



## CHARPALLET R&D

### 1 - GASIFICATION SYSTEM



The **ALL Power Labs CharPallet** unit is a compact, Combined Heat & Biochar (CHAB) gasifier system designed to convert waste woody biomass into syngas, heat and carbon. It is based on our third-generation reactor architecture incorporating APL's major breakthroughs in gasifier architecture and controls systems to widen the range of acceptable feedstocks, optimize the gasification process, and produce highly functional carbons such as biochar and activated carbon, and can provide syngas for research into the production of biofuels such as hydrogen, methanol, sustainable aviation fuel (SAF) and renewable natural gas (RNG). It has been developed over the last 5 years and has undergone over 1000 hours of cumulative testing with prototype units being tested at pilot sites, along with APL's over 10,000 hours of cumulative gasifier testing.

This CharPallet R&D unit is specifically designed as a laboratory test platform to support research in the areas of biomass gasification, biochar, activated carbon, biomaterials and carbon material development. The unit incorporates up to 30 temperature, pressure, gas and emissions sensing points coupled with our latest developments in controls and software architecture for ease of data collection, management and analysis.

### CORE SPECIFICATIONS

PERFORMANCE	
Biomass Consumption Rate (peak)	20 kg/hr (*under std. test conditions)
Biomass Consumption Rate (continuous)	15 kg/hr (*under std. test conditions)
Biomass to Biochar conversion	15-20% (biomass input by mass)
Available Thermal Output	N/A

SITE REQUIREMENTS	
Form Factor	Half Skid
Footprint	2.25 feet by 6.83 feet (685.8 cm x 208.3 cm)
Clearance: for external components & material loading	4 feet all sides (1.22 meters)
Shore Power	208-240 AC 1P 2 kW
Fuel Loading	Manual

### BIOMASS FEEDSTOCK

SPECIFICATIONS	
Particle Size	1/8 in. - 1 in. (3 mm - 25 mm)
Walnut, Pistachio Shells	Compatible
Hardwood Chips (e.g. oak, ash, beech)	Compatible
Softwood Chips (e.g. pine, fir, cedar)	Compatible
Fines Fraction: less than 1/8 inch	<12% by weight
Main Fraction: 1/8 inch to less than 1 inch	>75% by weight
Coarse Fraction: greater than 1 inch, all must be less than 1.5 inches	<3% by weight
Moisture Content (Dry Basis)	<20% external drying may be required

### SHIPPING PACKAGES

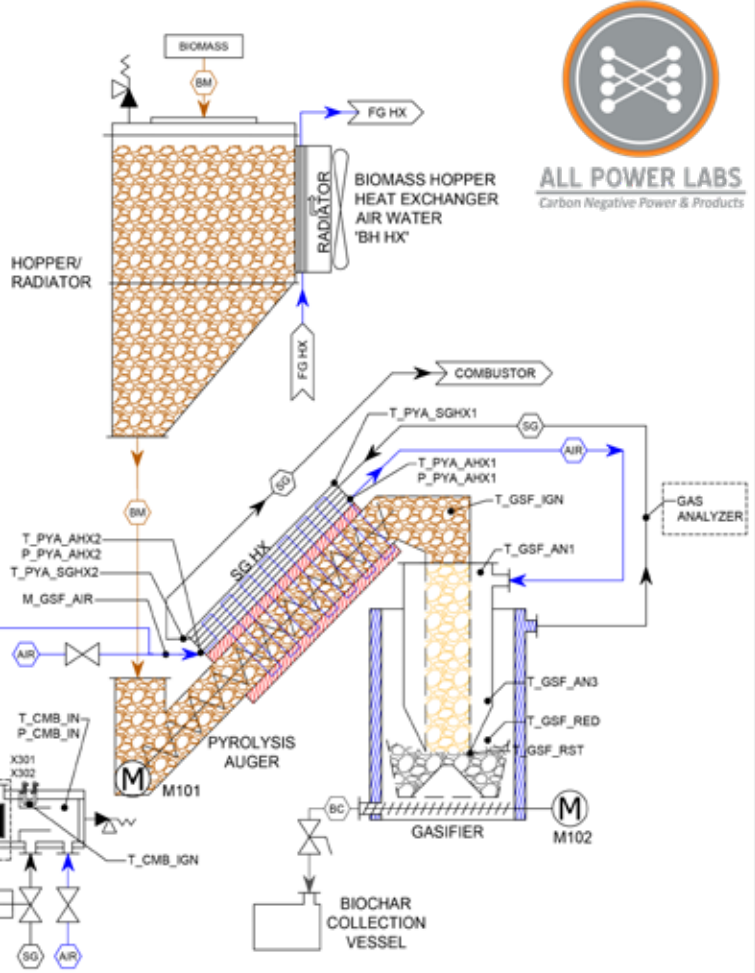
#1 - Main Unit	28 x 83 x 56.5 in = 71 x 211 x 144 cm 600 kg = 1320 lbs
#2 - Hopper Feed	28 x 45 x 31 in = 71 x 114 x 79 cm 206 kg = 454 lbs
#3 - Biochar Takeoff	28 x 28 x 56 in = 71 x 71 x 143 cm 120 kg = 265 lbs

