Biomass Power Generation
Using UTC PureCycle Technology

Presented by: Gwen Holdmann
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United Technologies

- Fortune 500 Company
- Divisions include: Hamilton Sunstrand, Otis, Pratt & Whitney, Sikorsky, UTC Power, and Carrier
- 20th largest US Manufacturer
- 39th largest US Corporation
- 220,000 employees
- 42.7 billion in sales in 2005
Carrier Chiller

Refrigeration Cycle
First working 200kW ORC Unit

The PureCycle© 200
ORC in Austin, Texas operating off landfill flare heat

1500 degree F Exhaust Gas
ORC in Danville, IL using exhaust heat from 3 Jenbacher engines

> 900 degree F Exhaust Gas
Chena Geothermal Power Plant

- 400kW net; installed in 2006
- Uses 500 gpm of 165°F water
- Air and water cooled
- Reduced local cost of power from 30¢ to 5¢
- Total project cost $2.2 million
- Thanks to AEA and Denali Commission
- Efficiency <10%
Chena Power Plant
Chena Power Plant
PureCycle w/ Water-Cooled System Configuration for Chena

Monument Creek Provides Cooling Water (~40F)

Geothermal Wells Provide Hot Water (~165F)
PureCycle using Biomass Heat Source

Air cooled condenser

Biomass (8000btu/lb)
Biomass Power Plant

- Proposed for Fairbanks North Star Borough Landfill
- 400kW gross, 300kW net output
- Fuel is 5000 tons of paper, cardboard and brush
- Designed for rural village application – thermal oil boiler, load following
- Increased efficiency over geothermal installation through addition of a topping cycle
Proposed Biomass Power Cycles

*Ketone topping cycle doubles efficiency to 20% and increases energy utilization to 80%*
Municipal Waste: Fairbanks

- Eielson Recycling Program to densify 1500 tons per year of waste paper and cardboard discontinued in 2006
- Fuel pellets co-fired with coal at Eielson
- Potentially 14,000+ tons available based on national averages – current no recycling of paper
- The FNSB is committed to implementing a more comprehensive recycling plan

Paper makes up ~ 50% of the waste stream in U.S.
Shred-Tech System

Photo of Shred-Tech STQ100 (photo of model at a different project location)
Live Floor to Feed Thermal Oil Heater

Right: Auger system automatically feeds boiler as heat is needed.
The Goal: Combined Heat and Power (CHP)
Short Rotation Woody Biomass Crops

- Successful biomass crop in Europe and in test plot at New York University
- Could be used in rural Alaska for heating and power generation
- Provides excellent moose and caribou habitat
- Already grows successfully in Alaska!!
Short Rotation Woody Biomass Crops

New York University 500 acre willow biomass test plot
Average Power Generation vs. Non-Firm Price

Source: Alaska Energy Authority
Design stand-alone biomass fueled power plant for Alaskan village applications

- 200kW Modular size
- Thermal oil substitutes for water (steam) to eliminate freezing problems with unplanned shutdown, eliminate need for makeup water and water treatment
- Couple with short-rotation woody biomass crop (willow)
- Unmanned grid independent operation with safe shutdown and remote monitoring
- Increase cycle efficiency to 20%