



[www.agrindmar.com](http://www.agrindmar.com)

[www.dynamisenergy.com](http://www.dynamisenergy.com)

Modular, Upgradable and Fully Containerized Waste Management Plants with Optional Outputs for Power Generation, Desalination or Sewage processing



The WasteStation™

'WasteStation' is a registered Trade Mark of Dynamis Energy

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# Who needs a Modular Upgradable Self-contained Waste Management System?



**ISLANDS**



**RESORTS**



**MILITARY INSTALLATIONS**



**REFUGEE CAMPS**



**NATURAL DISASTERS**



**MUNICIPALITIES**



**HOSPITALS**



**INDUSTRY**

## **Why is an efficient, affordable and adaptable Waste Management/Waste to Energy system vital to a Community?**

Agrindmar and Dynamis have joined forces in order to offer a choice of stand-alone Containerized Waste Management plants, of 3, 6, 9 and 12 tons per day capacity, with a further choice of an add-on Electrical Generator, Desalination Unit or a Sewage processing Plant utilizing the heat energy produced by the waste combustion process.

Our 3 tons per day WasteStation™ has a single hopper and is intended only for Waste Management purposes. The 6 tons per day unit has two hoppers, the 9 tons per day unit utilizes 3 hoppers and the 12 tons per day plant has four waste hoppers. Multiple hoppers allow around the clock waste destruction and continuous Power Generation if the optional boiler/steam turbine generator package is installed, Freshwater Production if the Evaporative Desalination package is selected or Sewage Processing.

Because of the modular construction of our WasteStation™ units, it is extremely easy to upgrade them by simply adding additional 3 ton hoppers should the need arise or the amount of Garbage produced increases exponentially with a growing population. With our optional add-on outputs, a community can utilize the heat energy produced by the Garbage Combustion Process to cater to its most pressing needs. An island situation for instance may feel that a Desalination Unit or a Sewage Processing Plant is more necessary than Generating Electricity.

All communities however large or small, permanent or transitory will inevitably have a problem with what to do with the tons of Garbage they produce every single day. This problem is especially acute for small, isolated communities where Land and Resources necessary to deal with the safe disposal of society's unwanted detritus are severely limited.

Examples of communities and situations that would benefit from a small scale Waste Management/Energy system are:

- **Islands**
- **Remote Villages & Towns (Mountain, Jungle, Marsh and Island Communities)**
- **Resorts**
- **Temporary Military installations in War Zones**
- **Emergency Situations such as Earth Quakes, Displaced Populations, Tsunamis and Natural Disasters**
- **Seasonal Populations (Tourist Destinations)**
- **Emergency clean-up operations (Major Oil Spills)**
- **Hospitals**

Agrindmar and Dynamis have teamed up to provide a highly efficient, fully adaptable and cost effective solution to the Waste Management issues of smaller communities. Islands or other examples of isolated communities have a unique set of problems when it comes to the issue of garbage disposal. Traditionally, these communities have used the common practice of landfill in order to remediate their Garbage Disposal problem. There are however obvious drawbacks to this method.

**Groundwater Pollution:** With available supplies of drinking water becoming more scarce, a community must do everything in its power to safeguard its limited natural freshwater supplies otherwise face vast expense by importing water or through costly desalination plants. This is especially true for island communities. The improper situation of a landfill could spell disaster for an island's drinking water supply if pollutants inadvertently tainted the groundwater.

**Limited Suitable Space:** A traditional landfill takes up valuable space particularly on a small island. The land could be used for more productive endeavors such as Agriculture or Industry.

**Maintenance Costs of a Landfill:** Landfills are usually located as far from human habitation as possible. Garbage is therefore hauled to the site by heavy trucks burning diesel fuel which adds further expense and pollution. An Agrindmar/Dynamis Waste Management/Energy system located closer to the area where most of the garbage is created will reduce the amount of road traffic by approximately 90-95%. Converting tons of garbage to a small amount of ash means a vast reduction in heavy truck traffic to remotely sited landfills.

**The Safe Disposal of Hazardous Waste:** The Agrindmar/Dynamis Waste Management system is approved and tested for the safe disposal of Hospital Waste, Dioxin containing material, Sewage Sludge and many other forms of recognized toxic substances. The ultra high temperature of the secondary stage burn (1800-2200<sup>0</sup>F) ensure that toxins such as Dioxin, Furans etc. are completely destroyed at a molecular level. Dynamis equipment was successfully used to safely dispose of contaminated materials after the Exxon Valdez Oil Spill in Alaska.

**Seasonal Populations:** When a community's population fluctuates due to seasonal influences, an adaptable Waste Management system is very important. The Agrindmar/Dynamis Waste Management energy system is totally adaptable. Our single hopper system can handle up to 3 tons per day and because it is a single process Waste Management system and does not generate electricity, it can be used as and when necessary. In Low season, for instance, the Garbage can be stored until the necessary 3 tons capacity is attained. In High season it can run on regular Daily Cycles.

**The Potential for Garbage to Spontaneously Ignite:** Landfills are prone to spontaneous ignition due to the high number of potential fuels and ignition sources as well as malicious acts of arson.

