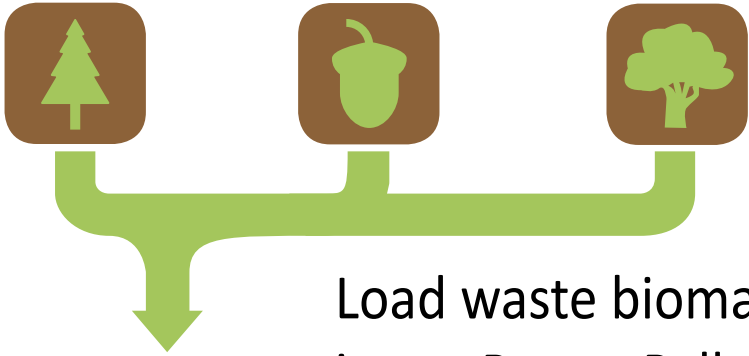




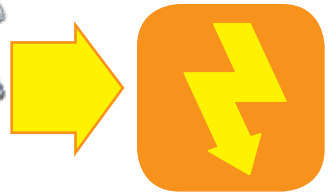
# ALL POWER LABS

*Personal Scale Power*





Load waste biomass into a Power Pallet, and it will produce 18 kW of renewable, carbon-lean power.



## **The Full Solution**

The Power Pallet is a **complete biomass power-generation solution** that converts woody biomass to electricity. It is a compact, automated system starting at the breakthrough price of \$1.75 per watt.

Power Pallets are currently available in a 20 kW size using a GM industrial engine, paired with Mecc Alte AVR generators. The resulting combination delivers **stable electricity from biomass** in a variety of international power configurations.

---

## **Why It's Different**

The PP20 Power Pallet is an **integrated power solution** that can meet the expectations for modern power generation equipment. With proper training, the Power Pallet is **practical for everyday use**. It is a sensible answer to a critical global problem, made in California and available now at an affordable price.

These advantages are the result of **breakthroughs in electronic control** and waste-heat recycling. An onboard microcontroller provides much of the expertise usually required from a professional operator. A multi-stage gasification architecture, combined with an **innovative gasifier-engine thermal integration**, significantly improves tar conversion and fuel flexibility.

The Power Pallet uses agricultural and forestry waste materials that can be readily sourced very near the point of generation. It is **compact and portable**, easily transported in the bed of a small pick-up truck to where the fuel is and where the power is needed. Unlike diesel fuel or gasoline, this fuel is often available at little or no cost, and most importantly, depending on feedstock selection and use details, **the PP20 can avoid the carbon impact of fossil fuels**.

---

**ALL Power Labs** is the global leader in small-scale gasification. We make biomass gasifiers that **serve real-world distributed energy needs**. Our project began in 2008 with the open source Gasifier Experimenters Kits (GEK) for research and education. It has since evolved into the Power Pallet - **an automated solution for biomass power generation**.

**Today you can find hundreds of our GEK Gasifiers and more than 100 of our Power Pallet systems in over 50 countries, supporting research in over 55 universities.**



# PP20 Power Pallet Features

The **PP20 Power Pallet** consists of a multi-stage gasifier, spark-fired industrial engine, generator head, and Process Control Unit (PCU). The PCU monitors and responds to all internal reactor, engine, and filter conditions, displaying the results on an LCD screen.

The PCU also automatically adjusts the syngas/air mixture via a wide-band Bosch oxygen sensor and agitates the ash grate when required by reactor conditions.

**Optional Grid Tie:**  
Automated grid-tie control system featuring Deep Sea DSE8610 Load Share Control Module.

**Automated Control System:**  
Senses and controls gas/air mixture, hearth grate and ash handling system, fuel feed and flare ignition.

**Engine:** The PP20 is powered by a rugged four cylinder GM Vortec 3.0L industrial engine.

**Genhead:** 20kW Mecc Alte industrial generator with automatic voltage regulation (AVR). 12-wire genhead is easily reconfigurable on-site for 120V to 480V AC. 50 Hz or 60 Hz in single, split, or 3-phase.





