Small-scale Wood Biomass Gasification

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www.trmiles.com
http://gasifiers.bioenergylists.org

Alaska Wood Energy Conference
November 14-15
Fairbanks, Alaska

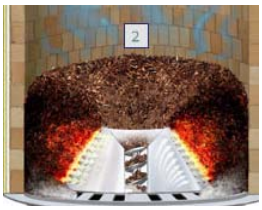
Gasification CHP Systems

- Origins: engines in WWII
- Adapted to Stationary Power in 1970's
- Publically funded demonstration projects- many attempts, few successes
- Research Development and Demonstration Programs Stimulate New Interest: Small Modular Biopower Program
  - US Department of Energy
  - US Forest Service

BIOMAX15

What is Gasification?

- Conversion of solid (biomass) to a combustible gas
- Add air/oxygen to
  - burn part of fuel to provide heat to
  - pyrolyze wood to gas and charcoal
  - gasify charcoal.
- Make smoke
- Burn up the smoke in an engine



Small Commercial Wood Gasifiers

- **Community/Industry**
  - Energy Product of Idaho, US 6 MWe
  - Nexterra, Canada 500 kWe-10 MWe
  - Condens Oy Finland, 1- 3 MWe,
- **Sawmill Industry/Small Community**
  - Biomass Engineering Ltd., UK 250 kWe
  - Ankur Scientific, India 4 kWe-425 kWe
  - Aruna, India 10-100 kWe
  - Fluidyne, NZ, 10 -35, 100, 500 kWe
  - Ngen Eco5 5 kW wood pellet gasifier

