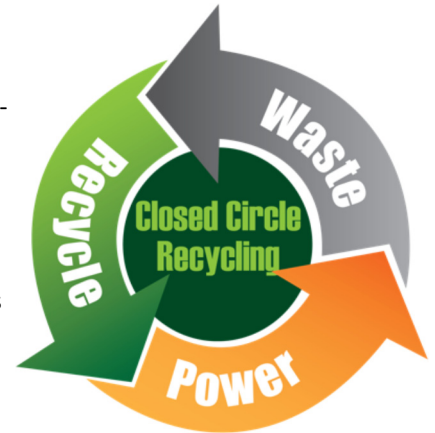




## PGFireBox® A Closed Circle Recycling System

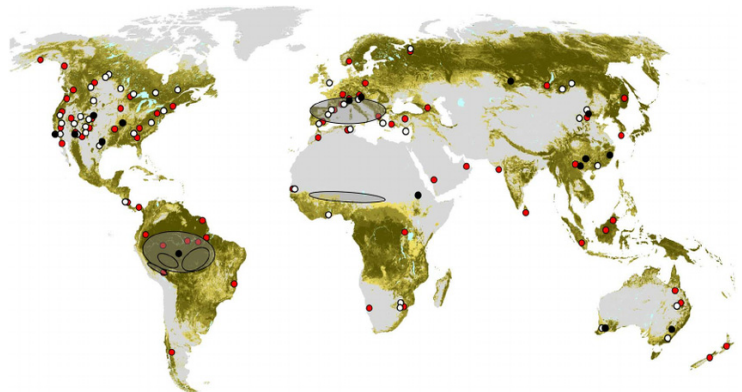
At Air Burners we are looking forward toward a new concept and direction in Biomass recycling with the PGFireBox® system. Closed Circle Recycling is a technique that takes recycled waste to make power which is used to recycle more waste. Some waste goes to making power some waste is transformed into usable product, all without consuming any other resources. In the case of woody biomass type waste there are not many possibilities for reuse, the most obvious being biomass energy. But the problem with all of our current biomass recycling schemes is they are not sustainable. The three most common wood and vegetative waste recycling options are; 1) energy, 2) mulch and 3) compost. Unfortunately all three of those options require more energy to produce in grinding, sorting and chipping than they contribute in recycled savings, with the net result being negative both economically and environmentally. Each of those “recycling” options require thousands of gallons of diesel fuel to run grinders, chippers and trucks. That is the primary economic reason today’s biomass energy facilities can not survive without significant government subsidies. Subsidies would be fine if the industry on the whole was making progress towards lowering their cost of energy production, like wind and solar are doing, but that is not happening in biomass energy. But we can not give up on sustainable uses for biomass waste because according to the USEPA and the World Bank, biomass waste accounts for approximately 20 to 30 percent of all the World’s waste. So it is a big problem that needs to be addressed, but a even bigger problem looms.



We can all argue about the benefits of compost versus biomass energy versus mulch etc, but here is the bad news; according to the USEPA we are not even recycling 30 percent of our “urban” biomass waste, that which is collected by your local waste company and is headed for the landfill. Here is the worse news; that “urban” biomass waste does not include all the dead and dying trees in our forests, you know, the ones that are burning down our houses from North American to Australia (see World Tree Mortality below). We have millions of acres of dead trees in the United States alone, the US Forest Service just finished a survey in California and found more than 100 million dead trees just in Central and Southern Sierra Nevada mountain range. That’s approximately 800 million tons of additional wood waste in Southern California alone. If you care about the environment as we all should, then you should know that not only is this a danger to the civil population but this represents the loss of a significant carbon sink; disrupting the balance of CO2 and oxygen on our planet. As a global community we have not even begun to address the worldwide biomass waste issue. We need more tools in our arsenal, tools that have a positive impact on the environment and tools that can be economically sustainable. At Air Burners we believe the PGFireBox system is one of those tools.



Typical picture in the western US, orange trees are dead. Unfortunately if they catch fire they take the green trees with them.



All of the circled and dotted areas are areas of very high tree mortality

### World Tree Mortality

## PGFireBox® “The next tool for the Biomass Recycling Industry”

Our approach at Air Burners is a new concept in recycling, a Closed Circle Recycling system. Instead of grinding and hauling all that wood and vegetative waste to huge biomass incinerators that try to compete with the power companies to make electricity for the national grid, let’s employ smaller more efficient biomass power generators and use them onsite where the power is needed to run our recycling machines. That way we eliminate all the high preprocessing cost and the expensive transportation cost plus we eliminate the harmful emissions from both those operations.