Landfills always generate Methane gas and contain a lot of waste oil products and tires. Ignition sources are sparks from earth moving equipment, oil soaked rags under compression, accidental mix of chemicals and sunlight magnified onto a single point by broken glass. Once ignited it is very difficult to extinguish a burning Landfill and many of these fires have been known to burn out of control for months, causing nearby populations to be exposed to extreme smoke hazards.

**Disease Carrying Insects, Rats and other Vermin are attracted to Landfill sites:** Because of all the potential food sources available at a landfill site, Rat and Mouse populations are very difficult to control and could cause the spread of disease to nearby communities. Tires take a long time to degrade and are often stored separately in above ground piles that rapidly become a breeding ground for Mosquitoes as rainwater becomes trapped inside them.

**A Landfill is Unsightly:** Nobody wants to buy property next to the local Garbage Dump and in a Tourist destination, a Landfill needs to be sited well away from people who are looking for a piece of paradise. This involves moving the garbage from where it is created to a remote location by heavy trucks burning expensive and polluting fossil fuels.

**A Landfill is Malodorous in Nature:** Everyone is acutely aware of the smell that Rotting Garbage makes and when the wind blows in an unkind direction, people living in the vicinity of a Landfill become all too aware of the downside of heaping garbage in one concentrated area. Sometimes the landfill spontaneously ignites and local people have to stay indoors and seal their windows against the choking smoke that fills the air for weeks.

**Portability:** An Agrindmar/Dynamis Containerized Waste Management/Energy unit is completely portable and can be easily transported to wherever it is needed most. The cost of shipping a twenty foot container to any part of the World is a known cost. In locations with narrow roads and difficult terrain, the waste plant, depending on its capacity, is split into two, three, four or five separate twenty foot containers.

**Asset Value:** With an anticipated life cycle of well over 30 years, the Waste Management unit will retain real asset value. If the anticipated demand is not met in one area, the containerized unit can be moved simply and cheaply to an area where it is guaranteed to be in full demand.

**Modular:** The Agrindmar/Dynamis containerized Waste Management/Energy plants are modular and other plants can be added as needed or existing plants can be upgraded by adding additional 3 ton hoppers up to a total of four and adding outputs to utilize the heat energy from the combustion process, such as a steam boiler which can drive an electrical generator, an evaporator to convert seawater into drinking water or a sewage processing plant. All situations demand a slightly different solution and the versatility of the Agrindmar/Dynamis Waste Management System can readily adapt to any need.

**Adaptability:** In some regions where the cost of existing electrical power generation is low, the primary consideration for the use of the combustion heat energy might be to produce drinking water. In disaster management situations garbage disposal and adequate supplies of clean water are obviously the first priority. The combustion of sewage might also take precedent in a refugee camp where cholera is a very real threat. In some situations a combination of energy uses are required and our system is more than capable of serving multiple emergency situations.

Because our modular and upgradable Waste Management plants all fit inside standard 20 foot shipping container footprints, they are very easy and cheap to ship anywhere in the World and our engineering team will only take a few days to make the plant operational which will include the training of local operators.

Remote monitoring is also available to assist local operators in the day to running and maintenance of our units.



