A Case Study of Biomass Use on a College Campus

GOVENERGY

New Orleans, LA

August 8, 2007

Mount Wachusett Community College

444 Green Street, Gardner, MA 01440-1000

Pieces of the Energy Puzzle

- ECM's
- Photovoltaic Array
- Renewable Energy Courses
- Wind Turbine
- Bio-based Products
- Demand Response
- Forward Capacity
- Algae
- ***Biomass District Heating System***
- ***Biomass CHP***

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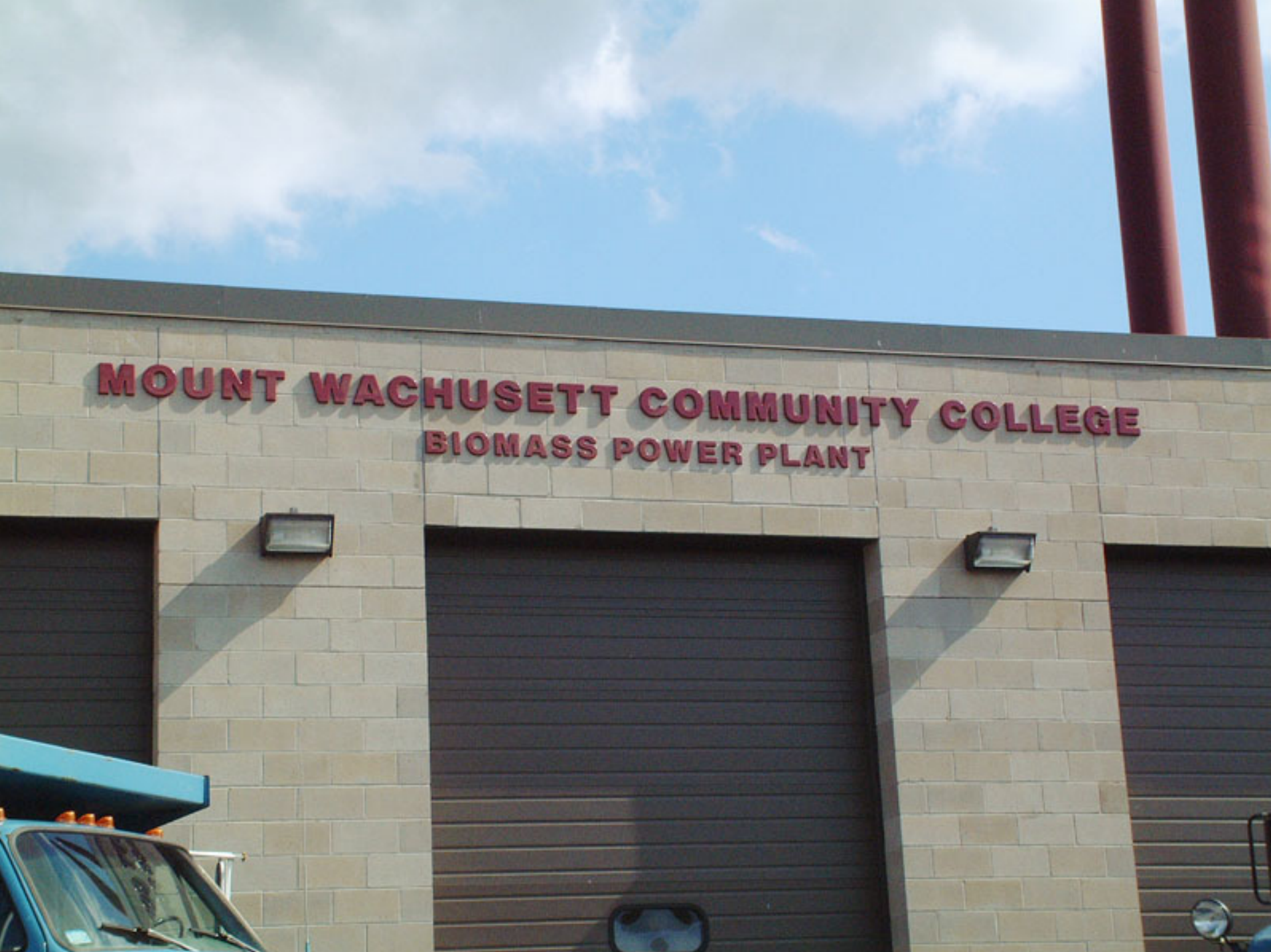
MOUNT WACHUSETT COMMUNITY COLLEGE
BIOMASS POWER PLANT