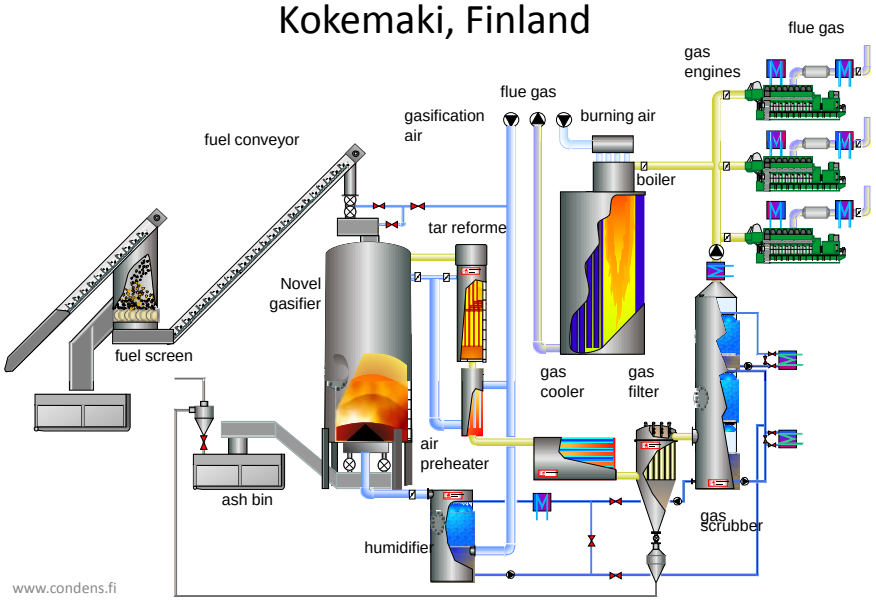
Nexterra, Canada

Nexterra Gasifiers and Boiler at Hefley Plywood, Tolko, BC

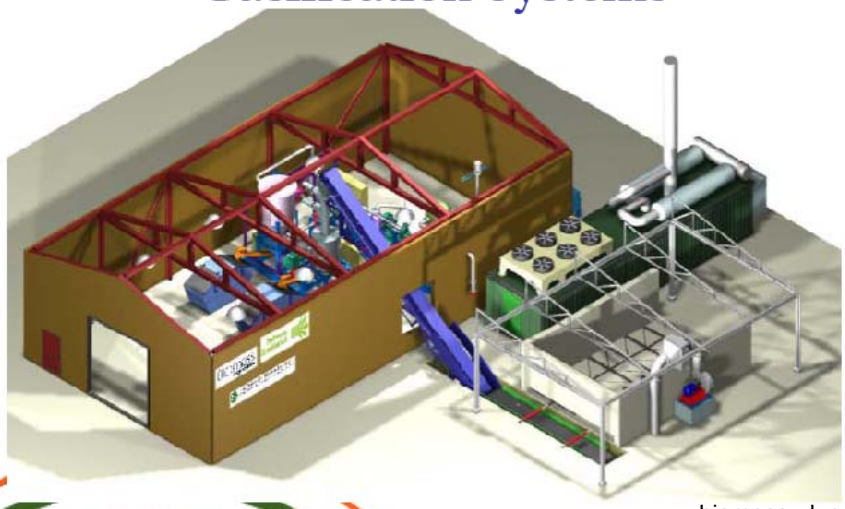
1. Wood Fuel Bin
2. Gasification Hearth
3. Ash removal
4. Gas exit

Condens Oy Novel Power Plant

Kokemaki, Finland



Biomass Engineering Ltd
Gasification Systems



www.biomass-uk.com

Biomass Engineering

Jim Campion, Managing Director

Module design

- 250kwe gasifier and filter module leaving the factory
- Module design enables flexible site layout and ease of installation for multi unit sites
- Units cold tested at the factory

Biomass Engineering

Wildshausen, Fuel delivery (operational)

Supplied with Laimet chipper.
www.laimet.net/eng/chippers.html

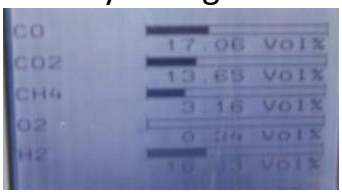
Biomass Engineering

ANKUR SCIENTIFIC ENERGY TECHNOLOGIES, PTY LTD.
200 KWe GASIFIER WITH GAS FILTERS, FLARE AND COOLER.

Energy and Environmental Research Center, University North Dakota
www.undeerc.org/centersofexcellence/biomass

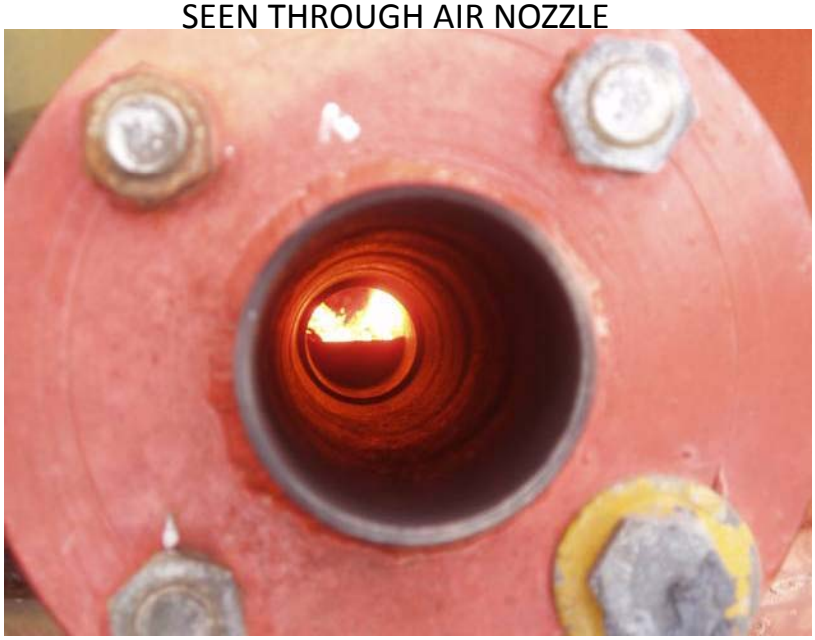
EERC Gasification Development and Demonstration for BERC/USFS/Mt. Wachusett Community College

