

April 10, 2017

Heating the Midwest

International  
Biomass Conference  
and Expo

# Biomass for Residential and Commercial Heating in Off-Grid Communities *A Case Study of Bella Coola, British Columbia*

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Overview

Background

Alternatives

DES/Decentralized

Economics & Risks

Co-generation

Wood Products

Conclusion

# Overview

- **Background** – Remote Communities & Bella Coola
- Heating Oil, Propane, Firewood, and Electric **Alternatives**
- **District** Energy vs. **Decentralized** Boilers
- Heat **Economics and Risks**
- **Co-generation** of Electricity
- Integration with **Wood Products** in a cluster approach
- **Conclusion**

# Background

## *Remote Communities in Canada*

- Not connected to North American electrical grid
  - 200 communities
  - Population of ~ 200,000
  - Range from 10 to ~25,000 people
  - Energy cost up to 10x average in Canada
  - Many First Nations (aboriginal) communities
  - A large number in NT, YK, QC, ON, and BC
- Micro-grid generation
  - Diesel dominates
  - Small hydro common
  - Several have integrated wind and/or solar
- Firewood heating common
- Remote location impacts cost of heating alternatives

# Background

## *Bella Coola, BC*

- Bella Coola Valley
  - Village and Four Mile; Hagensborg
  - Traditional territory of the Nuxalk Nation
  - Connected to Williams Lake by gravel road
  - Docking facilities
  - 1900 people in the valley; 850 on-reserve
  - Reserve average income <40% BC average
  - Reserve estimates of unemployed: 70-80%
- Research support: Nuxalk Development Corp. & MITACS
  - UBC lead academic institution
  - Bioheat one of nine projects on economic opportunities from the forest
  - Projects on biopower, briquetting, CNC products
  - Support tenure of 20,000 m<sup>3</sup>/yr, harvest of 12,500 m<sup>3</sup>/yr, and milling of 4,000 m<sup>3</sup>/yr





# Business-As-Usual

## *Nuxalk Reserve, BC*

	Heating Oil	Propane	Electricity	Firewood
Consumption	435,000 L	110,000 L	4,484,000 kWh	900 cords
Cost of Heat (\$/MWh)	163	141	130 (410*)	46

- 275 residences, 30 commercial buildings
  - Most residences use firewood, back-up heating oil, and electric hot water
  - Commercial buildings usually propane
  - Electricity cost subsidized by BC Hydro
  - Band office and school use ground-source heat pump and hydronic heating systems
- Yearly consumption of ~12,000 MWh (41,000 MMBTU)
  - Average cost of heat = \$100 MWh (\$29/MMBTU)



# DES vs. Decentralized

## *Local and Imported Fuel*

### **District Energy System**

- Surveyed community and used GIS analysis
- Four different layouts; energy centre in 4 Mile (flood)
- Heat load dictates pipe diameter
- Space and hot water heating
- Assumed harvest residue feedstock, covered storage
- RetScreen used for costing and climate

### **Decentralized Boilers**

- Boilers scaled, including buffer, for each building
- Bulk purchase of Fröling boilers (Evergreen pricing)
- Pellet fuel assumed – trucked from Williams Lake
- Space and hot water heating
- Retain forced-air systems (heating coil)

## Bioheat in Remote Communities

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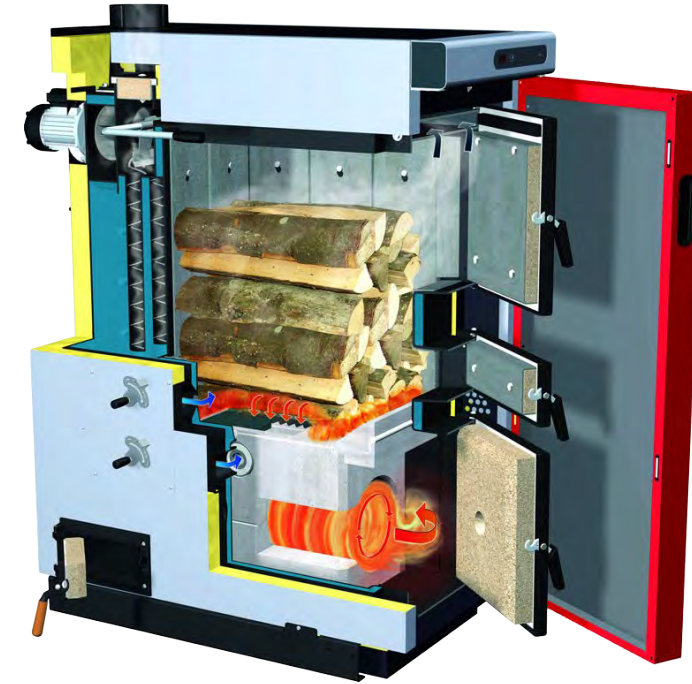
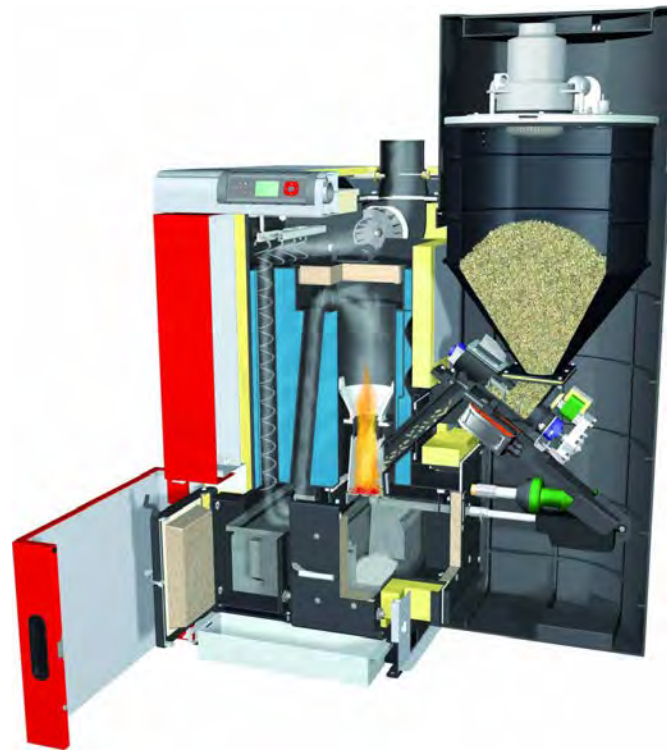
# District Energy System