The specifications provided herein are working values based on standard operation with qualified feedstock & are subject to change without notice

# APL CP R&D PIPING & INSTRUMENTATION DIAGRAM

## PROCESS FLOWS

R&D CP Instrumentation			
Description	Short Name	Type	Operating Ranges
Lambda Air/Fuel Mixture	L_EX_OUT	Bosch LSU 4.9	1 -> 5 lambda
Mass Air Flow	M_GSF_AIR	MH-80A-30	0 -> 60 kg/hr
Pressure at Blower inlet	P_BLR_IN	2 mm Pressure Line	0 -> -3.5 kPa
Pressure at Combustor inlet	P_CMB_IN	2 mm Pressure Line	0 -> -3 kPa
Pressure at Gasifier Cowling outlet	P_GSF_RCT	2 mm Pressure Line	0 -> -2.5 kPa
Pressure at Pyroauger air heat exchanger outlet	P_PYA_AHX1	2 mm Pressure Line	200 Pa -> -1.5 kPa
Pressure at Pyroauger air heat exchanger inlet	P_PYA_AHQ2	2 mm Pressure Line	60 Pa -> -1.5 kPa
Pressure at the Gasifier inlet	P_PYA_TOP	2 mm Pressure Line	300 Pa -> -1.5 kPa
Temperature at Blower inlet	T_BLR_IN	K-Type TC	0 -> 600 C
Temperature at Combustor Ignitor	T_CMB_IGN	K-Type TC	0 -> 1000 C
Temperature at Combustor inlet	T_CMB_IN	K-Type TC	0 -> 1000 C
Temperature at Gasifier Annulus inlet	T_GSF_AN1	K-Type TC	0 -> 1050 C
Temperature at Gasifier Annulus outlet	T_GSF_AN3	K-Type TC	0 -> 1050 C
Temperature at Gasifier Ignitor	T_GSF_IGN	K-Type TC	0 -> 500 C
Temperature at Gasifier Reduction zone	T_GSF_RED	K-Type TC	0 -> 800 C
Temperature at Gasifier Restriction zone	T_GSF_RST	K-Type TC	0 -> 1050 C
Temperature at Pyroauger air heat exchanger outlet	T_PYA_AHX1	K-Type TC	0 -> 450 C
Temperature at Pyroauger air heat exchanger inlet	T_PYA_AHQ2	K-Type TC	0 -> 260 C
Temperature at Pyroauger syngas heat exchanger inlet	T_PYA_SGHX1	K-Type TC	0 -> 640 C
Temperature at Pyroauger syngas heat exchanger outlet	T_PYA_SGHX2	K-Type TC	0 -> 260 C
Temperature at Gasifier inlet	T_PYA_TOP	K-Type TC	0 -> 200 C
Temperature at Pyroauger outlet	T_PYA_TOP_2	K-Type TC	0 -> 260 C



## ONBOARD DATA MONITORING

The Gasification Test System includes a monitoring package leveraging current protocols making the system into a Smart Device allowing the capture and management of operational data. It collects and transmits over 250 operations data-points directly from the equipment in real time. This critical information is securely stored in an on-site server as well as on a remote APL server to enable remote APL support and monitoring. The Base Monitoring System is designed to be a robust, high-availability platform, with provisions for an International Cell Modem/Plan.



Prototype wall-mounted data collection server

Building on the core data collection of the Base Monitoring System, these modules address the needs of specific R&D and educational institutions for in-depth, customizable research.

