Feasibility for Wood Heat

Collaborative Integrated Wood Energy Program for Yukon Flats Villages

DOE Tribal Energy Program

20 November 2008

Council of Athabascan Tribal Governments (CATG)

- Non-Profit Consortium of Ten Tribal Governments within the Yukon Flats.
- CATG Administers several Tribal Programs on behalf of the Tribes.
- CATG also applies for and administers several other grants.
  - **IHS**, Regional Clinic (Fort Yukon), Health Aids in Each Village, drug and alcohol programs, and other health related programs.
  - **Natural Resources**, EPA/IGAP, ANA (Traditional Land use Planning and Mapping), GIS, USDA RC&D, Contracts/Compacts with the USF&W (first tribal entity in U.S.), and many other NR related projects.
  - **Education**, NACTEC, NAVTEP, Early Head Start, Facilitate/ Cooperate with UAF on other education programs.

Gwichyaa Zhee Gwich'in Tribal Government (GZGTG)

Federally recognized tribe 1200+ Tribal Members. Administers all 638 tribal programs and many other grants to include:

Natural Resources, Realty, ICWA, General Assistance, Education/ Employment, Elders Nutrition, Forestry, Fire Management, Self-Governance, Economic Development, Tribal Operations, EPA/IGAP and many other programs and grants.

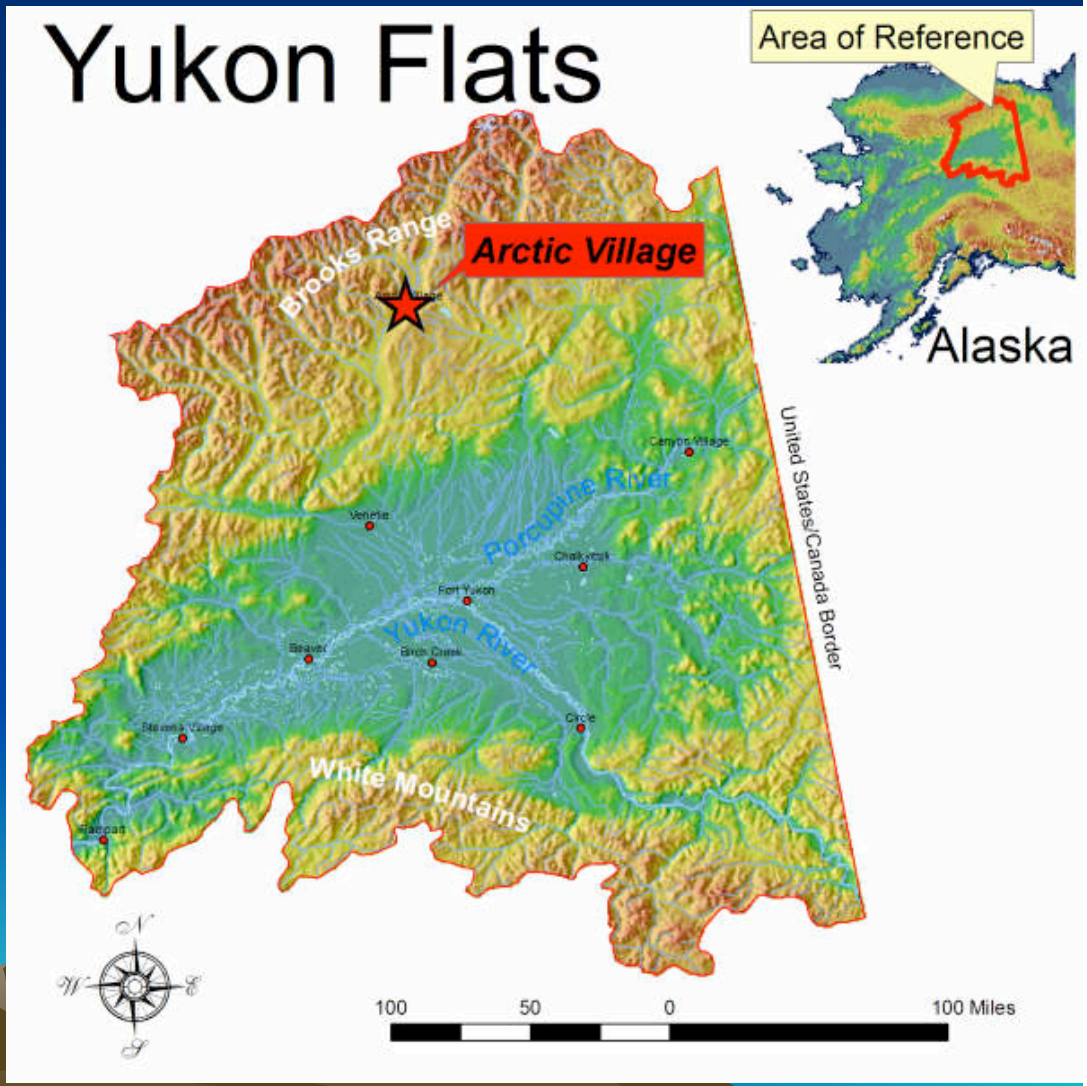
Gwitchyaa Zhee Corporation (G.Z. Corporation)

For-profit organization formed under the Alaska Native Claims Settlement Act (ANCSA) 1971. G.Z. is the village corporation, under ANCSA they also created 13 Regional Corporations, ours is Doyon Inc. G. Z. has 600+ shareholders, not all tribal members are shareholders, because the corporation hasn't voted to enroll children born after 1971.

Some of the economic projects the corporation has:

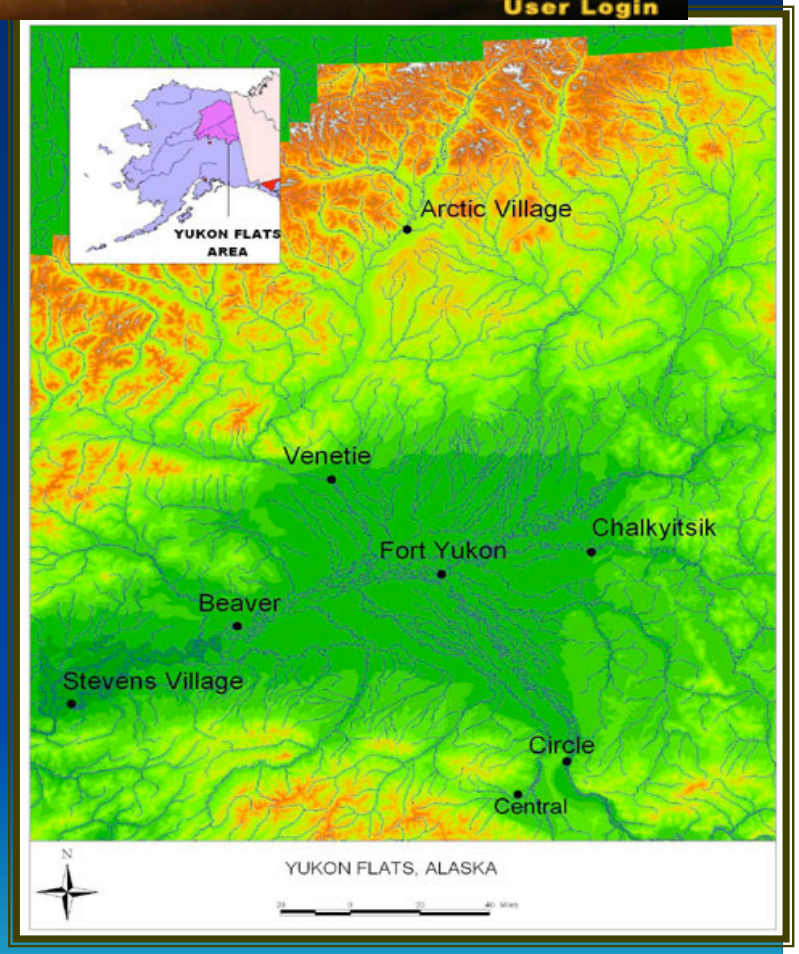
Fuel Station, rental buildings, land leases, 7i funds, mutual funds, gravel sales, timber sales, and hopefully Bio-mass.