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10
WESTCOTT
RULER

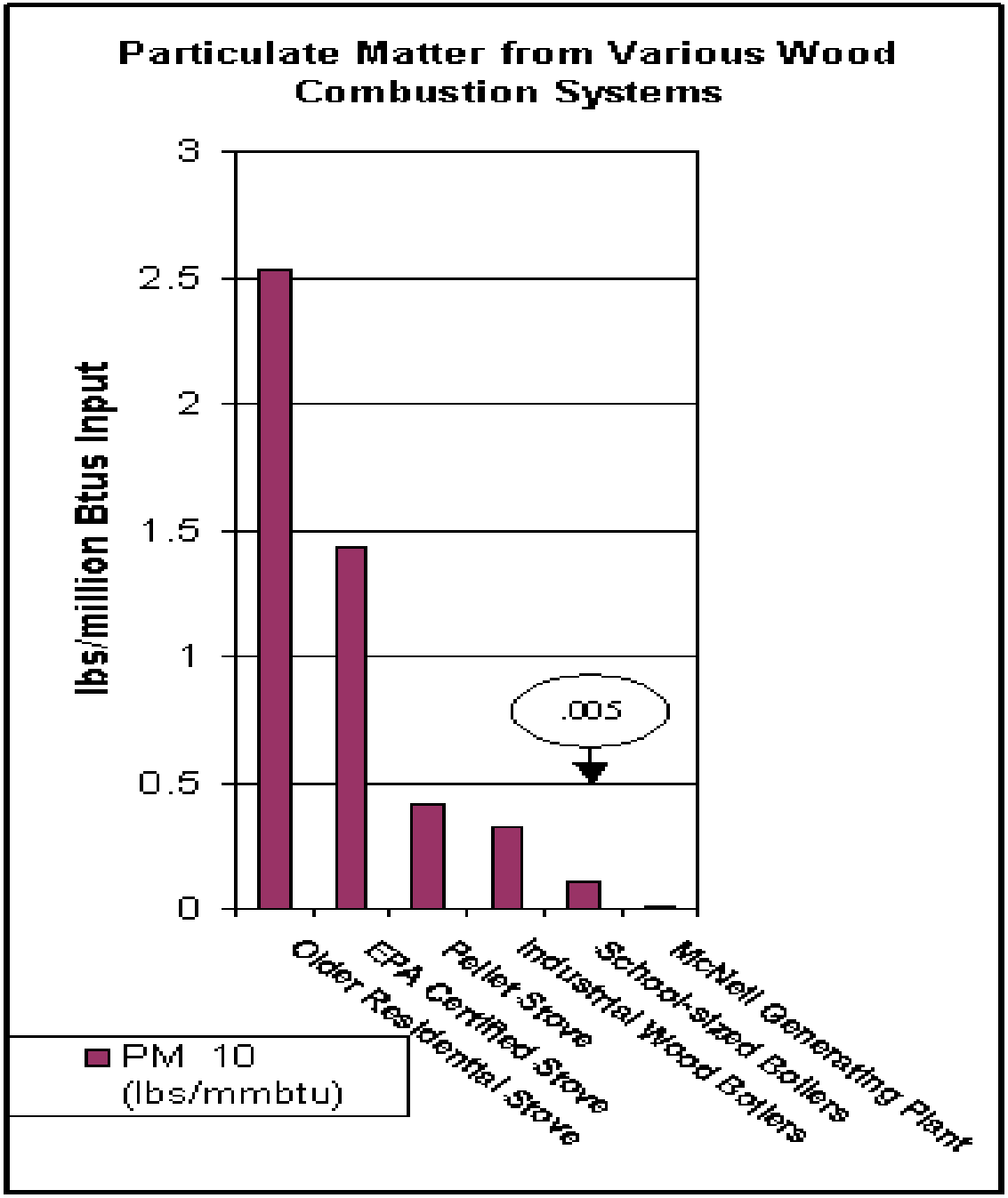
Biomass Heating System

Conversion of Electric Resistance Heating System to a Closed Loop Hydronic System Utilizing biomass Feedstock

- 8 million btu Messersmith Inc. wood chip combustion system with an 8 million btu oil fired backup
- Computer controlled facility
- Best Available Control Technology (BACT): baghouse

IRON HORSE

District heat



Source:

Biomass Energy Resource Center

Montpelier, VT

http://www.biomasscenter.org/information/emissions.html

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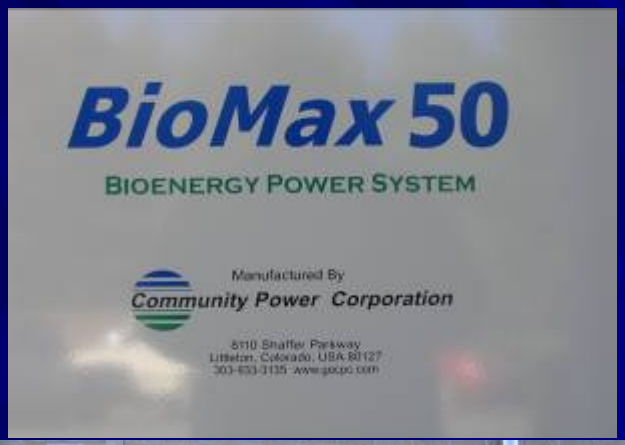
BIOMASS COMBINED HEAT & POWER PROJECT



Community Power Corporation
Energy Systems for Sustainable Power

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Research Partners

- Community Power Corporation
- U. S. Department of Energy
  Golden Field Office
- National Renewable Energy Laboratory
- USDA Forest Service
  Forest Products Laboratory

Total Project Cost: $1.2 million

Biomass Research Technical hurdles

- operational and economic viability
- feedstock integration
- system automation
- securing permits in US markets
- commercialization

COMBINED HEAT & POWER

Gasification

gasification is the thermal decomposition of organic matter in an oxygen deficient atmosphere producing a gas composition containing combustible gases, liquids and tars, charcoal, and air, or inert fluidizing gases.

