What is a BioMax®?

A BioMax® is a modular, fully automated, factory-built renewable energy system that converts biomass to a renewable energy syngas consisting mainly of hydrogen, carbon monoxide, small amounts of methane and some nitrogen. The syngas can be used to provide a variety of clean & green energy services including electricity, heat, cooling or liquid fuels.

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What is biomass energy?

Biomass (plant material and animal waste) is the oldest known source of renewable energy. It contains the stored solar energy of plants or products made from organic woody materials. About 1% of the solar energy striking a plant is stored as energy during the photosynthesis process. When the chemical bonds between adjacent carbon, hydrogen, and oxygen molecules of the biomass are broken by digestion, combustion, or decomposition, the stored energy is released and becomes available for use.

Biomass resources are available naturally, or can become available as a byproduct of human activities. According to the Michigan Biomass Energy Program, “biomass resources are quite significant, as approximately 100 terawatt-years of chemical energy are stored in plants each year (an amount of energy equivalent to ten times that of the world’s current energy needs).”

What types of biomass resources will the BioMax® Systems convert to usable energy?

The BioMax® Systems are designed to convert a variety of “woody” residues to electricity, heat, cooling or synthetic liquid fuels. Some of the many residues that have been processed by a BioMax® system include wood chips (hard and soft woods), many types of shells and husks including walnut, almond, pecan, palm kernel, macadamia, pistachio, coconut, nutmeg, coco bean and coffee bean, and densified low bulk density woody materials including corn stover, soybean stocks, switch grass, cotton gin trash, tamarisk fines, alfalfa stems, and spent algae. Most any “woody” material can be processed including waste streams such as paper and cardboard, and even some plastics.

Under contracts with the US military, the BioMax® is converting a variety of mixed organic waste streams from military supply and feeding operations, commissaries, encampments, etc. into a variety of energy services.

What are the factors contributing to a good biomass resource?

As a rule-of-thumb, “woody” types of biomass are good fuel for the BioMax®, including some paper products such as cardboard (all types), paper, and cartons. Light, low-density residues such as grasses and corn stover, or residues with very high moisture content have to be dried and most likely densified to be used in the BioMax®. Rice husks and similar residues with high silicon content are not suitable as a feedstock for the BioMax®.

The characteristics of a good feedstock are:
• Available onsite or locally (nearby) in sufficient quantity to assure long-term sustainability
• Ready-to-Use (nut shells), suitable for chipping (wood) or suitable for densification (agricultural residues)  
• Low moisture content
• Small size, able to flow through the gasifier
• Low fines, ash and silica content
• Low, no cost, or negative cost (avoided disposal cost) and not subject to price swings
• Non-toxic, able to be handled by humans and doesn’t form or release any toxins through the gasification process, in the biochar or though the emissions of the engine-generator, if electricity is being produced.

What are some of the features of the BioMax®?

The following is a partial list of features of the BioMax®:
• Fully automated start-up, operation and shutdown
• Follow loads in a ratio of 5:1 from peak to base
• Very low production of tars and < 1 ppm particulates in the engine exhaust
• Low NOx, CO and VOCs
• A closed system with no exhaust except for the internal combustion engine (engine-generator)
• No flue or smoke stack
• The only effluent is a non-toxic char/ash that is collected automatically and typically can be used as a soil amendment
• Uses locally available biomass residues to:
  o Displace higher priced fossil fuels, both gaseous (propane, NG) and liquid (diesel, gasoline)
  o Reduce greenhouse gas emissions
  o Create markets for otherwise waste materials
  o Reduce waste disposal requirements and save space in landfills
• Generates heat that can be used for productive uses including heating, cooling, hot water, or drying applications
• Modular, able to be paralleled with other power systems including other BioMax® systems.
• Manufactured and tested in a factory
• Mobile, able to be quickly installed and relocated
• Small footprint, the BioMax® 100 is ~ 30’ x 30’
• Can operate in a dual-fuel mode – biomass and a fossil fuel, either one at a time or both together.
• Designed to operate 24/7. Firm, base load power.
• Lower cost of energy than a photovoltaic or wind system producing the same amount of energy
• Meets World Bank environmental requirements for biomass systems and complies with US EPA emission standards
Adaptable to a range of prime movers such as internal engines, Stirling engines, micro-turbines and SOFC (fuel cells).

**How does the BioMax® generate electricity and heat?**

The heart of the BioMax® is a downdraft gasifier that converts biomass to a low Btu (120 – 160 Btu/cubic foot) syngas (sometimes referred to as “producer gas”), that consists of a mixture of energy gases including hydrogen, carbon monoxide and methane. The balance of the syngas is mostly nitrogen.