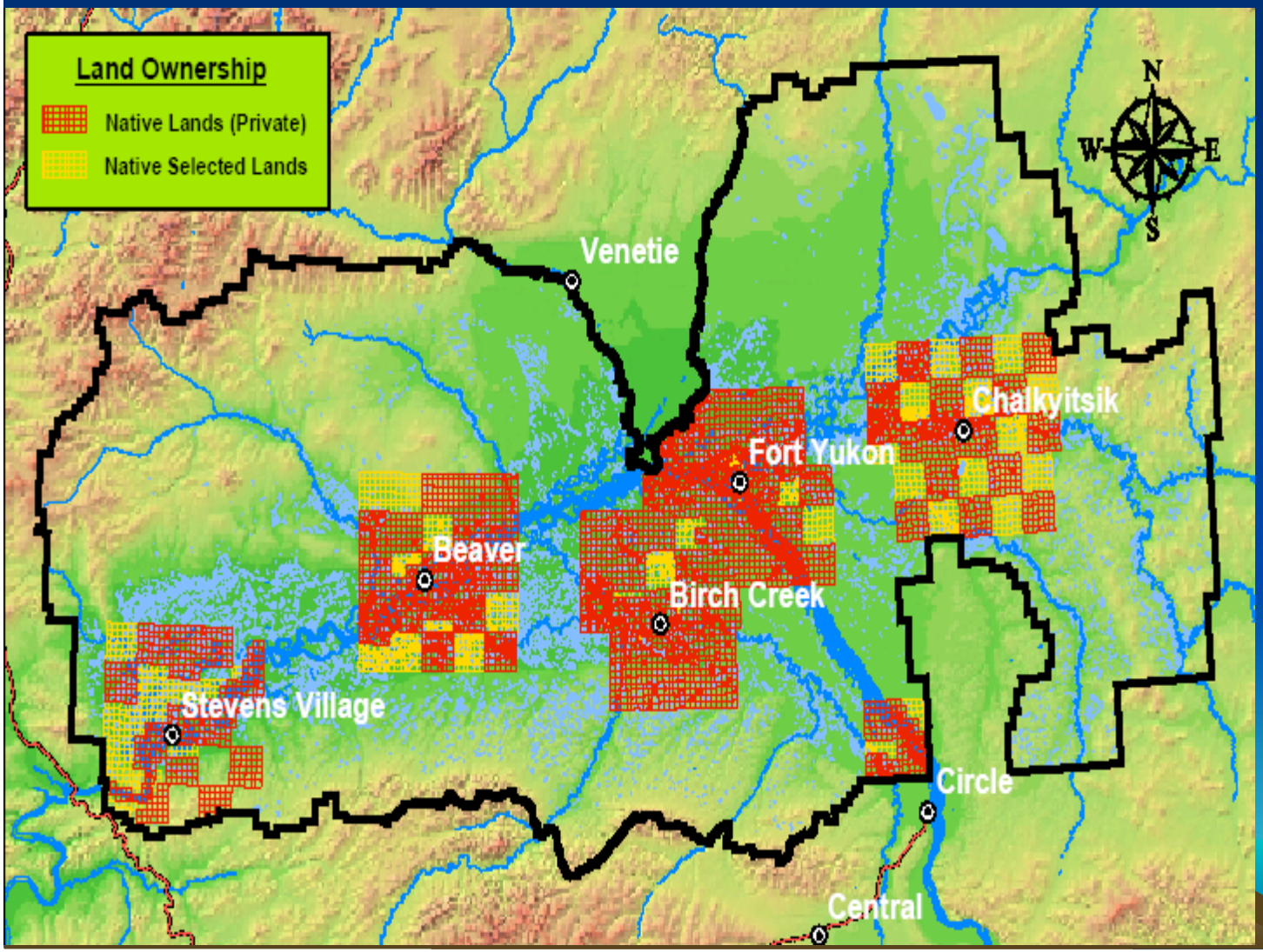
- 10 Athabascan villages in Yukon Flats
- 8 Gwich'in villages and 2 Koyukon villages.
- 55,000 sq. mi. Size of Wisconsin.
- 1500 people
- Fort Yukon largest Hub Village 650 people.
- Smallest Village Birch Creek 25 people.
- Fort Yukon and Circle are the only Villages with a City Government.
- There is no organized Borough in the Yukon Flats.
- Only one village on road system.



- All electricity is generated by diesel.
- 4 villages have to fly fuel in, no barge service.
- 2 villages cut their generators off at 10 pm and back on again at 8am. Venetie and Arctic Village.
- One Village has Pre-paid Meters. Chalkyitsik
- 80% of homes in Fort Yukon are heated by wood. Most use wood and fuel heat.
- All other villages heat by wood with a few that use fuel. All Village buildings are heated by fuel.
- Fort Yukon is only village that has piped water and is currently installing piped sewer.
- Chalkyitsik and beaver has some piped water and are developing septic tanks. All other villages have to haul own water and use honey buckets and outhouses. All Village Schools have running water and sewer.
- All villages have a washeteria where they get their water, shower, and wash clothes.

- Fuel cost in Fort Yukon $7.00 gal.
- Fuel Cost in Arctic Village $14.00 gal.
- Some of the alternative energy programs Fort Yukon has looked at:
- Wind, not Feasible only 7mph
- Hydro, not enough stream flow maybe as technology advances, pilot project in eagle.
- Solar, we have two projects one in Fort Yukon on a Elders building and one in Arctic Village on their water treatment plant. Between May and August we have 24 hours of daylight, so we need to look at more solar projects.
- No geothermal, Stevens Village has a Hot Springs but too far away.
- Coal Bed Methane, not giving off enough methane.
- Oil/Natural Gas, Alpine Size Oil Field and 83,000,000 cu.ft. Natural Gas, but Villages/ Residents are opposed to drilling.





