



Biomass Power Generation PGF100



A New Approach

2023

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“We don’t need to mine coal, but we do need to eliminate biomass waste”

1.0 Introduction

Air Burners, Inc. is the Number One manufacturer of Air Curtain Burner systems. We hold the most significant patents on Air Curtain Burners and FireBoxes with power generating capabilities. For the last twenty-three years, we have been building the best and most rugged machines in the industry.

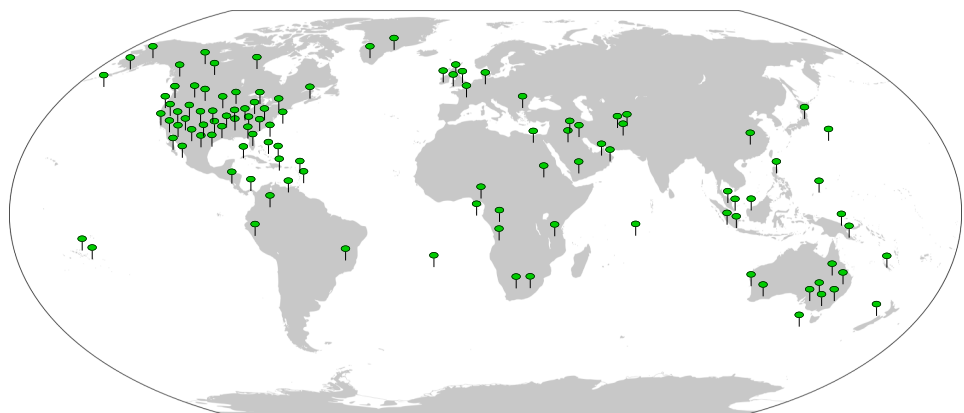
The primary objective of our machines is protecting the environment while efficiently reducing timber waste by combustion, but Air Burners machines are also the most economical method to dispose of such waste material and other vegetative waste streams. We are the only company to have our machines thoroughly tested by the best environmental agencies, including the US EPA and Australian EPA. We are proud to have found a good balance between the need for waste disposal and the need to protect the world we live in. No matter which side of the “global warming” issue you are on, we will help you breathe better with less particulates in the air and reduced CO2 .



Air Burners’ systems are used worldwide:

- 1) In the construction industry to support land clearing operations and demolition debris removal**
- 2) In forest industries for bushfire prevention (defensible zone building) and post-fire clean-up**
- 3) At landfills to eliminate wood and other vegetative waste to extend landfill life**
- 4) In agriculture, to eliminate waste from trimming and crop rotation of fruit and nut trees and vineyards**

They are also used in disaster recovery for clearing the aftermath from storm, flood or earthquake damage. All of the systems we manufacture are portable. They are designed for field use or semi-stationary to stationary placement. Our main manufacturing facility is located in Palm City, Florida which is on the Atlantic Coast about two hours north of Miami. We have a second manufacturing facility nearby and also have offices in Europe and Asia. This allows us to quickly and economically service our worldwide market. Our engineering staff uses the latest 3D CAD software for our equipment designs. We can quickly accommodate changes to support our customers’ particular requirements. The employees of Air Burners are dedicated to maintaining the high standard of design and manufacturing that has made us the recognized leader in air curtain burner equipment and technology.



Thousands of machines worldwide

2.0 New Concept in Biomass Energy

Today's Biomass systems are trying to solve the wrong problem. They are focused on energy and not waste. We do not have an energy problem, but we do have a worldwide vegetative waste problem. The priority of the PGFireBox is to eliminate waste and its second priority is to recover some energy.

"On average 20% of the World's waste is burnable biomass" - World Bank

For more than twenty-three years, Air Burners FireBoxes have been used around the world as the lowest cost method of eliminating wood and vegetative waste. Now, we are introducing the PGFireBox® the most economical biomass energy producing system available. This system is portable and does not require any permanent structures just like our standard machines. One of the major problems of today's biomass energy systems is the high cost of preparing the "waste", so it can be burned in the system. Systems on the market today require multiple stages of grinding and sorting before the waste is acceptable to the system; but not with the PGFireBox. Biomass-to-energy systems on the market today can only accept about 80% of the wood and vegetative waste due to decay, mold, too fibrous, foreign objects, etc., but not with the PGFireBox. Systems on the market today require a secondary fuel source, like natural gas to support combustion, but not the PGFireBox. These are the primary reasons biomass energy is so expensive and cannot compete with solar or wind energy, as alternative energy source to hydrocarbon fuels. Not anymore, the PGFireBox® eliminates all of these obstacles.

The PGFireBox accepts whole logs, root balls, branches, limbs, palm fronds, wood pallets, crates, lumber waste, saw mill waste, forest logging waste and more without grinding or sorting. Grab the waste, drop it into the top of the PGFireBox® and it's gone, converted into useful electricity and thermal energy. Plus, at the end of the day, clean carbon ash and highly valuable BioChar can be collected and made available for resale.