# Suitable Waste Streams



Before Processing



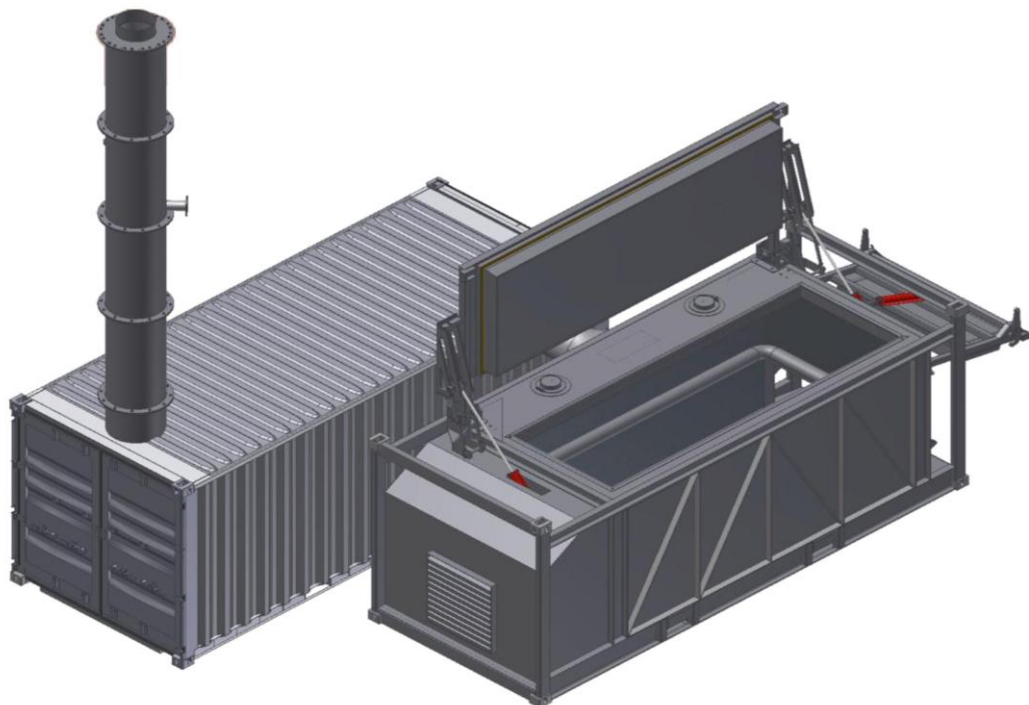
After Processing



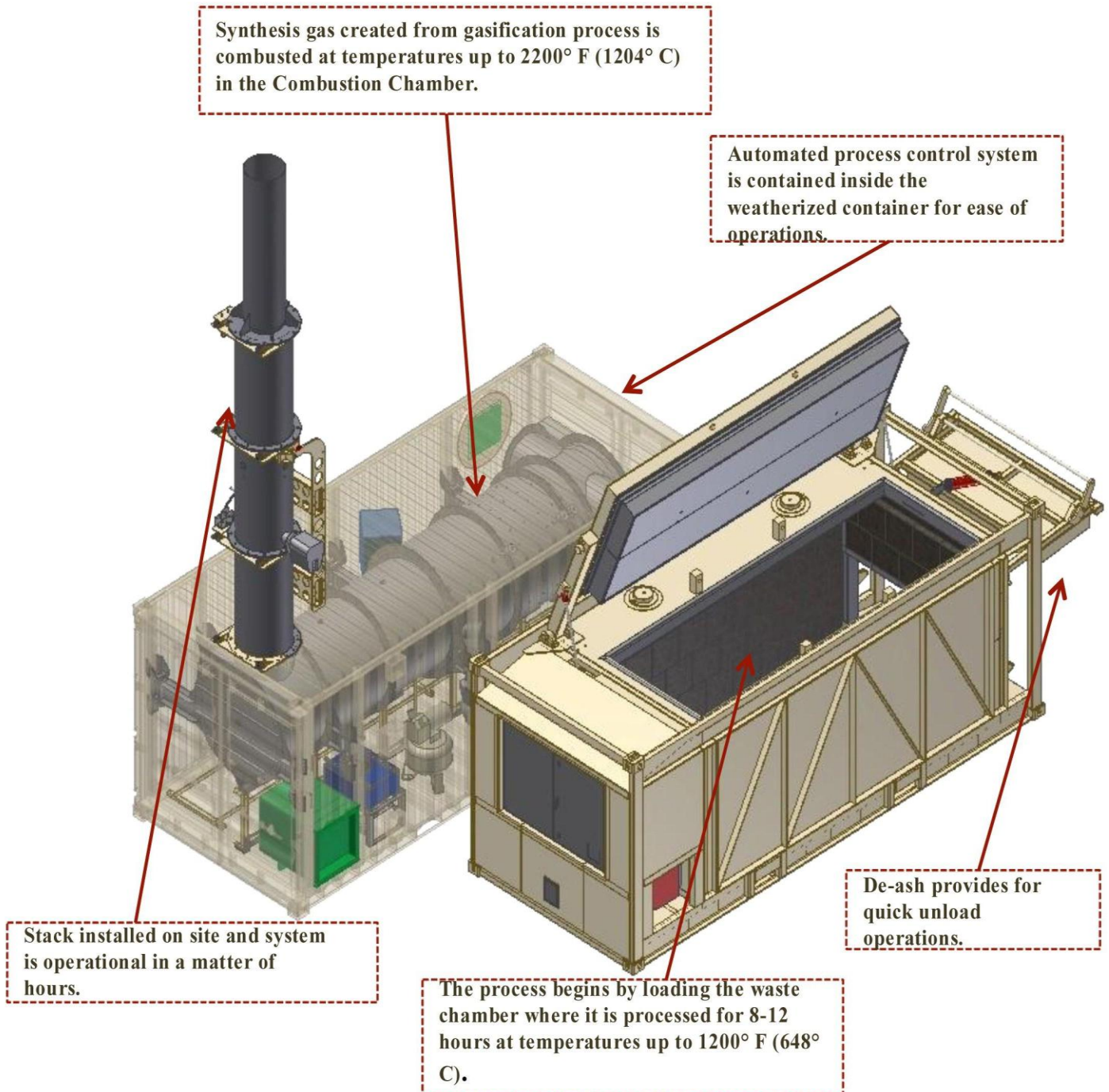
## Containerized Waste Management Plants 3, 6, 9 & 12 Tons of MSW per Day



The WasteStation™ Single Hopper Plant (3 Tons of MSW per day)  
Expandable to a total of four, 3 Ton Hoppers (12 Tons/Day)



# How the WasteStation™ works



# The WasteStation™ is an advanced thermal oxidation waste destruction system capable of handling up to 72\* cubic yards of waste per day.

## Why choose the WasteStation™?

### Large Load Capacity

Each Waste Chamber has a large 18 cubic yard load capacity. Up to four waste chambers' can be combined to process up to 72 cubic yards per day..

### Unique Portability and Deployment

The WasteStation™ can be quickly transported to any site and maneuvered into tight spots for very rapid deployment. It can be quickly and easily set up and operating in a matter of hours dependent on the number of chambers installed.