- Fort Yukon Received 226,000 acres Under ANCSA.
- Checker boarded with lands owned by Doyon Regional Corporation.
- Venetie/Arctic Village didn't participate in ANCSA and they claimed 1.9M acres which they thought was a reservation, but own land in fee.
- Within the Yukon Flats National Wildlife Refuge.
- Adjacent to Arctic National Wildlife Refuge.

Subsistence Life Styles

Subsistence Resources:

Moose, Caribou, Dall Sheep, Black Bear, Brown Bear, Wolves, Beaver, Muskrat, Otter, Fox, Salmon (Chinook, Coho, summer and fall Chum), White Fish, Sheefish, Pike, lake trout, grayling, Grouse, Spruce Hen, Waterfowl from 5 different countries, blueberries, raspberries, rosehips, wild onions, rhubarb, and many other natural resources that we utilize and depend on

Bio-Mass is not a new concept to the Yukon Flats. We Currently Utilize wood for Heating our Homes and back in the Steamboat Days we sold cordwood to power the steamboats.

People meeting a steamboat

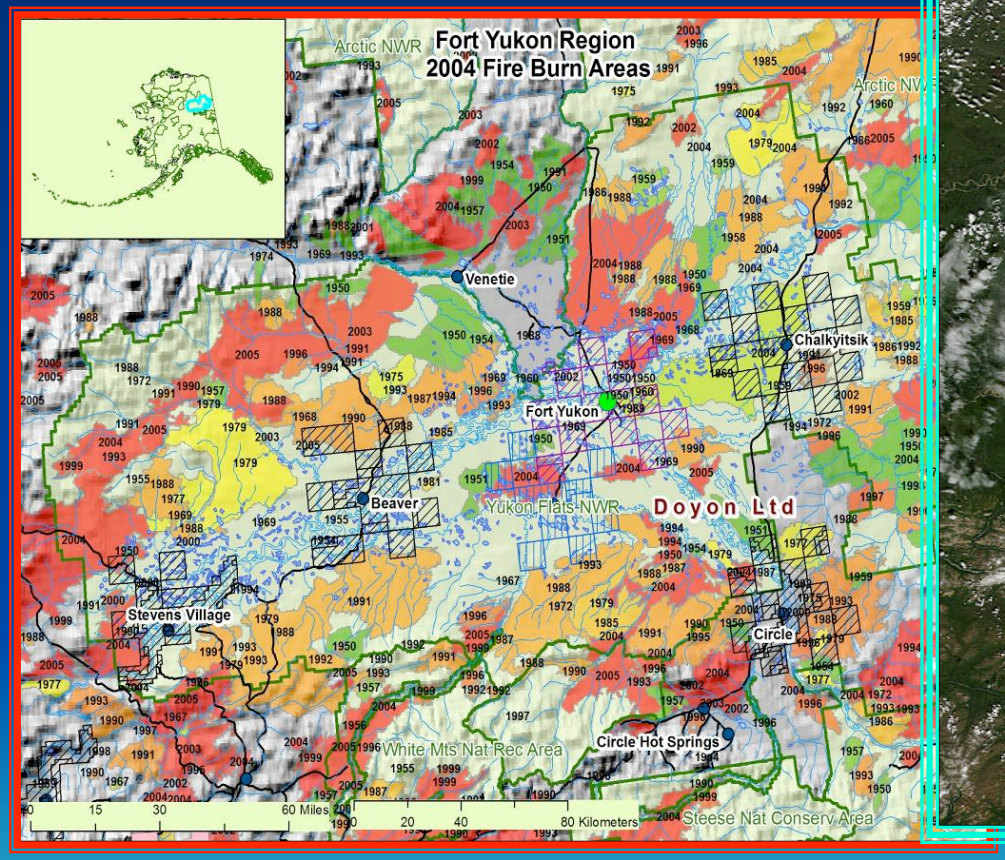
Old & New Housing

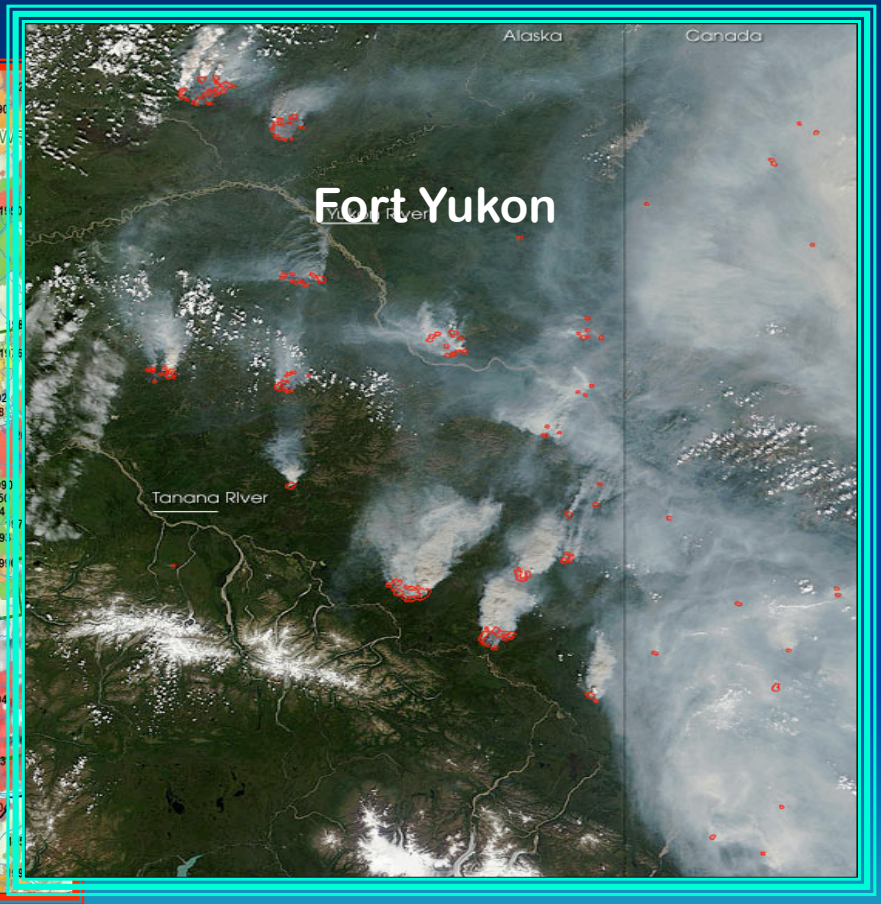
More info on Yukon Flats:

www.catg.org

www.fortyukon.org

Fire Driven Ecosystem
12MM acres statewide in 2004-2005





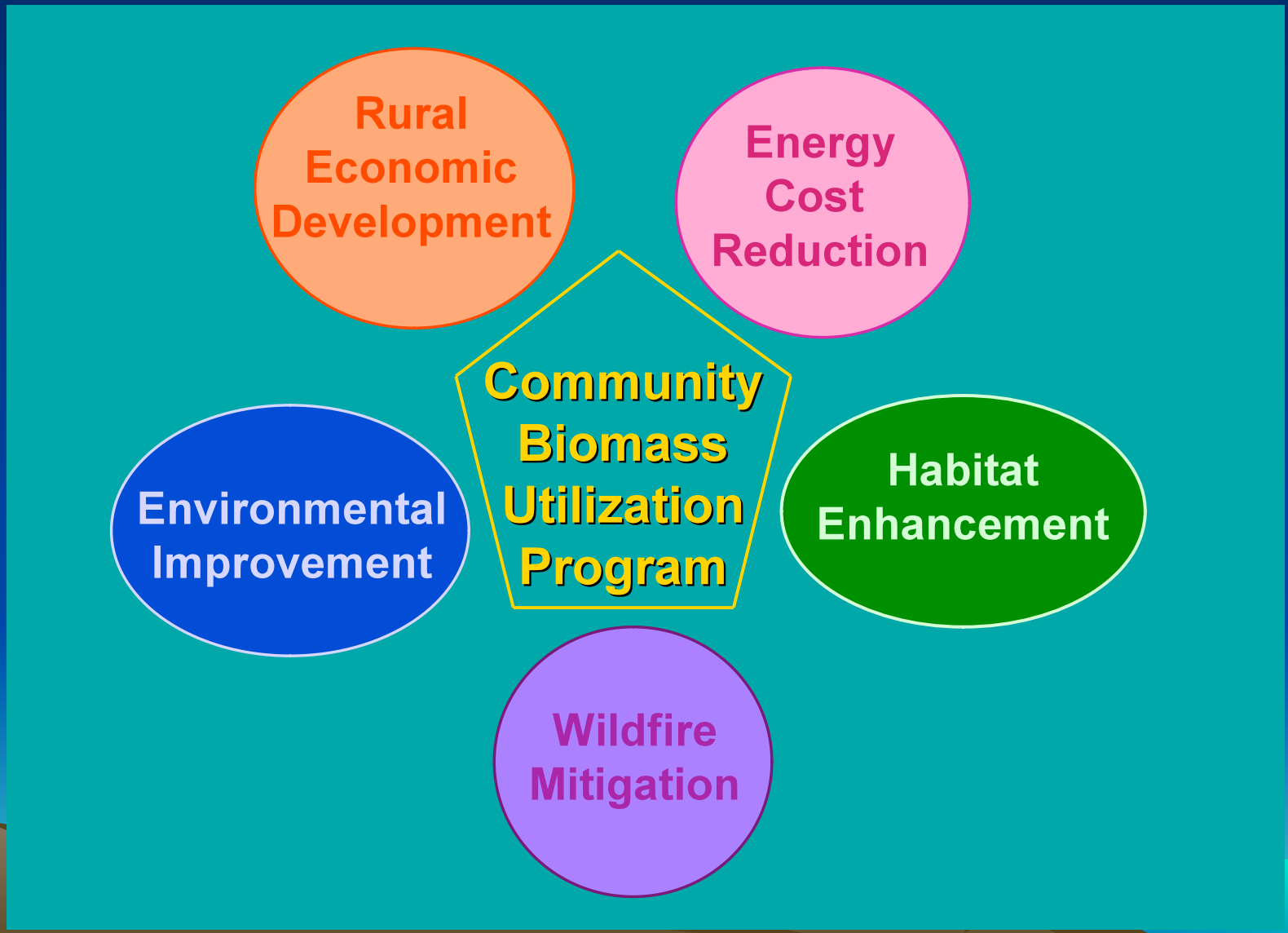
Fires 1950-2004 **Fires in 2004**

Typical Example of Seral Stages of Black Spruce Forest in Interior Alaska

Displacement of Fuel Oil, Local Economic Develop, Energy Self-Sufficiency & Sustainability

Summer 2005 Porcupine Burn 79,762-acre

Community Wood Energy Program

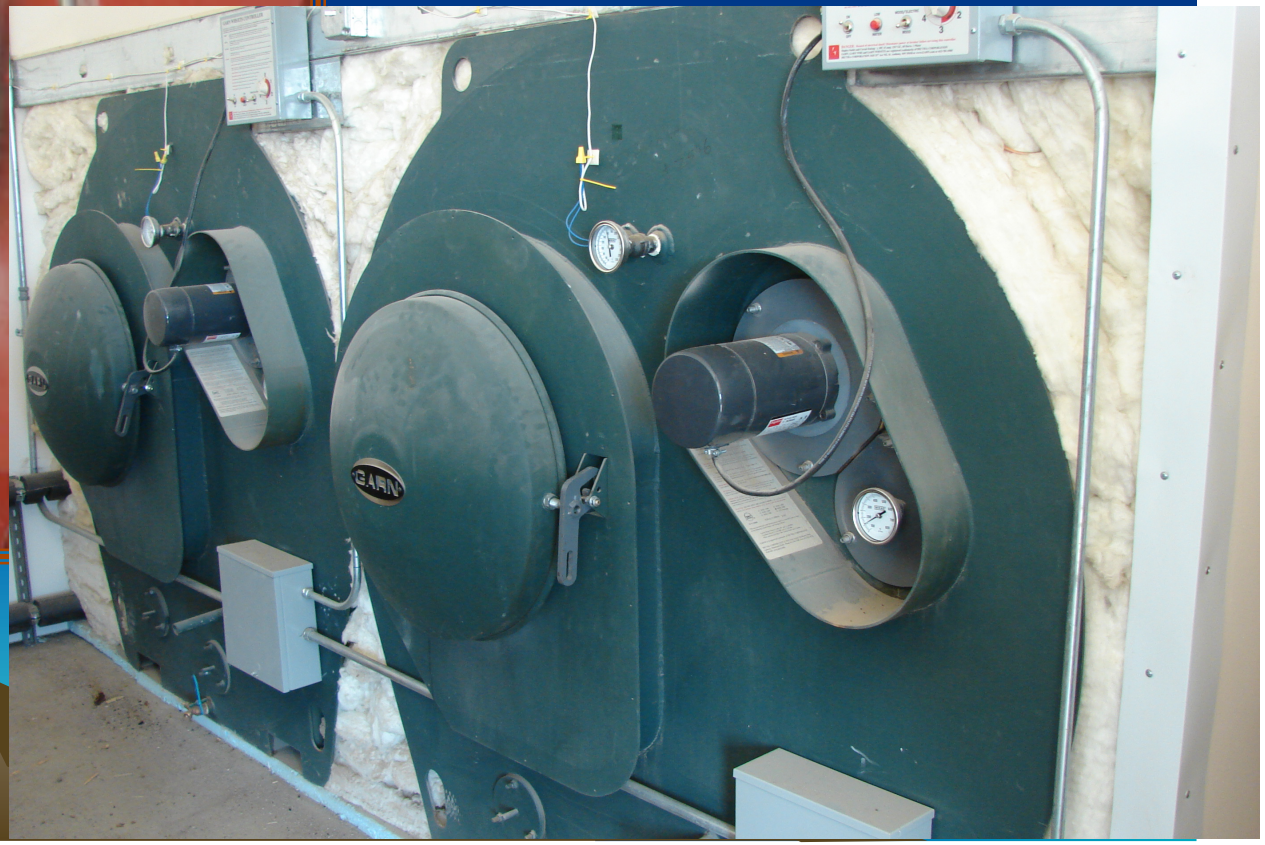


Wood Energy Program
Scales of Penetration

- **Village scale – create a wood energy utility**
- **Commercial buildings – economic driver**
- **Households – secure relatively inexpensive consistent supply**