The syngas from the BioMax® is converted to electricity as follows:

- Internal combustion engine: gas is ignited in the cylinders and the crankshaft spins an electrical generator.
- Stirling engine: gas is combusted in a radiant burner that heats the head and transfers heat to an internal working fluid for conversion to electricity via a linear alternator.
- Fuel cell: gas constituents are chemically combined in the fuel cell to create electricity.

While CPC has successfully operated spark ignited and compression ignition internal combustion engines, and successfully operated a small solid oxide fuel cell and a Stirling engine/generator, it has yet to apply the BioMax® technology to a micro-turbine.

Heat is produced by the cooling of the hot syngas and the engine’s exhaust and coolant. This thermal energy is captured in the CHP mode and delivered to customers in the form of hot water or hot air. The syngas from the BioMax® can also be combusted in a boiler, axial fan dryer, etc.

**What are the maintenance requirements for a BioMax®?**

The BioMax® is designed to operate 24x7. Daily maintenance averages about ½ hour per day. Other routine maintenance for the BioMax® is the standard engine maintenance (filters, oil changes, etc.) performed monthly on the engine-generators.

For the gasifier, the char/ash is automatically removed from the system to one or more drums. Disposal of this non-toxic char/ash is part of the daily maintenance activities. The gasifier is also routinely inspected and periodically cleaned. Occasionally, a bag filter may need to be replaced.

**Is the BioMax® safe to operate?**

By design and years of in-field experience, the BioMax® has proved to be a very safe system. Beginning two years ago, all BioMax® systems have been delivered with a closed top and feeding system. This prevents any exposed flame from the top of the gasifier in the event of an unscheduled shutdown. A second important safety feature is an automated oxygen sensor system that shuts down the BioMax® system if oxygen leaks into the gas stream. In the rare event that the syngas in the BioMax® system should be exposed to both oxygen and a source of ignition, multiple 7 psi rupture disks prevent dangerous pressures in the system. By design, the BioMax® system does not accumulate large volumes of syngas. Design features associated with the feeding system also
prevent any external fire. Since BioMax® systems operate under a slight negative pressure, any leaks will pull air into the system as opposed to leaking carbon monoxide out of the system.

Operators are trained in the safe operation of the BioMax® system and are provided with proper safety equipment.

**What is the operating efficiency of the BioMax®?**

Electrical conversion efficiencies vary by the choice of prime mover:
- Internal combustion engines: up to 40% (diesels will achieve higher efficiency than spark ignited engines)
- Stirling engine: up to 25%
- Fuel cells: up to 45%

When the systems’ heat can be used in a combined heat and power mode, the overall system efficiency can be up to 80%.

**What happens with the heat that is generated?**

In an all-electric application, the heat is not used. In a combined heat and power mode (CHP), a significant fraction of the heat is captured for use elsewhere. Heat is typically captured through the use of conventional heat exchangers. Maximum economic value is received if the heat is used to displace thermal energy from high priced natural gas or propane.

**What are the waste products and emissions of the BioMax®?**

The BioMax® uses a dry system to cool and remove particulates from the syngas; wet scrubbers are not used in the process eliminating the need to dispose of large quantities of contaminated water.

Solids are automatically collected and are processed as follows:
- Ash and char are automatically extracted and stored in drums for easy handling. The ash and char typically can be dispersed in the soil as an amendment
- Expended dry fabric filters are stored and periodically combusted

The char/ash effluent has been independently tested and found to be non-hazardous.

**What are likely uses of the BioMax®?**

There are many groups that will benefit from the use of a BioMax®. The groups are distinguished by their objectives.

**Sell Energy Services** – These customers will own and operate the power system, provide electrical and/or thermal energy to their customers and be paid based on the heat and power delivered. Example: Energy Service Company.
Displace Other Fuels – Typically these customers will have access to biomass fuel that is significantly lower cost than existing fossil fuel or electricity. Example: Agricultural processor that has a residue left over.

Military Garrisons, Commissaries, Forward Operating Bases, etc. – These customers will use a BioMax® WTE (waste-to-energy) system to convert a variety of on-based generated organic waste streams to onsite power, heat and synfuels.

Utilities – These customers can use multiple distributed BioMax® systems or clusters of BioMax® systems to provide combined megawatts of dispatchable utility grade power in support of RPS commitments, demand response, feeder grid support, etc.

Biopower Research – Perform bio-fuels experiments on a lab-based biopower system. Example: Private or public research organizations.

