

# Renewable Energy Benefits from Biomass for a College Campus

The University of Minnesota  
Morris as a case study.

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College of Food, Agricultural  
and Natural Resource Sciences

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# Typical College Heating Needs

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- Often central heating plant provides:
  - Steam for heating building space (radiators)
  - Hot water (via heat exchangers)
- Capable of rapid changes in load
- Dependable in northern climates
- Low cost and minimum labor for operation



# Benefits of Using Biomass Heat

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- Potential to reduce costs
- Environmental aspects
  - Good stewardship
    - Greenhouse gas emissions
    - Fossil carbon emissions
  - Marketability (potential students do care)
- Use of local products
  - Community development
  - Local employment



# University of Minnesota, Morris

## West Central Research and Outreach Center



- 1900 Students
  - 900 on campus
- 1 Million Sq. Ft.
  - Roughly 25 buildings
- Natural Gas Heat
  - \$900,000 /yr
- Rural Campus

# University of Minnesota, Morris

West Central Research and Outreach Center



- Biomass facility part of larger project
  - Wind (2 Turbines)
  - Solar (PV and Thermal)
  - Conservation measures
- Goal:  
Net-energy neutral





# Biomass Project

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- Factors that led to considering the project
  - High heating costs
  - Local ag resource (corn stalks & prairie grass)
  - Environmental concerns
  - Research and outreach potential
- Project discussions began in 2004
  - Last planning details arranged in 2007
  - Facility ‘built’ in 2008
  - Began operation in 2011







# Morris Gasification Facility

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- Built with the goal of using local biomass
- Primarily for steam heat (and hot water)
  - 2010 added absorption chiller for chilled water
  - 2010 added 320 kW steam turbine
- Gasification
  - Fuel flexibility
  - Fuels with high silica and/or other minerals