The Base Systems Data Extraction API provides a direct and structured interface to all 250+ operational datapoints collected by the CharPallet R&D. Its open access allows researchers to seamlessly integrate real-time and historical operational data into their own statistical and modeling software—such as Python, R, or MATLAB—for proprietary analysis, hypothesis testing, and deeper investigation into gasification dynamics and biochar and/or activated carbon formation.

To streamline the research process, the Base package includes Automated Run Reporting. This feature generates standardized, clean, and comprehensive reports at the conclusion of every operational cycle. This removes the manual labor of data aggregation and formatting, ensuring that researchers can focus on interpretation rather than preparation. Furthermore, Developed Analysis Plots provide a library of ready-to-use visualizations for common performance metrics, enabling rapid assessment of reactor health, feedstock conversion efficiency, and biocarbon quality. The Base package converts the CharPallet from a simple data source into a flexible, high-utility platform for advanced renewable energy and climate research, supporting publications and demonstration activities.

Additional hardware and support modules described below are integrated into the API to enhance data collection with gas sampling and analysis hardware and software to streamline the establishment of a comprehensive research and development system.



Example Monitoring Chart

## 2 - GAS CONDITIONING & OFFTAKE MODULE

The gas conditioning and offtake module provides for gas cooling to under 100°C using a heat exchange system with automated surface cleaning and particulate removal with a 5 micron bag house filter. Valving and automation allows for switching between internal gas use and external gas offtake to other downstream processes. The standard regenerative blower provides moderate outlet gas pressure.



## 3 - STEAM GENERATION MODULE

The steam generation module allows for generation of up to 8 kg/hr of steam to be blended with gasification air. An onboard peristaltic pump meters water flow into the monotube steam boiler. This module allows for production of activated carbons, as well as enriching the syngas with hydrogen for other downstream applications.



## 4 - GAS ANALYSIS MODULE

### INCLUDES:

- Cubic Gasboard 3100 Gas Analyzer
- Rack Mount Enclosure, Sampling Pump
- Monitoring Endpoint for Data Collection

### Gas Conditioning Device

- Two Water Scrubbers
- Activated Carbon Filter
- 0.3  $\mu\text{m}$  Filter
- Gas Flowmeter



### SYNGAS GASES ANALYZED

SPECIES	DETECTION RANGE	ACCURACY/RESOLUTION	METHOD	TYP. RANGE (CP)
Carbon Monoxide (CO)	0-25%	+/-2% FS / 0.01%	NDIR	15-25%
Methane (CH <sub>4</sub> )	0-10%	+/-2% FS / 0.01%	NDIR	0.5-3%
Hydrocarbons (CnHm)	0-10%	+/-2% FS / 0.01%	NDIR	0-0.1%
Hydrogen (H <sub>2</sub> )	0-25%	+/-3% FS / 0.01%	TCD	10-25%
Carbon Dioxide (CO <sub>2</sub> )	0-25%	+/-2% FS / 0.01%	NDIR	10-20%
Oxygen (O <sub>2</sub> )	0-25%	+/-3% FS / 0.01%	ECD	0-3%

## 5- EMISSION ANALYSIS MODULE

### INCLUDES:

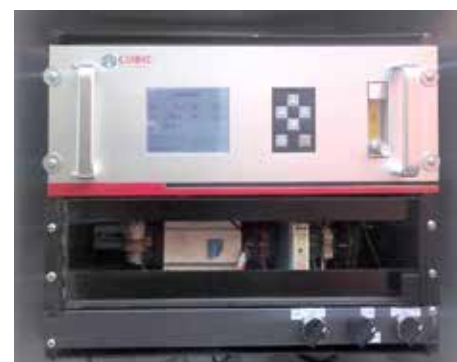
- Cubic Gasboard 3000 Emissions Analyzer (or equivalent)
- Rack Mount Enclosure, Sampling Pump
- Gas Conditioning (Cooling, Drying, and Filtering)
- Monitoring Endpoint for data collection and monitoring

### ANALYZER FEATURES:

- Built-in zero pump to achieve zeroing with air
- Accurate measurement of low concentration gas
- Large LCD (320x240) display