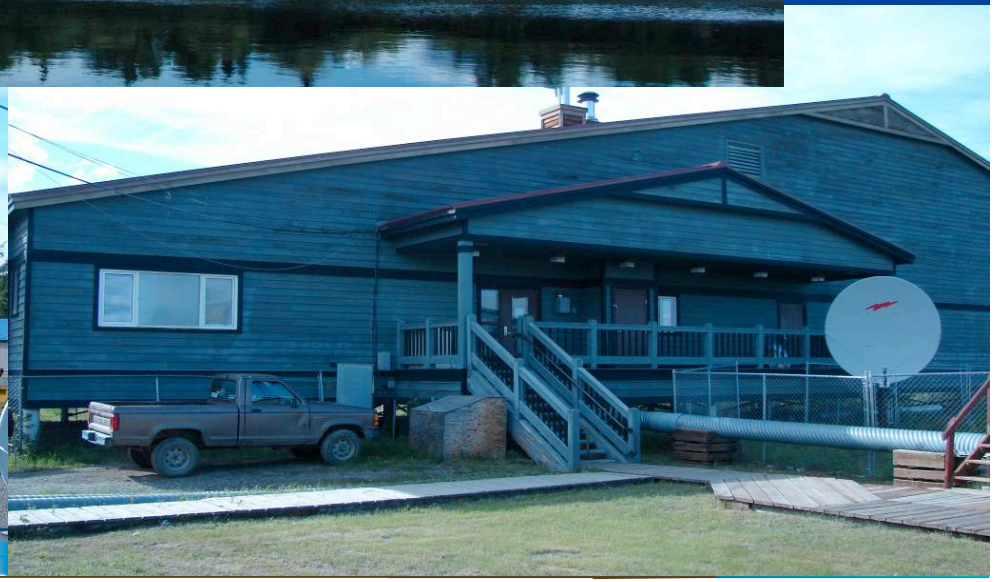
- **Local Management Capacity Development**

Heating Systems
Stick Fired



Heat Systems
Chip Boilers

Chalkyitsik
Wood Energy Heating Program



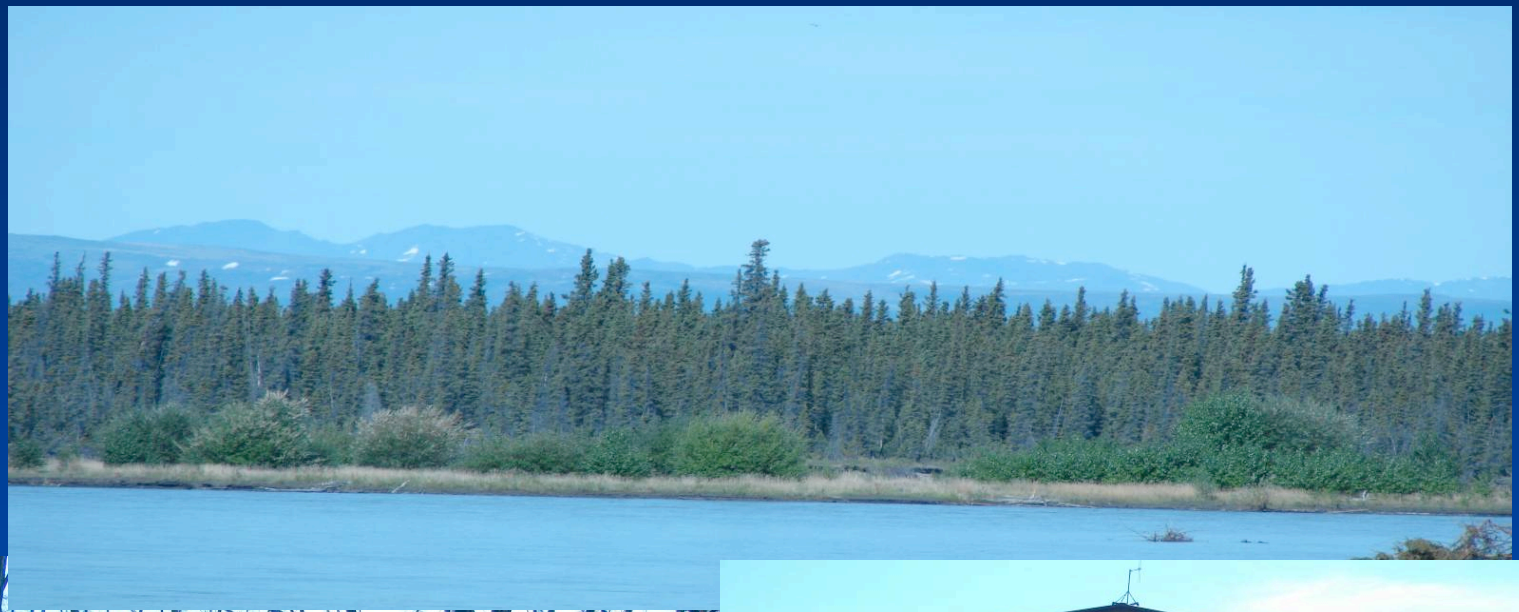
Chalkyitsik Feasibility Stick Fired

Summary of Results	School	Water Treat	Sch Housing	DH Plant	Comm CenterCC + Village Off
Stick-fired Performnace					
baseline oil consumption :	20,586	7,304	4,977	32,866	14,404	17,881
proposed biomass, cords/yr :	179	63	43	285	129	157
fraction of oil displaced :	1.000	1.000	1.000	1.000	1.000	1.000
Gam model :	WHS 3,200	WHS 2,000	WHS 1,500	WHS 3,200	WHS 3,200	WHS 3,200
No. of boilers :	2	1	1	3	2	2
Maximum wood loads per day req. :	4.0	3.8	3.9	4.0	2.7	3.2
Stick-fired Cost and savings :						
boilers, shipped and installed :	$268,221	$125,959	$118,307	$402,331	$268,221	$268,221
Slab/Building for Boilers :	$20,000	$15,000	$15,000	$25,000	$15,000	$25,000
direct buried piping :	$16,400	$16,400	$16,400	$117,650	$16,400	$58,500
interconnection :	$35,000	$35,000	$35,000	$105,000	$35,000	$70,000
other :	$15,000	$15,000	$15,000	$60,000	$15,000	$37,500
subtotal :	$354,621	$207,359	$199,707	$709,981	$349,621	$459,221
soft costs :	$112,592	$65,836	$63,407	$225,419	$111,005	$145,803
total :	$467,213	$273,195	$263,114	$935,400	$460,625	$605,023
baseline oil cost :	$164,688	$58,429	$39,814	$262,931	$115,232	$143,047
final oil cost :						
cord wood cost :	$44,853	$15,783	$10,791	$71,341	$32,222	$39,326
total savings :	$119,835	$42,646	$29,023	$191,590	$83,010	$103,721