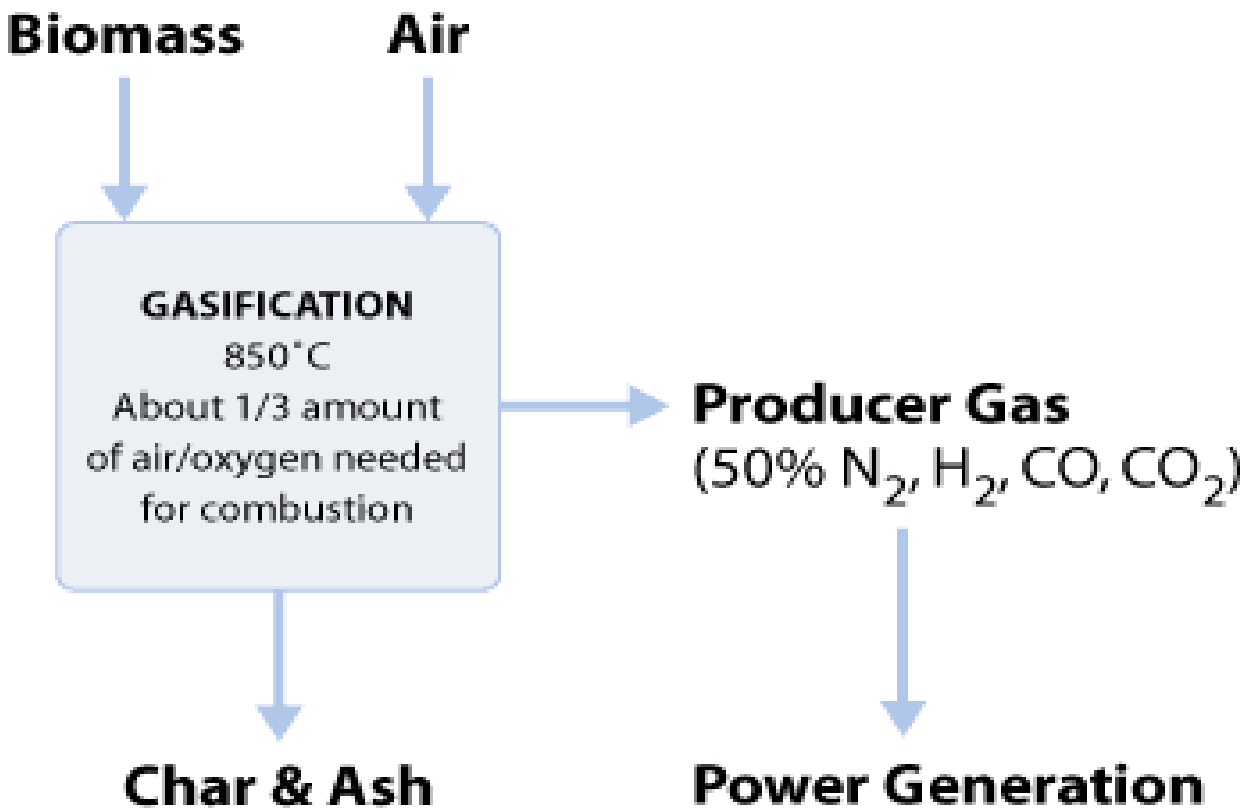
Biomass Pyrolysis Products

	Liquid	Char	Gas
GASIFICATION high temperature long residence time	5%	10%	85%
FAST PYROLYSIS moderate temperature short residence time	75%	12%	13%

