

# CONVERTING WASTE TO ELECTRICITY

*The Future of Waste Management*



**Balboa Pacific Corporation**

*"Advanced Thermal Conversion Technologies"*



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## 1.0 INTRODUCTION

### THE SOLUTION TO A SIGNIFICANT WASTE AND ENERGY PROBLEM

*Balboa Pacific Corporation's development of the Bal-Pac Thermal Conversion Pyrolytic Gasification System represents a significant breakthrough in waste-to-electricity and clean energy technology.*



Worldwide electricity demand is dramatically increasing every year, and will continue to do so for the foreseeable future. Along with the demand for more electricity comes an array of environmental problems caused by whatever energy bearing resource is being used to create the electricity. What if instead of causing more environmental problems during the production of electricity, we could generate electricity while solving problems? What if we could use a renewable resource to generate electricity, while reducing greenhouse gas emissions, increasing air quality, and eliminating unsightly landfills? Such a solution exists. Such a solution lies in a technology known as the Balboa Pacific Pyrolytic Thermal Conversion System.

Standard waste disposal techniques have created a substantial worldwide crisis, including: contaminating drinking water sources, contributing significantly to green house gas emissions, causing air and soil contamination, and contributing to significant health problems. Landfill scavengers in third world countries, make their living off of exposed dumps and landfills, but their life expectancy is very short.

Environmentally friendly waste disposal has historically had few economically viable solutions. Even the legal disposal of wastes into properly designed landfills hardly solves the bigger problems associated with how to manage our waste. The old model of depositing waste into landfills or dumps needs to be forsaken and replaced with a solution that does not require vast amounts of land.

Landfills and dumps are significant known contributors to greenhouse gas



emissions because of the methane produced by the decaying trash. In addition, landfills that have not been constructed to the highest environmental standards produce a liquid leachate that is often very toxic. It is a combination of the chemical breakdown of various forms of trash and garbage. The leachate sometimes penetrates the surface and has a considerable detrimental effect on groundwater. Where this groundwater is a local source of drinking water, health issues result in the population of people that consume the water.

The Balboa Pacific thermal waste conversion systems are designed to eliminate the need for landfills. That is a bold undertaking in and of itself, but by doing so this technology will also virtually eliminate the associated environmental problems, while providing avenues for generating electricity, profit, public relation benefits, and improving the public health. The technology is proven and the opportunity could not come at a better time.

## **1.1 A BRIEF OVERVIEW OF THE BALBOA PACIFIC THERMAL CONVERSION WASTE GASIFICATION SYSTEM**

The Balboa system uses pyrolysis as its base technology; that is significant heat in a low oxygen environment. There is no combustion. This is not an incineration technology. Organic material undergoes molecular restructuring, and is gasified without combustion.

The Bal-Pac system design also maximizes its efficiency is by using a continuous feed system for delivering waste into a thermal converter utilizing a slow-speed auger. Another unique attribute of the Balboa Pacific system is that that components are modular, and the system can be mobile rather than requiring a fixed base. As a mobile waste destruction alternative, the system sets up in a matter of hours, and the system can be ready to move to its next location in a matter of hours. If the intent is to bring the waste to the system rather than the system to the waste, it then is operated with a fixed base.

The Balboa Pacific thermal conversion system is an excellent solution for many waste disposal and electricity need applications, including confined locations such as islands, governmental agencies and armed forces, municipalities, and industry. The system not only destroys typical municipal solid waste, but also destroys organic hazardous industrial wastes (both liquid and solid) and other solid wastes such as tires and plastics without creating harmful emissions in excess of regulatory standards. Because of its efficiency, the Balboa system considerably reduces the amount greenhouse gasses generated by today's common waste management activities. With back-end equipment the system can facilitate the generation of electricity from renewable resources, produce biofuels, or supply the necessary resources for large-scale greenhouses.

The Balboa Pacific Corporation has developed proprietary thermal waste conversion equipment that uses a pyrolysis technology to destroy organic wastes; reducing the waste to a carbon char and various synthetic gases. The carbon char by-product is approximately 5-10 percent by volume of the organic material that is placed into the system, and 10 to 20 percent of the weight. The char can be a very valuable by-product. Inorganic material is melted into a mass that retains most of its original weight but is likely reduced in size based on its original structure.

Some unique qualities of the Balboa Pacific Pyrolytic Gasification technology include that it has been designed from the beginning to be a continuously operating machine that is manufactured as either fixed with modular components, or mobile with modular components. The mobile system can be hauled on and operated from a flatbed or from skids, and can be set up and operational in a matter of four hours or less. The system is even simpler to operate than it is to move. And of course it can be used as a fixed-base solution. The Bal-Pac system is excellent for a myriad of applications, such as the processing of municipal solid waste (MSW), dried sewage sludge, waste tires, spent grain, biomass, hazardous and medical waste, and toxic substances.