Chalkyitsik Feasibility Chip Fired

Chip-fired Performnace						
baseline oil consumption	20,586	7,304	4,977	32,866	14,404	17,881
proposed biomass, tons/yr	235	59	11	398	165	220
fraction of oil displaced	0.769	0.543	0.155	0.815	0.769	0.829
Kob model	Pyrot 220	Pyrot 100	Pyrot 100	Pyrot 300	Pyrot 150	Pyrot 150
No. of boilers	1	1	1	1	1	1
Chip-fired Cost and savings						
boilers, shipped and installed	$228,898	$202,537	$202,537	$259,347	$216,184	$216,184
Slab/Building for Boilers	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
direct buried piping	$16,400	$16,400	$16,400	$117,650	$16,400	$58,500
interconnection	$20,000	$20,000	$20,000	$60,000	$20,000	$40,000
other	$15,000	$15,000	$15,000	$60,000	$15,000	$40,000
subtotal	$285,298	$258,937	$258,937	$501,997	$272,584	$359,684
soft costs	$90,582	$82,213	$82,213	$159,384	$86,545	$114,200
total	$375,880	$341,150	$341,150	$661,382	$359,129	$473,884
baseline oil cost	$164,688	$58,429	$39,814	$262,931	$115,232	$143,047
final oil cost	$38,031	$26,705	$33,662	$48,546	$26,669	$24,445
chip cost	$41,181	$10,315	$2,000	$69,704	$28,795	$38,562
total savings	$85,476	$21,410	$4,152	$144,681	$59,768	$80,040
Net Simple Payback						
stick-fired	3.9 yrs	6.4 yrs	9.1 yrs	4.9 yrs	5.5 yrs	5.8 yrs
chip-fired	4.4 yrs	15.9 yrs	82.2 yrs	4.6 yrs	6.0 yrs	5.9 yrs

Venetie
Wood Energy Heat Program



Venetie Airport and Washeteria

CLINIC	1500 gpy
COUNCIL	1500 gpy
TRIBAL OFF	1500 gpy
ELDERS ASSN	600 gpy

Venetie Feasibility Stick Fired

Summary of Results		Washeteria	School	Sch Housing	DH Plant
Stick-fired Performnace					
baseline oil consumption	:	8,122	18,073	7,195	33,390
proposed biomass, cords/yr	:	72	159	64	290
fraction of oil displaced	:	1.000	1.000	1.000	1.000
Gam model	:	WHS 3,200	WHS 3,200	WHS 3,200	WHS 3,200
No. of boilers	:	1	2	1	3
Maximum wood loads per day req.	:	2.8	3.5	2.6	4.1
Stick-fired Cost and savings	:				
boilers, shipped and installed	:	$134,110	$268,221	$134,110	$402,331
Slab/Building for Boilers	:	$15,000	$20,000	$15,000	$25,000
direct buried piping	:	$16,400	$16,400	$16,400	$227,500
interconnection	:	$35,000	$35,000	$35,000	$105,000
other	:	$15,000	$15,000	$15,000	$60,000
subtotal	:	$215,510	$354,621	$215,510	$819,831
soft costs	:	$68,425	$112,592	$68,425	$260,296
total	:	$283,935	$467,213	$283,935	$1,080,127
baseline oil cost	:	$64,976	$144,586	$57,558	$267,120
final oil cost	:				
cord wood cost	:	$17,991	$39,719	$16,096	$72,411
total savings	:	$46,986	$104,867	$41,462	$194,709

Venetie Feasibility Chip Fired

Chip-fired Performnace				
baseline oil consumption	8,122	18,073	7,195	33,390
proposed biomass, tons/yr	78	219	62	403
fraction of oil displaced	0.648	0.816	0.582	0.813
Kob model	Pyrot 100	Pyrot 150	Pyrot 100	Pyrot 300
No. of boilers	1	1	1	1
Chip-fired Cost and savings				
boilers, shipped and installed	$202,537	$216,184	$202,537	$259,347
Slab/Building for Boilers	$5,000	$5,000	$5,000	$5,000
direct buried piping	$16,400	$16,400	$16,400	$227,500
interconnection	$20,000	$20,000	$20,000	$60,000
other	$15,000	$15,000	$15,000	$60,000
subtotal	$258,937	$272,584	$258,937	$611,847
soft costs	$82,213	$86,545	$82,213	$194,262
total	$341,150	$359,129	$341,150	$806,109
baseline oil cost	$64,976	$144,586	$57,558	$267,120
final oil cost	$22,872	$26,658	$24,032	$50,043
chip cost	$13,690	$38,343	$10,901	$70,580
total savings	$28,415	$79,585	$22,626	$146,497
Net Simple Payback				
stick-fired	6.0 yrs	4.5 yrs	6.8 yrs	5.5 yrs
chip-fired	12.0 yrs	4.5 yrs	15.1 yrs	5.5 yrs

Fort Yukon Feasibility

Summary of Results

Financial	Base P **A**	Base P **B**	Int P **A**	Int P **B**	Max P **A**	Max P **B**
estimated project cost :	$1,536,292	$1,856,504	$2,011,062	$2,331,274	$2,671,124	$3,033,012
estimated annual savings :	$227,748	$262,568	$263,777	$307,764	$380,381	$440,387
net simple payback, yrs :	6.75	7.07	7.62	7.57	7.02	6.89
Performance :						
:						
No. buildings connected :	6	6	8	8	9	9
peak load heating, kBTU/h :	2,295.0	2,295.0	2,645.6	2,645.6	3,450.3	3,450.3
peak losses to heating fuel, kBTU/h :	40.0	40.0	40.0	40.0	40.0	40.0
fraction :	0.017	0.017	0.015	0.015	0.012	0.012
:						
peak piping losses, KBTU/h :	72.1	72.1	115.9	115.9	198.4	198.4
fraction :	0.031	0.031	0.044	0.044	0.057	0.057
total losses, as a fraction of load :	0.049	0.049	0.059	0.059	0.069	0.069
:						
current oil consumption, gal/yr :	71,764	71,764	84,734	84,734	119,988	119,988
proposed consumption, gal/yr :	9,644	343	12,514	756	15,870	105
estimated savings, gal/yr :	62,120	71,421	72,219	83,978	104,118	119,883
fraction displaced :	0.866	0.995	0.852	0.991	0.868	0.999
:						
estimated wood chips, tons/yr :	1,134	1,303	1,318	1,533	1,900	2,188