### EMISSION GASES ANALYZED

SPECIES	DETECTION RANGE	ACCURACY/RESOLUTION	METHOD	TYP. RANGE (CP)
Carbon Monoxide (CO)	0-500 ppm	+/-2% FS / 1 ppm	NDIR	5-40 (operations) 5-2000 (peak)
Methane (CH <sub>4</sub> )	0-1000 ppm	+/-2% FS / 1 ppm	NDIR	0-10 (operations) 1-1000 (peak)
Nitrogen Oxide (NO)	0-200 ppm	+/-2% FS / 1 ppm	NDIR	5-250
Carbon Dioxide (CO <sub>2</sub> )	0-20%	+/-2% FS / 0.01%	Dual Beam NDIR	5-15
Oxygen (O <sub>2</sub> )	0-25%	+/-3% FS / 0.01%	ECD	8-15



Prototype Gasboard Analyzer Rack



## 6 - TECHNICAL SUPPORT

All Power Labs is dedicated to ensuring the successful integration and operation of your CharPallet R&D unit by offering a tiered structure of technical support and training services. This support begins with Remote Setup and Commissioning Support, which is included with your purchase. This comprehensive service covers pre-installation consultation, step-by-step assembly and startup assistance via remote channels, and initial operational verification to ensure a smooth deployment. To maximize your team's proficiency, Specialized Training Programs are available, offering hands-on, fee-based training at All Power Labs' Berkeley facilities or as customized on-site training at your location. These programs focus on advanced operation, routine maintenance, safety protocols, and basic troubleshooting. Finally, for customers with highly specialized research needs, Engineering Consultation for Research Programs is available on a case-by-case basis (cost TBD). This advanced support can include assistance with experimental design, expert review of data analysis and interpretation, and consultation on system modification or customization to accelerate critical research outcomes.

## EXAMPLES IN THE FIELD

### BERKELEY, CALIFORNIA



Production prototype CharPallet unit used for optimization of biomass gasification process (performance, emissions), instrumentation and data acquisition development, and production of functional carbons from various biomass feedstocks. Experiments on other feedstocks such as cannabis pellets and were conducted.



### FRESNO, CALIFORNIA



Production prototype CharPallet unit used for optimization of biomass gasification process, biofuels development for production of hydrogen from woody biomass

### UNIVERSITY OF MODENA, ITALY



Production prototype CharPallet unit used for experiments on local biomass waste feedstocks.

## CHARPALLET R&D PRICELIST

	ITEM	DESCRIPTION	PRICE
1	Gasification System	Down-draft, fixed bed, gasification system with temperature and pressure sensors with base s1.0 software with remote monitoring and data processing via APL-hosted server	<b>\$85,000</b>
2	Gas Conditioning & Offtake Module	Provides gas filtration using bag house filter, heat exchanger, and regenerative blower	<b>\$25,000</b>
3	Steam Generation Module	On-board steam production for temperature control, hydrogen production and carbon activation	<b>\$15,000</b>
4	Gas Analysis Module	Gas analyzer, sampling pump and gas clean up train. S1.1 software set up for data processing	<b>\$20,000</b>
5	Emissions Analysis Module	Emissions analyzer, flue stack sensor mount. S1.1 software set up for data processing	<b>\$15,000</b>
6	Technical Support	On-line support and training for equipment set up	<b>TBD</b>

Prices are EXW Berkeley, California, and subject to change without notice. Pricing, payment terms and lead times to be finalized upon request for quote.

CharPallets are warranted for 3 years against defects in material and workmanship under normal use. APL warrants manufactured parts (gasifiers, electronics, components); OEM warranties pass through for sourced parts (servers, drive motors). Defective parts will be repaired or replaced at our discretion, free of charge for parts. Shipping and labor costs for replacements are not covered.

All specifications are subject to change without notice

## ALL Power Labs

ALL Power Labs is the global leader in small-scale gasification technology. We make biomass-fueled equipment that is ready for everyday work, to serve real-world, distributed-energy, biochar, and CO<sub>2</sub> removal needs. Our compact gasifiers are now at work in over thirty countries, and support research at more than fifty universities around the world.

Our team is an unusual combination of hands-on 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.

ALL Power Labs makes machines that transform organic waste into useful Power and Products, for work at the intersection of industry, agriculture, and climate. APL intends to make a consequential impact on global energy poverty and carbon draw-down through mass delivery of its carbon-negative energy devices.

Our facility is in Berkeley, California. Please contact us to arrange a visit the next time you are in the Bay Area. We would love to show you around.

