Community Power Corporation

The Modular Biopower Company

Emerging Small Modular Biopower Systems

May 17, 2006
NAEMI Biomass & Business Training Workshop

Art Lilley
Chairman

Agenda

- CPC
- Modular Biopower
- BioMax Description
- FAQs
- Case Studies

CPC's Mission

Mission:

Provide small, modular, biopower systems to the distributed generation market.

Product Development Facility
Littleton, CO

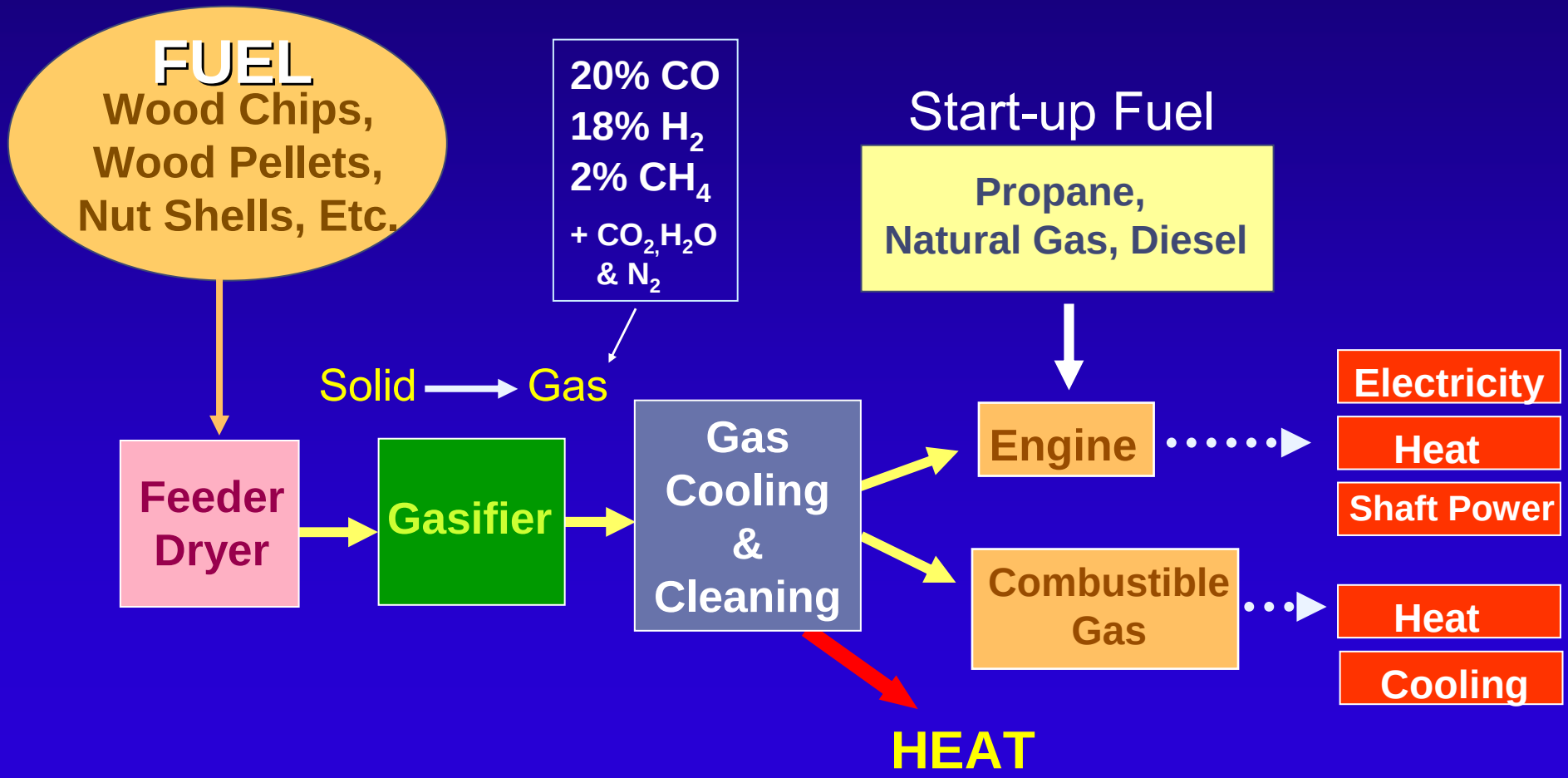
Advantages of Small Biopower

- ✓ Uses abundant local biomass residues
- ✓ Fuel flexible