Source: Stefan Czernik
National Renewable Energy Laboratory

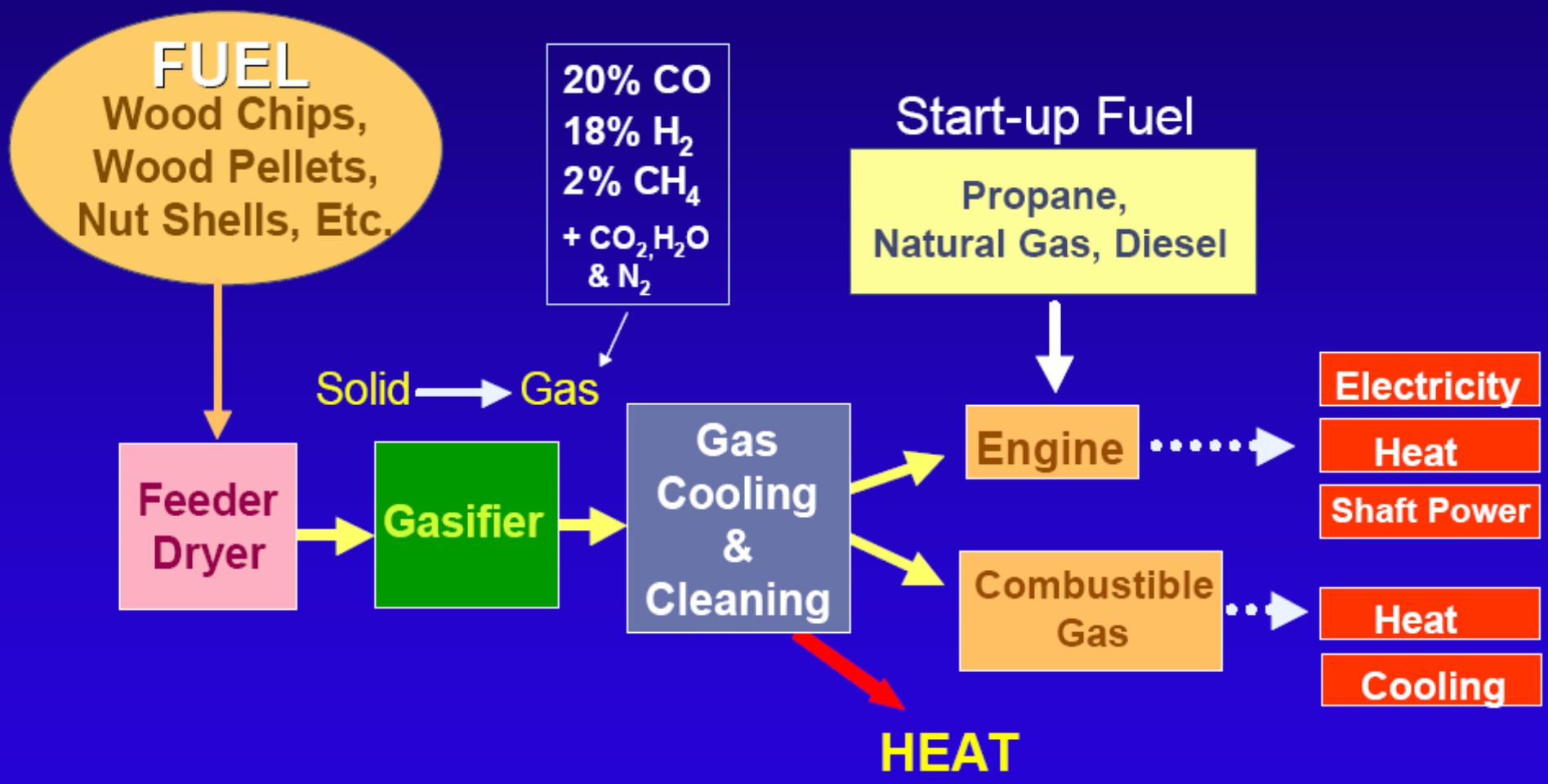
Small Modular Applications

Biomass Gasification via Partial Oxidation (Auto Thermal)