The PGFireBox® allows the biomass waste industry the option for more effective “closed circle recycling” by using the PGF as the primary power unit for other recycling tools. The principal idea is to replace diesel powered machines with electrically driven recycling machines. The machines would consume power generated by the PGFireBox®. The PGF will consume wood and vegetative waste that can not be otherwise recycled. Now the entire recycling operation is powered by “waste.” In addition the PGFireBox reduces the wood and vegetative waste to a reusable carbon ash and biochar both products highly valued in the agricultural marketplace. Another advantage of the PGFireBox, it’s a “machine” therefore it can be easily moved or resold if waste streams change, unlike most biomass incinerators today which are brick and mortar and stuck there forever.

The PGFireBox meets and exceeds all federal air quality requirements. Our machines have been tested by more government air quality agencies, including the USEPA, than any others. We regularly cooperate with air quality agencies around the world to develop local testing results, many of those results are available on our website or by contacting the factory.

In the drawings below various applications are depicted. Figure (1) shows the 100kW PGF. This unit is highly mobile and can easily be used in conjunction with smaller electrically driven machines like electric excavators, electric chippers and electric screens. A small community could locate one of these machines in a park for wildfire fuels reduction loading the machine with an electric “Bobcat” type loader and powering a small electric chipper. They could make biochar for the community and enough mulch to supply the local demand. Once an area has been cleaned-up the machine can be easily moved to another location.



Figure 1



## PGFireBox® “Modular design, multiple power ranges”

The PGFireBox is currently available in three sizes PGF100 (100kW), PGF500 (500kW) and the PGF1000 (1 MegaWatt). All these PGF designs are comprised of modular units and can be easily located and subsequently relocated as needed.

### “Closed Circle Recycling”

In Figure (2) the PGFireBox® is depicted providing the power for a complete sorting and recycling operation. The waste wood is eliminated in the FireBox, generating the heat that is converted into electrical energy. The electrical energy is used to power the sorting station and other recycling machines like electric grinders, electric crushers, electric trommels and electric wood pellet mills, creating valuable recycled products without consuming any outside energy. In addition the PGFireBox creates valuable ash and biochar which is removed from the FireBox each day and sold into the agriculture markets.

This has a significant positive impact on the cost and environment. The operation is supported economically by the elimination of wood waste. The PGF can consume between 8 and 10 tons of raw wood waste per hour. By using the electricity to support the additional recycling operations we eliminate the consumption of thousand of gallons of diesel fuel. Typically whole log grinders will consume 50 to 100 gallons of diesel fuel per hour of operation. Fuel consumption for trommels and pellet mills varies from 15 to 40 gallons of diesel fuel per hour of operation. Eliminating the hydrocarbon based fuels significantly reduces the environmental impact and lowers the operating costs. With a lower operating cost the recycled product now has a much better chance of competing on the open market.