Educational Institutions – These customers use trailer-mounted or skid-mounted BioMax® systems for educational, research and green power initiatives as well as winning federal or state grant funds for bioenergy and biofuel R&D projects.

Small Enterprises – Onsite or nearby biomass residues can be used to provide the high grade heat and power needed to add value to locally available natural resources. This is especially valuable in areas having high poverty. Example: Small processing plant, such as a grain mill that produces biomass waste that could be used for powering equipment and drying the grain.

Developing Countries - Rural Electrification and Economic Development – These customers use BioMax® systems as an alternative to diesel-fueled power plants for small communities in rural areas.

OEM Suppliers of Prime Power Generators – These customers can use a BioMax® system to displace a high percentage of diesel fuel in a small conventional power plant or combine a BioMax® system with a spark ignited engine-generator to eliminate the use of diesel fuel. The World Bank, Asian Development Bank and many bi-lateral donor nations will no longer fund or finance power generation systems that increase the dependency on diesel or other fossil fuels.

Develop Alternate Uses for Biomass – These customers will have access to an abundance of biomass and will be looking to develop applications for its use either as a source of revenue or to avoid other costs. Example: Forest Service desires to reduce forest fuel loading that could otherwise lead to degradation of forest health or increase the potential of forest fires.

Disaster Relief – Typically after certain natural disasters there is an abundance of biomass in the form of downed trees and construction waste. In addition power lines may be cut so that there is the potential that the biomass could be used to generate large amounts of AC power. In addition, waste heat may also be generated to sterilize water.
Avoid Disposal Costs – Customers in this category will be able to use the biomass to minimize costs that might result from rules and regulations that affect the disposal of biomass. Example: convert wood pallets to on-site energy as opposed to shipping to a distant landfill.

Can the output capacity of the BioMax® be scaled up or down from the current size?

Yes. Current BioMax® systems generate 25 kW or 100 kW peak power. Multiple systems can be placed to generate energy in excess of these amounts.

Is the BioMax® complicated to operate?

No, BioMax® systems are easy to operate due to the fully automated control systems. However, to operate the BioMax® system about 5 days of training in the operation, maintenance, and health and safety requirements is required.

Does the BioMax® require a full-time operator?

No, but there are a variety of tasks involved mainly with the feedstock supply and maintenance that require scheduled operator intervention.

Can the BioMax® be connected to a utility grid?

Yes, the BioMax® has been interconnected with numerous utilities in several states. Experience shows that interconnection to the utility grid is a local issue, and that interconnection permits in some states and utilities are easier to secure than others.

If the BioMax® is not providing power to the grid, the power can be used on-site and displace electricity at its retail value. Power delivered into the grid is typically priced at a lower wholesale value by the utility therefore on-site use is more beneficial for the customer.

Is the BioMax® a commercial product?

Yes. The BioMax® 25 and 100 combined heat and power systems are being sold on a commercial basis.

BioMax® 5, 15, 50 and 75 kW systems referenced in this website were non-commercial, research and development systems that have been discontinued.

How much does the BioMax® cost?

There are many variables that affect system price, so please contact Community Power Corporation to determine the cost of a system that will meet your needs.

Is the BioMax® cost effective?

Yes – in many applications. Community Power Corporation will gladly perform an analysis of your particular situation. The analysis will take into account such parameters as the intended application,
installed capital cost, biomass cost, hours of daily operation, peak load and daily energy
requirement, cost of conventional energy (power, heat, gaseous and liquid fuels, etc.), etc.

The best economics occur when the user can save money by displacing high priced conventional
energy (both electricity and natural gas for example) with readily available, low cost biomass. If the
user pays to dispose of onsite biomass residues, then the economics can be extremely favorable.

**What are the competing technologies for the BioMax®?**

For electrical applications, primary technology competitors include standard, fossil fueled, engine
generators and photovoltaic (PV) and wind systems.

Relative to photovoltaics, the BioMax® 25 and 100 systems are more cost effective in most
applications when compared on an equivalent energy basis and without subsidies or financial
incentives. The availability and cost of the biomass feedstock can be a factor in system economics.

For thermal applications, propane and natural gas are the major competing technologies. The
BioMax® systems can be competitive when displacing natural gas or propane, which are subject to
price volatility and potential shortages - depending on market conditions and the location.

In the biomass systems arena, there are very few competitors to the BioMax® in the US. In India,
there are several companies who have considerable experience in small biopower systems; however
the systems are not modular or automated, and are labor intensive to operate and refurbish. It is
doubtful that these systems could pass US environmental and emissions requirements.