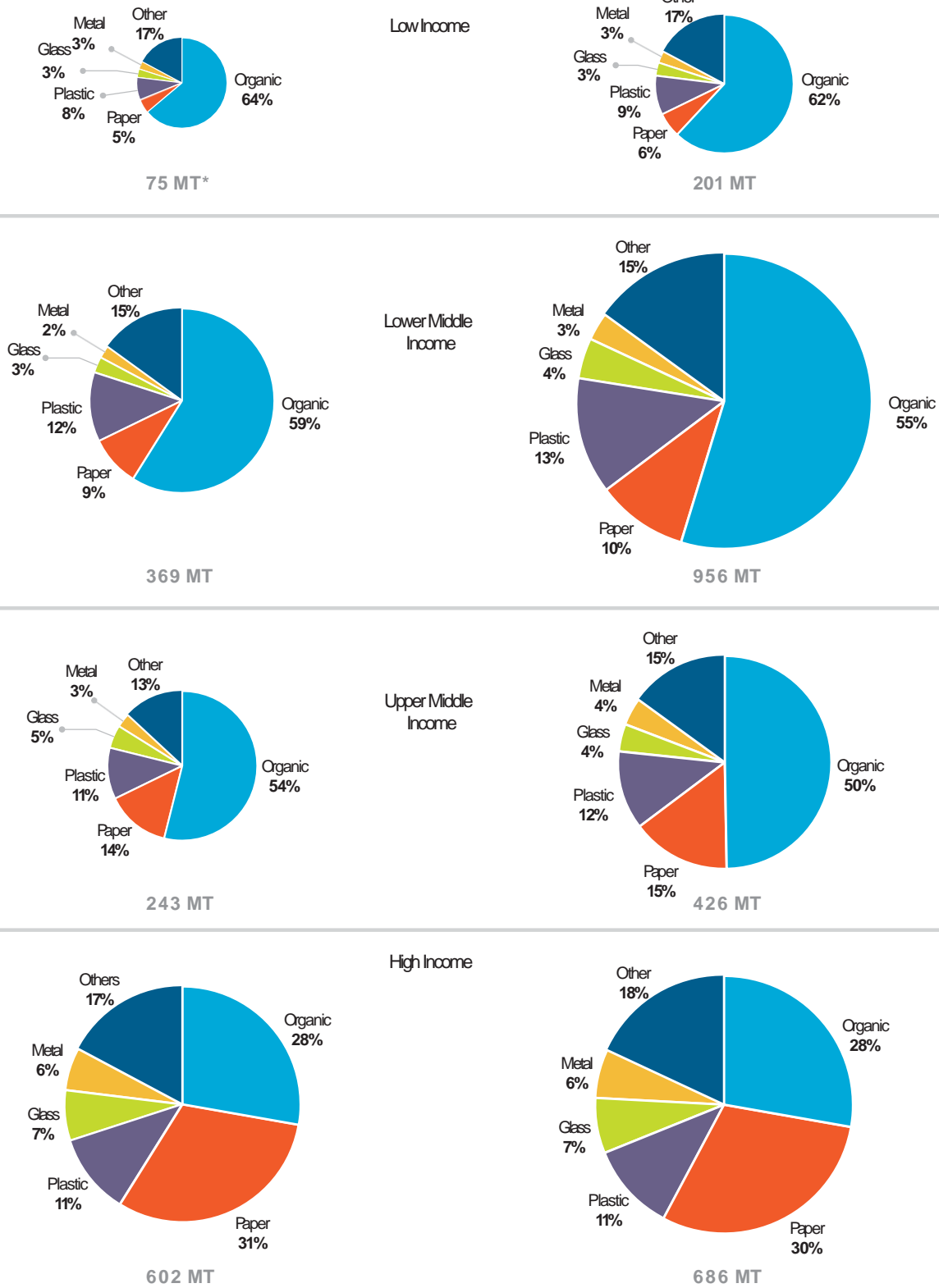
2025 ESTIMATES**

Income Level	Organic (%)	Paper (%)	Plastic (%)	Glass (%)	Metal (%)	Other (%)
Low Income	62	6	9	3	3	17
Lower Middle Income	55	10	13	4	3	15
Upper Middle Income	50	15	12	4	4	15
High Income	28	30	11	7	6	18

Waste Composition

Solid Waste Composition by Income and Year

CURRENT → **2025**



Source: Current data vary by country.
*Total annual waste volume in millions of tonnes

Waste-to-energy turns solid waste that would otherwise go to landfill into energy, burning the waste and leaving behind a small amount of ash that can be reused, for instance as road or construction aggregate, with the remainder (such as toxic waste) being disposed of in a landfill. There are different technical approaches that can be taken but the most common waste-to-energy technology, incineration, involves the burning of waste in the presence of high volumes of air, producing flue gas and heat. The heat and hot gases boil water to produce steam, which drives turbines to generate electricity. The technology is mature, efficient and waste does not need to be pre-treated before incineration. More than 2,000 plants worldwide use this approach. Flue gas needs to be cleaned and the ash left after burning needs to be disposed of properly.

500 kilowatt hours of electricity are typically produced for each tonne of waste burnt. Electricity from waste can increase where technologies such as gasification are used. Every tonne of waste burnt in a WTE facility, prevents about one tonne of carbon dioxide from entering the atmosphere.

87% High volumes of solid waste are sent to landfill and dump sites in the GCC, with little waste material recycled or reused. Through incineration, the amount of solid waste that goes to landfill can be reduced by about 87%.

85% Typically, about 85% of landfill waste can be incinerated, becoming fuel to generate electricity.

25% By weight, an estimated 20-25% of the solid waste burnt is left behind as ash.

10% By volume, about 5-10% of the waste is left as ash, making incineration an effective method of reducing the amount of waste going to landfill.

CHAPTER 2

- **SWM* in Pakistan**
- **WMC* in Lahore**
- **Waste Dumping-
Landfill Problems**
- **End Products – MRF**
- **End Products – WtE**
- **CSR**
- **Case For Investment**

***Solid Waste Management**

***Waste Management Company**



In Pakistan roughly 30 million tons of solid waste is generated annually, with annual growth rate of about 2.4 percent

Karachi

9,440

Tones per day

Lahore

6,510

Tones per day

Faisalabad

4,883

Tones per day

Solid waste management situation in Pakistan is a matter of grave concern as more than 5 million people die each year due to waste-related diseases. In Pakistan roughly 30 million tons of solid waste is generated annually, with annual growth rate of about 2 percent. Karachi, largest city in the country, generates more than 9,000 tons of municipal waste

daily. All major cities, be it Islamabad, Lahore or Peshawar, are facing enormous challenges in tackling the problem of urban waste. The root factors for the worsening garbage problem in Pakistan are lack of urban planning, outdated infrastructure, lack of public awareness and endemic corruption.

Existing Solid Waste Management System in Pakistan

Local and municipal governments are responsible for collecting waste throughout most of Pakistan's major cities. About 60-70% of solid waste in the cities is collected. The waste collection fleet typically comprises handcarts and donkey pull-carts for primary collection; then open trucks, tractor/trolley systems, arm roll

containers/trucks for secondary collection and transport. Some municipalities hire street sweepers and sanitary workers to augment other collection methods. They use wheelbarrows and brooms to collect solid waste from small heaps and dustbins, then store in formal and informal depots.

“In Punjab, Lahore is the only city with a proper solid waste management, treatment and disposal system. The system was outsourced to Albayrak and OzPak (Turkish companies)”