### Simplicity of Operations

The unit is easy to use with its automatic operations control panel and process logic control system. It's as simple as loading waste into the unit and pushing a button.

### Low Labor Operating Requirements

Because the system gets loaded once per day, the amount of time the operator is normally engaged in actual loading and operations is estimated at 2-3 hours.

### Low Maintenance Requirements

The WasteStation™ has very few moving parts; greatly reducing maintenance requirements, thereby reducing the on-going cost of operation, increasing uptime.

### Limited Material Handling

The WasteStation™ operates in a batch mode, reducing waste sorting or preparation to almost nothing. Limited sorting should occur to prevent large non-combustible items from entering the waste chamber.

## On-site Waste Conversion

### Eliminate Hauling and Tip Fees

A WasteStation on-site reduces expensive landfill tip fees and transportation costs, freeing up valuable resources that can be deployed elsewhere.

### Safety Considerations

The overall safety objectives are to exceed generalized safety requirements for a global customer base. Automated and redundant safety features are integrated into the control technology along with appropriate lock out/tag out procedures.

### Sturdy Rugged Construction

Built with high quality materials, the rugged modules are skid mounted and integrated into the container, offering reliability and stability to cope with the intense conditions that mobile deployment offers.

### Broad Spectrum of Waste Streams

The WasteStation™ has been tested with a broad range of waste types, including the following:

- Municipal Solid Waste
- Industrial Waste (Solids)
- Commercial and Demolition Waste
- Medical Waste
- Tires
- Mixed Plastics
- Auto Fluff

\* The WasteStation™ can accommodate up to four waste chambers offering up to 72 cubic yards of waste destruction per day.

## WasteStation™

## Technical Specifications\*

Power Requirement	480 VAC 3 Phase or 240 VAC 3 Phase or 208 VAC 3
Phase Load Capacity	18 Cubic Yards / 13.762 Cubic Meters
External Dimensions Each Container	Length: 20 Feet / 6.096 Meters Width: 8.0 Feet / 2.438 Meters Height: 8.6 Feet / 2.621 Meters - Traveling 25 Feet / 7.62 Meters -
Load Door Opening	Imperial: 160 in. wide by 54 in. deep Metric: 406.4 cm wide by 137.16 cm deep
Ash Door Opening	Imperial: 75 ½ in. wide by 31 in. tall Metric: 191.7 cm wide by 78.74 cm tall
Fuel	Natural Gas, Diesel, LPG, #2 Fuel Oil, JPT/JP8 Jet Fuel
Burners	Fully automatic, high efficiency burners with electronic ignition, flame recognition, and combustion control devices
Control System incorporate	Fully automatic state of the art process controls that digital displays for all major components to be monitored throughout each cycle.
Normal Operating Temperature Range - Primary	Imperial: 600- 1200° Fahrenheit Metric: 315-648° Celsius
Normal Operating Temperature Range - Secondary	Imperial: 1,600- 2,200° Fahrenheit Metric: 871-1204° Celsius
Ash Removal	Ash removal to an ashbin when the process is complete, ash is safely landfilled.
Connectivity	Ethernet, GSM Cellular (requires subscription)

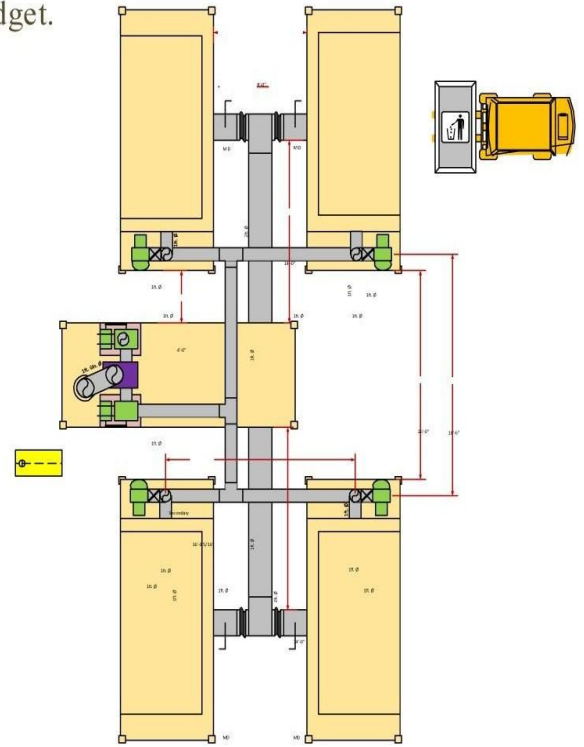
\*Exact dimensions and specifications are subject to change.

# The WasteStation™ expands to handle your growing waste needs

Increasing waste generation is a growing problem, but with the WasteStation™, and its expansion capabilities, you simply add another waste chamber to the system, as your waste demand increases. The WasteStation™ can be expanded from 1 to a maximum 4 waste chambers offering the flexibility to grow with your waste needs. Unlike similar options for waste destruction, the WasteStation™ allows you to plan for future needs, without impacting today's budget.