The preprocessing of the waste material to accommodate the biomass systems on the market today is both costly and environmentally hazardous. Sure, the burning of biomass is considered by all the World's environmental agencies as carbon neutral, but the diesel powered machines that preprocess the waste are not. As an example, most of these grinders are powered by 500 to 1000 horsepower diesel engines consuming 50 to 100 gallons of diesel fuel per hour; the emissions from these machines are monumental. Grinders and chippers are good and useful machines, but if you don't need to use them to create biomass energy, then why would you want the environmental and economic costs added to your project?

Power is not the problem, biomass waste is the problem. We have too much biomass waste in the world and no good options for recycling or elimination.....until now. Unlike other biomass energy systems, a waste input to power output efficiency calculation does not apply to our machines. Our machines are designed for efficiency of waste elimination (98%), not efficiency of power production. For our customers, we first consider how much timber waste they want to eliminate and second, we size the generator to meet their budget and local needs to avoid (or reduce) the need to buy electricity from the power company. The PGFireBox® is ideal for customers who have a wood and vegetative waste problem and need to eliminate the waste. Our smallest machine can eliminate on average 8 tons per hour and our largest system eliminates 20 tons per hour (98% eliminated, remaining is BioChar and carbon ash).

The PGFireBox eliminates the cost and the environmental impact, but it also opens some new doors to recycling. In the following pages, we will briefly describe the Air Burners PGFireBox® systems and their role in a new recycling method we call "Closed Circle Recycling." This document provides a brief overview, for more details please visit our website www.AirBurners.com, call us or one of our sales representatives.



This portable 100kW Power Module powers all three FireBoxes, produces resalable BioChar and only requires one operator.

2.1 Thermal Energy

Utilizing the thermal energy is important in maximizing your overall efficiency. The thermal energy (heat) can replace the need for natural gas or propane. Thermal energy can be used simply to provide heat for a large work shop or garage, or the thermal energy can be used for heat processing, like drying material in a kiln.

In the PGFireBox system we capture the thermal energy to first create electricity, we then exhaust it out of the Power Module. There is still a significant amount of heat energy available for other uses, and it is easily accessed at the exhaust port of each Power Module. The thermal energy is captured on each of the PGF machines at the outlet of the Power Module providing 1 megawatt to 5 megawatts usable heat.

Example of thermal energy being used to heat a workshop



Example of thermal energy being used to supply a wood kiln for drying

2.2 Biochar

Biochar is charcoal from wood burning; it is used to improve soil conditions for growing crops and to foster forest health. That knowledge is not new, but in an effort to improve harvests without the need for undesirable chemical fertilizers and pesticides, Biochar is getting a lot of worldwide attention in recent years. If you operate an Air Burners FireBox, you too, can make a fair amount of Biochar without much effort and add a profit line to your business. Biochar, as a porous carbon substance that retains water makes nutrients more available thereby strengthening plants in agriculture, gardening and woodlands. It is also produced naturally by forest fires and agricultural field burning.

The process to produce Biochar is by pyrolysis; wood is burned in the absence of oxygen and what we have left is Biochar. This sounds like a simple process, but to produce large quantities of commercial Biochar economically and in an environmentally sound way has proven difficult. Air curtain burners were designed to control emissions and quickly eliminate wood waste. As any combustion process leaves behind an ash residue, so does the FireBox. As the wood ashes collect in the bottom of the FireBox, some coals are insulated by the ash and starved of oxygen. If their further combustion is curtailed, you have created Biochar.



Recently, the US Forest Service, keen on using Biochar in forests around the country, has recognized the simplicity of this and has teamed up with Air Burners to develop a way to optimize Biochar production in a FireBox, yet still eliminate large amounts of wood waste or forest slash at the same time. This is underway through a CRADA, a research and development agreement between the US Forest Service and Air Burners. Some of Air Burners customers are already producing Biochar from their FireBoxes. With little effort they are both helping the environment and creating a secondary income from their machines. These are the 5 basic steps to making Biochar in your Air Burners FireBox:

1. At the end of each work day the ash and coals are raked out of the FireBox.
2. Air Burners ash rake is used to rake away the solids which may include some unburned wood separating them from the powdery light-colored ashes.
3. The solid coals and wood chunks are dowsed (quenched) with water from a hand-held hose.
4. Now the material is sized by using a simple ½" screen.
5. The Biochar that passes through the screen is half-inch minus in size and taken to the Biochar storage pile.

And that is it. Some of our customers are making as much as 10-15 cubic yards per day, per machine. The Biochar can now be sold in bulk or bagged to local farmers, tree nurseries and home gardeners. As no special equipment or machinery is needed for the Biochar extraction, the only additional cost component is the extra time at the end of the normal work shift to complete the above steps.