KÖB
Heat from Wood


KÖB
PYROT®

Gwitchyaa Zhee Corporation

CATG – AWEA

A Collaborative Integrated Wood Energy Program for Fort Yukon

Implementation

DOE Tribal Energy Program

2 0 November 2008

For-Profit Wood Energy Business Model Fort Yukon

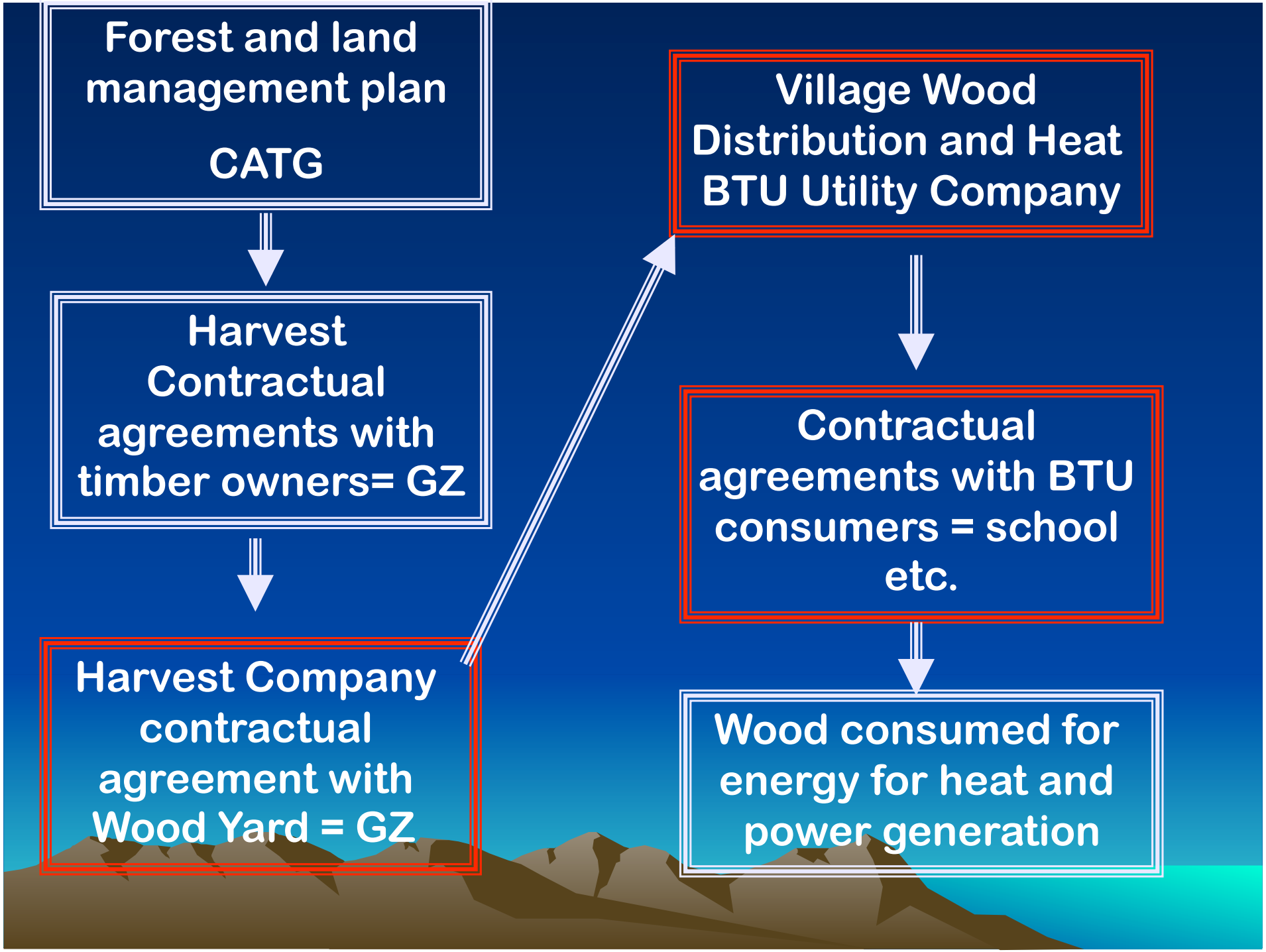
- Forest Management Service – CATG
- For-Profit Wood Utility Company – Vertically Integrated
- Gwitchyaa Zhee Native Corporation
  - Wood Harvest Company
  - Village Wood Yard/Distribution Company
  - Wood Energy Utility – Diesel Biomass
  - Wood diesel hybrid power plant CHP – still dreaming for 200-700 Kwh technology

Wood Harvest Company

- Harvests wood from GZ lands summer and winter – start with recent fires
- Delivers to Village Wood Yard
- Paid upon delivery of wood by weight and dryness formula
- Requires harvest equipment with capacity for 5-7,000 tons production per year sticks and chips

Village Wood Yard/Distribution Company

- 2-3 acre wood yard - capacity to deliver split fire wood, boiler round wood, wood chips for chip boilers;
- Small sawmill for production of dimension lumber for village use;
- Commercial buildings do not want to own or operate boilers;
- GZ owns heat boilers and sells BTUs of heat and is responsible for feeding boiler


Forest and land management plan
CATG
Harvest Contractual agreements with timber owners= GZ
Harvest Company contractual agreement with Wood Yard = GZ
Village Wood Distribution and Heat BTU Utility Company
Contractual agreements with BTU consumers = school etc.
Wood consumed for energy for heat and power generation

Acreage Harvested for Heating

- 3,000 tons / year heat
- 18 tons/acre
- 60 year rotation
- 167 acres / year
- 10,020 acres / rotation
- Moose habitat for 20 years
- Historical wildfire events have burned 80,000 acres in one month

Yukon Flats Villages Annual Consumption

- We estimate that the Yukon Flats Region will require more than 6,000 tons of wood annually to fuel their heat and electrical power consumption

Three concurrent projects

- **Boiler installation and operation**
  - 2 boilers 2009 one at clinic and one at Voc ed
  - District heating system downtown 9 buildings 2010.
- **Wood harvest system equipment purchase and operations/training 2009**
- **NRCS fire rehabilitation contract $450,000**
- **Capacity development:**
  - 5 year harvest plan
  - Equipment and harvest system integration = harvesting wood to chips to feeing boilers
  - Boiler operations
  - Annual harvest operations plans and implementation
  - Community communications and coordination's across organizations

2 boilers and one district heating systems

Equipment Wish List

Biomass Harvest Start Up Equipment

WOOD HARVEST EQUIPMENT TO BE PURCHASED

Fecon FTX100L		$115,000
Kubota KX080 Excavator		$84,000
Kesla Processor head		$39,000
Vermeer BC 1400TX Chipper		$85,000
Kubota M125X Tractor w/loader		$57,000
Fecon/Kubota Attachments	Bucket	$2,500
	Tree Shear	$12,000
	Brush Rake	$3,800
	Rear Fecon Grapple	$5,800
	Excavator log grapple	$4,500
	Backhoe	$7,000
	Guarding for Excavator	$12,000
Aluminum Chip Bin		$12,000
Kelsa Forwarder Trailer with loader		$55,000
20 foot skiff		$30,000
Firewood Processor (Blockbuster model 1820)		$34,000
Firewood Elevator		$7,500
Sawmill		$75,000
Freight		$45,000
Total Equipment Cost		$686,100

Harvest System Development

- A complete harvest system capable of producing 6-8,000 tons of woody biomass annually will cost approximately $650,000