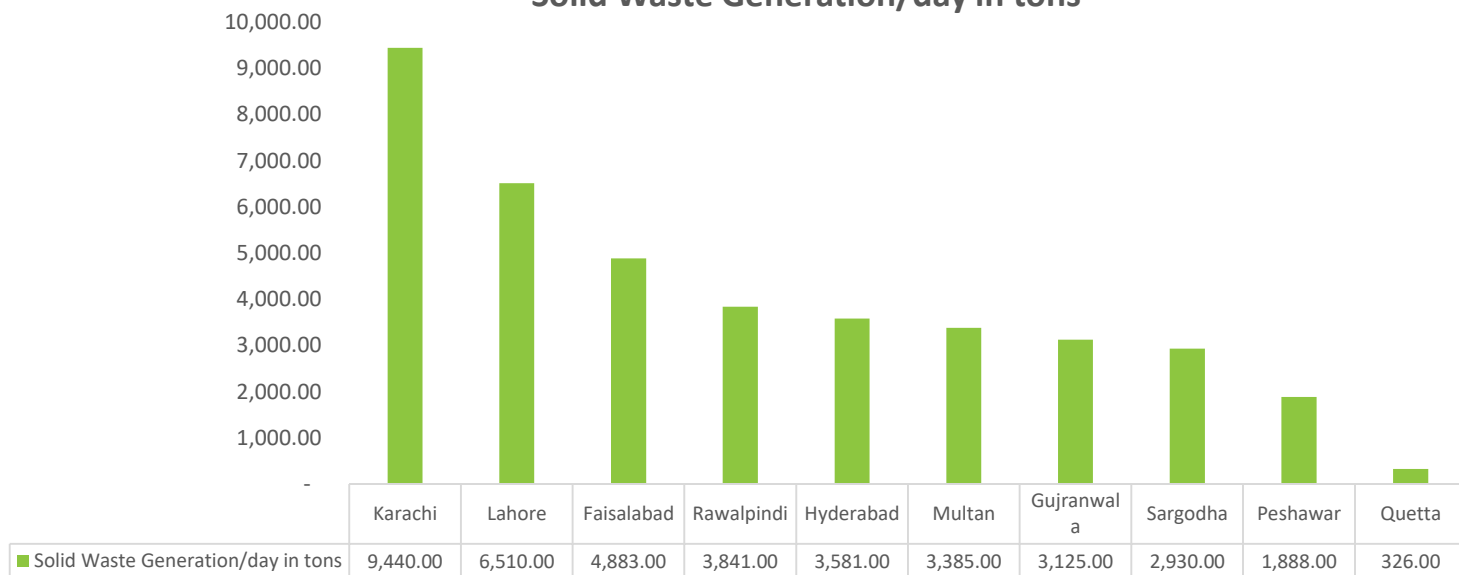
In Lahore, the capital of Punjab and the second largest city in Pakistan, there are currently no controlled waste disposal facilities are formal recycling systems, though roughly 27% of waste (by weight) is recycled through the informal sector, Lahore does not have very high performing governmental management in the waste management situation. Instead, the City District Government Lahore established the Lahore Waste Management Company and left the responsibility of the Solid Waste Management in Lahore to them. Beginning in 2011, Lahore Waste Management Company strives to develop a system of SWM that ensures productive collection, recovery, transportation, treatment and disposal of the waste in Lahore.

Lahore Waste Management Company (LWMC) has over 10,000 field workers involved in waste collection and disposal.

Though the LWMC is working in phases, 100% collection rates are not seen yet. Lahore currently only has three disposal sites which are no more than dumps, where illegal dumping and trash burning is common. However, there is some resource recovery taking place. It is estimated that 27% of dry recyclables are informally recycled within the city. Additionally a composting plant converts 8% of waste into compost.

In general, the governance over the Waste Management in Lahore is hardly present. Though there are current projects and plans taking place, by the Lahore Waste Management Company for example, in order to achieve a productive and sustainable system in the city it is necessary for all service providers (formal, private, and informal) to take part in decisions and actions.

Solid Waste Generation/day in tons



Source: [Mr. Saadat Ali, USCS Pakistan contact from Project Procurement International, Pakistan.](#)

2 Billion Tons Waste Worldwide P/Y
30 Million Tons Waste Pakistan P/Y
6,510 Tons Lahore Waste Daily



Mahmood Booty

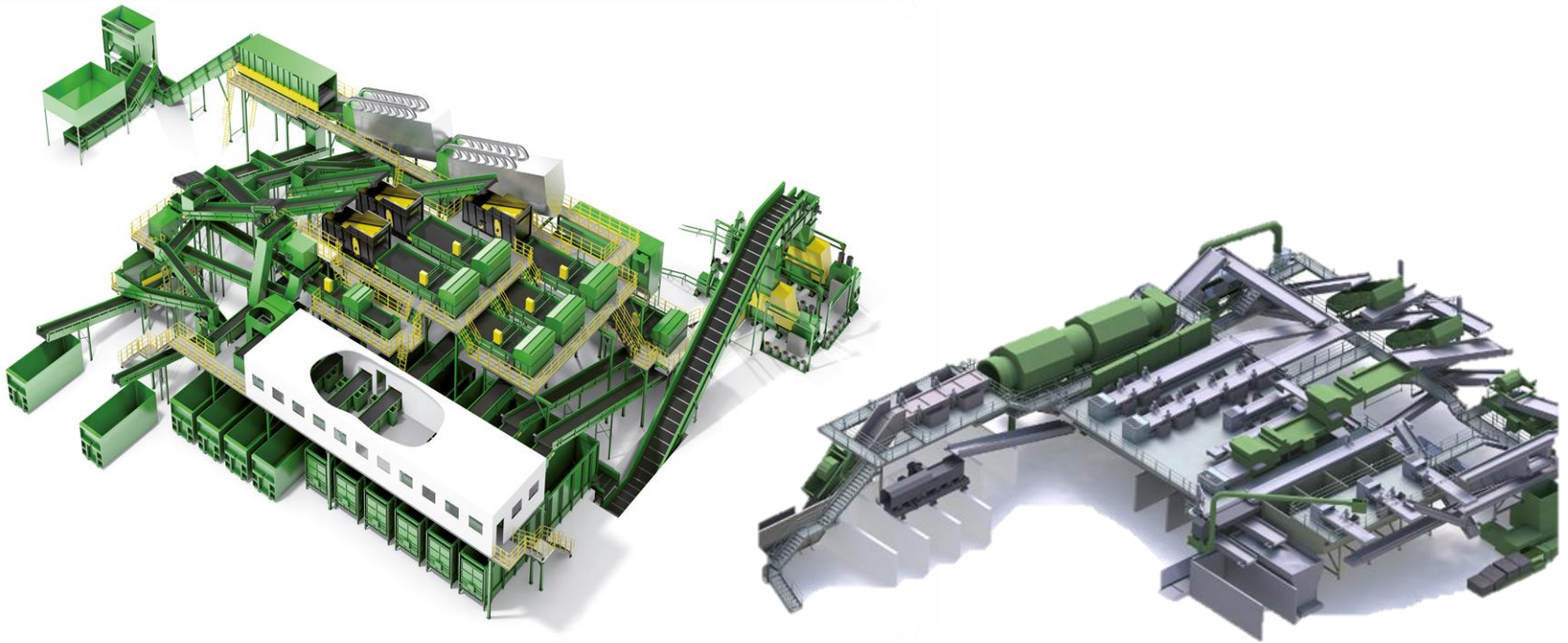


Lakhodair

- Wastage Of Valuable Land
- Viruses, Disease, Bacteria
- Mosquitos, Rates
- Methane Pollution PM 2.5

- Land, Water & Air Contamination
- Loss Of Energy Resources
- Loss Of Potential Income
- Usage Of Fossil Fuels

- Landfill Sites Are Full-costs
- Waste Ends Up In Sea
- Unsustainable Landfills, Result Inefficient Waste Collection



End Products:

Solid
Recovered Fuel
(SRF)



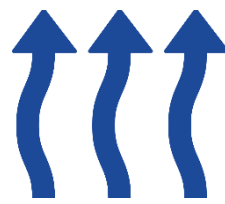
Aggregates
(Stone Chips)



Compost,
Fertilizer, Soil



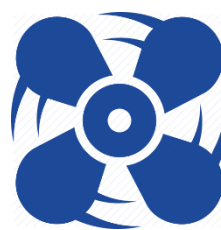
Electricity



**Syngas,
Steam**



**Bio-Diesel,
Bio-Fuels**



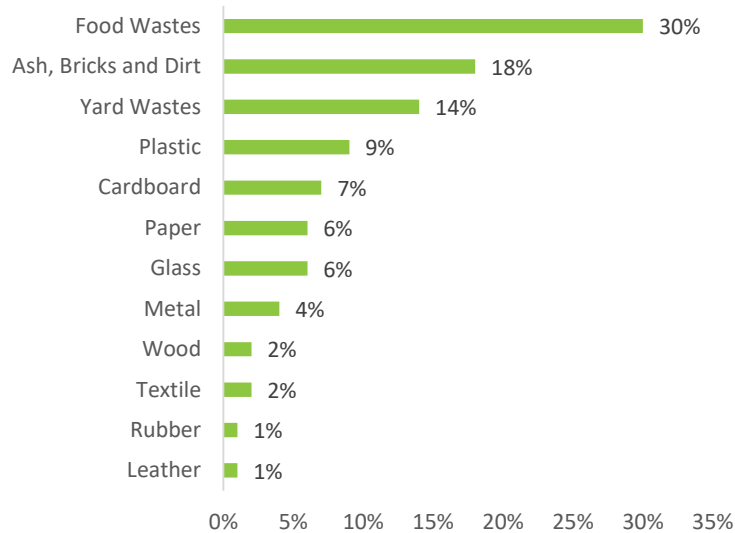
**Air Cooling,
Refrigeration**

- Solid waste management situation in Pakistan is a matter of grave concern as more than **5 million people to die each year** due to waste-related diseases.
- The root factors for the worsening garbage problem in Pakistan are lack of urban planning, outdated infrastructure, lack of public awareness and endemic corruption.
- Pakistan might not be contributing to a large amount of Greenhouse Gas (GHG) emissions but it is still among the top ten most climate-affected countries of the world. The Climate Change Bill passed in 2016 also states:

“Pakistan’s per capita emissions of greenhouse gases today is one of the lowest in the world. Yet it ranks amongst the top ten countries most affected by climate change during the last twenty years”.