3.0 Power Generating Systems



Air Burners designed and manufactures a revolutionary new machine that combines two well known and refined technologies to create the first portable machine for power generation from unprocessed biomass. We call this system the “PGFireBox®”.

This system uses two current technologies, Air curtain pollution control technology and Organic Rankine Cycle Power Generation. We have teamed with one of the best ORC manufactures in the world: ElectraTherm, based in the USA. These technologies combine to produce a portable self-contained unit which generates significant amounts of electricity from vegetative waste and is the most economical and environmentally friendly method for eliminating vegetative waste

Vegetative waste, in particular wood waste, has long been a difficult problem for community landfills and lumbering operations. Grinding it to reduce its volume is expensive and extremely harmful to the environment, and while grinding reduces the “volume”, you are still left with the same amount of wood waste. Ten tons of logs in will give you ten tons of wood chips out.

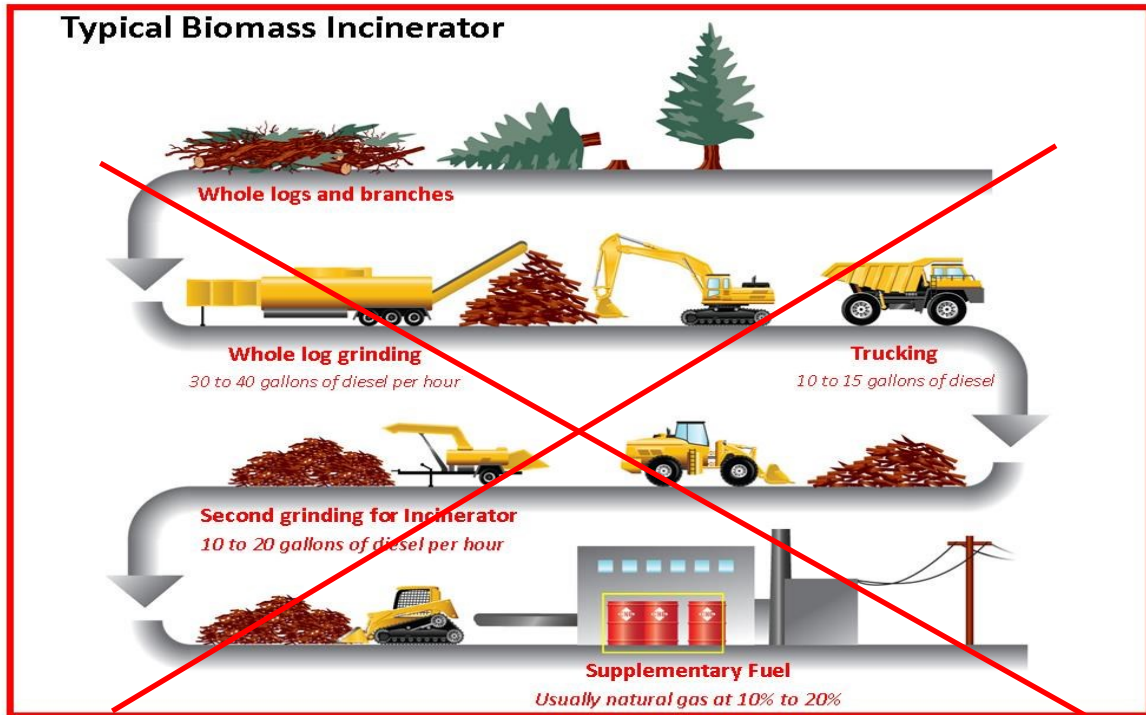
When you consider the amount of energy stored in wood, it is highly desirable to extract this energy as opposed to depositing it in a landfill and losing it forever. Wood has long been used as a fuel, but extracting this energy on a large scale has been cumbersome and expensive until now. As an example, the Air Burners 100kW PGFireBox®, the PGF100, is delivered to a site fully self-contained and ready for use, no permanent fixtures, structures or buildings are necessary, and the PGF100 can be purchased and delivered for less than the cost of a typical whole log grinder.