Ground Harvest Systems

- **Small scale harvest systems with proven reliability will be employed**

Fort Yukon Power Barge

Harvest Production Model

Cost and Revenue Data

In Tons and Cordwood Units

Cordwood Production Cost Summary

Species	Annual Tons Produced	# Cords (8' logs)	Logging Cost/Ton	Harvest Days Required	$/Cord Short Logs	Total Annual Harvest Cost	Annual Markup
Spruce	2,000	1,657	$ 128.39	89	$ 154.97	$ 256,782.72	$ 64,195.68

Cordwood Energy Value

Species	BTU/ Cord	BTU/Gal-Diesel	Gal Diesel/ Cord	Diesel $/Gallon	Diesel $ Value /Cord	Mark Up (25%)	Distributor Costs	Delivered Cost/Cord	De Co
Spruce	15,900,000	138,000	115.22	$ 3.50	$ 403.26	$ 154.97	$ -	$ 154.97	$

Annual Savings From Cordwood

Species	Annual Cords Consumed	Annual Cost Cordwood	Efficiency Loss Wood Boiler	Gals Diesel Displaced	Value-Diesel Displaced	Annual Savings
Spruce	1,657	$ 256,783	25%	143,186	$ 501,153	$ 244,370

Biomass Acreage Requirements

Tons/Acre	Tons Required Annually	Acres Required Annually	Rotation Age Assumption	Total Sustained Acres Required
15	2000	133	60	8,000

Biomass Harvest Assumptions

Annual Harvest-Acres	Pieces Per Acre	Acres/Day Harvested	Pieces/Day Harvested	Tons/Day Harvested	Total Harvesting Days/Year	Cords/Day Harvested
133	500	1.5	750	23	89	19

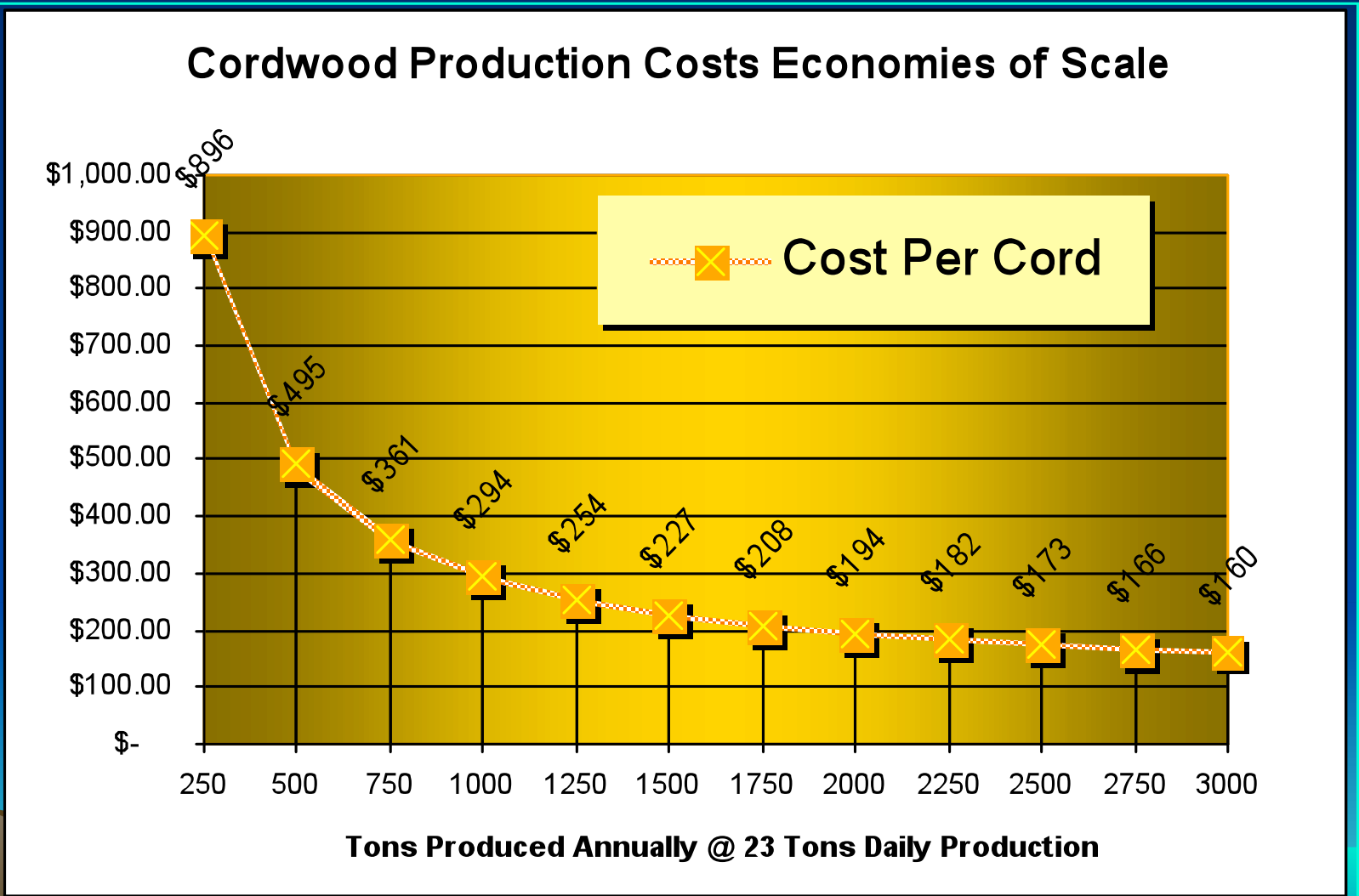
Biomass Harvest Costs Work-up

Annual Equipment Lease Payments	Annual Maintenance/ Repair Costs	Annual Fuel Consumption (Gallons)	Fuel $/Gallon	Annual Fuel Cost	Annual Insurance Cost	Total Annual Equipment Costs
$ 132,000	$ 3,000	4,750	$ 3.55	$ 16,863	$ 25,500.00	$ 182,116.05

Man-hrs Per Day	$/Man-hr (All Inclusive)	Labor Cost Per Day	Labor Cost Per Acre	Labor Cost Per Ton	Machine Cost Per Ton	Annual Payroll	Logging Cost Per Ton
24	35	840	$ 560.00	37	$ 91.06	$ 74,667	$ 128.39

Economies of Scale

Annual Production Influence on Cost



Woody Biomass Advantages

- Stabilizes village energy costs
- Energy import substitution
- Local employment
- Self-sufficiency
- Subsistence based culturally sound jobs 1@ $30/hr 2@$20-25/hr 3@$15/hr

  All jobs are 6-8 months with time off for fishing hunting!!!!!
- Village sustainability

Funding Partners

- **USDA NRCS**
- **DOE Tribal Energy Program**
- **Division of Forestry – DNR**
- **Denali Commission**
- **Alaska Wood Energy Development Task Group**
- **Alaska Energy Authority**
- **USDA Rural Development**
- **State and Private Forestry – USFS**