## Waste Heat Recuperation Option

When you expand the WasteStation™ by adding additional waste chambers for waste handling, you have the option to add recuperation of the waste heat. This option allows the reuse of the superheated flue gas to pre-dry and start the gasification process of waste in awaiting chambers. This option will reduce the fuel usage and also prepare the unit for energy recovery. Adding this option would include a Heat Exchanger, allowing the addition of power generation equipment. Typically this option is added when using more than 1 waste chamber.



## Heat Exchange Option

One of the options that can be added to the WasteStation is a Heat Exchanger. This option allows the customer to take advantage of waste heat. A Heat Exchanger is simply a heat exchanger with hot stack exhaust on one side and water on the other. Options include:

- Air-to-air heat exchangers can be used to provide pre-warmed fresh air back to process ovens, dryers and/or plant make up air units.
- Air-to-fluid heat exchangers can be used to transfer stack heat to boiler feed water, plant makeup water, process water, glycol and other thermal fluid loops.
- Allows the addition of power generation equipment.

# WasteStation™ Technology and Siting

## The Dynamis Energy Technology

The **WasteStation™** utilizes the **Dynamis Energy** two-stage process of batch waste gasification and thermal combustion/oxidation. The untreated solid waste is initially loaded into a Waste Chamber (hopper) where it is thermally reacted under air controlled (starved) conditions and transformed into burnable gases and ash. Unlike typical thermal treatment methods, the Gasification reactions occur at relatively low temperatures under controlled conditions that minimize the production of airborne 'fly ash' particulates and carry over. The Gasification process ensures 90-95% destruction (burn-out) of the waste and the by-product of ash is sterile with minimal residual Carbon. To complete the process, the gases from the reaction enter the combustion chamber where they are mixed with Oxygen (taken from the ambient air) and oxidized at very high temperature to complete the process. The energy from this hot gas can then be recaptured for local heat, power or other energy recovery such as Desalination or Sewage treatment.

## Typical Steps for Siting the Waste Station.

A **WasteStation™** will require a site that is properly zoned with the appropriate industrial infrastructure. Before taking delivery of the **WasteStation™**, the following should be secured.

- Identify types of Waste
- Site control through Leasing or Ownership
- Proper Zoning or Land Conformance
- Environmental Permits if required
- Waste Agreement if required
- Ash Disposal Solution (Land-fill)
- Current Cost of Waste Disposal
- Flat surface area for Installation of **WasteStation™** (Dirt or Concrete)
- Power availability for Operation
- Fuel availability for Operation

# WasteStation™ Features

The **WasteStation™** is the most efficient and environmentally friendly way to process bulk waste in remote or varied locations.

- Modular and Expandable
- Low Operating and Labor Costs
- Low Maintenance Costs
- Limited Material Handling
- Rapid Startup and Deployment
- Low Electrical Consumption
- Fully Automatic Control System
- Large Top Load Door
- Minimal Visual Footprint
- Flexible Fuel Alternatives
- Rugged, Durable, High Quality Construction
- Environmentally Friendly
- Safe and Reliable Operations
- Low Noise
- Typical Ash Stream of 5-10% by Volume
- Reliable, Proven Technology
- Ease of Shipping

## Environmental Advantages

On average, it has been estimated that one ton of MSW combusted, rather than dumped in a Land-fill, reduces greenhouse gas emission by one ton of Carbon Dioxide.

- Most waste streams thermally converted by the **WasteStation™** reduce the volume by 90-95%, thereby saving valuable Land-fill space for those items that cannot be thermally treated.
- **Dynamis** Technology has been used in an operating plant since 1996 and has met the EPA requirements and continues to receive permits to operate.
- Using the **WasteStation™** results in fewer trucks on the road hauling trash, saving valuable fuel and related emissions.
- According to the Waste-to-Energy Research and Technology Council, Waste-to-energy plants conserve fossil fuels when generating electricity. One ton of MSW combusted reduces oil use by one Barrel or 0.25 tons of high heating value coal.

## Environmental Awareness

One of the most compelling challenges of our time is finding a way to meet global waste management and energy needs while minimizing the impact on the environment. The **WasteStation™** can help meet those challenges.

### Trashing Energy

Most of the waste we throw away daily at our homes and businesses has significant value in the form of energy. **Dynamis Energy** technology can convert this waste and produce energy in an environmentally friendly way.

### Not Incineration

The **Dynamis Energy** thermal conversion technology is not incineration. Incineration is the burning of fuels in an Oxygen-rich environment where the waste material combusts and produces heat and Carbon Dioxide along with a wide variety of other toxic pollutants. Our technology is the conversion of waste into their simplest molecular forms – Carbon Monoxide, Hydrogen and Methane, forming a Syngas which is then used to produce energy.





## General Overview of Waste Management Projects

### Introduction

**Agrindmar Global LLC**, is pleased to provide this proposal for the supply of the technology, equipment, training and technical field representation to support the installation and construction of **Dynamis Energy LLC** supplied equipment for a waste to energy facility to be located at:

The facility has been designed to:

- Thermally treat and process up to 12 Tons of Municipal Solid Waste per Day utilizing 1-4 of **Dynamis'** 3 Ton primary Gasifiers (Hoppers).
- If desired, produce 250 KW of Electrical Generation utilizing a steam engine, assuming the heat content of the waste is at least 5,350 BTU/lb. The actual final electrical output may vary depending on the exact makeup of the waste, including the average energy value of the waste. However, the customer may need to increase the amount of Tires and Plastics in the waste to at least 15% of the total tonnage if maximum output is to be achieved.
- Operate as a base load facility 24 Hours per Day for 350 days per Year or match the operating schedule of the Owner if the Owner does not require 24 Hour Operation.