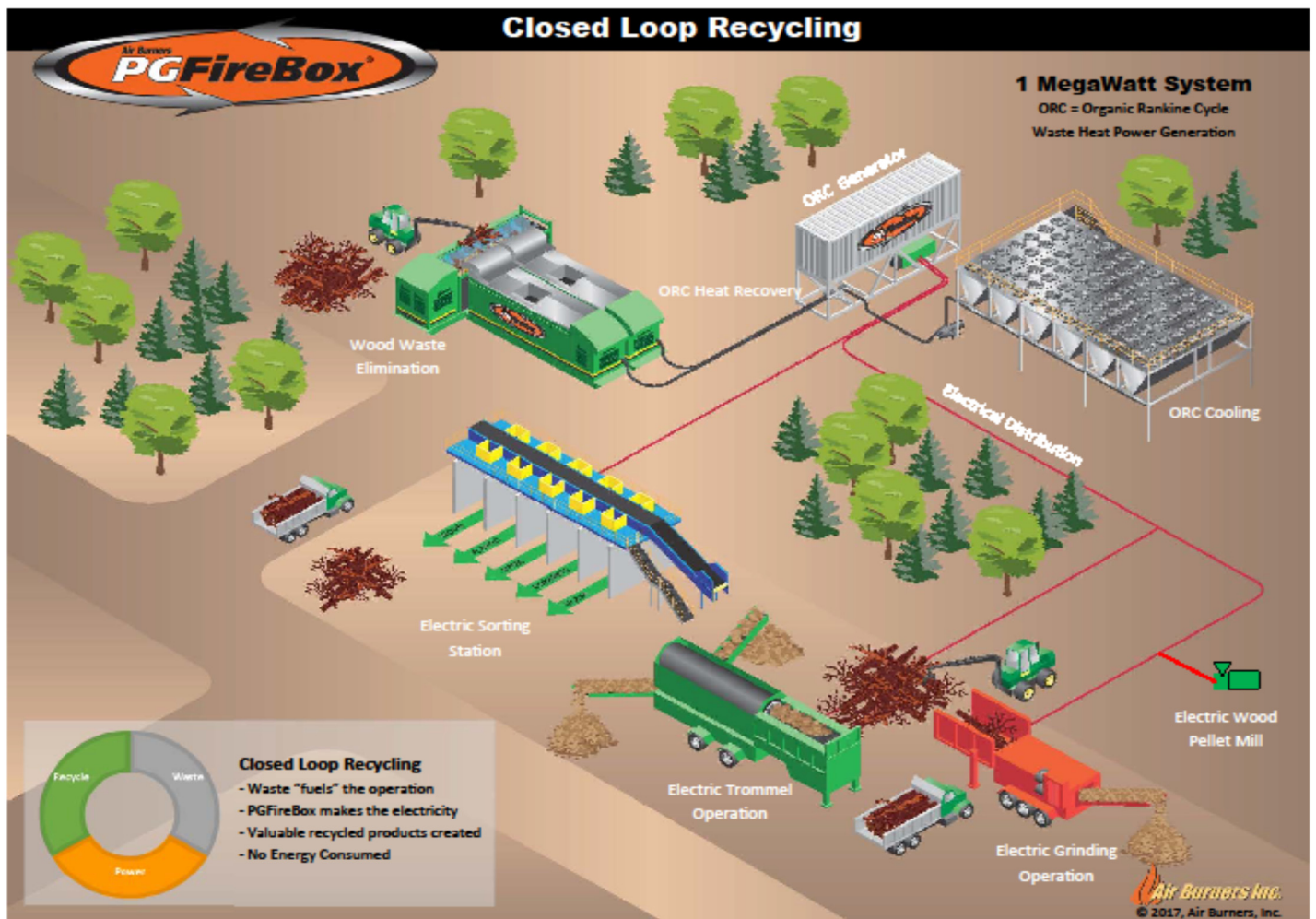


Figure 2

# PGFireBox® “The New Center of Recycling”

In figure (3) below an optional heat recovery system is shown. Some processes require dry, clean heat as in the example below where the exhaust heat from the PGF is captured and rerouted to a stone and aggregate dryer. For this example the recycling yard takes in waste wood and concrete for recycling. The concrete is crushed using electric crushers powered by the PGF. Once the concrete is crushed it must be “sized.” In this example an electric trommel is used to screen the aggregate to various sizes. One of the issues with recycled aggregate is moisture getting to the crushed raw material making it very difficult to run through the sizing trommel. So Air Burners has added a secondary heat recovery system to direct the FireBox exhaust heat to an electrically driven aggregate dryer. Once dry the aggregate can then be sized and sold. Typically these dryers require large amounts of diesel fuel or propane to support the burners for drying. All of that is eliminated in this scheme and again no external energy is consumed to produce this recycled product.

This method significantly reduces the cost and the environmental impact. One of the biggest challenges to the resale of recycled products is the cost. In this scheme the PGF is already paying for itself just on the elimination of the wood waste. In addition all the diesel fuel and propane are eliminated saving thousands of dollars in the production of the crushed aggregate. Plus, eliminating the hydrocarbon based fuels has a significant positive impact on the environment. In this operation thousands of gallons of fuel would have been consumed in less than six months. Grinders and crushers will consume up to 100 gallons of diesel fuel per hour of operation and dryers can consume in excess of 100,000 SCF per hour of propane or natural gas. All of those operations are now provided essentially “free” in the total electric mode.