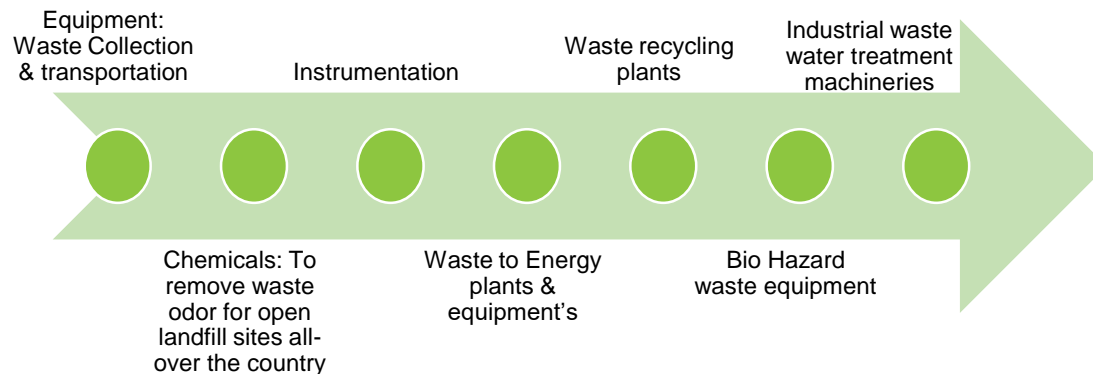


Composition of Municipal Solid Waste (MSW) in Pakistan



Food Wastes	30%
Ash, Bricks and Dirt	18%
Yard Wastes	14%
Plastic	9%
Cardboard	7%
Glass	6%
Paper	6%
Metal	4%
Textile	2%
Wood	2%
Leather	1%
Rubber	1%

Leading Sub-Sectors



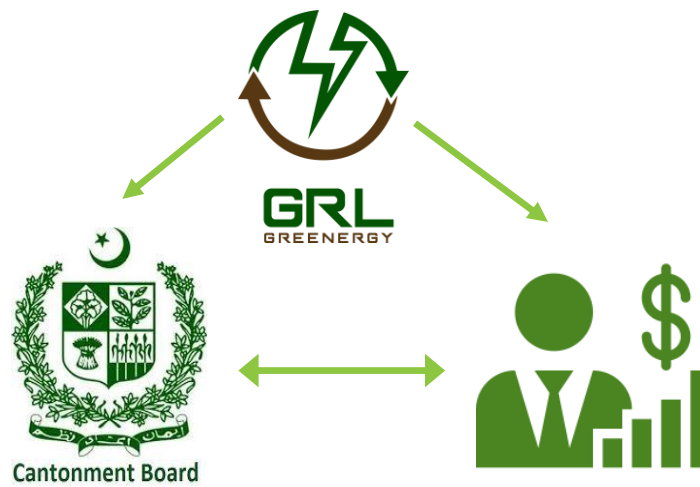
Opportunities

The local market has shown moderate growth in terms of its volume and FDI contribution during the past few years. Both the public and private sectors have or will initiate small to large-scale projects, small-to-large scale waste collection and waste treatment projects. According to industry experts, the local market will continue to offer sizeable business opportunities to local and foreign companies for the foreseeable future.

MUNICIPAL SOLID WASTE (MSW)

2 Billion Tons Waste Worldwide P/Y
36 Million Tons Waste Pakistan P/Y

8,000 Tons Lahore Waste Daily
800-Tons Waste of Cantt, DHA, Walton Daily



• LAHORE CANTT

• WALTON, DHA



CHAPTER 3

- **GRL UK Limited**
- **GRL – International Experience**
- **Problems**
- **Solutions**



GREENENERGY LIMITED (GRL) is an established UK based company, specialised in environmental science and advanced engineering, converting waste materials into energy “heat & power” in an environmentally sound manner. We are focused on protecting our environment and converting waste into highly valuable commodities, creating jobs in developing countries to support economic growth.

GRL specializes in the design, manufacturing and operations of Waste to Energy Plants (WtE), Advanced Thermal Technologies (continuous feed Pyrolysis/Gasification Plants), Emission Control/Flu Gas Treatment Systems and Material Recovery Facilities (segregation) of any scale and capacity as EPC and O&M contractors on international levels. GRL invests extensively in R&D projects to tackle excessive amounts of waste produced every day and generating revenues from the process.

GRL produces Solid Recovered Fuels (SRF) from Municipal Solid Waste (MSW) and from Commercial & Industrial Waste (C&I) for the plants we sell and operate. Our alternative fuels are renewable and cleaner fuels manufactured and modified in accordance with our customer’s and market specific requirements.

Any industrial plants, machinery or equipment supplied by GRL is covered by WRAP Professional Indemnity (PI) insurance, customers gets exactly what they ordered from GRL. WRAP PI insurance protects plant machinery against any failures in performance, investments and return on investments.

GRL in-house engineers are continuously improving WtE plant technologies and techniques within the recycling industry. GRL invests significantly in developing new technologies for the waste recycling industries. Our significant achievements to date include the production of the most efficient and cost-effective WtE plant, without compromising on quality.

PARTNERS/CUSTOMERS & PROJECTS

GRL has developed strong network in many countries, with the offices established in UK, Pakistan, Turkey and Africa. GRL is currently working actively with the number of technology partners, customers and the organizations, some mentioned below;

- A. KCM Waste Management (UK) Customer
- B. Ron Hull Jnr Ltd (UK) Customer
- C. Pyrofuels Ltd (Ireland) customer
- D. Winno Energy (Finland) Technologies Partners
- E. IRIS Digital (UAE) Sales & Marketing Consultant
- F. Lahore Waste Management Company LWMC the biggest waste collection firm in country (PAKISTAN) Customer
- G. Pyro Tech smc pvt ltd (Pakistan) Technologies Partners
- H. In partnership with Army of Pakistan for the rural development, gender inequality and to manage the waste within Army owned towns/cities as cant, DHA, Askary, Walton etc.
- I. Iwatch Islamabad (Pakistan) Environmental consultation CEO, EX Director General of EPA Pakistan
- J. Punjab Board of Investments & Trade PBIT (Pakistan) setting up the legal framework between GRL and customers, providing assistance in any aspects of the business related to the legal framework, contracts etc.

PROJECTS

- A. Landfill gas to energy Lahore (Completed Pilot plant successfully & and expansion in progress)
- B. Pyrolysis plant Shekhupura (Producing crude liquid oil from rubber tyres)
- C. Emission treatment system (Munir Steel Mills Pakistan)
- D. Waste to Energy Plant 14MWh (MOU signed for LWMC through PBIT)
- E. Material Recovery Facilities (*In partnership with Army of Pakistan, project relates to this business plan \$3.9M investment*)
- F. Pyrolysis Plant, 10 TPD facility, crude oils from scrap tyres & plastics (KZN Everready South Africa)
- G. Small Scale Waste Incineration plant SWIP (KCM Waste Management Sheffield UK)
- H. Heat treatment to convert organic fines into fertilizer, utilizing the energy from waste combustion (Pyrofuel Ireland)

2 Billion tons of waste produced every year. World is drowning in its own waste. Waste is A global issue and volumes of waste produced are increasing day by day. Current disposal method for more than 90% of waste are established as Landfilling/dumping sites in most of Asian and African countries. Market is not fully developed in UK/EU either, but the problems in Asian and African countries are severe.

Landfill sites are one of the major cause for ground waters and land contamination, polluting air, and are the perfect breeding ground for viruses, bad bacteria, disease, mosquitos, rates and snakes. Landfill sites are releasing millions of tons CO2 into the atmosphere, by decomposition process of the organic contents.

- “A large quantity of toxic leachate has been produced from Mahmood Booty Landfill site of LWMC, which further contaminated the city’s groundwater while posing threats to the environment and ecosystem”. (Source: Pakistan today)
- Illegal Dumping of waste put half a million people’s life in danger in Lahore by skin, lungs and stomach disease. (Source: Nation.com)



Waste is only waste, if it is not used, furthermore, landfilling waste is the WASTAGE of;

- A. Usable, valuable land.
- B. Energy resource, which is trapped in waste.
- C. Potential income, which can be achieved through the conversion of the waste into energy.
- D. “Wastage of the fossil fuels, fossil fuels are burnt for energy purposes, if not replaced with the waste, burning the dirtiest fuel coal, crude oil and natural gas, mining process, transportation of fossil fuels are the major cause of emission levels ever high and resulting in global warming. Fossil fuels mined, extracted elsewhere and transported around the world via sea, 15 Biggest Ships Create More Pollution Than All Cars in the World waste produced in every country, town and city, which can be converted into waste derived fuel, solid recovered fuel (SRF) quite easily. SRF than processed further into heat, steam, power/energy, bio-fuels, syngas, and bio-char etc.”. (Source: *The Guardian*)
- E. Wastage of the opportunity to help economic growth and to create jobs by utilization of the latest waste conversion technologies.