Balboa Pacific can put together a complete turnkey project for about \$7,500,000 that would produce between 2.2 and 3.0 mWh (depending on feedstock) of electricity from the consumption of 50 US tons per day of waste. Although municipal solid waste (MSW) could certainly be a component of the feedstock for the project system, it is not the only reliable feedstock, or for that matter the most reliable. Almost any organic waste material can be used as, and the higher the Btu value of the waste, the better for the system to maximize energy generation. Hazardous wastes make a very good feedstock, as do, tires, plastics, medical waste, botanical waste, and organic construction debris. The Balboa Pacific Corporation has developed the Bal-Pac Thermal Conversion Pyrolytic Gasification System for the environmentally friendly destruction of waste. The system offers an ecologically sound solution to the very messy problem of what to do with the waste that humans generate.



## 2.0 TECHNOLOGY BRIEFING

### 2.1 THE BALBOA PACIFIC TECHNOLOGY

Balboa Pacific has developed the Bal-Pac Thermal Conversion Pyrolytic Gasification System, as a continuous feed waste treatment technology. The process is the destructive distillation of toxic and non-toxic organic material, either solid or liquid substances, reducing the waste to a sterile ash and hot exhaust gases. The Bal-Pac Systems are **not** incinerators. Rather than burning waste, the Pyrolytic Gasification System thermally degrades organic material in an oxygen starved environment (pyrolysis) at temperatures from 800° F to 1200° F and then, through a closed conduit, the process gases are introduced to the Thermal Oxidizer with temperatures up to 2250° F.



*Bal-Pac 12-Ton Per Day System*

The ash produced is primarily carbon and stabilized (oxidized) metals. The hot gasses produced may be used for a variety of applications including energy co-generation and vehicle and machinery fuels. Several of the nation's leading environmental engineering companies, and research and development institutions such as Dames & Moore (now URS), Sandia National Laboratories, and Pacific Environmental Services have tested the process emissions from the decomposition of a wide range of waste material processed by the Bal-Pac Thermal Conversion Systems, with documented results declaring that the Bal-Pac System exceeds all standards set by the United States Environmental Protection Agency (EPA) and the South Coast Air Quality Management

District (SCAQMD, southern California), which is often known as the world's most stringent air quality regulatory agency.

As validated by independent environmental engineers "Balboa's Pyrolytic Gasification destroys 99.999984 percent of the toxic elements found in any feedstock that is introduced through the system and is cost effective in its application to waste management." The Company has received acceptance of its technology and application to the treatment and eradication of waste by the US EPA and SCAQMD. The emissions and by-product wastes are non-hazardous and non-toxic.

## **2.2 HAZARDOUS MATERIALS**

The Bal-Pac Thermal Conversion System processes solid wastes, liquids, and sludge's containing, dioxins, furans, PCBs, rubber, chlorides, hydrocarbons, plastics, wood, and paper products. The Balboa Pacific pyrolytic process has been used successfully on contaminated soils, industrial and petroleum-based sludges, municipal waste, medical waste, and other hazardous waste materials. The emissions from processing hazardous waste, as well as non-hazardous wastes, have been found to be below US EPA and other more-stringent regulatory authority guidelines.

## **2.3 WASTE VOLUME REDUCTION**

The Balboa Pacific system reduces all organic materials to a small fraction of their original volume. A ninety-five percent (95%) reduction in volume is not uncommon. Typically the weight reduction is between 70% and 90%. Organic materials are reduced to sterile ash composed mostly of carbon. Most metals are transformed to a non-leachable, oxidized material that meets all US EPA disposal requirements. The salts are eliminated from metals that contain them.

## **2.4 NET HEAT PLANT EFFICIENCY**

The Bal-Pac Thermal Conversion Systems are 75% to 90% efficient depending on the input waste stream composition. Incineration systems typically are 50% efficient. With the Bal-Pac System, the BTU value of the waste stream is available as an energy source. The energy conversion of the Bal-Pac



systems, using waste heat boilers, will produce steam for several applications, including co-generation with a steam driven turbine generator set. The power generated by the system depends on the average BTU content of the waste stream. Typically, tires, plastics, oil sludge's and solvents have high energy values in excess of 14,000 BTUs per pound, while typical municipal solid waste (MSW) averages about 7,000 BTUs per pound.