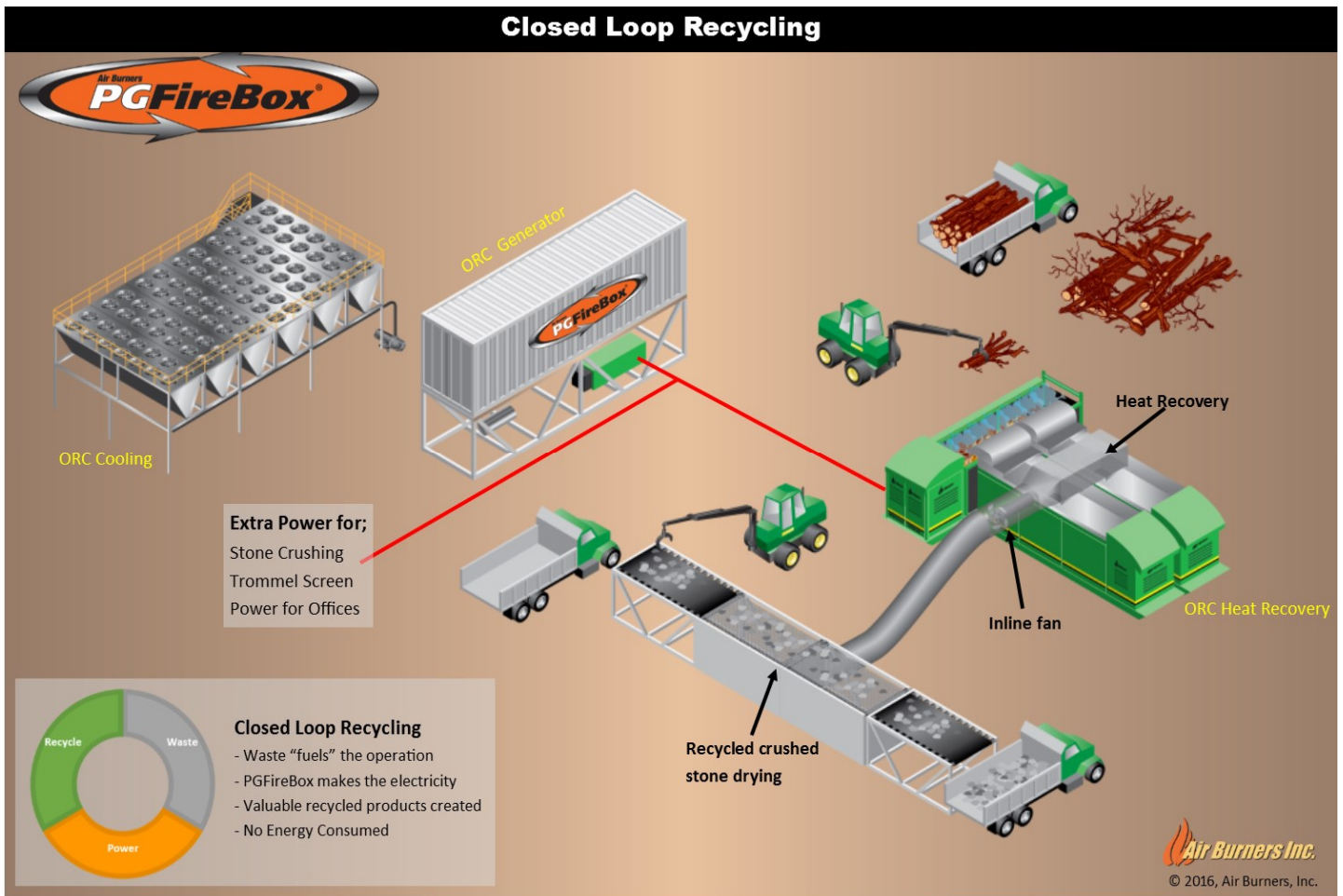


Figure 3

## Summary

At Air Burners we are advocating for some logic and expediency to prevail in the efforts to eliminate biomass waste. What we know: wood and vegetative waste are a big problem around the world and it is a dangerous problem, homes and lives are being lost. What we also know is that today there are very few recycling options for this type waste, and right now the markets for those recycled products are limited. So what do we do with this waste stream? We exploit its energy content in an environmentally responsible manner.

Wood was the first energy source on Earth and has remained an important energy source today. A significant portion of the World's population still cooks and heats their homes with wood. As we work to develop alternative recycling options for wood and vegetative waste we should not be grinding it up and throwing it in our landfills. All that does is waste millions of gallons of diesel fuel and shorten the life of our landfills and create excess methane gasses.

We should utilize the energy stored in this waste stream the best we can. At Air Burners we are advocating a new approach by using our PGFireBox, a well proven (USEPA) and sound environmental method to eliminate this waste while capturing the energy and using it to power other recycling machines, close the circle on recycling. Our FireBoxes have significantly less impact on the environment than grinding and hauling use energy, our system creates energy. Now use that energy locally to run the recycling equipment, all of the grinder manufactures have electrically powered machines available today. With this system we can bring the cost of recycled products down significantly and make them more desirable in the marketplace. You can't get any more efficient than that. Visit our website and learn more. Let's stop wasting our energy and start using it wisely.



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