**Flare:** Premixed swirl burner ensures clean start-up.

**PyroReactor:** Waste-heat-driven pyrolysis and air preheating system for efficient combustion and tar cracking.

**Gas Filter:** Packed-bed filter with washable foam elements.

**GEK Gasifier:** Compact multi-stage downdraft gasifier for efficient gas production.

**Skid Base:** All components come mounted to a forklift-ready skid.

**Automatic Ash Removal:** PCU-controlled grate shake, scroll & ash auger with 24 hr. ash vessel.

POWER PALLET SPECS	PP20
Max Continuous Power Output	15 kW@50 Hz & 18 kW@60 Hz
Biomass Consumption	22 kg/50 lbs per hour at 18 kW
Fuel Moisture Tolerance	Up to 30%
Dimensions	1.4 m x 1.4 m x 2.2 m 53.5" x 53.5" x 88"
Weight	1065 kg / 2350 lbs
Feedstock Hopper Capacity	330 liters / 88 gal





## GENHEAD

*Mecc Alte NPE 32*

Mecc Alte is a top-quality Italian generator manufacturer and a world leader in the production of synchronous alternators with an excellent reputation for reliability and performance. The NPE 32 uses automatic voltage regulation and is CE, CSA and UL certified. It includes sophisticated monitoring and has easily field-reconfigurable options:

- 120/208/240/380/440/480 VAC
- Single, split or three phase
- Configurable as 50 Hz or 60 Hz



## ENGINE

*GM Vortec 3.0 L I-4*

The Vortec 3.0L inline 4-cylinder engine is produced exclusively for industrial and marine applications. It has the longest production history of any GM Powertrain industrial engine, with a well-earned reputation for durability and reliability. The engine comes factory configured for gaseous fuels, with features including:

- Increased compression ratio
- Sintered powder metal exhaust valve seat inserts for enhanced durability
- Nodular iron crankshaft for increased strength and durability

# Biomass Feedstock

The best fuel for the GEK gasifier is chunky, dry, carbon-dense woody biomass.

- Effective particle size: 1 cm – 4 cm (0.5 inch – 1.5 inches)
- Moisture content (% by dry weight): less than 30%
- Ash content: less than 5%

Dark Green	Known to work with minimal operations and maintenance effort.
Green	Known to work with increased operations and maintenance effort.
Yellow	Will work with increased operations and maintenance effort. May have increased slagging and other downtime impacts.
Red	Not tested or not known to work.

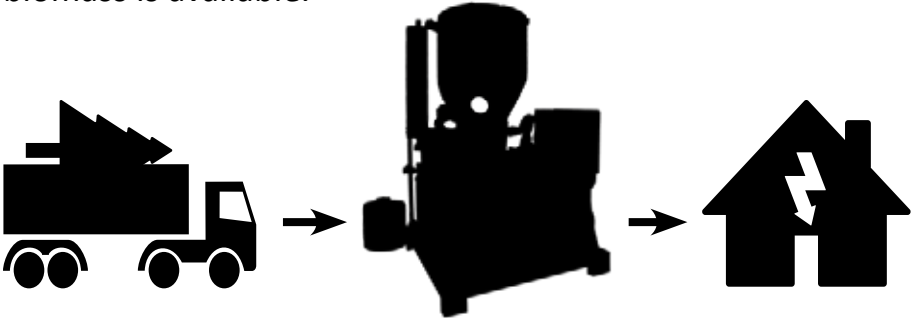
FUEL TYPE	COMMENTS
Walnut Shells	Shell halves & large pieces work; finely crushed shells will not.
Softwood Chips - Fir, Pine	Must be chipped, dried, & sifted.
Hardwood Chips - Oak, Beech	Also chipped, dried, & sifted. Thick chips may bind auger.
Coconut Shells	Broken into chunks and sized. Large pieces may cause jams.
Corn Cobs	Increased risk of slagging. Chopped to size. No husks.
Palm Kernel Shells	Risk of high temps unless blended with lower temp feedstock.
Wood Pellets	Decomposition requires special handling.
Rice Husks	High silica content leads to slagging.
Switchgrass/Miscanthus	High silica, low bulk density.
Sugar Cane Bagasse	Too stringy, not physically compatible.
Corn Stover	High ash content; silica content leads to slag
Poultry Litter	Caution: High slag, low energy density.
Saw Dust	Too fine, not physically compatible.
Coffee Grounds	Pellets of grounds prone to disintegration.
Coconut Husk	Not physically compatible.
Bamboo	Processing into chips is difficult.

The following fuels represent serious hazards & should definitely not be used with our gasification systems: Municipal Solid Waste (MSW), tires, medical waste, plastics & coal.



## *Use Cases and Benefits*

The **PP20 Power Pallet** provides reliable, affordable, and renewable electricity anywhere & everywhere that waste biomass is available.



### ***Renewable Clean Energy***

Biomass gasification is a clean, renewable method of producing electricity. Distributed, waste-biomass gasification is a proven technology that is helping to reduce our current greenhouse gas emissions and curb global climate change.