An Air Burners PGFireBox® is the most economical and lowest environmental impact method to deal with vegetative waste. The Power Generating FireBox accomplishes five important tasks:

- 1) It reduces the wood waste by 98%, ten tons of logs in, gives you a couple hundred pounds of ash out. A clean, natural ash which is a highly desirable recycled product for agriculture, growers, nurseries and it is also a good daily landfill cover supplement.
- 2) It captures energy from the wood waste and converts it to electricity providing an additional income from the use or sale of that electricity.
- 3) It delivers a significant amount of Thermal Energy, eliminating the need for natural gas or propane. Thermal Energy can be used for drying operations, like a wood kiln or for heating large buildings or garages.
- 4) It significantly reduces the greenhouse gas emissions from the current methods of disposal, grinding and landfilling.
- 5) Relocate - The PGFireBox is easily relocated. One of the major problems for biomass energy is the “Waste Travel Zone”, the distance the waste must travel to the biomass facility. It is not uncommon for a permanently placed biomass energy plant to close, because it has become too costly to transport the waste. Consider as an example, a small town installs a biomass energy system to eliminate waste generated by cleaning the forests to construct defensible zones to prevent bushfires. After 5 or 8 years the forest at some radius, say 50 miles, is clear. Transporting the timber waste and forest slash beyond that radius will be cost prohibitive and the brick-and-mortar biomass facility will eventually shut down due to lack of fuel. With the PGFireBox, the system is packed-up and moved, no permanent structures are necessary.

4.0 Compare the Systems

The primary difference between the PGFireBox and current designs of biomass power generating facilities is the ability to convert whole logs, branches, limbs, pallets and other wood waste into energy without the costly processing (see the comparison chart below). This is one of the major downfalls of biomass energy facilities today, as this preprocessing adds a significant cost and creates large amounts of greenhouse gas emissions. To accept whole logs, branches and other whole wood waste products, current biomass energy systems require multiple stages of grinding and pelletizing to precondition the waste. Then, most of these type of biomass facilities require a supplemental fuel like natural gas (as high as 20%) to support combustion. The PGFireBox® does not require any waste preconditioning or supplemental fuels.



5.0 Systems Overview

The Air Burners PGFireBox (PGF100)



PGF-100

- **100 kW Electric Power**
- **1 MW Thermal Power**
- Eliminates up to 8-20 tons of wood waste per hour
- Truly portable - ships in three self-contained modules



6.0 Model PGF100 (100 Kilowatts - 1MW Thermal Energy)

The 100 kW Power Generating FireBox by Air Burners brings together the cost savings and environmental advantages of our standard machines with the electrical power generating capabilities of the ElectraTherm Organic Rankin Cycle waste heat generator. This machine is portable, fully self contained and eliminates wood waste without the burdensome need for chipping and grinding. Whole logs and slash go straight into the FireBox eliminating the waste and creating electricity. Your waste is your fuel, no supplemental fuels are used to support combustion, the wood waste is allowed to combust naturally. That all combines to produce the lowest environmental impact possible in eliminating vegetative waste and the lowest cost method of disposal.

This new machine arrives self-contained in three units, the Power Module, FireBox Module and the Cooling Module. The modules are delivered to site, pushed together, connected to the local electrical grid and they are ready to operate. If sufficient cooling water is available from a stream, river, large lake or well, the air blast Cooling Module can be eliminated.

The FireBox Module uses a self-powered electric motor to drive the air curtain fan. The Power Module includes the control room. Touch screens provide the user interface but the system is fully automated so other than start and stop, the only time any attention might be needed is a hardware fault. In that circumstance through offsite monitoring, Air Burners engineers at the factory will get an alarm notice and with your permission, can remotely access the system to analyze and correct most faults.

The complete system, including air blast cooling has an MSRP less than USD \$898,000 (FOB Factory/US) based on early 2023 pricing. Please, contact Air Burners Sales Department for a firm quotation that would include freight, commissioning and operator training and certification.

See the operation video at: www.PGFireBox.com



Air Burners 100 kW Demonstration Unit in Florida

PGF100 consists of three units: the FireBox Module where the wood waste burns, the Power Module where the heat is captured and turned into electricity, and the Cooling Module used to condense the working fluid. The operation of the PGFireBox only requires one person to load waste, the electricity generating component is fully automated.

FireBox Module uses Air Burners' patented air curtain technology to eliminate wood waste. Whole logs, stumps and trimmings are loaded directly into the top of the FireBox. The air curtain technology reduces particulate release and is the most cost effective method of eliminating wood waste. The two rear doors allow for ash removal. The ash removal process is completed each morning before a new burn; the ash removal takes about 15 minutes.

Power Module includes the unique heat recovery system, the ElectraTherm ORC generator and the operator control station. Operation is fully automated. Using a touch screen interface, the operator pushes the green start button, the system will go through a series of checks and setup actions, then position the hood and begin generating electricity when sufficient heat is available. The operator's primary job is to load the Fire-Box Module, but he/she can review the complete status of the machine anytime using the touch screen display. System maintenance and health are also monitored, notices are displayed as appropriate. With owner permission, factory remote access is also available. This option will alert the factory of any maintenance or fault issues which can generally be corrected remotely by our engineers.

Cooling Module that is included in the Standard price is an air blast cooling system. This air blast cooler is skid mounted, fits in a standard container and arrives on site ready to use, pre-tested at the factory. Connections are made easy with two quick disconnect flexible hoses on the side of the Power Module (other options are available, depending on your site).