- Operational Tests
- Environmental Tests



LIGHTING GASIFIER WITH TORCH

WOOD CUBES IN COMBUSTION ZONE OF GASIFIER AS SEEN THROUGH AIR NOZZLE



GAS IS COOLED AND CLEANED WITH A WET VENTURI SCRUBBER AND DRY FILTERS

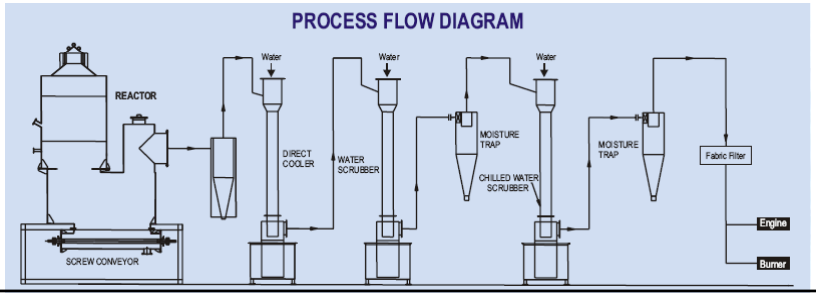
ANKUR SCIENTIFIC ENERGY TECHNOLOGIES LTD
www.ankurscientific.com

4 kW Ankur Gasifier in Rural Cambodia

ARUNA Electrical Works (P) Ltd. Tamilnadu, India

10-100 kWe www.arunabiomass.com

50% Cost Savings with subsidy



FLUIDYNE (NZ) Gasifiers

www.fluidynenz.250x.com

10 kW Pioneer Class

Wood Block Fuel

35 kW Pacific Class

100 kWe Atlantic Class
Innovation Technologies/Fluidyne
www.innovation-tech.co.uk

WOOD PELLET GASIFIERS 5 kWe

Ngen Eco5 5 kW Pellet Gasifier,
Colorado www.ngenpower.com

Fluidyne (NZ) Micro Class
Gasifier
Gas out 12 m3/h ~ 3-5 kWe
www.fluidynenz.250x.com

Eleca 10+ kWe pellet gasifier
France
www.eleceau.com

Community Power Corporation
Pre-commercial 5 kW for USFS
Small Modular Biopower Program

www.gocpc.com

Demonstration and Pre-commercial Gasifiers

- Pudhas Energy/Connecticut Clean Energy Fund
  - Tallon Lumber, CT 300 kWe
- Community Power Corporation
  - Mt. Wachusett Community College, MA 50 kWe
  - Shasta Opportunity Center, CA 25 kWe