### Scope of Work

#### **Provided by Dynamis**

Upon award of a contract, **Dynamis** will arrange for the design, fabrication, and supply of the equipment to support the advanced thermal destruction of the solid waste that will be delivered for processing at the **Dynamis** supplied facility. The **Dynamis** supplied equipment will include the following:

- 1, 2, 3 or 4 primary Gasifiers(Hoppers) each capable of handling 20 cubic yards of waste per day, which generally equates to 3 tons of municipal solid waste. Each Gasifier will be 20 ft in length and be equivalent to the nominal dimensions of height and width to match the specifications of a standard shipping container.
- 1 secondary combustion/retention chamber in a standard 20 ft shipping container.

- If requested by Customer, One 250 kW steam engine generator, 1 waste heat boiler, 1 de-aerator, 1 air cooler along with feed pumps, control system, piping and other peripherals included in a standard sized shipping container. By providing all the equipment in containerized packages, the **Dynamis** equipment should be relatively simple to install.
- If requested by Customer: One Evaporative Desalination Unit. Output to be determined.
- If requested by Customer: One Sewage Processing plant. Capacity to be determined.

**Dynamis** will provide technical supervision to support the initial plant startup and commissioning. Eighty hours of training period will also be provided. Additional training of owner furnished personnel can be secured under a separate contract. **Dynamis** has included 3 weeks of technical assistance and supervision during construction and commissioning periods. **Dynamis** will also assist with reasonable support as required by the owner in an effort to obtain an air permit for the Facility.

#### ***Provided by Owner***

Owner or Management Company will be responsible for the land, civil work, buildings, installation equipment, construction permits, and all other required resources for installation, construction and commissioning.

#### **For Operations, the Owner/Manager should provide:**

- MSW Feedstock supply of the appropriate heat content.
- All staff necessary to load and operate the Facility.
- Equipment or means necessary to load primary chambers.
- Roll offs or bins for ash storage.
- All utilities, including but not limited to fuel supply, electricity, and water to support the boiler operations and, if desired to support emergency quench and shut off operation.
- Air quality permits or other permits required for operation, as required.

#### **General Project Timeline**

- Phase 1. Project assessment and engineering, including waste stream classification and determination of available energy capacity from the waste stream based on data to be supplied by **Agrindmar**– 3 to 4 weeks (according to the specific conditions agreed upon by owner and **Dynamis**)

- Phase 2\*. Fabrication and Procurement of **Dynamis** supplied equipment – 3 to 4 months (according to the specifications required and upon approval of engineering drawings)
- Phase 3\*. Installation of the units 2 weeks after delivery to site.
- Phase 4\*. Start-up and commissioning, 1 to 2 weeks after completion of Phase 3.

*\*Final timeline to be determined based upon manufacturer's lead times on boiler and turbine.*

### **Site Requirements and Layout**

The site requirements for the **Dynamis** advanced thermal conversion facility will be defined in Phase 1.

### **Projected Permitting and Construction Schedule and In-Service Date**

**Dynamis** will provide a startup and commissioning timeline for inclusion in owner's master project schedule. The final completion will be dependent on the approval of any necessary permits to construct and operate the facility, which is outside the scope and responsibility of **Dynamis**.

### **Projected Emission from Plant**

The anticipated waste stream is to be consistent with normal municipal solid waste. , **Dynamis** believes that the emissions should be better than indicated in the World Bank Environmental Guidelines. Any supplemental high value waste such as tires or medical waste would be advantageous for overall energy creation. However, these types of wastes will increase certain emissions levels and may require additional emissions control equipment.

### **Ash and Other Byproducts**

The byproducts from the overall facility consist of material from the solid waste process, which will be in the form of ash and other non-combustible input materials. The ash removed from the gasification process is cooled and removed from the process system. Ferrous and non-ferrous metals are not melted or destroyed, due to the relatively low temperature of the primary Gasifier, and may be reclaimed and recycled by the owner which may provide an additional revenue stream. No separation equipment is included in the estimate, but metal objects should be relatively easy to reclaim. Typically, the remaining ash volume will be 5-10% of the original volume. Final determination of disposal or reuse of the ash is the responsibility of Owner.

### **Water Use**

The overall waste destruction process does not require water to operate. However, if the Facility is equipped with a waste heat boiler, this will require an initial volume of water as well

as ongoing boiler make-up water. The facility can also be equipped with a water quenching system to be used when a quick shutdown may be required. The Owner is to provide water supply, which is required for this safety feature to be functional.

### **Electrical Requirement**

The plant will require a 3 Phase 208 Volt electrical connection to the plant to be used for operating the control system, fans and other equipment as may be determined. Final requirements will be supplied upon completion of preliminary engineering.

