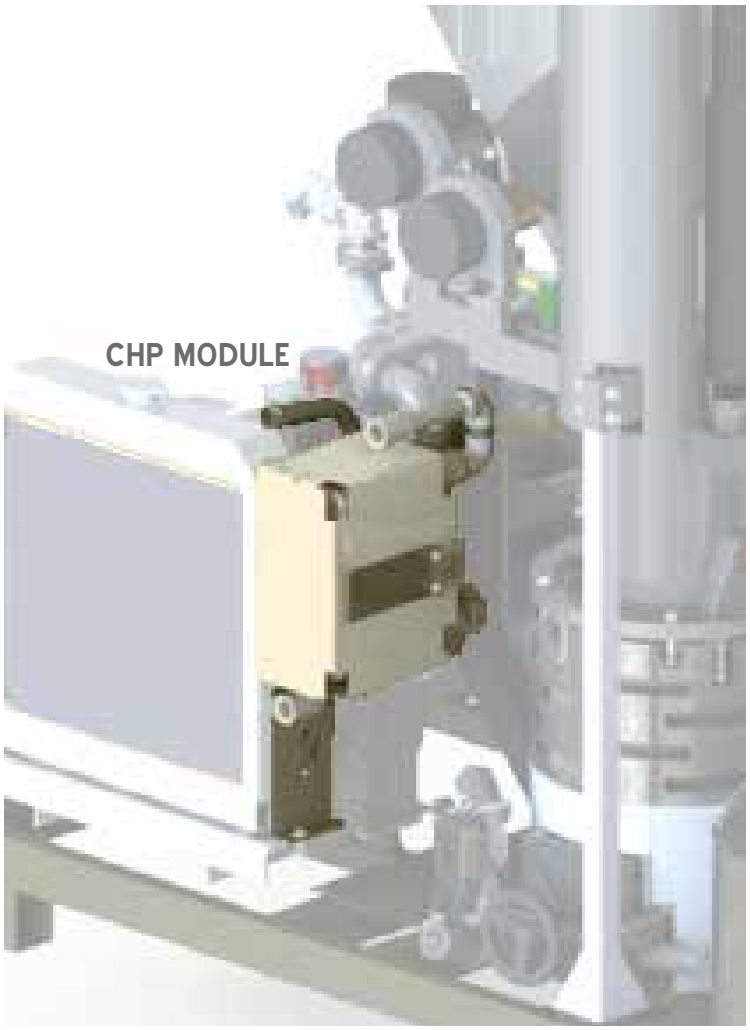
ALL POWER LABS

Carbon Negative Power & Products

COMBINED HEAT and POWER (CHP) ACCESSORY



Our **Combined Heat and Power (CHP) Accessory** can be added to our Power Pallets, more than doubling their total system efficiency by adding the thermal output to the electrical output. APL's CHP System uses a flat plate heat exchanger to capture heat from the engine's cooling system in this stage 1 system to raise the temperature of the working fluid by as much as 14 °C.

This is possible because only 20% of the energy contained in the feedstock is able to be converted to electricity by our genset. Most of the other 80% is normally lost via heat in the engine's cooling system and exhaust. By recovering some of this heat, the CHP allows the total efficiency of the whole system to exceed 35% by delivering up to 20 kW of thermal energy in addition to the 18 kW of electrical energy. This heat can be pumped via the working fluid to other locations where it can used for radiant floor heating and numerous other processes.

NOTE: APL's CHP System does not include the working fluid or any of its pumps, plumbing or other components of its circulation system.

TECHNICAL SPECIFICATIONS

VALUE	SPECIFICATION
Electrical + Thermal Efficiency [1]	~35%
Max CHP System Output [1]	~20 kWt (@15 kWe) 70,000 BTU-h
Working Fluid	Coolant: 50/50 Water/Ethylene Glycol
• Flow Rate	~1.5 m^3/h (~6.5 GPM)
• Target Inlet Temperature	60 °C (140 °F)
• Target Outlet Temperature	74 °C (165 °F)
• Max. Temperature Rise	14 °C (57 °F)
Plumbing Connection	1 inch NPT
Shipping Weight	120 kg (260 lb)
Potable Water	No

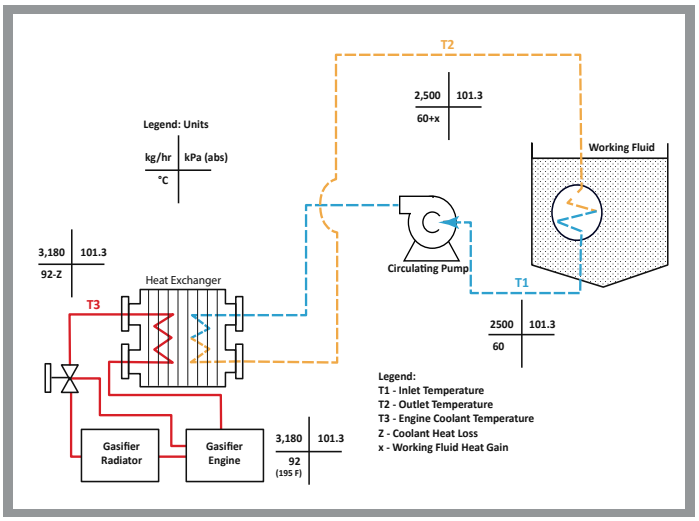
[1] Actual heat output varies depending on operating power levels and specifications of user-supplied hydronic components (not included).