“On another note, Pakistan is a fuel deprived country, the demand for the fuel is ever high for the fast-growing population and the industry. Country suffers always from the shortages on fuel. Industry operate only 30% to 40% of its capacity, due to the shortages of fuel supplies. Number of the industrial units moved out of Pakistan and established their businesses in India, Bangladesh and China, where the fuel supplies for the industrial usage is widely available and available on competitive rates”.

GRL team will focus and are confident to mitigate the issues and bring a better change within the country and societies. GRL specialised in manufacturing of clean, financially viable and environmentally friendly SRF pelletized fuel, utilised by the cooking devices provided by GRL with ZERO cost. The biggest demand for the SRF pelletized fuel is in cement industry and power generation industry.

- A. Waste is A major problem
 - B. Preparing foods with the old conventional fuels & methods, is the 2nd problem
 - C. GRL specialised to convert problem A, into the solution to eliminate problem B.
- Both problems resolved with the number of other benefits are mentioned below

Converting solid waste into energy, is the best solution for the excessive amounts of waste produced, it helps to save on fossil fuels, reduce carbon footprint and generate income as well as creating the large number of jobs. Waste to fuel & WtE plant helps to meet ever increasing energy demands and to promote the latest technologies. Municipal Solid Waste or Commercial & Industrial Waste, including hazardous and non-hazardous waste can be recycled into energy, in an environmental sound manner, without the risks of spreading pollution. Almost ZERO waste will be left behind to send out to the landfill sites at the end of the process. A new cost effective and more efficient mechanism/technique has been invented by GRL engineers, that is fully automated to produce high quality SRF fuel in various forms.

FURTHER BENEFITS:

- Less dependency on imported fuels (security of supply)
- Increased public trust & acceptance of solid recovered fuels common procedures and free trade on the internal market
- Measurement of “biodegradable = biomass content’ in support of the RES-E Directive creation of jobs in an expanding industry
- Increased recovery and less final disposal of combustible non-hazardous wastes



CHAPTER 4

Pre Feasibility

- **Waste Management**
- **Waste to Energy**

Project setup costs

The project will require an estimated total capital outlay of USD 3.9 Million. This project cost includes the working capital contribution of USD 150,000. Equity contribution comprises USD 1.1 Million from Cantonment board Lahore and USD 0.9 Million from Green energy. The major portion of the project cost USD 1.9 Million is proposed to be contributed from Local JV partner.

Description	Detail	Remarks
Total Equity (51%)	USD 2 Million	Equity contribution: CB: USD 1.1 m Green Energy: USD 0.9 m
JV Partner Equity Contribution (49%)	USD 1.9 Million	Project Financing/ commercial loan assumed in the financial model.
Tenure of the Loan (Years)	15 Years	180- Months
Cost of Debt/Bank loan (Kd)	16%	Annual Markup (Long Term Loan)
Cost of Equity (R)	$9.75\%+5\%=14.75\%$	10 year PIB Rate + Market Risk Premium
WACC/Discount Rate	15.4%	$WACC= 51\% (14.75\%) + 49\% (16\%)$

Fixed costs

Useful life of all fixed assets is assumed 25 years.

Description	Cost	Useful Life
Material Recovery Facilities "MRF"	2,350,000	25
Civil Work	150,000	25
Loading/Unloading Machinery	430,000	25
90,000 sq. feet shed-building	690,000	25
Furniture and Fixtures	10,000	25
Workshop Improvements & PPE	40,000	25
Additional Fabrication Machinery	80,000	25
Total- USD	\$3,750,000	

Working Capital

Each component of working capital is kept constant throughout the projection period (Yr.1 to Yr.10).

Description	Cost	Growth
Pre-Opening Salaries and Wages	50,000	Constant (2018-19 to 2027-28)
Prepaid Insurance Premiums	10,000	Constant (2018-19 to 2027-28)
Staff Training/WAMITAB/POCA	15,000	Constant (2018-19 to 2027-28)
Legal and Accounting Fees	5,000	Constant (2018-19 to 2027-28)
Advertising and Promotions	3,000	Constant (2018-19 to 2027-28)
Licenses	7,000	Constant (2018-19 to 2027-28)
Travel	10,000	Constant (2018-19 to 2027-28)
Cash	50,000	
Total- USD	\$150,000	

Assumptions

Revenue

Total revenue from 800 tons of waste processing/day includes sale of (20% Output of Solid Recovered Fuel (SRF) @ \$30/ton) and (55%-60% output of aggregates soil @ \$5/ton).

USD	(Yr. 1 to Yr. 10)	Description
Solid Recovered Fuel	1,782,000	(59,400 Tons per Year)* (\$30/Ton)
Aggregates/soil	819,000	(163,800 Tons per Year)* (\$5/Ton)
Revenue	\$2,601,000	Constant (2018-19 to 2027-28)

Variable Cost

Cost of sales

The variable cost includes direct cost of processing SFL and Aggregates which is estimated as;

USD	(Yr. 1 to Yr. 10)	Description
Solid Recovered Fuel	59,400	(59,400 Tons per Year)* (\$1/Ton)
Aggregates/soil	81,900	(163,800 Tons per Year)* (\$0.5/Ton)
Total	\$141,300	Constant (2018-19 to 2027-28)

Assumptions

Salaries and Wages

The average monthly salary and number of staff for each designation is assumed and a growth rate of 10% for each year is considered over the period of 10 year.

Description	Staff	Avg. Salary/month (USD)	(Staff)* (Avg. Monthly salary)* (12 Months)
Managing Directors	2	1,700	40,800
Operations Director	1	3,000	36,000
Full-Time Employees	30	542	195,000
Part-Time Employees	9	271	29,296
Independent Contractors	4	2,500	120,000
Total salaries excluding	46	\$763	\$421,097
Benefits			
Pension and Benefits (A)			\$14,938
Total			\$436,035- Year1 (10% Growth YOY- Yr. 2-10)

Pension and Benefits (A)

Each benefit is considered as a fixed percentage of total annual salary of 46 employees for each year whereas a growth rate of 10% is considered for salary increment Year on Year for 10 years.

Benefits	% of Total \$- Annual salary	Total
Employee Pension Programs	1%	7,468
Other Employee Benefit Programs	1%	7,468
Total		\$14,938 Year1 (10% Growth YOY- Yr. 2-10)

Assumptions

Operating Cost

Variable Operating Expenses

lump sum monthly expense is assumed for each line item of the operating expense and is taken constant for 12 months whereas 5% growth is considered through out the projection period (Yr.2 to Yr.10).

Items	Monthly	Annual	Description
De-Oxidation/Deodorize	1,000	12,000	Assumed/Estimated
Electricity	11,000	132,000	Assumed/Estimated
De-Pollution System	2,000	24,000	Assumed/Estimated
Total	\$14,000	\$168,000	(5% Growth YOY- Yr. Year-1 2-10)

Fixed Operating Expenses

Monthly Fixed operating expense is estimated for first year and 5% incremental growth is calculated for each year until year 10.

Items	Monthly	Annual	Description
Fuel/Diesel	5,000	60,000	Assumed/Estimated
Bank & Merchant Fees	250	3,000	Assumed/Estimated
Conferences & Seminars	200	2,400	Assumed/Estimated
Dues and Subscriptions	200	2,400	Assumed/Estimated
Miscellaneous	150	1,800	Assumed/Estimated
Insurance (Liability and Property)	2,500	30,000	Assumed/Estimated
Licenses/Fees/Permits	200	2,400	Assumed/Estimated
Legal and Professional Fees	500	6,000	Assumed/Estimated
Office Expenses & Supplies	100	1,200	Assumed/Estimated
Postage and Delivery	50	600	Assumed/Estimated
Rent (on business property)	2000	24,000	Assumed/Estimated
Telephone and Communications	200	2,400	Assumed/Estimated
Travel	1000	12,000	Assumed/Estimated
IT services (infrastructure, security etc.)	200	2,400	Assumed/Estimated
Utilities	250	3,000	
GRL Head Office Support Services	1,500	18,000	Assumed/Estimated
Total USD Year-1	\$14,300	\$171,600	(5% Growth YOY- Yr. 2-10)

Assumptions

Depreciation expense

All fixed assets are depreciated on a straight line method over the period of 25 years.

Finance Cost

USD 1.9m which is 49% of the total Project cost is finance for the tenor of 15 years at a fixed rate (assumed) of 16%. The loan is fully amortized over the period (Year.1 to Year.15).