### **Fuel Supply**

A supply of fuel to the plant will be required for start up and commissioning, as well as normal operations. This fuel can be either propane, natural gas, or a liquid fuel such as diesel. Owner should provide preference. Final pressure and volume of supply will be determined upon completion of Phase 1

### **Feedstock Procurement**

Owner will supply all MSW feedstock for normal operations, including that necessary for the startup and commissioning period. Processed feedstock is anticipated to match closely the makeup of normal municipal solid waste.

### **Performance Guarantees, Warranties, and Risk Mitigation**

- **Dynamis Energy** will provide a guaranteed price and schedule for the design, supply, training and support of startup of the project.
- **Dynamis Energy** will support the warranties from its third party equipment suppliers. In addition, all **Dynamis Energy** fabricated equipment will be warranted for 12 months from commissioning for workmanship, defects and performance of plant operations.
- All Guarantees and Warranties will be detailed in the final agreement between **Dynamis** and the Owner.

### **Energy Recovery**

- The **Dynamis** proposal can include an optional electrical generation using a waste heat boiler and a steam engine, an optional Desalination Unit or an optional Sewage Processing Plant.
- Owner to provide **Dynamis** a waste stream analysis for final determination of energy value of the waste stream which will determine the final electrical output.
- It is estimated that the waste should have an energy value of 4,500-5,800 BTU/lb.

**Pricing**

*Pricing may be affected by final waste characterization determination and final permitting requirements.*

*Several Financing options are available, including a leasing option. Specifics will be determined after completion of the Phase I feasibility study.*

Upon acceptance of the Proposal by the customer, all parties will engage in contract discussions to formalize terms and responsibilities for the successful completion of the project.

Please do not hesitate to contact us if you have any questions or require further information.

# Appendix A

## Dynamis Technology: History and Reference

**Dynamis Energy** has acquired and improved a two-stage, thermal conversion technology for the gasification of municipal solid waste (“MSW”) and other wastes in a primary chamber followed by the combustion of the produced syngas in a secondary system. Energy is recovered from the combustion products for the production of steam and electricity.

The inventors of the advanced thermal waste destruction technology have collectively been in the waste destruction industry for 50+ years. Those years have seen them design and engineer literally 100’s of systems and projects from wood waste oxidation to bio mass boilers, to industrialized auto fluff solutions. The original prototype of our thermal waste destruction technology was a 1.5-ton system and was designed, developed and constructed in 1988. Trial runs were performed to witness the validity of the final Prototype System. With the success of the trial oxidation cycles, performance data and design sketches were sent to the Western Research Institute (WRI) in Laramie, Wyoming. WRI was contracted for proof of concept using their combustion modeling software program.

The modeling program indicated that the system design contained the right attributes for further testing and warranted moving the prototype to the testing grounds in Laramie. In all, the system operated in over 30 tests under EPA Testing Protocol for emissions and ash results. The prototype system was operated with a manual control system.

In 1991 the testing programs at WRI were complete and a scale-up system was designed and constructed in Anchorage, AK. The scale- up system was named, Model TOS-80. The Primary Chamber was capable of holding 15 tons of waste materials. The TOS-80 operated over the next three years under commercial operations in the destruction of oily waste materials from the Valdez Oil Spill, medical waste and MSW operations. The 15-ton system, which had automated controls and continuous emission monitoring, was tested for the proof of scale-up in comparison to the 1.5-ton system.

During this time period further testing was performed utilizing different waste materials. These tests were performed under the same EPA Protocol under which, the prototype TOS system had been operated at the WRI testing labs. These tests were performed to demonstrate the validity of the scale-up design and the ability to operate under commercial and industrial applications. Along with WRI research personnel an additional 3rd party, AmTest Alaska was contracted to further confirm the test results and scalability of the system design. The results of all tests further confirmed the scalability of the engineering and the consistency of emission performance leaving no question as to the validity of the technology.

Upon successful completion of the Anchorage pilot plant, a fully operational plant was funded and purchased by the North Slope Borough in Barrow Alaska.

The engineering for the Barrow, AK 30 ton plant was based on the 15 ton Anchorage plant. The Barrow plant achieves 30 tons per 24-hour cycle by using two 15-ton Primary Chambers. This system was commissioned for operations in the community of Barrow, Alaska in 1996.

At the request of the North Slope Borough the controls for the system were designed and constructed for manual operation. The permitting for the Barrow, AK project followed the procedures for emissions in a non-attainment zone. The plant operated under the permit as a Primary Emissions producer in its first years of operation (continuous daily reporting). After several years of documented emissions results with the Alaska DEQ, the Permit reporting standards have been lowered to a Secondary Emission producer, reporting only for upset conditions and once every quarter for confirmed emission results.

Along with this confirmation of mechanical attributes of the technology, **Dynamis** has since incorporated state-of-the-art automated controls in parallel with its own proprietary control system to guarantee the combustion process, emissions and ash content. The facility treats all municipal solid waste generated by the community as well as the medical waste generated from the local hospital and medical offices. The North Slope Borough has been able to close one landfill, and uses the remaining landfill for the ash and non-combustibles.

The facility is designed with two primary chambers and a shared secondary chamber utilizing natural gas fired burners. Each primary chamber has a maximum practical operating capacity of 97 cubic yards, which gives the facility a practical process rating of up to 30-tons per day.