The other cooling option is water. This generally is a lower cost option. For water cooling there is an inlet and outlet connection standard pipe size on the side of the Power Module. Cool water is pumped into the Power Module from a well, stream, lake or other water source. The water circulates in a isolated system and is returned to the outlet connection with no physical change, except an approximate temperature rise of 10°C. No water is consumed or evaporated in the process.



Electrical Connection is completed by the system owner and is determined according to local regulations. Typically, the connection is very simple and includes a “net meter” which is an electrical meter that runs both ways. If you are using electricity, it adds the kWh’s to your account with the power company; if you are creating electricity, it subtracts kWh’s from your account. The PGFireBox requires a 3-phase, 480 volt connection to the power company’s electrical grid (other voltage and frequency options are available; contact Air Burners for more information).



Cooling Module



Water Cooling

Pond or nearby stream

Shipping the PGFireBox is not difficult. For truck shipment each Module will travel on a standard flat deck trailer. For ocean shipment each unit will fit in a 40 foot high cube container. If you have selected the air blast cooling then it will fit in a container as well. For the water cooling option the components will ship in the FM and PM containers. Air Burners will arrange all shipping (shipping cost quoted upon request).

Operating the machine is easy. The operator enters the “control station” on the Power Module and will see a green start indicator on the touch screen panel. Pressing the start button will put the system in standby automatic mode. The waste material is loaded into the FireBox Module and is ignited. Once the unit senses the correct temperature from the FireBox Module it will automatically start generating electricity. The operator continues loading waste material. At the end of day once the temperature drops below minimum required the Power Module will automatically go back into standby mode.



Power the Job Site

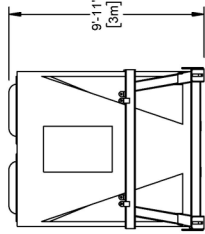
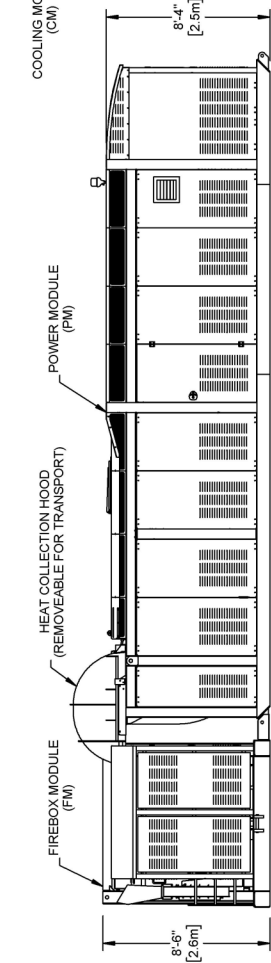
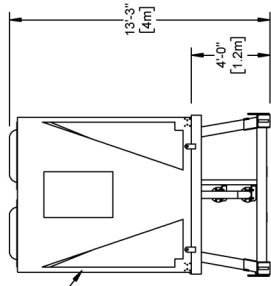
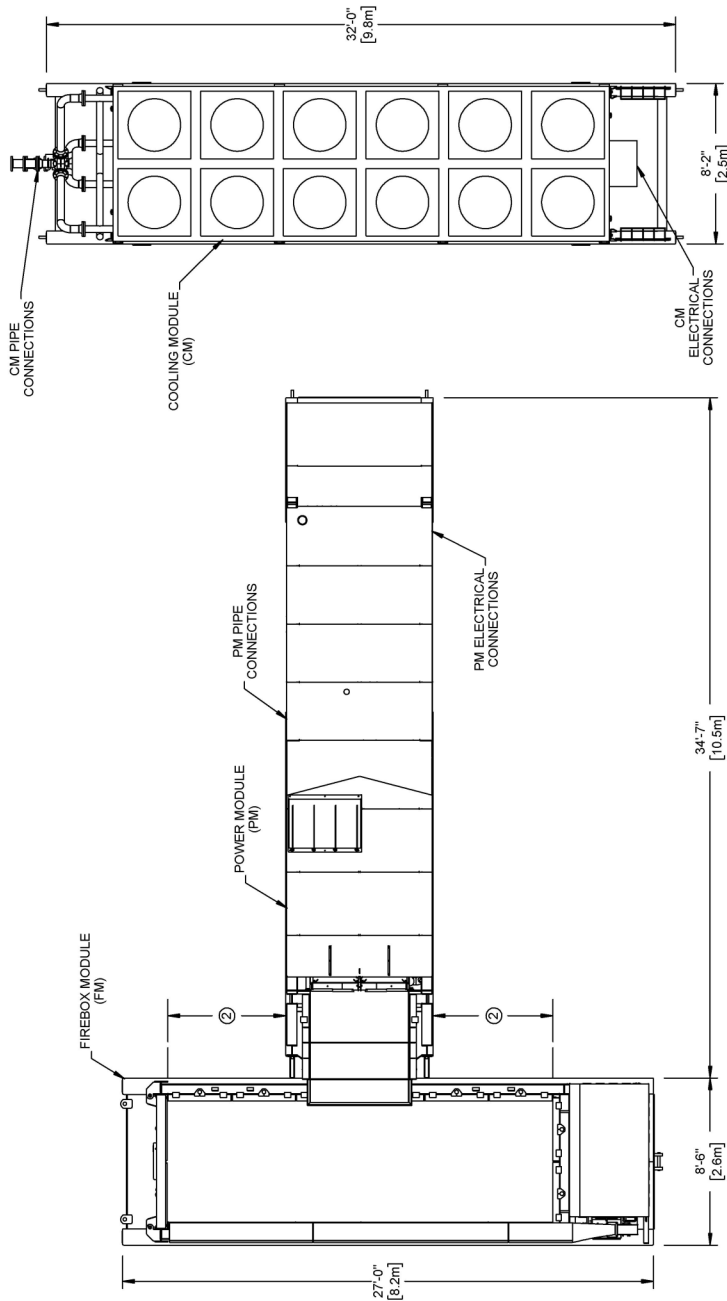
Air Burners PGFireBox 100 kW_e Specifications