USE CASE EXAMPLES

INDUSTRY	USE
Residential - Commercial	Radiant Hydronic Heating Water to Air Heating Pool & Spa Heating Snow Melt Adsorptive Chilling
Animal Husbandry	Barn & Enclosure Heating Sterilization & Cleaning
Agriculture	Greenhouse Heating Food/Seed Drying Process Heat
Forestry	Kiln Drying Lumber Pulp Drying Space Heating
Manufacturing	Chemical Processes Food Processing Fluid Transport Textiles Minerals

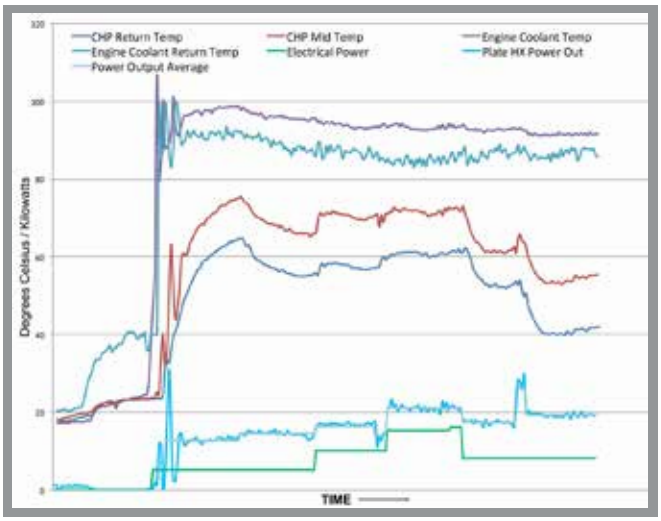
NOTE: Not suitable for direct heating of potable water.
All specifications are subject to change without notice.

TECHNICAL DESCRIPTION



PIPING & INSTRUMENTATION DIAGRAM

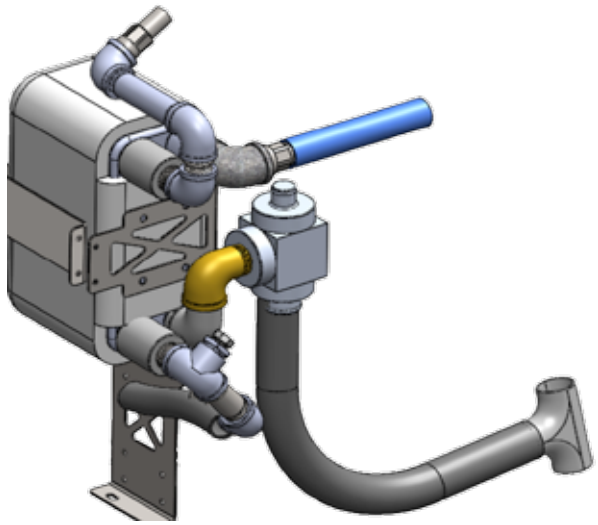
The flow of the working fluid is shown in dashed lines, and flow of engine coolant is shown in solid red lines. Detains of critical values are shown in quadrants adjacent to the loop they refer to.



POWER & TEMPERATURE TEST DATA

The chart above compares test measurements of electrical power outputs and fluid temperatures plotted over time during a typical test run of the CHP system using a dummy heat load.

COOLANT HEAT RECOVERY MODULE



Engine coolant is directed through a system of piping into a brazed-plate heat exchanger where some of the engine's waste heat will be transfered to a working fluid. The heat is transported to the application site via a circulation system supplied by the customer.

Mechanical thermostats and a radiator-bypass circuit maintain safe and efficient engine operating temperatures while optimizing the thermal output to the working fluid.

HEAT EXCHANGER

FEATURES	SPECS
Type	Brazed Plate
Material	316T Stainless steel Pure copper brazing
Flow Capacity	14 m^3/hr (60 GPM)
Maximum Pressure	3.0 Mpa (435 psi)
Design Temperature	-160 ˚C to 225 ˚C (-256˚F to 437˚F)

PERFORMANCE

VALUES	SPECS
Maximum Outlet Temperature	90 °C (190 °F)
Return Temperature Range	40 °C - 90 °C (160 °F - 190 °F)
Standard Temperature Difference	14˚ (57 °F)
Heating Water Volume Flow	1.5 m^3/hr (6.5 GPM)
Maximum Operating Pressure	1.0 Mpa (145 PSI)
Pressure Loss	45 mbar (18 inH_2O)

ALL Power Labs - 1010 Murray Street Berkeley, CA 94710 U.S.A.
+1-510-845-1500 Email: sales@allpowerlabs.com Web: allpowerlabs.com

Rev 10.14.15