---

### ***Affordable***

The PP20 Power Pallet is one of the most affordable renewable energy systems on the market, delivering attractive ROI even without economic subsidies. Starting at under \$1.75 per watt, the capital cost of our system is much less than comparable solar or wind power systems.

---

### ***Simple to Use and Maintain***

The PP20 Power Pallet is the first system of its kind that makes gasification easy and user-friendly. Our systems are easy to service, can be maintained by most engine or generator mechanics, and we provide a range of training videos and manuals to get you up and running quickly.



### **Power Where it's Needed**

The Power Pallet is ideal for use cases that need on-demand energy in locations where the alternatives are either more expensive or impractical and where waste biomass is available.

## **DIVERSE USES AND INDUSTRIES**

Agriculture	Forestry
Rural Electrification	Pumps, Wells, & Boreholes
Microgrids	Hospitals & Clinics
Commercial Refrigeration	Small Businesses
Colleges & Universities	Energy Research
Agricultural Processing	Telecom Infrastructure
Off-Grid Homesteads	Eco-Development



**Booker Washington Institute - Kakata, Liberia**



# Return On Investment (ROI)

## Low Cost Electricity

Electricity can be generated from biomass for as little as \$0.10 per kWh, significantly less than gasoline or diesel. Solar and wind are often prohibitively expensive without subsidies.

<b>FUEL PRICE COMPARISON</b>	
<b>Fuel</b>	<b>Price Range</b>
Diesel	\$0.35 - \$0.70/kWh
Gasoline	\$0.50 - \$1.00/kWh
Biomass	<b>\$0.10 - \$0.30/kWh</b>

## Electricity in Remote Areas

The Power Pallet uses locally available fuel. Unlike diesel, agricultural and forest wastes are readily available and do not require shipping over long distances.



**Portable Power: New PP20 Delivery to Nakai Eco Lodge, Malawi**

### **Biomass Energy Density**

Typical waste biomass feedstock has an energy density is about a third that of fossil fuels. Meaning that about 10 kg (20 lbs) of biomass, when converted by a Power Pallet, will produce about the same amount of electricity as 4 liters (3.5 gal or 1 gal) of diesel fuel in a typical genset.

Gasifying **1.2 kg (2.5 lbs) of biomass**

produces about **2.5 m<sup>3</sup> of gas**

which produces about **1.25 HP-hr**

which produces about **1 kWh**

### **Low Biomass Demand**

The **PP20 Power Pallet** is designed at a scale that permits individual users to source biomass fuel locally and sustainably. This allows for operation without dependence on large-scale biomass supply chains, enabling operation in remote locations and developing countries.

## **BIOMASS FUEL CONSUMPTION**

*PP20 Genset (@ 75% load)*

Runtime	Biomass Weight	Power Output
1 Hour	18 kg	15 kWh
8 Hours	144 kg	120 kWh
24 Hours	432 kg	360 kWh

**Note: 1.2 kg biomass is roughly equivalent to 1 kWh electrical output**



## Process Control Unit (PCU)

The PCU is an microcontoller-based, open-source sensing and control circuit board based on the Atmel AVR ATmega1280 processor. The board is specifically designed for the types of instrumentation and automation requirements used in biomass thermal-conversion systems.

The board offers a generous number of thermocouple, pressure, analog signal, and frequency inputs, and an array of servo-driver and high-current PWM-capable DC N-channel switched outputs. Networking to other devices is supported via USB, serial, SD card, and CANbus (the networking standard for engine systems).

The PCU is ideal for applications which require integrated instrumentation, datalogging and control.



PCU FEATURES (V3.03)	
Processor	Atmel ATmega 1280
Thermocouple Inputs	16 K-type
High/Low Pressure Inputs ( $\pm 28''/8''$ H <sub>2</sub> O)	4/2
FET Outputs (5 A continuous)	8
Analog Inputs (10-bit, Phidget connectors)	8
Frequency/Counter Input	1
R/C Hobby Servo Outputs	3
Display (4x20 Character)	YES
4 Button Keypad	YES
MicroSD Slot	YES
CANbus Hardware	YES
RS-232 Interface	YES
Prototype/Expansion Area	YES



**Deep Sea Electronics DSE8610  
Load Share Control Module**

## **PP20 Grid-Tie Generator Control**

Utility grid phase-synchronization is managed via a separate enclosure housing custom bus and transfer architecture and controlled via the Deep Sea DSE8610 control module.