Power Module		
1	POWER REQUIREMENTS	460 VAC/60 Hz/3φ or 400 VAC/50 Hz/3φ, 225 A Service
2	POWER FACTOR	Load- and site-dependent (0.9 - 1.0)
3	POWER GENERATION MODULE	Fully-Integrated Organic Rankine Cycle (ORC) Power Module with 100 kW Gross Asynchronous Generator
4	POWER GENERATION	Gross Electric: 100kW, Thermal: 1MW
5	ORC WORKING FLUID	Honeywell Genetron 245fa (Non-ozone-depleting)
6	SAFETY SYSTEMS	Electrical Grid Protection, Over-Temperature, Over-Pressure
7	CONTROL SYSTEM	PLC-Based with Touch-Screen
8	REMOTE MONITORING	Internet-based monitoring and Operations
9	TRANSPORTATION AND SETUP	Ships in containers; Ready for immediate use after simple hood installation; Padeyes provided for crane lifting. Full skid base facilitates final positioning
10	COOLING WATER (CW) REQUIREMENTS	325 gpm [20.5 l/s], 70° F [20° C] See option below
11	CW INTERFACE	4" Nominal, 150 lb-Class ANSI Flanges
12	INDUCTION FAN	PLC-Controlled; Variable Speed
13	HOT WATER (HW) PUMP	PLC-Controlled; Variable Speed
14	HW SYSTEM WORKING FLUID	Ethylene-Glycol/Water Mix
15	CONSTRUCTION	Steel WF beam and square tubing construction with full-length skid plate; Epoxy-paint
16	APPROX. WEIGHT	35,500 lbs [16,100kg]
17	DIMENSIONS (W/ HOOD INSTALLED)	L x W x H
		34' x 7'5" x 8'5"
		[10.4 m x 2.1 m x 2.6 m]
FireBox Module		
1	AIR CURTAIN FAN POWER	30 hp [22 kW] Electric Motor VFD-Controlled
2	BURN CONTAINER (FIREBOX)	4" [102 mm] thick refractory panels filled with proprietary thermal ceramic material. Two full-height rear doors, two ignition holes
3	SAFETY SYSTEMS	Fully integrated with PGF controller
4	INSTRUMENT PANEL	Touch-screen control from PGF Control Room
5	AIR CURTAIN FAN MOTOR CONTROL SYSTEM	PLC-Based; Speed selection fully integrated with system controller
6	AIR SUPPLY	Custom Heavy Duty Fan
7	TRANSPORTATION AND SETUP	Shipped fully assembled and tested, requires only connection of the three-phase motor power to the PG Module power distribution panel
8	WASTE MATERIAL ELIMINATION RATE	Up to 8 tons per hour
9	FIREBOX MODULE WEIGHT	36,000 lbs [16,300 kg]
10	OVERALL DIMENSIONS	L x W x H
		30' x 7' 5" x 8' 5"
		[9.1 m x 2.1 m x 2.6 m]
Cooling Module (Optional)		
1	APPROX. WEIGHT (DRY)	17,500 lbs [7900 kg]
2	DIMENSIONS (INCLUDING SKID BASE)	L x W x H
		32' x 7' x 13'
		[9.7 m x 2.1 m x 4 m]

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	INITIAL RELEASE	1/24/2019	JWH

INSTALLATION NOTES:

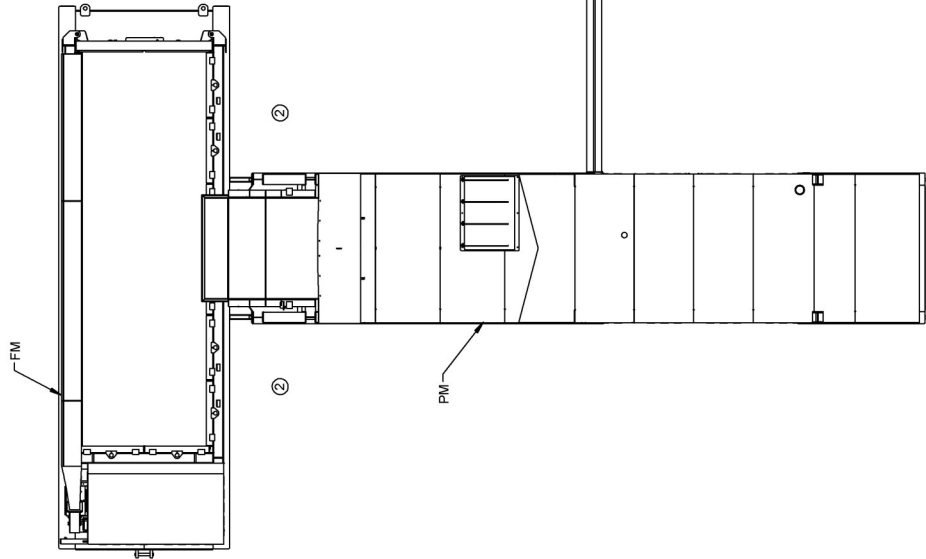
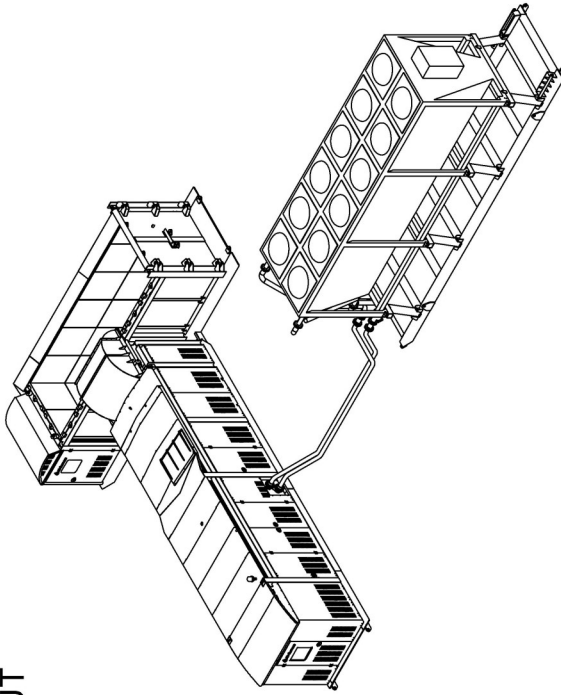
- ① COOLING MODULE FLUID LINE CONNECTIONS (BY CUSTOMER). COOLING MODULE FLUID LINES MINIMUM OF 20'. MAXIMUM 30" IN LENGTH. USE AS FEW PIPE BENDS AS POSSIBLE TO MINIMIZE PRESSURE DROP.
- ② FIREBOX MODULE IS TYPICALLY CENTERED (AS DRAWN) ON THE POWER MODULE BUT MAY BE SHIFTED TO EITHER SIDE, AS NECESSARY.
- ③ TYPICAL LOCATION FOR MODULES IS GRADED GROUND, LEVELED TO 1" IN ALL PLANES.
- ④ COOLING MODULE SHOULD BE LOCATED TO MINIMIZE DUST IMPACT.
- ⑤ ELECTRICAL GRID CONNECTION IS REQUIRED PER YOUR SYSTEM SPECIFICATION. TYPICALLY A "NET METERING" INSTALLATION.
- ⑥ INTERNET ACCESS IS REQUIRED FOR FACTORY ACCESS TO CONTROL SOFTWARE.
- ⑦ SEE FOLLOWING PAGES FOR RECOMMENDED SITE LAYOUTS.