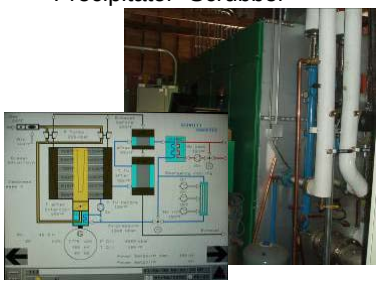
Tallon Lumber 300 kWe CHP

Chipper at Sawmill

Electrostatic Precipitator+Scrubber

Dryer and Fuel Bin

Pudhas Energy Gasifier



Schmitt Enertec 300 kWe CHP+kilns

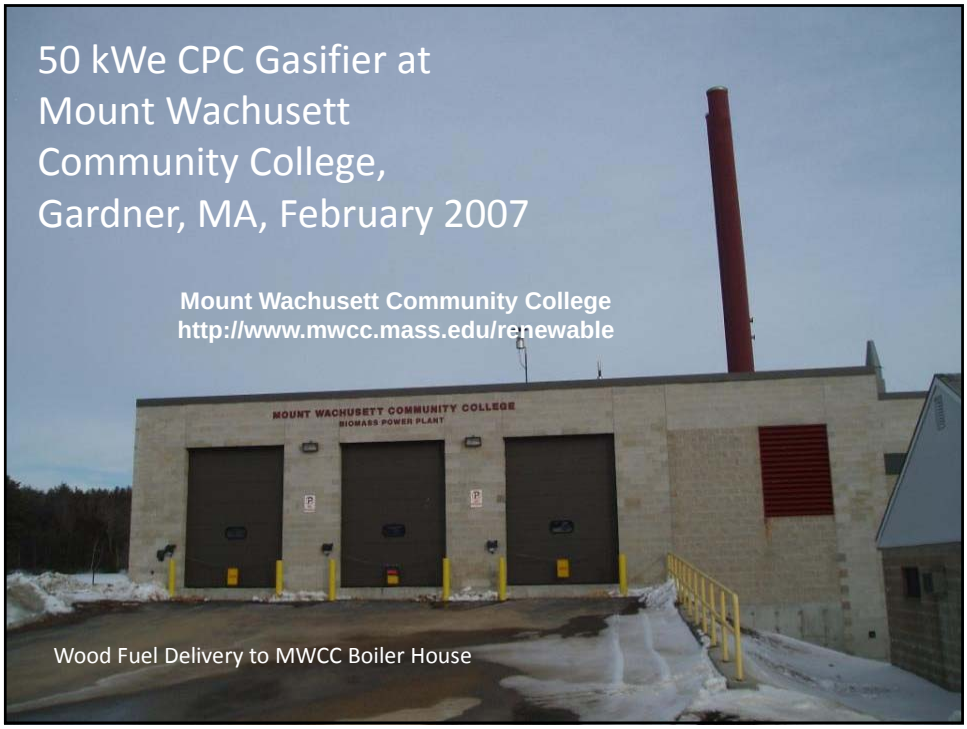
www.puhdasenergia.com

Auxiliary Systems and Equipment
Fuel Dryer
Diesel tank
Radiator
Hot Water System and Kiln
Transformer, Switchgear
Building, Services

Community Power Corporation
50 kWe Gasifier-Generator

Baghouse-Gasifier-Chip Screen-Dryer

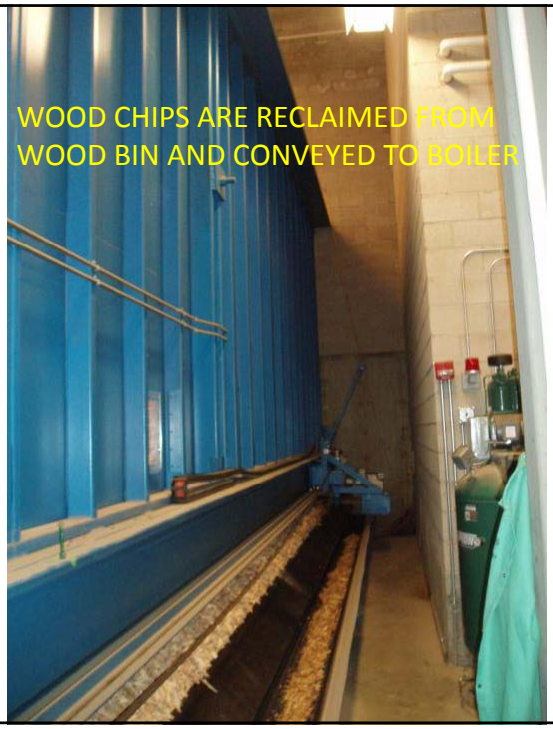
Engine-Generator


50 kWe CPC Gasifier at
Mount Wachusett
Community College,
Gardner, MA, February 2007
Mount Wachusett Community College
http://www.mwcc.mass.edu/renewable
MOUNT WACHUSETT COMMUNITY COLLEGE
BIOMASS POWER PLANT
Wood Fuel Delivery to MWCC Boiler House