USD	2019	2020	2021	2022	2023
Long term finances - secured	\$1,900,000	1,866,769	1,827,814	1,782,147	1,728,614
Repayment of long term loans	(33,231)	(38,955)	(45,666)	(53,533)	(62,756)
Outstanding	1,866,769	1,827,814	1,782,147	1,728,614	1,665,858
Interest Expense	301,633	295,908	289,197	281,330	272,108

USD	2024	2025	2026	2027	2028
Long term finances - secured	\$1,665,858	1,592,292	1,506,052	1,404,955	1,286,443
Repayment of long term loans	(73,567)	(86,240)	(101,097)	(118,513)	(138,929)
Outstanding	1,592,292	1,506,052	1,404,955	1,286,443	1,147,514
Interest Expense	261,297	248,624	233,767	216,351	195,935

Project Valuation

Waste to Energy

Pre-Feasibility Study

USD	Free Cash Flow										
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Terminal Year
Net income	1,232,432	1,177,574	1,118,492	1,054,878	986,407	912,739	833,518	748,373	656,926	558,787	
Add: Depreciation	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	
Add: Amortization of contingency cost	-	-	-	-	-	-	-	-	-	-	
Working Capital Changes	(100,000)	-	-	-	-	-	-	-	-	-	
Add: Interest Expense	301,633	295,908	289,197	281,330	272,108	261,297	248,624	233,767	216,351	195,935	
Less: Capital Expenditure	(3,750,000)	-	-	-	-	-	-	-	-	-	
Free Cash Flow	(2,165,935)	1,623,482	1,557,689	1,486,208	1,408,516	1,324,036	1,232,141	1,132,140	1,023,277	904,722	10,002,172
NPV of Free Cash Flow	(1,877,561)	1,219,957	1,014,674	839,217	689,453	561,813	453,211	360,985	282,833	216,771	2,396,517

Project Valuation

FCFF is the cash flow available to the suppliers of capital after all operating expenses are paid and working and fixed capital investments are made. Considering the cash flow projection prepared after taking into account project setup cost, Key assumptions and operating results, the project is expected to generate IRR of 71% and NPV of USD 6,157,871. The estimated payback period of the project is 3.89 years.

NOTE:

A Conservative approach is been assumed in case of revenue forecast by keeping sale price per ton for SRF & aggregate soil constant, however all expenses including operating & fixed are projected with assumed growth rate.

USD

Terminal Growth Rate	5.79% GDP Growth rate - FY18
Terminal WACC	15.36% Weighted Average Cost of Capital
Estimated Terminal Free Cash Flow	904,722 2028
Estimated Terminal Value	10,002,172 2028
NPV of Terminal Value	2,396,517 2028

Terminal Value

DCF Valuation

NPV of Forecasts	3,761,354 2019 to 2028
NPV of Terminal Value	2,396,517 2028
Enterprise Value	6,157,871 2019
IRR	71% 2019
PayBack Period	3.89 2019

Annexure

Waste to Energy

Pre-Feasibility Study

USD	Projections									
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Balance Sheet										
NON CURRENT ASSETS										
Material Recovery Facilities "MRF"	2,256,000	2,162,000	2,068,000	1,974,000	1,880,000	1,786,000	1,692,000	1,598,000	1,504,000	1,410,000
Civil Work	144,000	138,000	132,000	126,000	120,000	114,000	108,000	102,000	96,000	90,000
Loading/Unloading Machinery	412,800	395,600	378,400	361,200	344,000	326,800	309,600	292,400	275,200	258,000
90,000 sqf shed-building	662,400	634,800	607,200	579,600	552,000	524,400	496,800	469,200	441,600	414,000
Furniture and Fixtures/offices	9,600	9,200	8,800	8,400	8,000	7,600	7,200	6,800	6,400	6,000
Workshop Improvements & PPE	38,400	36,800	35,200	33,600	32,000	30,400	28,800	27,200	25,600	24,000
Additional Fabrication Machinery	76,800	73,600	70,400	67,200	64,000	60,800	57,600	54,400	51,200	48,000
	\$3,600,000	\$3,450,000	\$3,300,000	\$3,150,000	\$3,000,000	\$2,850,000	\$2,700,000	\$2,550,000	\$2,400,000	\$2,250,000
CURRENT ASSETS										
Pre-Opening Salaries and Wages	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Prepaid Insurance Premiums	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Staff Training/WAMITAB/POCA	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Legal and Accounting Fees	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Supplies	-	-	-	-	-	-	-	-	-	-
Advertising and Promotions	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Licenses	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000
Travel	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Cash	1,469,201	2,757,820	3,980,645	5,131,989	6,205,641	7,194,814	8,092,091	8,889,368	9,577,781	10,147,639
	\$1,569,201	\$2,857,820	\$4,080,645	\$5,231,989	\$6,305,641	\$7,294,814	\$8,192,091	\$8,989,368	\$9,677,781	\$10,247,639
	\$5,169,201	\$6,307,820	\$7,380,645	\$8,381,989	\$9,305,641	\$10,144,814	\$10,892,091	\$11,539,368	\$12,077,781	\$12,497,639
TOTAL ASSETS										
EQUITY AND LIABILITIES										
SHARE CAPITAL AND RESERVES										
Issued, subscribed and paid-up capital	2,070,000	2,070,000	2,070,000	2,070,000	2,070,000	2,070,000	2,070,000	2,070,000	2,070,000	2,070,000
Unappropriated profit/ Retain earnings	1,232,432	2,410,006	3,528,497	4,583,375	5,569,783	6,482,522	7,316,040	8,064,413	8,721,338	9,280,125
	\$3,302,432	\$4,480,006	\$5,598,497	\$6,653,375	\$7,639,783	\$8,552,522	\$9,386,040	\$10,134,413	\$10,791,338	\$11,350,125
NON CURRENT LIABILITIES										
Long term Debt	1,827,814	1,782,147	1,728,614	1,665,858	1,592,292	1,506,052	1,404,955	1,286,443	1,147,514	984,652
	\$1,827,814	\$1,782,147	\$1,728,614	\$1,665,858	\$1,592,292	\$1,506,052	\$1,404,955	\$1,286,443	\$1,147,514	\$984,652
CURRENT LIABILITIES										
Current portion of long term financing	38,955	45,666	53,533	62,756	73,567	86,240	101,097	118,513	138,929	162,862
	\$38,955	\$45,666	\$53,533	\$62,756	\$73,567	\$86,240	\$101,097	\$118,513	\$138,929	\$162,862
	\$5,169,201	\$6,307,820	\$7,380,645	\$8,381,989	\$9,305,641	\$10,144,814	\$10,892,091	\$11,539,368	\$12,077,781	\$12,497,639
TOTAL EQUITY AND LIABILITIES										

Annexure

Waste to Energy Pre-Feasibility Study	Projections									
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
USD										
Profit and Loss Account										
Revenue	\$2,601,000	\$2,601,000	\$2,601,000	\$2,601,000	\$2,601,000	\$2,601,000	\$2,601,000	\$2,601,000	\$2,601,000	\$2,601,000
Cost of sales										
SRF	59,400	59,400	59,400	59,400	59,400	59,400	59,400	59,400	59,400	59,400
Soil/Aggregates	81,900	81,900	81,900	81,900	81,900	81,900	81,900	81,900	81,900	81,900
	141,300	\$141,300	\$141,300	\$141,300	\$141,300	\$141,300	\$141,300	\$141,300	\$141,300	\$141,300
Gross profit/(loss)	\$2,459,700	\$2,459,700	\$2,459,700	\$2,459,700	\$2,459,700	\$2,459,700	\$2,459,700	\$2,459,700	\$2,459,700	\$2,459,700
Gross profit margin	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Operating Cost										
Salaries and Wages	436,035	479,638	527,602	580,362	638,398	702,238	772,462	849,708	934,679	1,028,147
Variable Operating Expenses	168,000	176,400	185,220	194,481	204,205	214,415	225,136	236,393	248,213	260,623
Fixed Operating Expenses	171,600	180,180	189,189	198,648	208,581	219,010	229,960	241,458	253,531	266,208
Depreciation expense	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
	925,635	\$986,218	\$1,052,011	\$1,123,492	\$1,201,184	\$1,285,664	\$1,377,559	\$1,477,560	\$1,586,423	\$1,704,978
Operating profit/(loss)	\$1,534,065	\$1,473,482	\$1,407,689	\$1,336,208	\$1,258,516	\$1,174,036	\$1,082,141	\$982,140	\$873,277	\$754,722
Finance Cost	301,633	295,908	289,197	281,330	272,108	261,297	248,624	233,767	216,351	195,935
Net Income	\$1,232,432	\$1,177,574	\$1,118,492	\$1,054,878	\$986,407	\$912,739	\$833,518	\$748,373	\$656,926	\$558,787
Net profit margin	47%	45%	43%	41%	38%	35%	32%	29%	25%	21%
ROI	31%	30%	28%	27%	25%	23%	21%	19%	17%	14%
ROE	37%	26%	20%	16%	13%	11%	9%	7%	6%	5%
ROA	24%	19%	15%	13%	11%	9%	8%	6%	5%	4%