## 2.5 MATERIAL HANDLING AND PRE-PROCESSING

Waste should be less than 20% moisture to help maximize the efficiency of the system. The drier the waste the more desirable it is to pyrolyze. There are many ways to accomplish reducing excessive moisture, such as by use of industrial driers. A pelletizer can also be used to help reduce high moisture content because it typically reduces moisture to about 18%. However, the drying mechanism will depend upon the waste stream and the specific needs of the client.

A shredder may be necessary to reduce the input size of the waste stream to approximately 2-inches or less. This reduction size allows for a consistent flow of material through the system that provides for a more complete pyrolysis of the waste. It is often beneficial to pelletize wastes so that a consistent size and weight of waste material is delivered to the system.

If waste size is larger than 2-inches, it may only be partially pyrolyzed, thus presenting a greater amount of residual carbon char output. After the waste material is an adequate size for pyrolyzing it is loaded into a hopper where it encounters an auger that allows for the continuous flow of the waste material into the thermal converter..

Depending upon the size of the Bal-Pac system, a front-end loader of some type may be required to feed the waste into the hopper after it has been appropriately sized. The front-end loader can also be used to remove the carbon char to a storage area prior to resale. One front-end loader can be used for more than one system.

## 2.6 SYSTEM FLOW

The processed fuel is then placed (or pumped in the case of a liquid) into a hopper where it goes through two or more locks where air is removed to aid in more complete pyrolysis. The feed stock encounters an auger that moves the



waste through a thermal converter that operates between 1200 and 1800 degrees Fahrenheit. Critical to the operation of the thermal converter is the residence time that the waste spends in the chamber. In the thermal converter organic waste is converted in gasses with a residual carbon char. The carbon char exits the thermal converter near the terminus of the chamber. The gasses are directed to a thermal oxidizer chamber that is heated to temperatures ranging from 1600 to 2600 degrees Fahrenheit. Gasses and waste heat can be then used to fuel a waste heat boiler to create steam which then drives a steam turbine generator to produce electricity.

## **2.7 OPERATIONS AND MAINTENANCE**

### **Operation**

It takes only three full time staff to operate a Balboa Pacific system that is designed to consume 50 tons of waste per day. With continuous operation there would be a need for a total of nine personnel over three shifts. The same amount of staff could operate 50-ton systems located adjacent to each other (for a total of 100 tons of waste destruction). Smaller systems may only require two staff to operate per shift. Balboa Pacific will train staff as needed, and provide an operations manual. Operation of the equipment does not require an elevated skill level.

### **Maintenance**

The Balboa Pacific thermal conversion systems require very little periodic maintenance, however some parts such as conveyors may need to be replaced when worn. We suggest an annual maintenance program where the system is shut down for approximately two weeks and thoroughly examined for worn parts that might need to be replaced to allow for an additional year of trouble-free use. No major parts should have to be replaced until after about 10 years of continuous operation. Balboa Pacific can be contracted to maintain the system. However, specific high-level mechanical skills are not necessary for the annual maintenance.

An Operations And Maintenance Manual will be provided to the client after installation of the system and during training of onsite employees. Balboa Pacific will be available to answer specific operations and maintenance questions whenever there is the need.

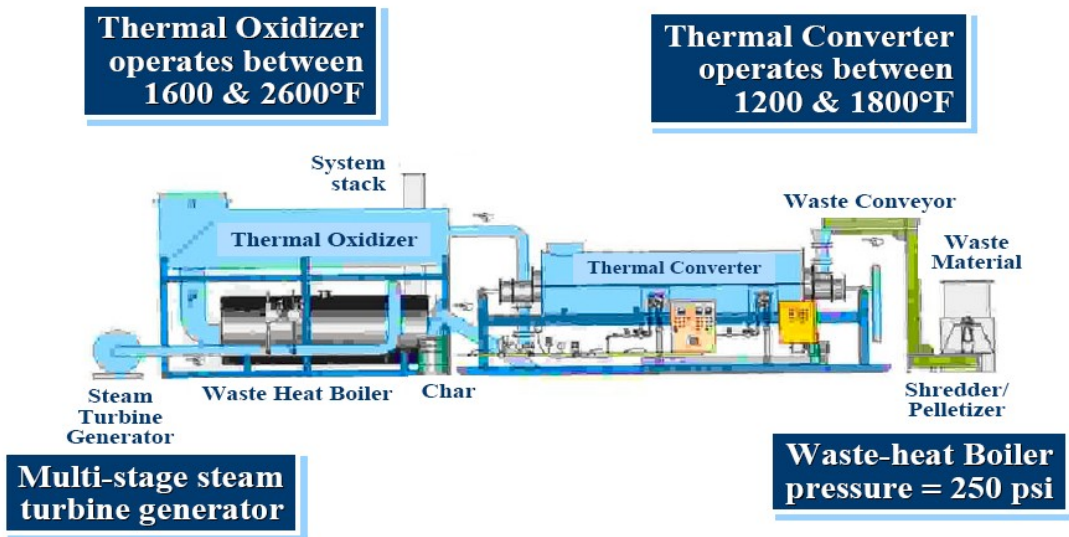
## **2.8 SIZE OF WASTE HANDLING AREA AND EQUIPMENT**