50 kW Engine-Generator
Gas to Flare - Gas Inlet - Exhaust

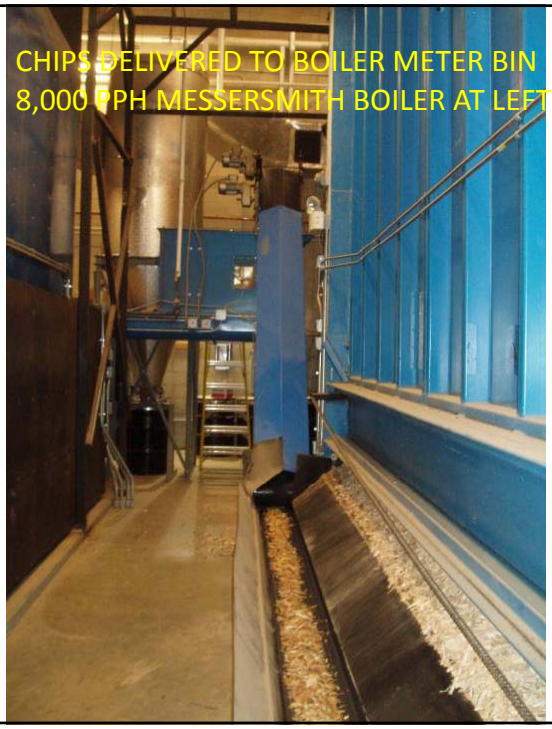

Piloted Flare for Gasifier


FACILITIES DIRECTOR ROB RIZZO AT 50 kW
ENGINE-GENERATOR OUTSIDE BOILER HOUSE


WOOD CHIPS ARE RECLAIMED FROM
WOOD BIN AND CONVEYED TO BOILER


MESSERSMITH CHIP RECLAIMER

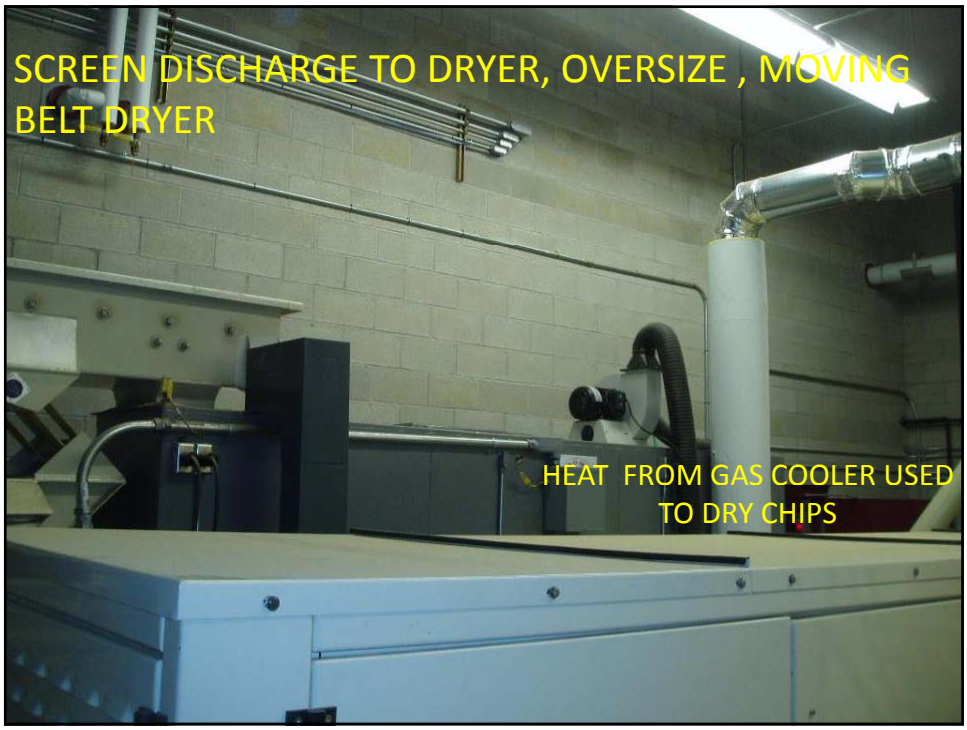

FUEL CHIPS FROM COMMERCIAL SUPPLIER


CHIPS DELIVERED TO BOILER METER BIN
8,000 PPH MESSERSMITH BOILER AT LEFT


BOILER METER BIN WITH AUGER TO
DELIVER CHIPS TO GASIFIER


CHIPS AUGERED THROUGH WALL
TO GASIFIER CHIP SCREEN


CHIPS DISCHARGE TO VIBRATING SCREEN
ACCEPTS DISCHARGED TO MOVING BELT DRYER