Annexure

USD	Projections									
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Waste to Energy Pre-Feasibility Study										
Cash Flow Statement										
CASH FLOWS FROM OPERATING ACTIVITIES										
Profit before taxation	\$1,232,432	\$1,177,574	\$1,118,492	\$1,054,878	\$986,407	\$912,739	\$833,518	\$748,373	\$656,926	\$558,787
Adjustment for:										
Depreciation/ Amortization	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Interest Expense	-	-	-	-	-	-	-	-	-	-
Contingency Cost	-	-	-	-	-	-	-	-	-	-
Pre-Operations Cost	-	-	-	-	-	-	-	-	-	-
	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000
Operating profit before working capital changes	\$1,382,432	\$1,327,574	\$1,268,492	\$1,204,878	\$1,136,407	\$1,062,739	\$983,518	\$898,373	\$806,926	\$708,787
Working Capital Changes (Increase)/ Decrease in Current Assets										
Pre-Opening Salaries and Wages	(50,000)	-	-	-	-	-	-	-	-	-
Prepaid Insurance Premiums	(10,000)	-	-	-	-	-	-	-	-	-
Staff Training/WAMITAB/POCA	(15,000)	-	-	-	-	-	-	-	-	-
Legal and Accounting Fees	(5,000)	-	-	-	-	-	-	-	-	-
Supplies	-	-	-	-	-	-	-	-	-	-
Advertising and Promotions	(3,000)	-	-	-	-	-	-	-	-	-
Licenses	(7,000)	-	-	-	-	-	-	-	-	-
Supplies	-	-	-	-	-	-	-	-	-	-
	-\$100,000	-	-	-	-	-	-	-	-	-
Net cash generated/used in operating activities	\$1,282,432	\$1,327,574	\$1,268,492	\$1,204,878	\$1,136,407	\$1,062,739	\$983,518	\$898,373	\$806,926	\$708,787
CASH FLOWS FROM INVESTING ACTIVITIES										
Capital expenditure	(3,750,000)	-	-	-	-	-	-	-	-	-
Net cash (used in) investing activities	-\$3,750,000	-	-	-	-	-	-	-	-	-
CASH FLOWS FROM FINANCING ACTIVITIES										
Owner's equity/ Drawings	2,070,000	-	-	-	-	-	-	-	-	-
Proceed from long term loans	1,900,000	-	-	-	-	-	-	-	-	-
Long term finances - secured	(33,231)	(38,955)	(45,666)	(53,533)	(62,756)	(73,567)	(86,240)	(101,097)	(118,513)	(138,929)
Repayment of long term loans	33,231	38,955	45,666	53,533	62,756	73,567	86,240	101,097	118,513	138,929
Long term finances - secured										
Net cash (used in) financing activities	\$3,936,769	-\$38,955	-\$45,666	-\$53,533	-\$62,756	-\$73,567	-\$86,240	-\$101,097	-\$118,513	-\$138,929
Net (decrease)/increase in cash and cash equivalents	1,469,201	1,288,618	1,222,825	1,151,345	1,073,652	989,173	897,278	797,277	688,413	569,858
Cash and cash equivalents at the beginning of the year	-	1,469,201	2,757,820	3,980,645	5,131,989	6,205,641	7,194,814	8,092,091	8,889,368	9,577,781
Cash and cash equivalents at the end of the year	\$1,469,201	\$2,757,820	\$3,980,645	\$5,131,989	\$6,205,641	\$7,194,814	\$8,092,091	\$8,889,368	\$9,577,781	\$10,147,639



Project Pre Feasibility
Waste to Energy

Project setup costs

The project will require an estimated total Capital outlay of USD 60 Million. This project cost includes the working capital contribution of USD 5.3 Million. Equity contribution comprises USD 9 Million from Green energy and USD 0.5 Million each from investor Wahid and Turkish investor. The major portion of the project cost is financed through Commercial banks.

Description	Detail	Remarks
Total Equity (17%)	USD 10.00 Million	Owner's Equity
Commercial PK Bank Loan/Investor (19%)	USD 11.12 Million	Project Financing
Commercial Loan FINVERA Finland (65%)	USD 38.91 Million	Project Financing
Tenure of the Loan (Years)	10 Years	120- Months
Cost of Debt/Bank loan (Kd)	7.5%	Annual Markup (Long Term Loan)
Cost of Equity (R)	$9.75\%+5\%=14.75\%$	10 year PIB Rate + Market Risk Premium
WACC/Discount Rate	8.23%	WACC= 10% (14.75%) +90% (7.5%)

Fixed costs

Useful life of all fixed assets is assumed 10 years.

Description	Cost	Useful Life
Material Recovery Facilities "MRF"	5,000,000	10
Civil Work	250,000	10
Loading/Unloading Machinery	200,000	10
WTE Plant/FGT/Boiler/Turbine 15MWh	49,000,000	10
Furniture and Fixtures	25,000	10
Vehicles	150,000	10
Work Wear PPE	25,000	10
Total- USD	\$54,650,000	

Working Capital

Each component of working capital is kept constant throughout the projection period (Yr.1 to Yr.10).

Description	Cost	Growth
Pre-Opening Salaries and Wages	500,000	Constant (2018-19 to 2027-28)
Prepaid Insurance Premiums	60,000	Constant (2018-19 to 2027-28)
Staff Training/WAMITAB/POCA	50,000	Constant (2018-19 to 2027-28)
Legal and Accounting Fees	25,000	Constant (2018-19 to 2027-28)
Supplies	150,000	Constant (2018-19 to 2027-28)
Advertising and Promotions	4,000	Constant (2018-19 to 2027-28)
Licenses	25,000	Constant (2018-19 to 2027-28)
Travel	25,000	Constant (2018-19 to 2027-28)
Cash	4,541,100	
Total- USD	\$5,380,100	

Assumptions

Revenue

Total revenue includes per day 29,000 tons of waste tipping @ \$5/ton and 17,400 tons of sale of aggregates soil @ \$3/ton. Revenue from Metal recovery is assumed 1% of total waste collected per year @ \$200/ton. Major revenue consist of revenue from sale of electricity.

USD	(Yr. 1 to Yr. 10)	Description
Waste tipping fee	1,740,000	(348,000 Tons per Year)* (\$5/Ton)
Aggregates/soil	626,400	(208,800 Tons per Year)* (\$3/Ton)
Electricity sale	11,692,800	Production: 15MW/Hour, 360MW/day, 325 days/Year =116,908MW/year * \$100 P/MW-h
Metal recovery	696,000	(348,000 Tons per Year * 1%)* (\$200/Ton)
Revenue	\$14,755,200	Constant (2018-19 to 2027-28)

Variable Cost

Cost of sales

USD	(Yr. 1 to Yr. 10)	Description
Waste tipping fee	34,800	(348,000 Tons per Year)* (\$0.10/Ton)
Aggregates/soil	20,880	(208,800 Tons per Year)* (\$0.10/Ton)
Electricity sale	116,928	1% of the sale price of electricity.
Metal recovery	17,400	(348,000 Tons per Year * 1%)* (\$5/Ton)
Total	\$190,008	Constant (2018-19 to 2027-28)

Assumptions

Salaries and Wages

The average monthly salary and number of staff for each designation is assumed and a growth rate of 3% for each year is considered over the period of 10 year.

Description	Staff	Avg. Salary/month (USD)	(Staff)* (Avg. Monthly salary)* (12 Months)
Managing Directors	3	900	32,400
Operations Director	1	1,500	18,000
Full-Time Employees	48	606	349,440
Part-Time Employees	6	303	21,840
Independent Contractors	2	1,000	24,000
Total	60	\$34,340	\$445,680- Year1 (3% Growth YOY- Yr. 2-10)

Staff Benefits

Each benefit is considered as a fixed percentage of total annual salary of 60 employees for each year whereas a growth rate of 3% is considered for salary increment Year on Year for 10 years.

Benefits	% of Total \$- Annual salary	Total
Medicare	0.5%	2,228
Employee Pension Programs	1%	4,120
Employee Health Insurance	0.5%	2,060
Other Employee Benefit Programs	1%	4,120
Total		\$12,530 Year1 (3% Growth YOY- Yr. 2-10)

Assumptions

Operating Cost

Variable Operating Expenses

lump sum monthly expense is assumed for each line item of the operating expense and is taken constant for 12 months whereas 3% growth is considered through out the projection period (Yr.2 to Yr.10).

Items	Monthly	Annual	Description
Ammonia Solution NH3	1,500	18,000	Assumed/Estimated
Ca(OH2) Calcium Dioxide	500	6,000	Assumed/Estimated
Calcium Lime Powder (Ca)	500	6,000	Assumed/Estimated
Total	\$2,500	\$30,000	(3% Growth YOY- Yr. Year-1 2-10)

Fixed Operating Expenses

Monthly Fixed operating expense is estimated for first year and 5% incremental growth is calculated for each year until year 10.