- ✓ Grid quality power
- ✓ Easy to site, connect to grid
- ✓ Small footprint = high power density
- ✓ Dispatchable
- ✓ Modular, able to parallel
- ✓ Cooling, heating, power = high efficiency
- ✓ Fully automatic
- ✓ Reliable: dual fuels
- ✓ Competitive against other distributed generators
- ✓ Standard systems, ideal for mass manufacture

Biomass Fuels for Downdraft Gasifier

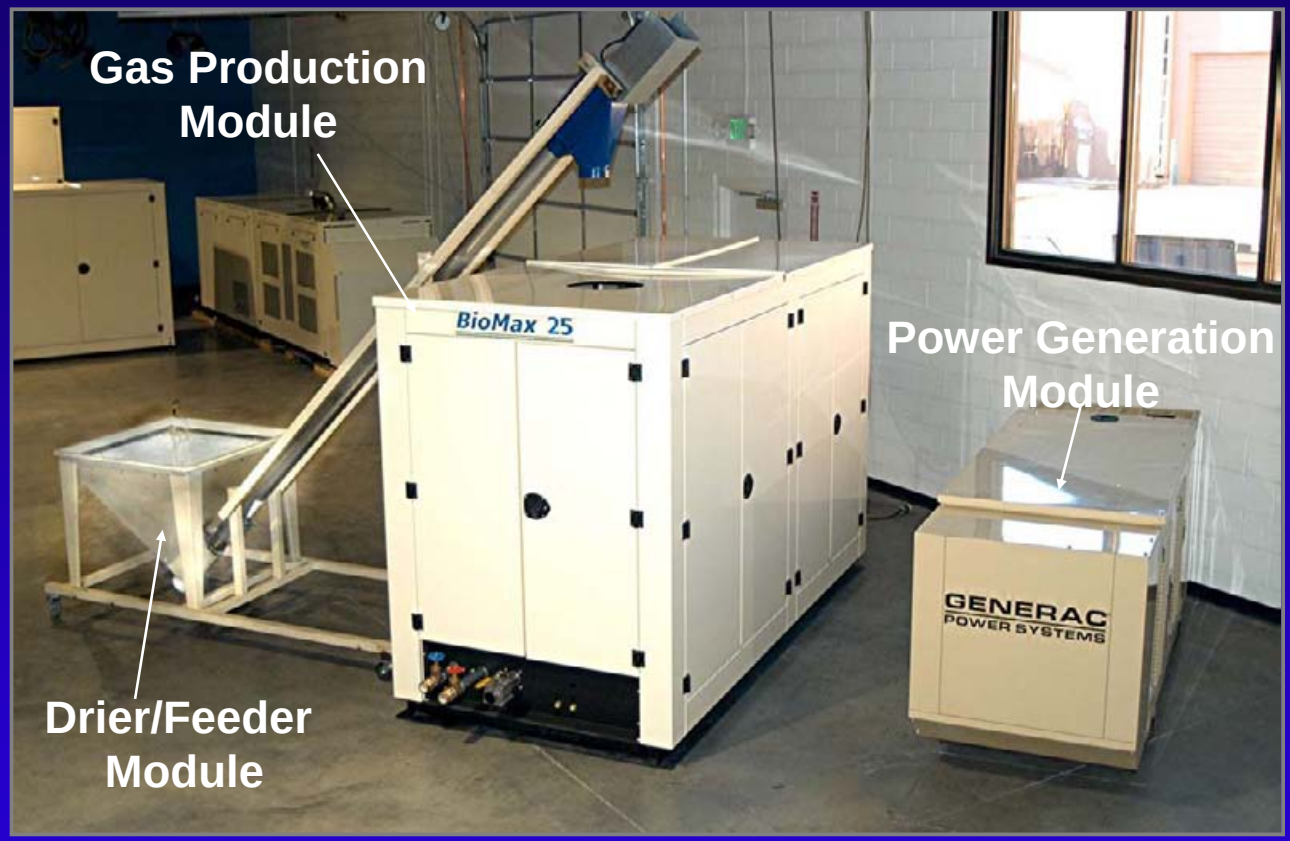
- Good
  - Wood
  - Nutshells
  - Pellets
  - Corn
  - Cubed grasses
- Difficult
  - Sawdust
  - Rice husks
  - Leaves
  - Corn Stover