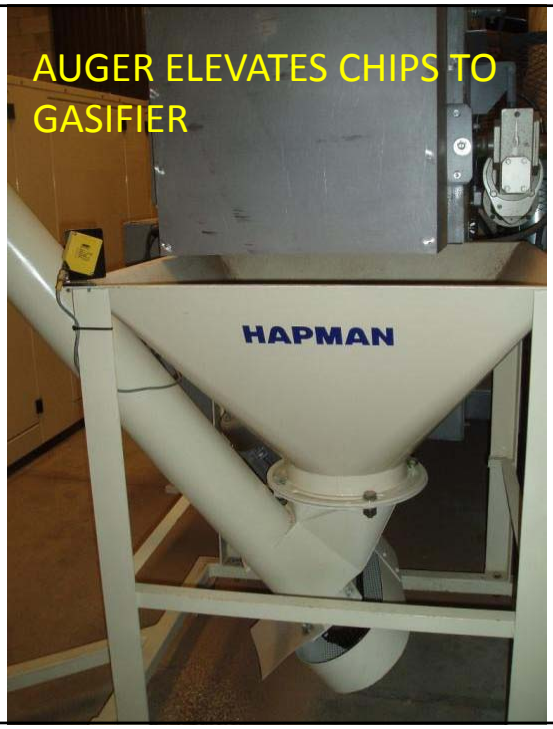

SCREEN DISCHARGE TO DRYER, OVERSIZE , MOVING BELT DRYER
HEAT FROM GAS COOLER USED TO DRY CHIPS

OVERSIZED CHIPS REMOVED BY SCREEN

MOVING BELT DRYER

DISCHARGE FROM DRYER TO HOPPER

AUGER ELEVATES CHIPS TO GASIFIER




CHIPS DROP INTO GASIFIER
HOOD EXHAUSTS TOXIC GAS FROM GASIFIER THOUGH POWERED ROOF VENT


SOLID WOOD CHIPS CONVERT TO GAS AS THEY FLOW DOWN THROUGH VERTICAL REACTOR AT RIGHT
HOT GAS EXITS TO BOTTOM LEFT COOLED IN HEAT EXCHANGER
ASH DISCHARGED AT BOTTOM RIGHT


GAS COOLER – GASIFIER – GAS FILTER


POWERED VENT THROUGH ROOF
ABOVE GASIFIER

MOTOR CONTROLS (ABOVE)
HOT GAS COOLER (BELOW)