Items	Monthly	Annual	Description
Advertising	100	1,200	Assumed/Estimated
Car and Truck Expenses	400	4,800	Assumed/Estimated
Bank & Merchant Fees	150	1,800	Assumed/Estimated
Conferences & Seminars	100	1,200	Assumed/Estimated
Miscellaneous	200	2,400	Assumed/Estimated
Insurance (Liability and Property)	5,000	60,000	Assumed/Estimated
Licenses/Fees/Permits	2,083	24,996	Assumed/Estimated
Legal and Professional Fees	150	1,800	Assumed/Estimated
Office Expenses & Supplies	100	1,200	Assumed/Estimated
Postage and Delivery	25	300	Assumed/Estimated
Telephone and Communications	150	1,800	Assumed/Estimated
Travel	500	6,000	Assumed/Estimated
IT services (infrastructure, security etc.)	100	1,200	Assumed/Estimated
Utilities	200	2,400	Assumed/Estimated
GRL Head Office Support Services	150,000	1,800,000	Assumed/Estimated
Total USD Year-1	\$159,258	\$1,911,096	(5% Growth YOY- Yr. 2-10)

Assumptions

Depreciation expense

All fixed assets are depreciated on a straight line method over the period of 10 years.

Finance Cost

USD 50,030,100 which is 83% of the total Project cost is finance for the tenor of 10 years at a fixed rate (assumed) of 7.5%. The loan is fully amortized over the period (Year.1 to Year.10).

USD	2018-19	2019-20	2020-21	2021-20	2022-23
Long term finances - secured	\$50,030,100	46,537,527	42,773,816	38,717,919	34,347,153
Repayment of long term loans	(3,492,572)	(3,763,710)	(4,055,896)	(4,370,766)	(4,710,080)
Outstanding	46,537,527	42,773,816	38,717,919	34,347,153	29,637,072
Interest Expense	3,633,820	3,362,683	3,070,496	2,755,626	2,416,312
USD	2023-24	2024-25	2025-26	2026-27	2027-28
Long term finances - secured	\$29,637,072	24,561,335	19,091,556	13,197,144	6,845,133
Repayment of long term loans	(5,075,736)	(5,469,779)	(5,894,412)	(6,352,010)	(6,845,133)
Outstanding	24,561,335	19,091,556	13,197,144	6,845,133	-
Interest Expense	2,050,657	1,656,614	1,231,981	774,382	281,259

Project Valuation

Waste to Energy

Pre-Feasibility Study

Fiscal Year- 1st Jan- 31 Dec

USD	Free Cash Flow										
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Terminal Year
Net income	3,067,065	3,228,005	3,406,240	3,600,390	3,813,256	4,046,457	4,301,749	4,581,030	4,886,355	5,219,947	
Add: Depreciation	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000
Add: Amortization of contingency cost	-	-	-	-	-	-	-	-	-	-	-
Working Capital Changes	(839,000)	-	-	-	-	-	-	-	-	-	-
Add: Interest Expense	3,633,821	3,362,683	3,070,497	2,755,627	2,416,313	2,050,657	1,656,615	1,231,981	774,383	281,260	
Less: Capital Expenditure	(54,650,000)	-	-	-	-	-	-	-	-	-	-
Free Cash Flow	(43,323,114)	12,055,688	11,941,737	11,821,017	11,694,569	11,562,114	11,423,364	11,278,012	11,125,738	10,966,207	476,433,259
NPV of Free Cash Flow	(40,030,598)	10,292,878	9,420,733	8,616,769	7,876,735	7,195,678	6,569,024	5,992,552	5,462,362	4,974,856	216,135,511

Project Valuation

FCFF is the cash flow available to the suppliers of capital after all operating expenses are paid and working and fixed capital investments are made. Considering the cash flow projection prepared after taking into account project setup cost, Key assumptions and operating results, the project is expected to generate IRR of 41% and NPV of USD 242,506,498. The estimated payback period of the project is 8.46 years.

USD	Terminal Value
Terminal Growth Rate	5.79% GDP Growth rate - FY18
Terminal WACC	8.23% Weighted Average Cost of Capital
Estimated Terminal Free Cash Flow	10,966,207 2028
Estimated Terminal Value	476,433,259 2028
NPV of Terminal Value	216,135,511 2028
DCF Valuation	
NPV of Forecasts	26,370,988 2019 to 2028
NPV of Terminal Value	216,135,511 2028
Enterprise Value	242,506,498 2019
IRR	41% 2019
PayBack Period	8.46 2019

Annexure

Waste to Energy Pre-Feasibility Study

Fiscal Year- 1st Jan- 31 Dec

USD	Projections											
	Base Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Balance Sheet												
NON CURRENT ASSETS												
Material Recovery Facilities "WRF"					3,000,000	2,500,000	2,000,000	1,500,000	1,000,000		500,000	-
Civil Work	5,000,000	4,500,000	4,000,000	3,500,000	3,000,000	2,500,000	2,000,000	1,500,000	1,000,000		500,000	-
Loading/Unloading Machinery	250,000	225,000	200,000	175,000	150,000	125,000	100,000	75,000	50,000		25,000	-
W/E Plant/FGT/Boiler/Turbine 15MWh	200,000	180,000	160,000	140,000	120,000	100,000	80,000	60,000	40,000		20,000	-
Furniture and Fixtures	49,000,000	44,100,000	39,200,000	34,300,000	29,400,000	24,500,000	19,600,000	14,700,000	9,800,000		4,900,000	-
Vehicles	25,000	22,500	20,000	17,500	15,000	12,500	10,000	7,500	5,000		2,500	-
Work Wear PPE	150,000	135,000	120,000	105,000	90,000	75,000	60,000	45,000	30,000		15,000	-
	25,000	22,500	20,000	17,500	15,000	12,500	10,000	7,500	5,000		2,500	-
	\$54,650,000	\$49,185,000	\$43,720,000	\$38,255,000	\$32,790,000	\$27,325,000	\$21,860,000	\$16,395,000	\$10,930,000		\$5,465,000	\$0
CURRENT ASSETS												
Pre-Opening Salaries and Wages	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000		500,000	500,000
Prepaid Insurance Premiums	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000		60,000	60,000
Staff Training/WAMT/AB/POCA	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000		50,000	50,000
Legal and Accounting Fees	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000		25,000	25,000
Supplies	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000		150,000	150,000
Advertising and Promotions	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000		4,000	4,000
Licenses	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000		25,000	25,000
Travel	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000		25,000	25,000
Cash	4,541,100	9,580,592	14,509,886	19,325,229	24,019,852	28,588,027	33,023,748	37,320,718	41,472,336		45,471,680	49,311,493
	\$5,380,100	\$10,419,592	\$15,348,886	\$20,164,229	\$24,858,852	\$29,427,027	\$33,862,748	\$38,159,718	\$42,311,336		\$46,310,680	\$50,150,493
TOTAL ASSETS	\$60,030,100	\$59,604,592	\$59,068,886	\$58,419,229	\$57,648,852	\$56,752,027	\$55,722,748	\$54,554,718	\$53,241,336		\$51,775,680	\$50,150,493
EQUITY AND LIABILITIES												
SHARE CAPITAL AND RESERVES												
Issued, subscribed and paid-up capital	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000	10,000,000		10,000,000	10,000,000
Unappropriated profit/ Retain earnings	-	3,067,065	6,295,069	9,701,309	13,301,699	17,114,955	21,161,412	25,463,161	30,044,191		34,930,546	40,150,493
	\$10,000,000	\$13,067,065	\$16,295,069	\$19,701,309	\$23,301,699	\$27,114,955	\$31,161,412	\$35,463,161	\$40,044,191		\$44,930,546	\$50,150,493
NON CURRENT LIABILITIES												
Long term Debt	50,030,100	42,773,817	38,717,920	34,347,153	29,637,072	24,561,336	19,091,557	13,197,144	6,845,134		-	-
	\$50,030,100	\$42,773,817	\$38,717,920	\$34,347,153	\$29,637,072	\$24,561,336	\$19,091,557	\$13,197,144	\$6,845,134		\$0	\$0
CURRENT LIABILITIES												
Current portion of long term financing	-	3,763,710	4,055,897	4,370,767	4,710,081	5,075,737	5,469,779	5,894,412	6,352,011		6,845,134	-
	\$0	\$3,763,710	\$4,055,897	\$4,370,767	\$4,710,081	\$5,075,737	\$5,469,779	\$5,894,412	\$6,352,011		\$6,845,134	\$0
TOTAL EQUITY AND LIABILITIES	\$60,030,100	\$59,604,592	\$59,068,886	\$58,419,229	\$57,648,852	\$56,752,027	\$55,722,748	\$54,554,718	\$53,241,336		\$51,775,680	\$50,150,493