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



System CH&P Efficiency: >80%

BioMax 25


Gas Production Module
BioMax 25
Power Generation Module
GENERAC
POWER SYSTEMS
Drier/Feeder Module

CPC's Renewable Fuel-Gas Generator Is A Versatile Distributed Generation Platform

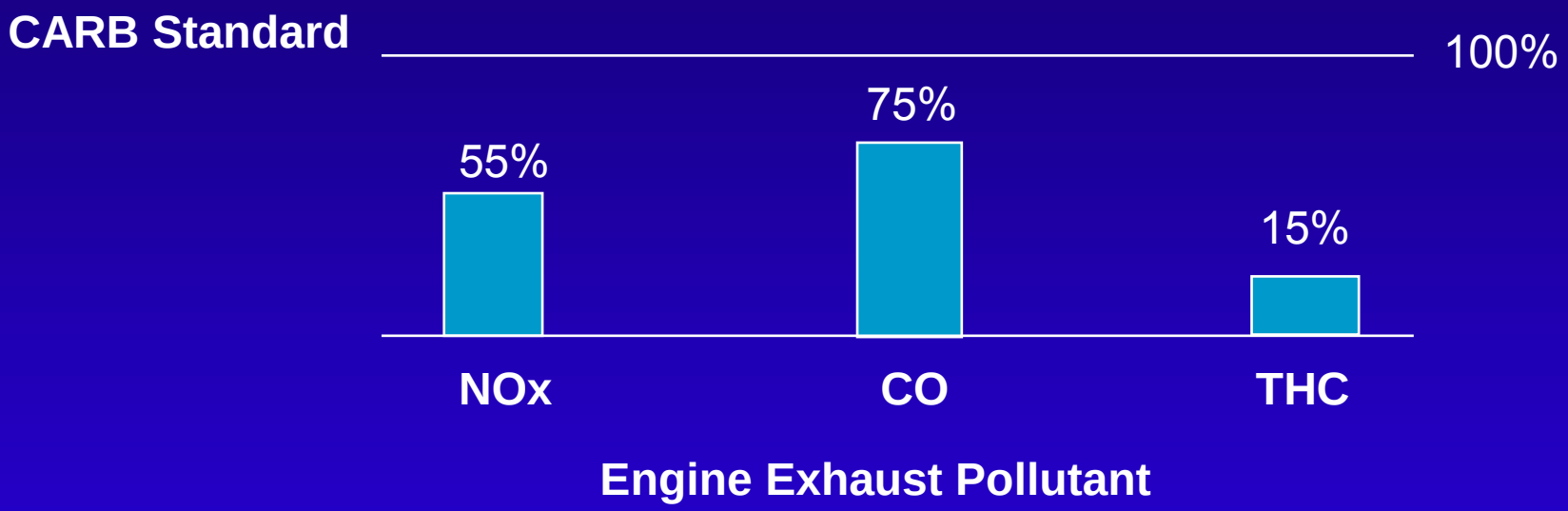
Gas Production Module

Fuel Gas

RUNS:

- IC Engines ✓
- Stirling Engines ✓
- Fuel Cells ✓
- Microturbines
- Driers & Chillers ✓

EMISSIONS: BioMax Meets Current (CARB)* Standards



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

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

BioMax Char and Ash Residues Are Non-Hazardous

"…the waste stream [*from the BioMax*] neither exhibits a hazardous waste characteristic, nor is it a listed hazardous waste."