A 68-foot horizontal refractory lined secondary chamber incorporates a turbulent air mixing manifold and natural gas burners that complete the combustion of the off gases (**Syngas**) from the primary chambers. The secondary chamber exits into a vertical refractory lined stack.

The **Dynamis** Energy, modular design incorporates the confirmed engineering compiled for the prototype, 15-ton and 30- ton system designs. The question of scale up has been confirmed with the process of testing and the complete fully operation system working for 15 + years of service with no technological down time of service. The modular designs of today are nothing more than a series of 15-ton systems or, in the case of the WasteStation™ Containerized System, a series of 3-ton units.

# Appendix B

## Dynamis Technology (Detailed Explanation)

The **Dynamis** Technology is based upon the principals of **Gasification** and **Pyrolysis**. These technologies are not considered incineration. Incineration is the burning of fuels in an oxygen rich environment, where the waste material combusts and produces heat, water and carbon dioxide, along with a variety of other pollutants. Gasification is the conversion of feedstock (raw material for processing) into combustible gas molecules and ash. The gas consists of carbon monoxide, hydrogen and methane forming what is known collectively as **Syngas**. This **Syngas** can then be burned to generate steam, used directly to run a combustion engine or create other products such as drinking water.

**Gasification** and **Advanced Thermal Conversion Technologies** are increasingly being used to convert municipal solid wastes (MSW) and biomass into usable forms of energy. While this type of waste has been burned or incinerated, for decades to produce heat and electricity, the **Dynamis** Technology represents significant advances over incineration. In order to understand the advantages of the **Dynamis** Technology when compared to incineration, it's important to understand the significant differences between the two processes.

The dictionary definition of incineration is to 'burn up completely; reduce to ash'. Incineration uses solid wastes as a fuel, burning it with high volumes of air to form hot gases, mainly Nitrogen, Carbon Dioxide, Oxygen and water vapor. These hot gases are then used to create steam, which is then used to generate electricity. The introduction of large volumes of air into the combusting waste causes a significant amount of combustion particles (PM), or fly ash, to be carried along with the hot gases. Fly ash contains many hazardous and toxic air pollutants such as un-combusted Carbon, Heavy Metals, Dioxins and Furans, to name but a few. Due to the large amount of PM generated, incineration flue gas must be filtered to remove the PM (fly ash) prior to venting it to the atmosphere. This step of filtration requires very large and expensive equipment that consumes a significant portion of the energy that is generated. Incineration also creates some hazardous colorless gases such as NOx and HCl. Large amounts of NOx are generated during incineration due to the combination of high temperatures (3000 F) and excess air that contains Nitrogen. NOx must then be removed from the flue gas by injecting additional chemicals into the flue that neutralize the NOx before it is vented to the atmosphere.

The **Dynamis** Technology operates in such a way that the production of fly ash, NOx and many other pollutants are significantly reduced. The result is that a Dynamis system can be built with fewer expensive emission controls and more energy can be generated with less waste. The **Dynamis** Technology uses the MSW not as a fuel directly, but as feedstock for a low temperature thermal chemical conversion process. The MSW reacts with a controlled amount



of Oxygen under closely controlled temperature well below the vaporization and oxidation temperature of most metals. Closely controlled conditions such as these breaks down the feedstock into simple molecules and converts it into **Syngas**. The **Syngas** is then completely combusted in a separate secondary combustion system to create a hot exhaust. This hot exhaust has significantly fewer pollutants, such as PM, NOx, Dioxin and Furans than in the incineration process. The exhaust heat is then used to produce Steam, electricity, water or to treat Sewage.

One of the main concerns with Incineration of MSW is the formation and reformation of toxic Dioxins and Furans, especially from PVC containing plastics and other materials that form these highly toxic substances when they burn. Incineration produces many times more Dioxins and Furans than the **Dynamis** Technology. These toxins end up in the exhaust streams by three distinct pathways:

- By decomposition, as smaller parts of larger molecules.
- By reforming when smaller molecules combine together; and/or
- By simply passing through the incinerator without change.

The direct incineration of waste does not control these processes, so all pollution control occurs after combustion in a cleanup stage. The **Dynamis** Technology actively controls these toxins in the following ways without the need of additional expensive scrubber systems:

- In the **Dynamis** thermal conversion process, large molecules (which may be in the form of Dioxins/Furans) present in the feedstock are broken down into the components of **Syngas**, which are then completely combusted in the secondary combustion system.
- Dioxins and Furans need sufficient Oxygen to form and re-form and the Oxygen deficient and controlled atmosphere in the **Dynamis** process does not provide the environment needed for Dioxins and Furans to form or re-form.
- Dioxins need fine particulates in the exhaust to act as a carrier. **Syngas** from the **Dynamis** process contains very little particulate matter to act as a carrier.

Dioxins are destroyed at temperatures above 1500° F so any trace amounts that do form, are totally destroyed in the secondary combustion chamber, which operates at temperatures way above 1500° F. The flue gas remains at 1800°-2000° F for more than 2 seconds, providing the time required to destroy these dangerous toxins.