Source: US DOE EERE

BioMax: Converts Woody Biomass to a Clean Fuel Gas for Power, Heat and Cooling

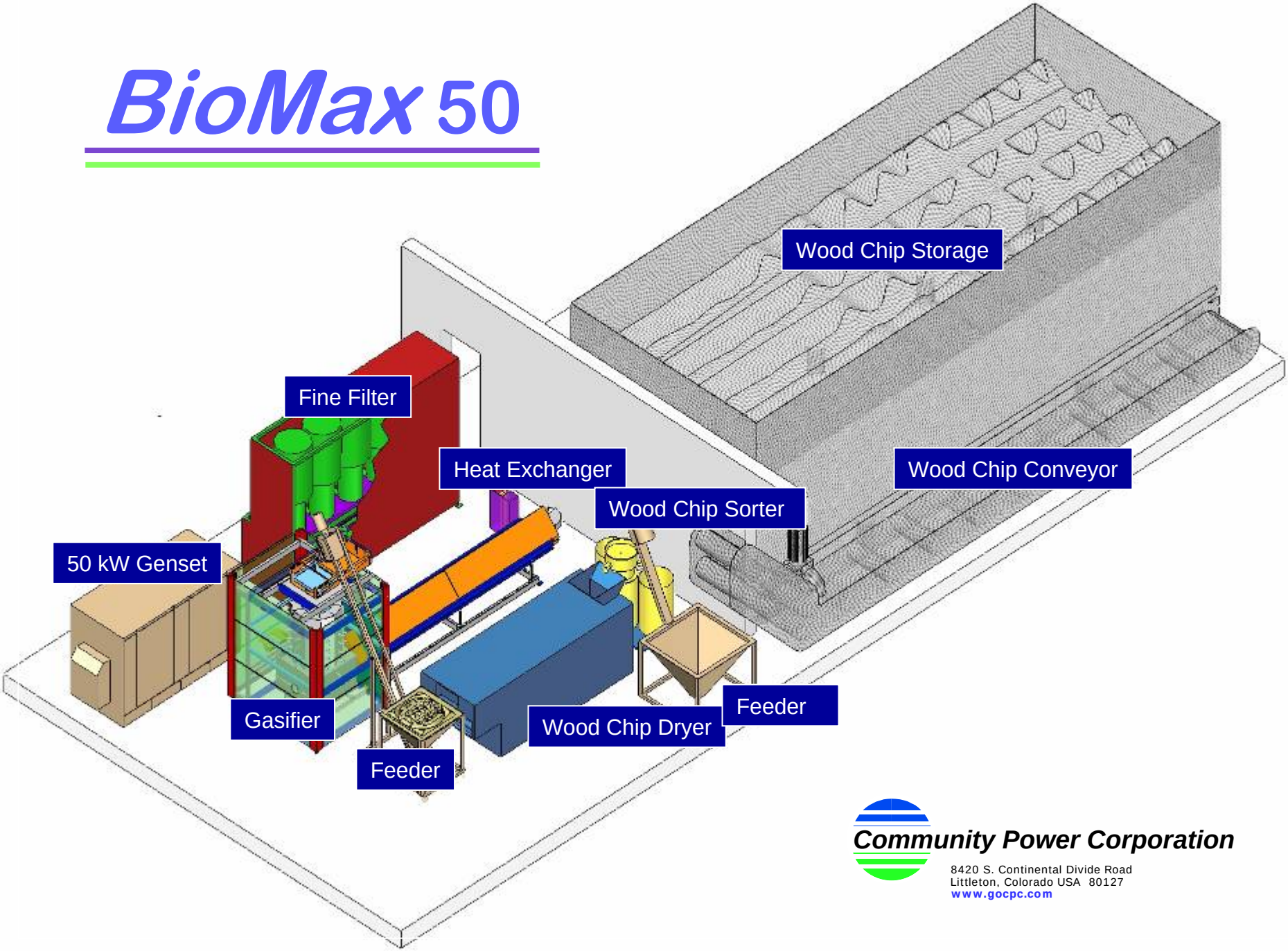


System CH&P Efficiency: >80%

Biomax 50

- 50 kWe combined heat and power
- Thermal energy for heat
- Thermal energy for absorption chiller
- Electricity: 8.1 liter GM turbocharged stationary engine with genset
- 24/6 operation
- No additional staffing
- transparent
- 1.5 tons/day green chips consumption
- Seeking funding for other prime movers

BioMax 50



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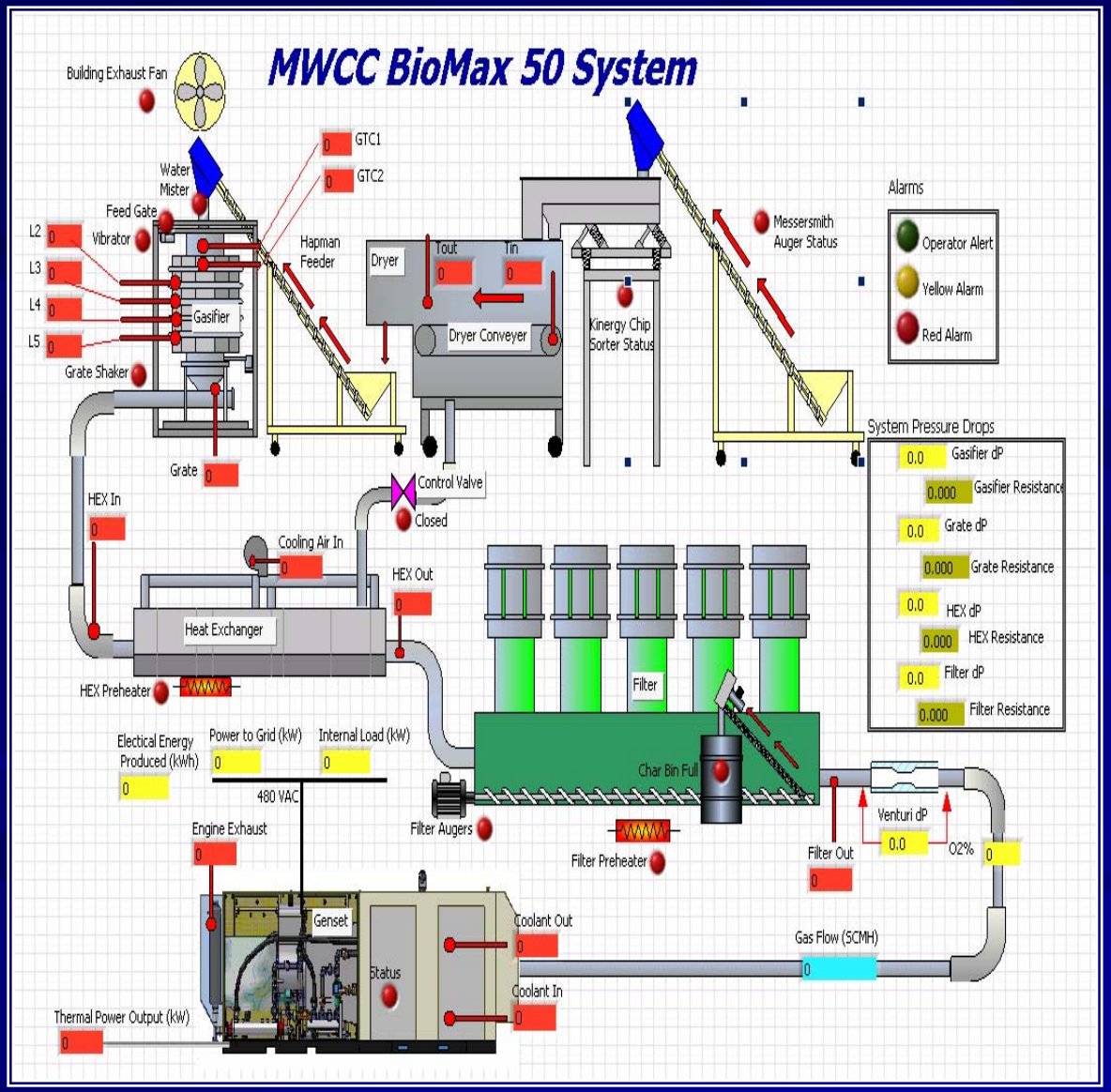
System Overview



- Fuel Conditioning
- Gasification
- Gas Cooling
- Gas Cleaning
- Power Generation