The Balboa Pacific 50-ton per day thermal conversion system requires about 2 acres of space to operate at maximum efficiency. A site of this size will allow sufficient room for waste storage, ancillary equipment such as shredders, grinders, or pelletizers, storage for carbon char, and the free movement of front end loaders. As stated earlier the system is modular and the thermal oxidizer and thermal converter can be stacked if it is

necessary to put the system in a more constrained area. In addition, in most geographic regions waste should be stored under canopy or inside of a building to prevent the debris from retaining excess moisture due to rainfall and/or fog.

If the project necessitates destruction of 100 tons of waste per day, the area necessary for efficient operation will only increase slightly to facilitate either an additional 50-ton per day system or increasing the size of a single system to facilitate the conversion of 100 tons of waste per day. Although Balboa Pacific has designs for systems up to 150 tons per day, we feel that having redundant systems capable of 50 tons is the most proficient method of handling 150 tons of waste.

The thermal oxidizer and thermal converter for a 50-ton per day system each require a rectangular space of approximately 40 feet long, by 10 feet wide, by 10 feet in height. As was mentioned earlier, the thermal oxidizer and thermal converter can be



stacked where there are space concerns. The size of other equipment such as shredders and pelletizers, and add on equipment such as electricity generation equipment or bioreactors necessary for the client’s needs will vary widely depending on the manufacturer. These items are third-party equipments and are not manufactured by Balboa Pacific.

### 3.0 BENEFITS OF THE BAL-PAC SYSTEMS

The primary by-products of the Balboa Pacific Pyrolytic Gasification System include: carbon char, waste heat, and synthetic gasses. The synthetic gasses can be altered to a useable gas similar in structure to methane. The specific nature of the gasses will depend upon the feedstock used to generate them. The waste heat can be piped for any applicable use. The carbon char also has many potentially beneficial economic uses.

#### 3.1 PROFITABLE BY-PRODUCTS

##### **Waste-To-Energy**

- The Bal-Pac system can be used for producing electricity by using the synthetic gasses that are produced from the pyrolyzing of organic waste and the waste heat energy to fuel boilers. The steam from the boilers is directed to turbine generators to produce electricity.

Transportable electrical power can be generated by the system in the area of 3.8 kWh per 7000± BTUs, which is the approximate average value per pound available in municipal solid waste (MSW). Depending on the precise nature of the feedstock, a 50-ton per day Balboa Pacific thermal conversion with electrical system backup equipment will produce between 2.5 and 3 mWh of electricity. The wastes produced will be heat and CO<sub>2</sub>, both of which can be delivered to additional back-up systems described later.

##### **Heat Energy**

- Even if electricity production is not required, the waste heat can be pumped directly for use in industrial applications where a great deal of heat is required, such as a brewery. In addition, in smaller applications where electricity is not needed or wanted waste heat can be fed back to the thermal oxidizer cutting the need for a heating fuel by about 90 percent.

If the system is designed to provide electricity there is still enough residual heat to have beneficial uses, including providing heat to commercial greenhouses, or to produce biofuels from algae.

##### **Fuel Production**

- Somewhat dependent upon the waste stream introduced into the system, the



synthetic gas produced by the pyrolysis can be similar in chemical structure to methane. With minor modifications, vehicles and other machinery, that have been designed to operate using diesel fuel, can use the synthetic gas produced by the Bal-Pac system to operate without any loss of efficiency.

#### **Carbon Char**

- The carbon char by-product of the pyrolyzing of organic wastes can be used as a soil amendment, increasing water retention in the soil for availability to plant roots. Depending upon the introduced waste stream there can be many valuable uses for the carbon char output.

#### **Process Wastewater**

- Wastewater from drying, shredding, and pelletizing activities can be reclaimed for additional use, where needed.

#### **Biofuels from Algae**

- As noted earlier synthetic gases can be manipulated for use in diesel fueled vehicles and machinery. In addition, the heat and CO<sub>2</sub> that are natural byproducts of the system are the primary substances required for the production of algae. With a third-party bioreactor, left over heat and CO<sub>2</sub> are used as the feedstock for producing algae. The oils are extracted from the algae and refined using simple methods. The biofuel is then refined using a catalyst for use in machinery and vehicles that would normally require diesel. This can be an add-on to the Bal-Pac system even if electrical production is also used.