HEAT FROM GAS COOLER PIPED TO CHIP DRYER


COOLED GAS CLEANED IN FILTER
TO ENGINE

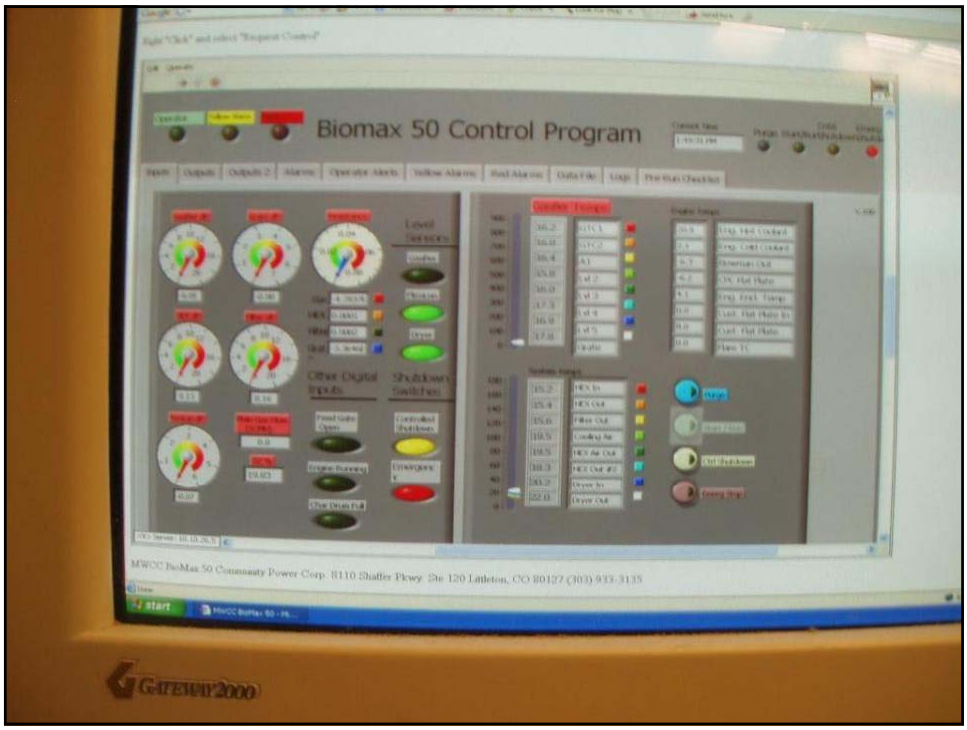

FABRIC FILTERS

CHAR FROM FILTER REMOVED TO DRUM FOR DISPOSAL

ENGINE EXHAUST AND ENGINE JACKET COOLING WATER HEAT CAMPUS WATER

WATER BY WASTE HEAT FROM ENGINE JOINS CAMPUS HEATING LOOP FROM WOOD BOILER

FIRE SUPPRESSION SYSTEM AND BIOMAX50 CONTROL COMPUTER




CPC Biomax 25
Siskiyou Opportunity Center, Mt. Shasta, CA
March 31, 2007
Fuel: Peeler Cores from veneer plant