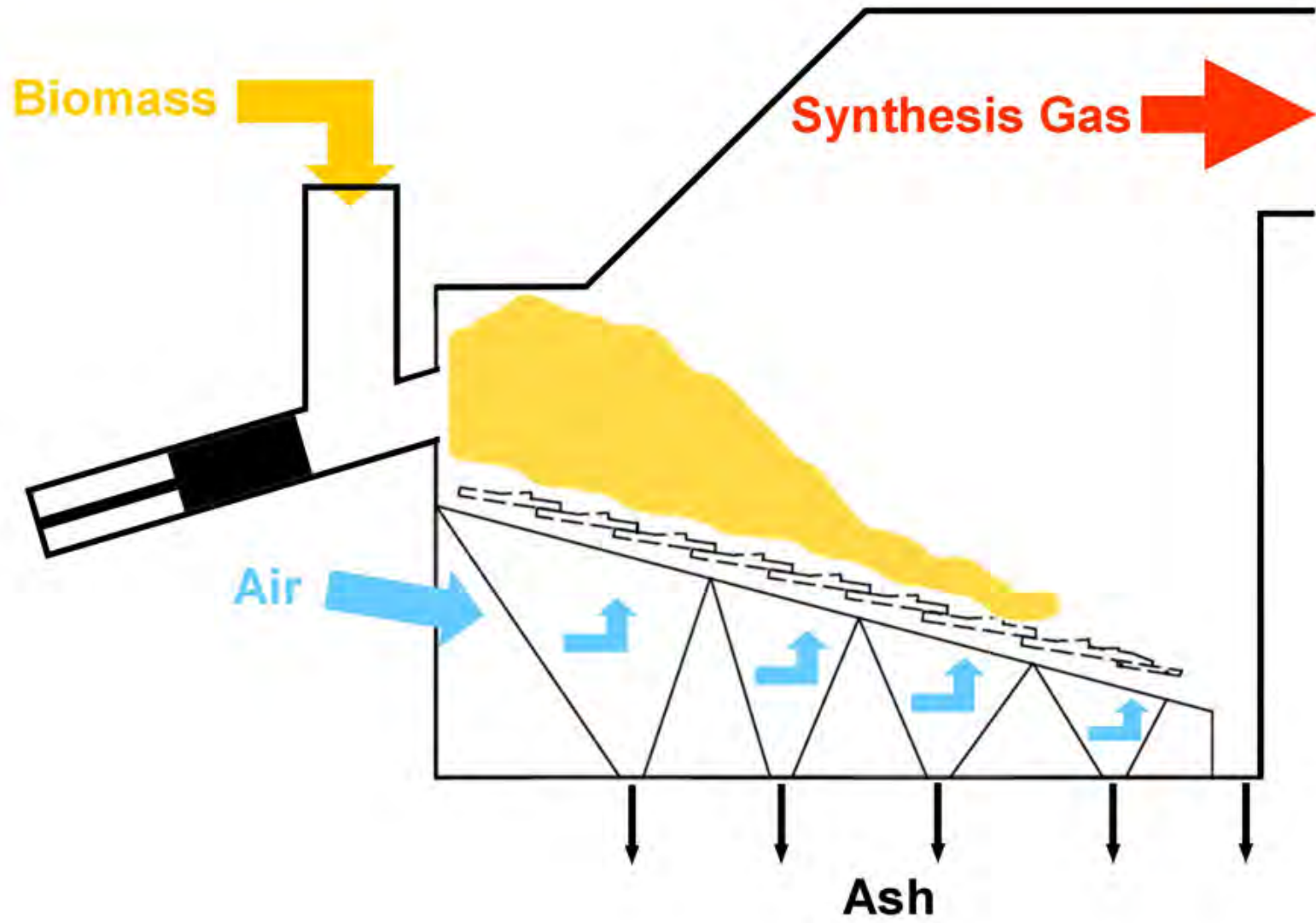


# Gasification vs. Combustion

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- Combustion is a commonly used technology
  - Works well with clean fuel
  - Used extensively in several industries
  - Least expensive biomass-to-heat technology
- Gasification is a specialized process
  - More expensive
  - More complex
  - Used for specialized applications
    - Produces a gas as the first product
    - Difficult fuels (Such as AGRICULTURAL BIOMASS)





# Results: Facility and Equipment

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- Manufacturer was overly optimistic in the specifications and performance
  - Biomass jammed easily in infeed equipment
  - Not able to use low-density biomass
    - Chemical reactions happened too fast
    - Could not feed material in fast enough
  - Densified material also had issues
    - Chemical reactions didn't penetrate densified material
    - High alkaline ag residues 'slagged' in the gasifier



# Results: Operations

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- Have begun regular operations
  - Supplied a significant portion of winter's heating
  - System has been used for summer cooling load
    - 600 Ton absorption chilling unit
  - Corn Cobs (winter fuel of choice)
  - Wood (summer fuel of choice)
- Still mechanical/equipment issues
  - Working on modifications to improve operations
  - Hope to improve efficiency and reduce downtime



# Results: Economics

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- Construction costs higher than natural gas or wood combustion systems.
  - Facility has unique research equipment
  - University building code increased cost
- Facility maintenance is more expensive.
  - Hard to predict in the long term





# Results: Economics II

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- Biomass costs currently similar to NG
  - Current contract is for corn cobs at \$85/ton
  - At 14 MMBtu/ton equal to \$6.00 MMBtu
  - Natural gas delivered is around \$4-5/MMBtu
- Local biomass contract
  - Contracted for 6,000 tons
  - Approximately \$550,000 dollars spent locally
- Local employment
  - 2-3 full time equivalents employed by suppliers





# Results: Research and Outreach

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- Initial Research
  - Multiple biomass types
  - Several processing methods
  - Work on refining gasification conditions
  - Several agricultural projects
- Outreach and Education
  - Tours: policy makers, industry, schools
  - Short courses/capstone classes
  - Classes



# Overall Results to Date

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- Technology risk in gasification
  - Not yet ready for low density ag biomass
  - More chance of mechanical issues
- Hard to compete with cheap natural gas
  - Added labor and logistics adds expense to biomass
- Long term outlook is good
  - Mechanical issues are being addressed
  - Natural gas and heating oil prices will likely increase



# When Biomass Makes Sense

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- District Heating (one central steam plant)
- Near a biomass resource
- Campus location that is tolerant of biomass transport and logistics
- Facility staff willing to learn about biomass logistics and accept added maintenance



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West Central Research and Outreach Center

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