Reference: Colorado Dept of Health and Environment; Hazardous Materials and Waste Management Division

CPC's New BioMax 50

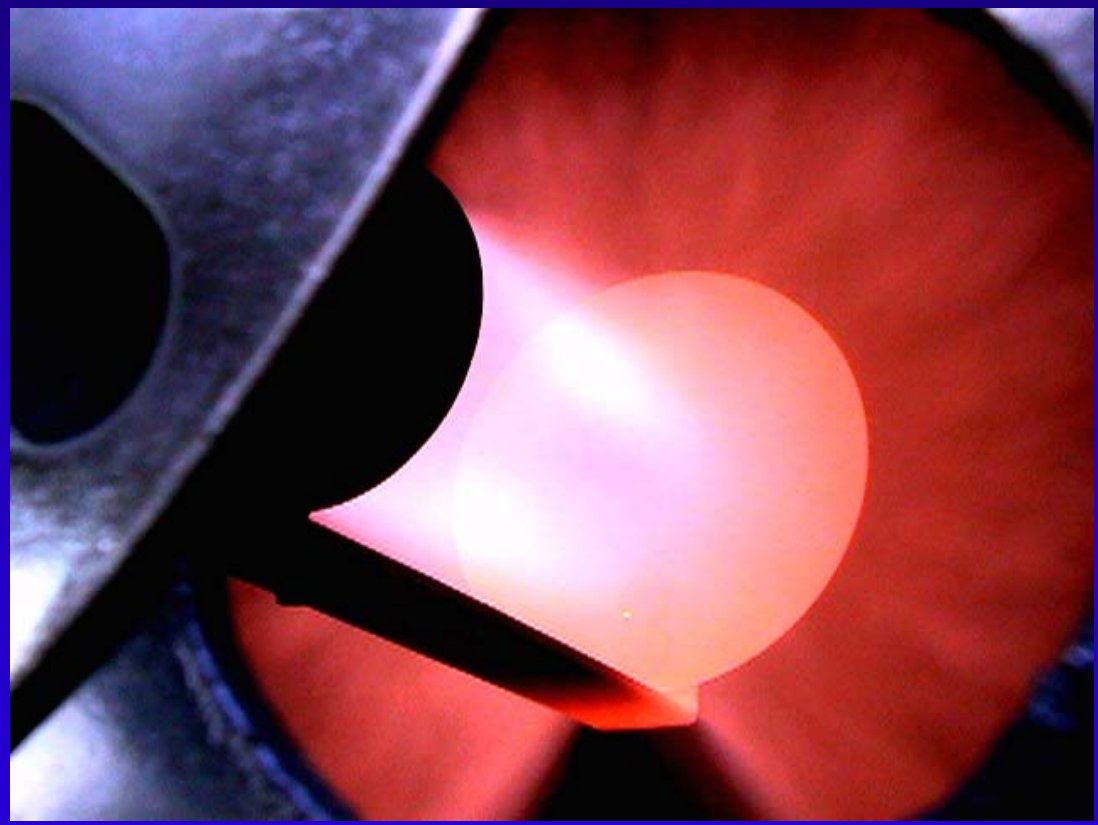
Pre-prototype Gasifier Testing

New Features:

- 24/6 Operation
  - ~1.2 MWhe/day + 12 MM Btu/day
  - Greater control of gasifier
  - Automatic char & ash extraction
  - Continuous dry filtration
- Options:
  - Combined Heat and Power
  - Thermal
- Being upgraded to 75 kW