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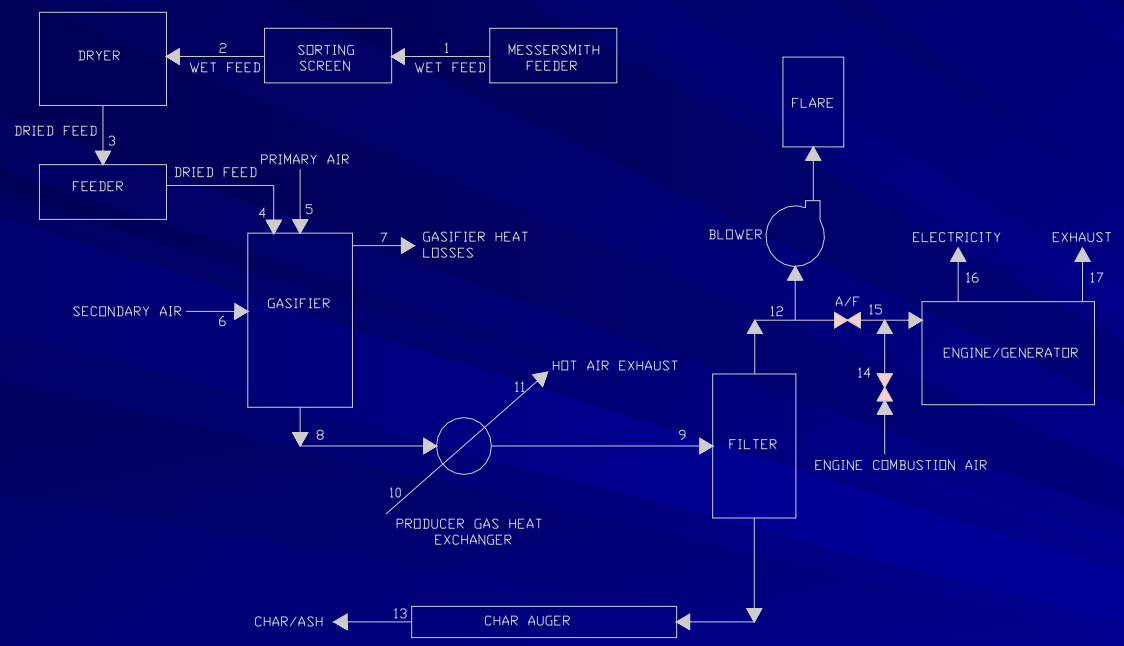
System Components



- 10 components
  - Messersmith Feeder
  - Sorting Screen
  - Dryer
  - Fuel Feeder
  - Gasifier
  - Heat Exchanger
  - Filter
  - Engine/Generator
  - Flare
  - Control System

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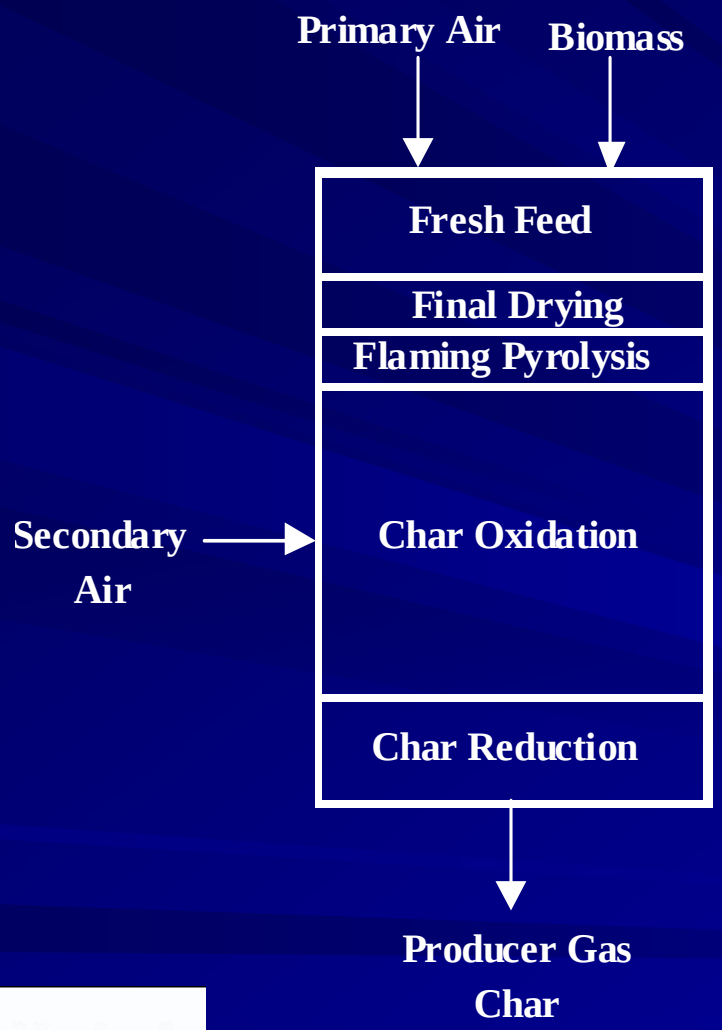
Downdraft Gasifier



- 5 zones
  - Fresh Feed
  - Final Drying
  - Flaming Pyrolysis
  - Char Oxidation
    - CO_2 + Heat
  - Char Reduction
    - CO + H

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Engine/Generator

- Commercial Gillette Engine/Generator Set
  - GM V-8, 8.1 Liter, Vortec Engine
  - WEG 60kW Generator

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Engine/Generator (cont.)