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		ENGR.	B. O'CONNOR	DESIGN ACTIVITY	1/16/2019
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PGF-100 SYSTEM PREFERRED SITE LAYOUT



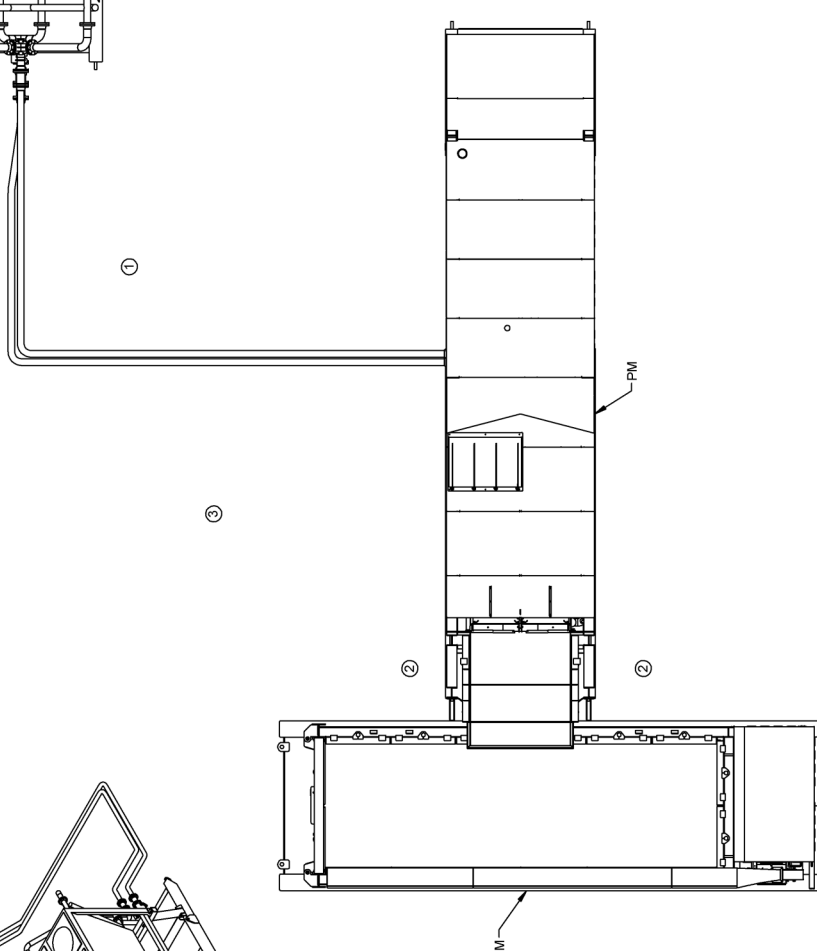
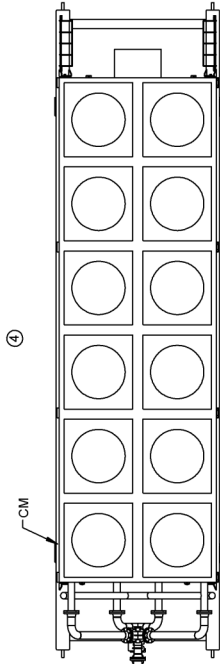
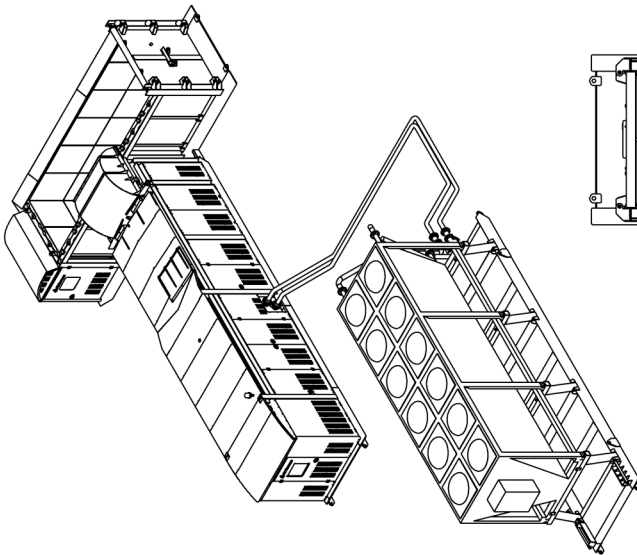
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BHEET 2 OF 4

PGF-100 SYSTEM OPTIONAL SITE LAYOUT



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					SHEET 3 OF 4

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7.0 Summary

The PGFireBox system represents a revolution in Biomass Energy and eliminates road blocks that have prevented us from realizing the energy stored in wood and vegetative waste at reasonable costs. The high cost of waste processing and the associated harmful emissions have been eliminated. The PGF is not a permanent system therefore it can be moved if the biomass waste supply in a particular area diminishes. Waste is actually eliminated and the system produces a desirable recycled product. Due to its size and portability the PGFire-Box supports the power company's desire for "distributed power production," giving us a more secure and reliable power grid.

Taking a page from the "green cycle of life", we have developed a system that makes a positive contribution to our waste and energy infrastructure. For more details on the Air Burners PGFireBox Systems please contact the factory, and please visit our website for videos and additional information on the Air Burners product line.



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"We don't need to pump oil out of the ground, but we do need to eliminate biomass waste"

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