CPC's New Thermal System

- Combusts gas directly in burner
- Dual fuel – producer gas and propane
- No need for heat exchanger or filter



300,000 Btu/hr Burner
(Same gasifier as for BM 25)

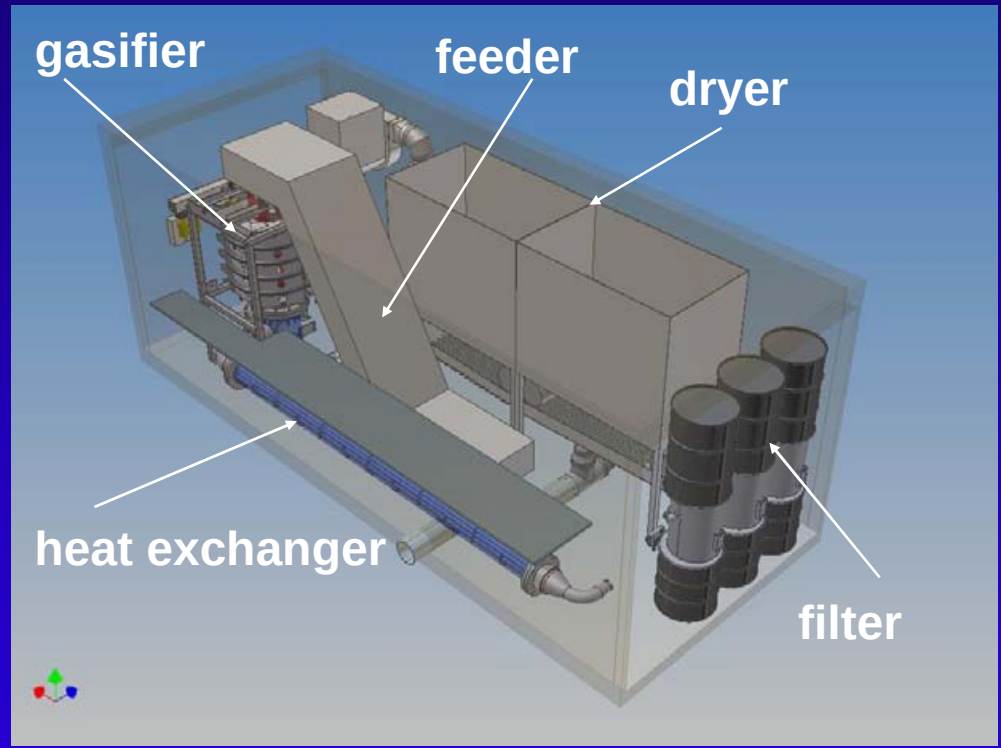
First Thermal Application: Lumber Drying

- 3,500 board foot capacity
- Primarily softwood
- Shakedown testing underway
- Host selection process ongoing

Dry Kiln

Containerized BioMax Systems

- 8’ x 20’ x 8’ Container
  - Contains dryer, feeder, gasifier, heat exchanger, and filter.
  - Gen-set external



Containerized BM 25

BioMax Development Partners

NREL (DOE)

Shell Renewables & Foundation

California Energy Commission

US FOREST SERVICE

Xcel Energy

The World Bank Group

Development & Demonstration Sites

Location and Size (kW)

- Hoopa - 15
- Zuni, NM - 15
- Ruidoso, NM - 15
- Walden, CO - 15
- Starkville, Ms -15
- Philippines - 15
- San Bernadino, CA –15
- Madison, WI – 5
- Grand Forks, ND -15
- Truckee, CA – 15
- Natick, MA – 25
- Purdue - 25
- Mt. Shasta, CA –25
- El Salvador – 2 x 50
- TBD - 50
- Big Bear Lake, CA - 50
- Mt. Wachusett, MA – 50