Modified Engine

- In-line gas blower
- Automatic Engine Starting
- Control system controls the A/F ratio with the use of an O2 sensor

Generator

- Can run in stand alone or utility parallel configuration
- 50kW Max continuous power

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Control System

- Programmable Automation Controller (PAC)
  - Compact Field Point
  - 1 control module and a variety of I/O modules
  - Can be connected to the internet or a LAN
  - All incoming data is recorded and stored
  - Automatic control and monitoring system
    - Automated alarms, responses, and shutdowns

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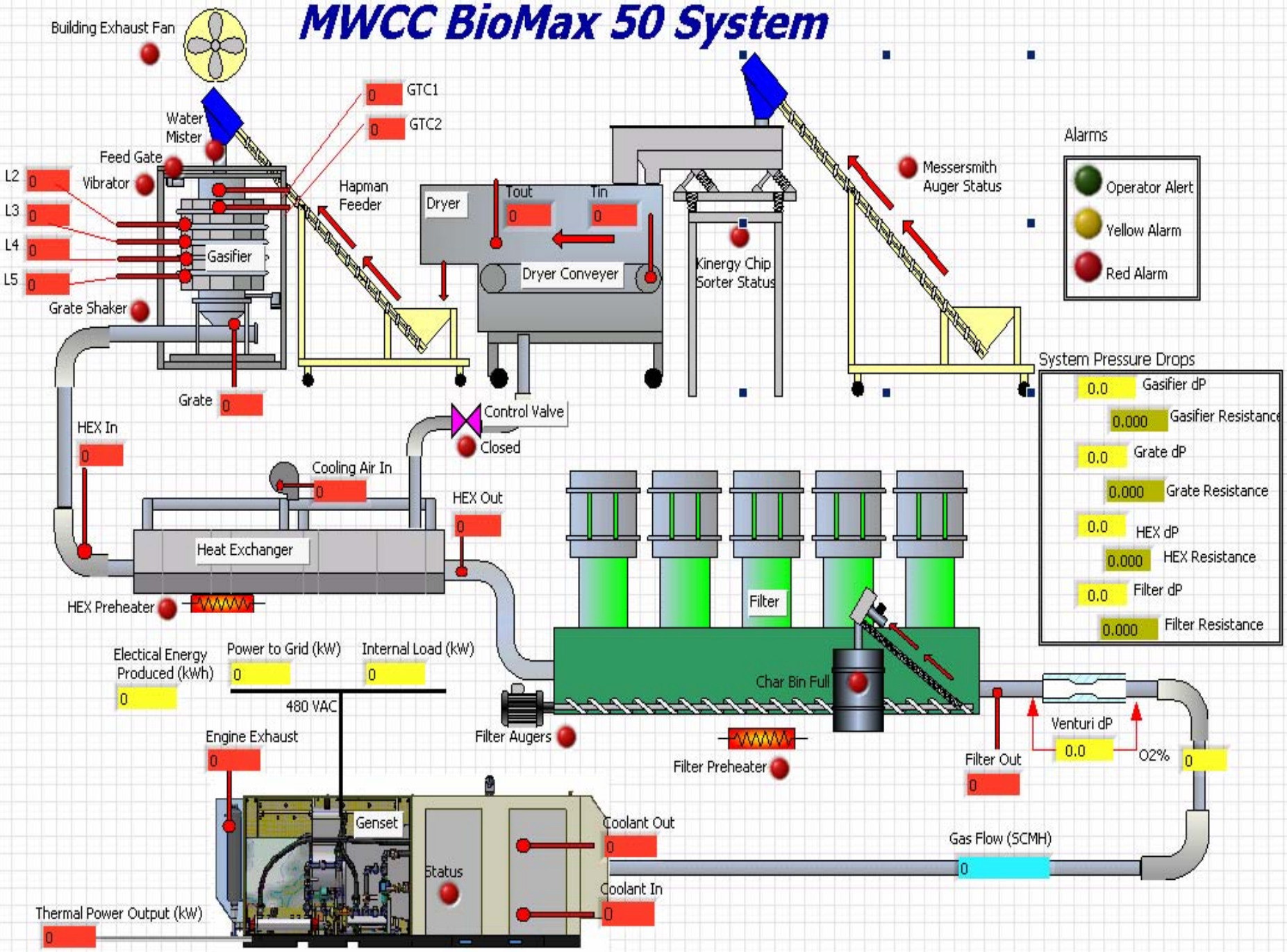
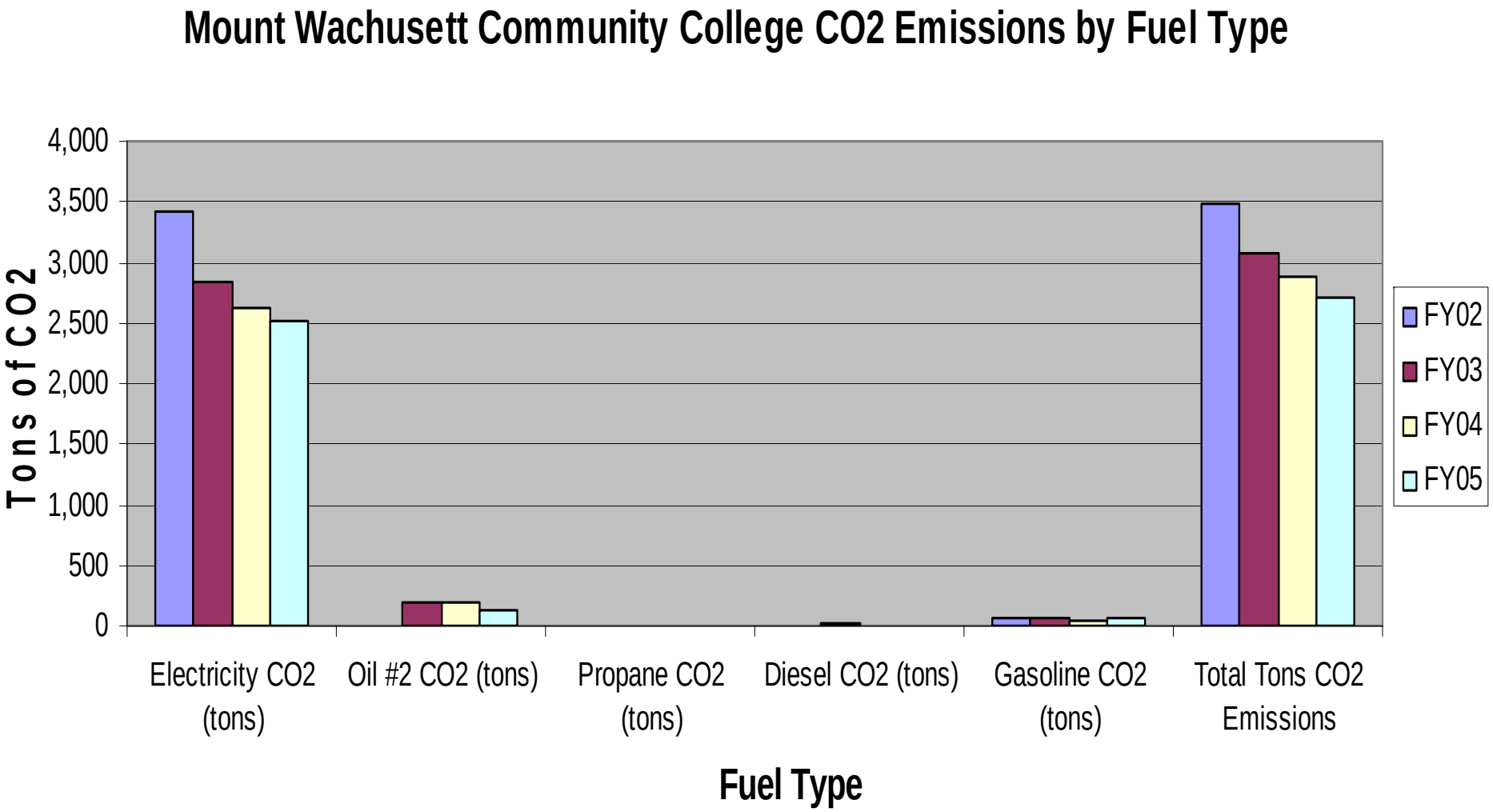