### **3.2 ADDITIONAL BENEFITS**

There are many benefits to using the Balboa system that may not immediately include making a monetary profit. Although some of the following statements do not necessarily create monetary profit, they will likely eventually generate profit by reducing costs and by creating a sense of environmental stewardship in the employees and in the community.

#### **Remote Area Waste Reduction**

- Illegal dumps and the necessity to cleanup hazardous materials spills pop up from time to time in remote areas that are not accessible for easy cleanup. The mobility of the Balboa system allows for relatively easy access to sites that need in-situ cleanup. Since the pyrolysis system destroys organic wastes, it renders hazardous and toxic material inert and turns them into useful gases that can be used to fuel the system in remote locations.

#### **Energy From Renewable Resource**



- Waste is considered by most local and federal governments to be a renewable resource. Producing energy from a renewable resource helps cut dependency on foreign fossil fuel importation, which in turn aids in the country's import imbalance. There can also be tax incentives and other government sponsored benefits for producing electricity from a renewable source.

### **Reducing Greenhouse Gas Emissions**

- The Balboa-Pacific pyrolysis technology captures and uses gases from the destruction of the waste that would otherwise be emitted over a long period of time from waste that is landfilled, thus significantly reducing greenhouse gas emissions. Methane is the most common of landfill gasses and is a recognized significant contributor to global warming. In the Bal-Pac system methane is captured and used as fuel for electrical generation thus mostly eliminating methane from emitting to the atmosphere.

### **Disaster Relief**

- The Balboa Systems can be mobile and thus can be used to clean up debris from natural disasters like that caused by Hurricane Katrina. Much of the debris left by the hurricane was contaminated from the numerous ruptured chemical containers industry was storing in the area of the hurricane landfall. The Balboa Pacific system can be easily taken to an area of need, and ready to consume waste in a matter of hours upon arriving. The machine does not only destroy the waste, but also destroys the hazard involved with the airborne emissions of the waste. It took many months of very difficult work to remove debris from the neighborhoods of New Orleans after Hurricane Katrina. The mobile Balboa Pacific systems would have made the task much faster, more efficient, and definitely limiting the health risk of the survivors.

### **Environmental Justice**

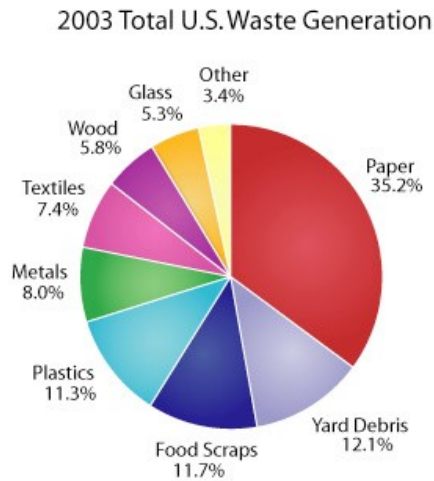
- The Balboa Pacific system is also very adaptable to areas where there are environmental justice issues. Waste can be destroyed while keeping emissions to a minimum and protecting the health of residences in urban areas. The space needed to destroy wastes can fit into a light industrial building, so there will be little or no associated blight concerns. The system can then be used to provide



electricity to the grid, elevating the image and perception of the area in which it is housed.



## 4.0 BALBOA PACIFIC CORPORATE OVERVIEW



Balboa Pacific Corporation and its affiliate Balboa Conversion Technologies, Inc. are Delaware corporations with corporate offices in San Diego, California. The Company's primary business is the development of environmentally friendly, and economically viable waste processing systems and mineral resource technologies.

Balboa Pacific's extensive research and development has been primarily in the area of pyrolytic gasification of organic material. This research has resulted in the development of a waste treatment system using heat in a low-oxygen environment. The thermal conversion system changes the molecular composition of organic waste material, thereby destroying the organic waste that is introduced through the system. The company has also developed water treatment, soil remediation, thermal conversion, and heat recovery/co-generation systems.

### Available Services

*Balboa Pacific* offers a wide range of support services including:

- Site Assessment
- Waste Stream Analysis
- Assistance with the Regulatory Entitlement Process and Permits
- Development Coordination
- System Installation
- Turnkey Operation and Management
- Performance Verification
- On-Site Service and Maintenance
- Waste Destruction Service Contracts



If you have questions please feel free to contact me at any time.

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