Completed Installed In-process

Frequently Asked Questions

- How much biomass is required?
  - ~2 lb will yield 1 kWhe + 2 kWht
  - 50 dry lb/hr for 25 kW BioMax
- What kind of biomass is best?
  - Woodchips (most experience to date)
  - Nut shells (easy to feed, minimal pre-processing requirement)
  - Pellets (easy to feed, no pre-processing required)
- Does system need full-time operator?
  - No
  - Part-time attendant duties:
    - Start and stop system
    - Replenish biomass
    - Inspect/maintain
    - Respond to alarms

Frequently Asked Questions

- What kind of maintenance is required?
  - Same as for any engine (filter change, oil change)
  - Clean out ash hopper once a week
  - Inspect gasifier internals once per month, remove tramp materials
- What is the footprint of the system?
  - System hardware (25 kW) – 300 sq ft max
  - Biomass storage area determined by user
- How can I use the electricity?
  - Can tie to the grid, sell excess
  - Provide transfer switch, meet on-site loads

Frequently Asked Questions

- How can I use the heat?
  - Can heat water and circulate it in hot water system, or
  - Can heat air and use it for space heating (or drying)

- Does the BioMax Consume Water?
  - No

- What does the BioMax emit as waste?
  - Dry ash with some carbon in it – non hazardous
  - Ash depends on the biomass, but wood is 1% ash
  - 100 lbs of biomass = 1 lb of ash

Frequently Asked Questions

- What is life of BioMax?
  - Engine life same as commercial engines
  - Heat exchanger and filter – 20 years
  - Gasifier shell – 20 years
  - Gasifier internals – undetermined, but easily serviceable
- How much does a BioMax cost?
  - Typical current price between $4,500 and $7,000/kW
  - Will decrease with volume
  - Depends on a host of factors best determined by a site visit
- Is it economic at this cost?
  - Yes, see following case studies

Case Study 1: Combined Heat and Power

	Financial Return	
• Assumptions	Low	Hi
• Capacity (kW)	62	62
• Electricity (cents/kWh)	8	12
• Gas Heat ($/MM Btu)	10	14
• Biomass – ($/ton)	30	0
• Conversion rate (lb/kWhe)	2	1.8
• O&M Cost – (cents/kWh)	3	2
• Capacity Factor – (%)	65	75
• Capital Cost ($/kW)	4,500	3,500

Case Study 1: Combined Heat and Power

	Internal Rate of Return	
• Results	Low	Hi
	0%	40%

	Financial Return	
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• Conversion rate (lb/kWhe)	2	1.8
• O&M Cost – (cents/kWh)	3	2
• Capacity Factor – (%)	65	75
• Capital Cost ($/kW)	4,500	3,500

Case Study 2: BioMax Vs PV

Assumptions	BioMax	PV
Annual energy (kWhe/yr)	358,000	358,000
Capacity Factor – (%)	65	20
Capacity (kW)	62	200
Electricity (cents/kWh)	11	11
Gas Heat ($/MM Btu)	10	0
Fuel costs – ($/ton)	30	0
O&M Cost – (cents/kWh)	3	1
Capital Cost Now ($/kW)	4,500	7,250
Incentives	0	0

Case Study 2: BioMax Vs PV

Net Present Value*

- Factor
  - Capital Cost
  - Electricity savings
  - Heat savings
  - O&M cost

BioMax	PV	Delta
283k	1,450k	1,167k
261k	261k	0
162k	0	162k
172k	24k	-138k
	Net NPV Savings	1,191k

*10 yr life, 10% discount rate

Summary: Best Economics for BioMax

- Displace energy having high retail price
  - Electricity
  - Natural gas
  - Propane
- Competitive against other renewables
  - Capital cost advantage
  - Capacity factor advantage
  - Dispatchable
- Use low cost local Forest or Ag residues
  - At a natural collection point for biomass (e. g. - enterprise)
  - Avoid high disposal costs
- Use both power **and** heat
  - Year round thermal load

Community Power Corporation

www.gocpc.com

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