Bandit Model 95 chipper


Screened fuel


bobcat
Gasifier Building with Extension

Dryer, Gasifier, 25 kWe Genset


Fuel Dryer Open Vent to Building

Heat inlet, vibratory screen outlet

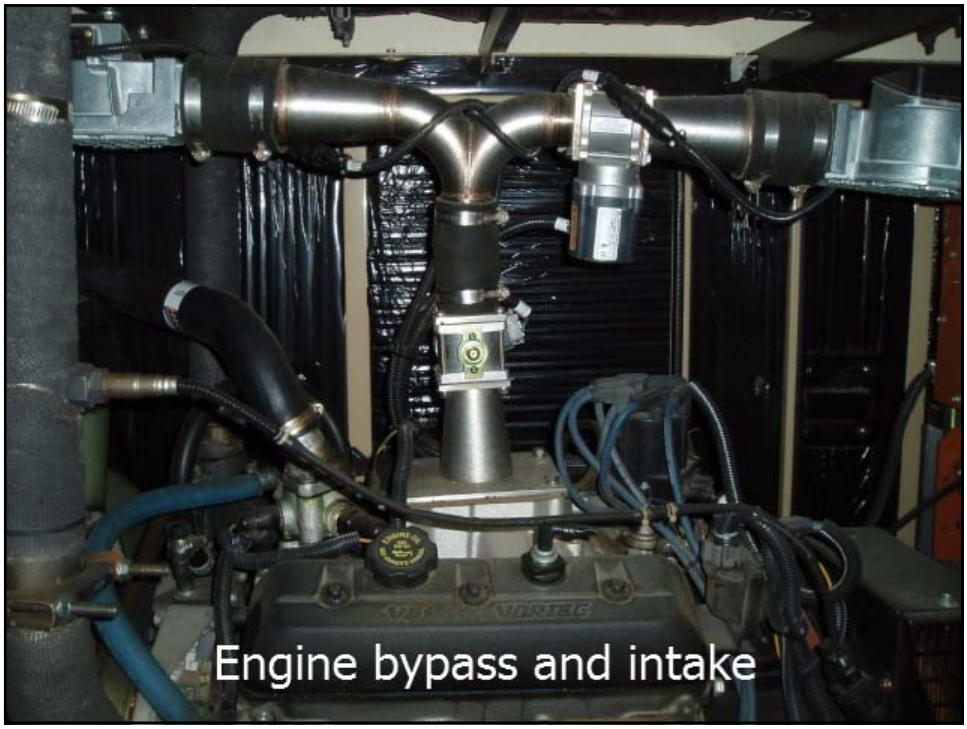
Chip screen and gasifier feed auger


Gasifier Feed Auger

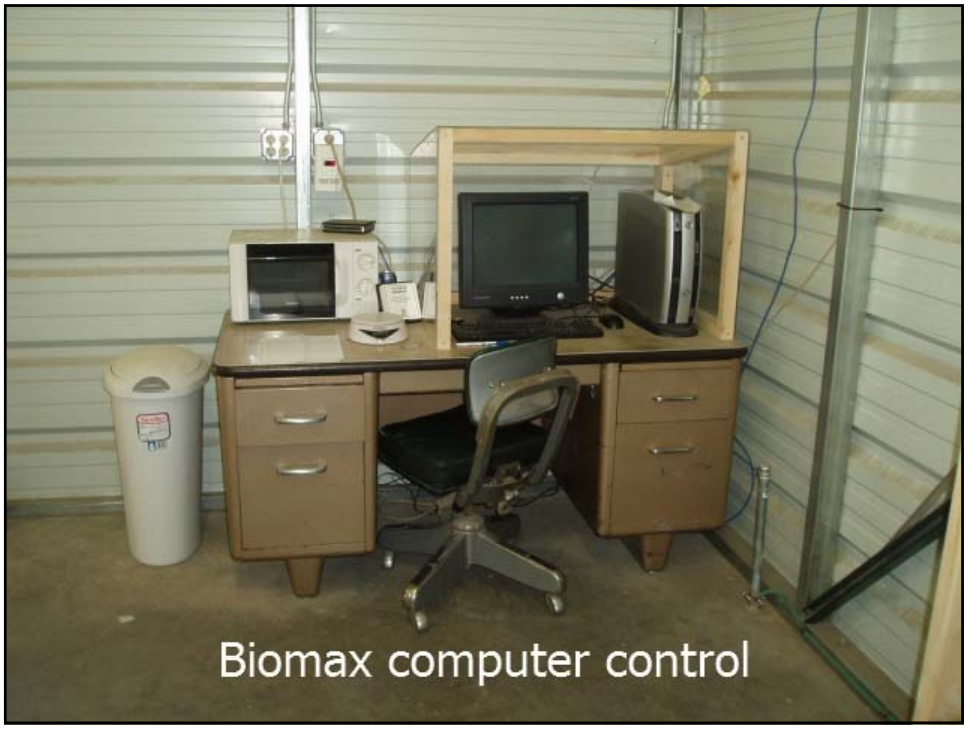

Gasifier, heat exchanger and filter enclosure


CPC 25 kWe gasifier


CPC Gas filter


Engine bypass and intake


Engine exhaust and gas flare



Is Gasification Suitable for Rural Alaska?

1. Cost (if you have to ask, you can't afford one)
2. Operation and Maintenance
3. Repair
4. Cold climate
5. Remote area
6. Potential savings?

Challenges for Small Scale Wood Gasifiers

- High Cost $5,000-$10,000/kW
  - 50 kW $500,000-$1,000,000
  - 300 kW $1.5-$2 million
- Fuel Size
  - Chunks, dense fuel
- Similar in efficiency to small scale steam engine: 3 lb dry wood/kWh
- Better efficiency than Organic Rankine Cycle at 6 lb dry wood /kwh.
- High Labor Cost
- Automation needed
- Must Demonstrate Reliability for 5,000 hrs/year

Short Term Prospects

- Gasification for Development, Demonstration or Education – Research Centers, Sites with Suitable Support
- Direct heat substitution for high cost liquid and gaseous fuels.
- Use with other energy conversion – Stirling engines and ORC.

Acknowledgements

- Fluidyne Ltd. www.fluidynenz.250x.com
  - Doug Williams
- Biomass Energy Foundation www.woodgas.com
  - Tom Reed
  - Agua Das
- IEA Task 33 Gasification of Biomass www.gastechnology.org/webroot/app/xn/xd.aspx?it=enweb&xd=iea/homepage.xml
- Gasification Discussion List Gasifiers.bioenergylists.org
- Renewable Energy Policy Project www.repp.org