Annexure

Waste to Energy

Pre-Feasibility Study

Fiscal Year- 1st Jan- 31 Dec

USD	Base Year	Projections										
		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Profit and Loss Account												
Revenue	\$0	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200	\$14,755,200
Cost of sales												
WASTE TIPPING FEE	-	34,800	34,800	34,800	34,800	34,800	34,800	34,800	34,800	34,800	34,800	34,800
AGGREGATES/SOIL	-	20,880	20,880	20,880	20,880	20,880	20,880	20,880	20,880	20,880	20,880	20,880
ELECTRICITY SALE \$100 P/MW-h	-	116,928	116,928	116,928	116,928	116,928	116,928	116,928	116,928	116,928	116,928	116,928
METAL RECOVERY 1%	-	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400	17,400
	-	\$190,008	\$190,008	\$190,008	\$190,008	\$190,008	\$190,008	\$190,008	\$190,008	\$190,008	\$190,008	\$190,008
Gross profit/(loss)	\$0	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192	\$14,565,192
Gross profit margin	0%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
Operating Cost												
Salaries and Wages	-	458,210	471,833	484,396	498,804	513,644	528,930	544,674	560,891	577,594	594,798	594,798
Variable Operating Expenses	-	30,000	31,020	32,077	33,039	34,030	35,051	36,102	37,186	38,301	39,450	39,450
Fixed Operating Expenses	-	1,911,096	2,006,651	2,106,983	2,212,333	2,322,949	2,439,097	2,561,051	2,689,104	2,823,559	2,964,737	2,964,737
Depreciation expense	-	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000
	-	\$7,864,306	\$7,974,504	\$8,088,455	\$8,209,175	\$8,335,623	\$8,468,078	\$8,606,828	\$8,752,180	\$8,904,454	\$9,063,985	\$9,063,985
Operating profit/(loss)	\$0	\$6,700,886	\$6,590,688	\$6,476,737	\$6,356,017	\$6,229,569	\$6,097,114	\$5,958,364	\$5,813,012	\$5,660,738	\$5,501,207	\$5,501,207
Finance Cost	-	3,633,821	3,362,683	3,070,497	2,755,627	2,416,313	2,050,657	1,656,615	1,231,981	774,383	281,260	281,260
Net Income	\$0	\$3,067,065	\$3,228,005	\$3,406,240	\$3,600,390	\$3,813,256	\$4,046,457	\$4,301,749	\$4,581,030	\$4,886,355	\$5,219,947	\$5,219,947
Net profit margin	0%	21%	22%	23%	24%	26%	27%	29%	31%	33%	35%	35%

Annexure

Waste to Energy

Pre-Feasibility Study

Fiscal Year- 1st Jan- 31 Dec

USD	Projections										
	Base Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Cash Flow Statement											
CASH FLOWS FROM OPERATING ACTIVITIES											
Profit before taxation	\$0	\$3,067,065	\$3,228,005	\$3,406,240	\$3,600,390	\$3,813,256	\$4,046,457	\$4,301,749	\$4,581,030	\$4,886,355	\$5,219,947
Adjustment for:											
Depreciation/ Amortization	-	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000	5,465,000
Interest Expense	-	-	-	-	-	-	-	-	-	-	-
Contingency Cost	-	-	-	-	-	-	-	-	-	-	-
Pre-Operations Cost	-	-	-	-	-	-	-	-	-	-	-
	\$0	\$5,465,000	\$5,465,000	\$5,465,000	\$5,465,000	\$5,465,000	\$5,465,000	\$5,465,000	\$5,465,000	\$5,465,000	\$5,465,000
Operating profit before working capital chang	\$0	\$8,532,065	\$8,693,005	\$8,871,240	\$9,065,390	\$9,278,256	\$9,511,457	\$9,766,749	\$10,046,030	\$10,351,355	\$10,684,947
Working Capital Changes											
(Increase)/Decrease in Current Assets											
Pre-Opening Salaries and Wages	(500,000)	-	-	-	-	-	-	-	-	-	-
Prepaid Insurance Premiums	(60,000)	-	-	-	-	-	-	-	-	-	-
Staff Training/WAMITAB/POCA	(50,000)	-	-	-	-	-	-	-	-	-	-
Legal and Accounting Fees	(25,000)	-	-	-	-	-	-	-	-	-	-
Supplies	(150,000)	-	-	-	-	-	-	-	-	-	-
Advertising and Promotions	(4,000)	-	-	-	-	-	-	-	-	-	-
Licenses	(25,000)	-	-	-	-	-	-	-	-	-	-
Supplies	(150,000)	-	-	-	-	-	-	-	-	-	-
	-\$839,000	-	-	-	-	-	-	-	-	-	-
Net cash generated/used in operating activit	-\$839,000	\$8,532,065	\$8,693,005	\$8,871,240	\$9,065,390	\$9,278,256	\$9,511,457	\$9,766,749	\$10,046,030	\$10,351,355	\$10,684,947
CASH FLOWS FROM INVESTING ACTIVITIES											
Capital expenditure	(54,650,000)	-	-	-	-	-	-	-	-	-	-
Net cash (used in) investing activities	-\$54,650,000	-	-	-	-	-	-	-	-	-	-
CASH FLOWS FROM FINANCING ACTIVITIES											
Owner's equity/ Drawings	10,000,000	-	-	-	-	-	-	-	-	-	-
Proceed from long term loans	50,030,100	-	-	-	-	-	-	-	-	-	-
Long term finances - secured	-	(3,492,573)	(3,763,710)	(4,055,897)	(4,370,767)	(4,710,081)	(5,075,737)	(5,469,779)	(5,894,412)	(6,352,011)	(6,845,134)
Repayment of long term loans											
Long term finances - secured	-	-	-	-	-	-	-	-	-	-	-
	\$60,030,100	-\$3,492,573	-\$3,763,710	-\$4,055,897	-\$4,370,767	-\$4,710,081	-\$5,075,737	-\$5,469,779	-\$5,894,412	-\$6,352,011	-\$6,845,134
Net (decrease)/increase in cash and cash eq	4,541,100	5,039,492	4,929,294	4,815,343	4,694,623	4,568,175	4,435,721	4,296,970	4,151,618	3,999,344	3,839,813
Cash and cash equivalents at the beginning of the	-	4,541,100	9,580,592	14,509,886	19,325,229	24,019,852	28,588,027	33,023,748	37,320,718	41,472,336	45,471,680
Cash and cash equivalents at the end of the y	\$4,541,100	\$9,580,592	\$14,509,886	\$19,325,229	\$24,019,852	\$28,588,027	\$33,023,748	\$37,320,718	\$41,472,336	\$45,471,680	\$49,311,493

SOURCES

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ABOUT US

Punjab board of investment & trade is a provincial trade and investment promotion agency established by the Government of Punjab in 2009. In today's global economy, trade and investment play an increasingly important role in generating means for transformative change. At PBIT, we strive to ensure that this transformative change is sustainable and more impactful. PBIT is committed to enhancing the global competitiveness of Punjab and its business. To this end, we work to attract new investments in the region and strengthen the existing ones by promoting local investment opportunities, facilitating businesses and highlighting the distinct advantages of Punjab as a business location.

Incorporated under Section 42 under the Companies Ordinance of 1984, Punjab Board of Investments & Trade (PBIT) assists companies which intend to invest in the manufacturing and services sectors of Punjab. The wide range of services provided by PBIT include providing information on the opportunities for investments, as well as facilitating companies which are looking for joint venture partners. PBIT acts as Punjab's marketing arm and actively promotes the province worldwide as one of the best investment hubs in Asia. PBIT as Special Economic Zone Authority Punjab also evaluates the applications/proposals from Developers to declare their Industrial Parks as Special Economic Zones. For granting one time import duty exemption on machinery, equipment, spare parts, consumables in Special Economic Zones, PBIT is responsible to issue a confirmation Letter on the status of the applicant prior to seeking the permission from the relevant department/agencies to claim for the exemption. Investors are always encouraged to discuss their project interests with PBIT officers, wherein Information can be obtained on major public/private projects, prevailing sectoral policy framework, existing incentive regime, financing options, trade statistics etc. Punjab Board of Investment & Trade is a Steering Committee Member and the Director of South Asia at the World Association of Investment Promotion Agencies (WAIPA) - a prestigious world association of organizations similar to PBIT created by UNCTAD.

Projects and Policy Research Department

Punjab Board of Investment and Trade targets a socio-economic growth through its P&PR. The department plans to fortify its deep roots, both locally and internationally, by reaching out to leading businesses for discussing the panoramic commercial opportunities. As per the initiative of inventiveness, the department plans to provide a transaction advisory as defined in its role to bring-in the investments and establish new businesses. For this purpose, Pitch books of different identified sectors are a new resourcefulness of this department which would target to develop the in-house capacity of production by connecting the local and international market players. This would not only ensure the technology transfer but also create several jobs in the province. The department plans to connect through the regional IPAs, financial institutions, the embassies in different countries and local chambers as well so as to fast-track the process of economic growth and industrialization in Punjab in regard to its recognition as 'The Land of Opportunities

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