For a set of generators, or a generator and utility grid, to be interconnected, the output phases of all inputs must be synchronized, and any backfeed into a de-energized grid must be prevented via automatically controlled mains decoupling. A variety of coupling arrangements are available via custom programming of the interface.

Utilities enforce stringent regulations for grid-tie interconnections. With the optional inclusion of the Grid-Tie Accessory Package, ALL Power Labs can support these grid-integrated use conditions:

**Utility Grid-Tie** systems involving connection of the Power Pallet to a large public power transmission system. This allows for the power generated to be sold back to the utility company and capture net-metering benefits. Many jurisdictions also have feed-in tariffs where power produced using a renewable resource like biomass is given preferential pricing as an incentive for alternative-energy build-out.

**Microgrids** established by coupling a series of smaller power generators together to provide an integrated and balanced power system. Each generator must communicate with the others and the loads must be balanced between them. The DSE 8610 can be configured to either combine multiple Power Pallets, or integrate the Power Pallet with other generating equipment.

- **Connection to a Utility**

Each Power Pallet is independently tied to the grid with no load sharing between units.

- **Part of a Microgrid**

A microgrid is an electrical system that may connect to a larger grid system but is capable of meeting and controlling its own needs within the system.



## Authorized Representatives Program



*G'day from Austeco, our representatives down under in Brisbane Australia*

We believe our distributed-scale power products are on the cusp of a transformational uptake in the market and on the ground. Waste biomass fuel is nearly everywhere and often free. Rural electrification—whether in the developing world or elsewhere—usually suffers from high cost or high intermittency, with few options that can truly replace the usability of the grid or a diesel genset.

However, it is difficult to demonstrate this remarkable technology from our base in Berkeley, California. That's why ALL Power Labs is growing a network of local market partners, or Authorized Representatives, who understand the profound market potential of our technology and want to be a part of our continued growth.

To learn more about our Authorized Representative Program, please contact: [sales@allpowerlabs.org](mailto:sales@allpowerlabs.org).

## About ALL Power Labs

ALL Power Labs is the global leader in personal-scale gasification. We make biomass-fueled power generators that are ready for everyday work, to serve real-world, distributed-energy needs.

We are committed to supporting and developing biomass energy conversion by curating and disseminating comprehensive information and data on gasification science and technology—online, in free workshops, and via our open-source gasifier plans.

With our affordable, ready to run Power Pallet systems, APL makes it easier than ever to deploy sensible, carbon-lean energy strategies anywhere on earth.

The ALL Power Labs team is an unusual combination of DIY fabricators and university-trained scientists and engineers. The result is a powerful combination of technical ability and physical know-how for developing innovative energy solutions.



*Most of the over 30 members of our APL team*

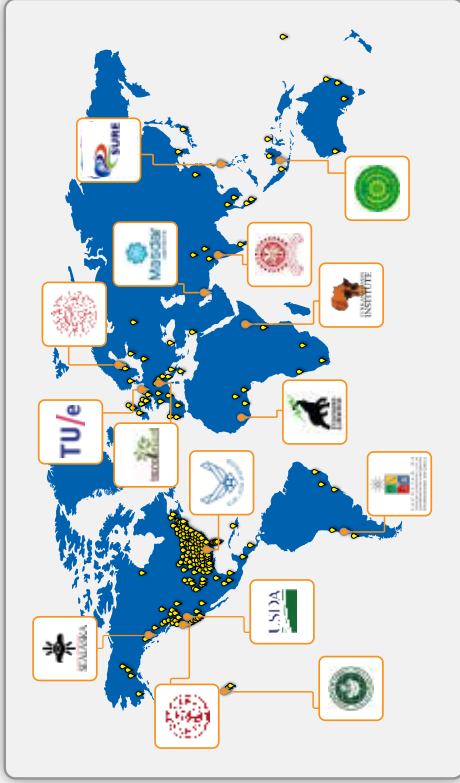
If you're planning to be in the Bay Area, please contact our sales team to schedule a visit to our facility. We'd love to show you what we're up to.





# ALL POWER LABS

1010 Murray Street Berkeley, CA 94710 U.S.A.



**Tel: 510-845-1500 Toll Free: 1-888-252-5324**  
***sales@allpowerlabs.org [www.gekgasifier.com](http://www.gekgasifier.com)***

The GEK Gasifier was developed and is manufactured by ALL Power Labs in Berkeley, CA.  
GEK® Power Pallet™ and TOTTI™ are trademarks of ALL Power Labs.  
© 2014 All rights reserved.