MWCC BioMax 50 System
Building Exhaust Fan
Water Mister
Feed Gate
Vibrator
L2
L3
L4
L5
Gasifier
Grate Shaker
Grate
GTC1
GTC2
Hapman Feeder
Dryer
Tout
Tin
Dryer Conveyer
Kinergy Chip Sorter Status
Messersmith Auger Status
Alarms
Operator Alert
Yellow Alarm
Red Alarm
System Pressure Drops
Gasifier dP
Gasifier Resistance
Grate dP
Grate Resistance
HEX dP
HEX Resistance
Filter dP
Filter Resistance
HEX In
Control Valve
Closed
Cooling Air In
HEX Out
Heat Exchanger
HEX Preheater
Filter
Char Bin Full
Electical Energy Produced (kWh)
Power to Grid (kW)
Internal Load (kW)
480 VAC
Engine Exhaust
Filter Augers
Filter Preheater
Venturi dP
O2%
Filter Out
Genset
Status
Coolant Out
Coolant In
Gas Flow (SCMH)
Thermal Power Output (kW)

EMISSIONS: BioMax 15 Exceeds Current (CARB)* Standards

Engine Exhaust Pollutant	% Below CARB Standard
NOx	8%
CO	99%
THC	97%

No Water, No Smoke, No Smell, No harmful effluents

* California Air Quality Resources Board
Standards for Distributed Power and Heat (CHP)



SOURCE: MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

MOUNT WACHUSETT COMMUNITY COLLEGE
GREENHOUSE GAS INVENTORY AND REDUCTION FY 2002 - 2005

FY	Electricity CO2 (tons)	Oil #2 CO2 (tons)	Propane CO2 (tons)	Diesel CO2 (tons)	Gasoline CO2 (tons)	Total Tons CO2 Emissions	CO2 Emissions Annual Percent Change	CO2 Emissions Percent Change From 2002 Baseline
FY02	3,411	0	0	10	58	3,480		
FY03	2,831	188	0	12	54	3,085	-11.36%	
FY04	2,628	191	5	8	43	2,875	-6.79%	-17.38%
FY05	2,510	125	2	6	67	2,710	-5.75%	**-22.12%**

SOURCE: MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

For more information

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Visitors are always welcome

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