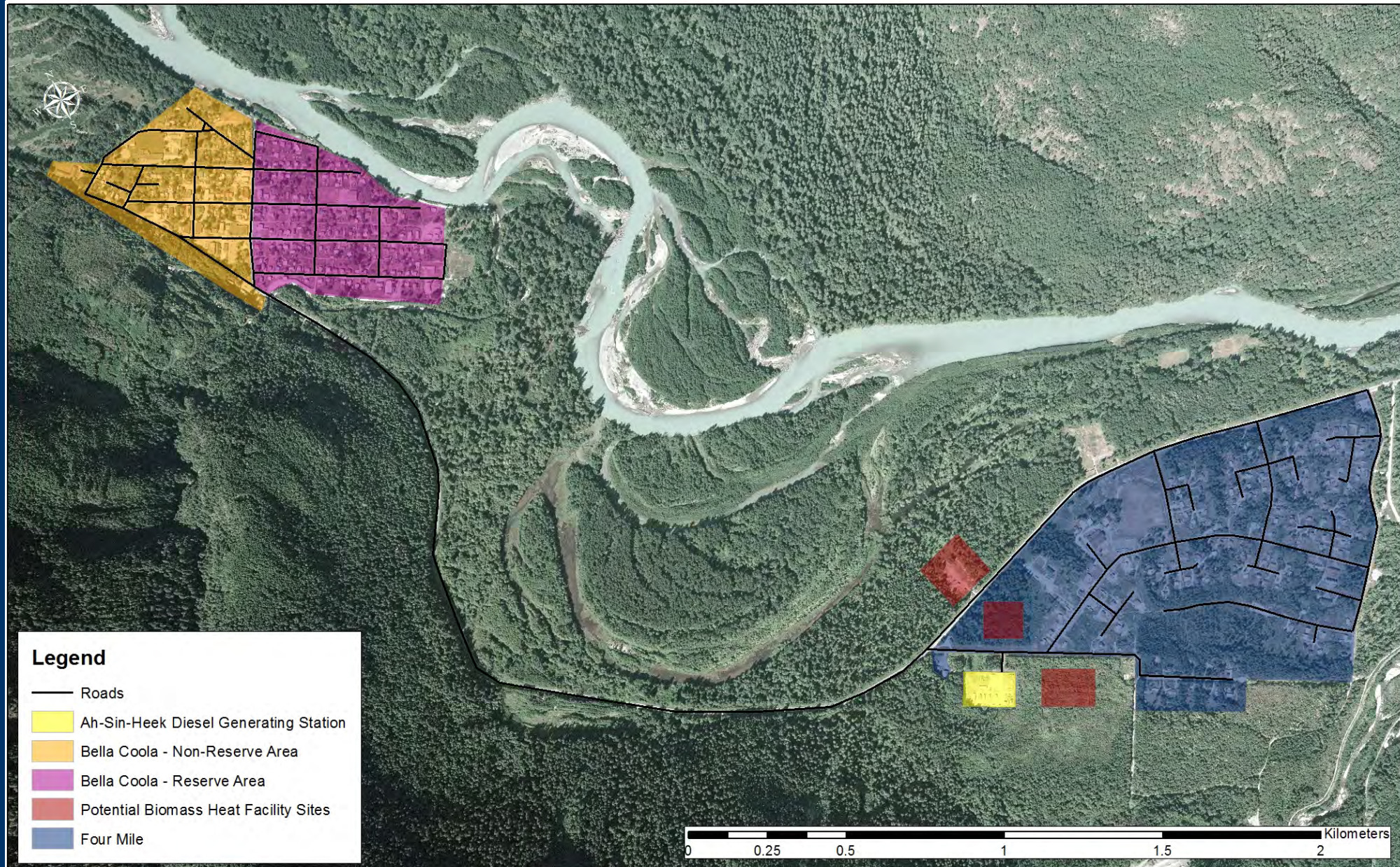
# Bioheat in Remote Communities

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- Alternatives
- DES/Decentralized**
- Economics & Risks
- Co-generation
- Wood Products
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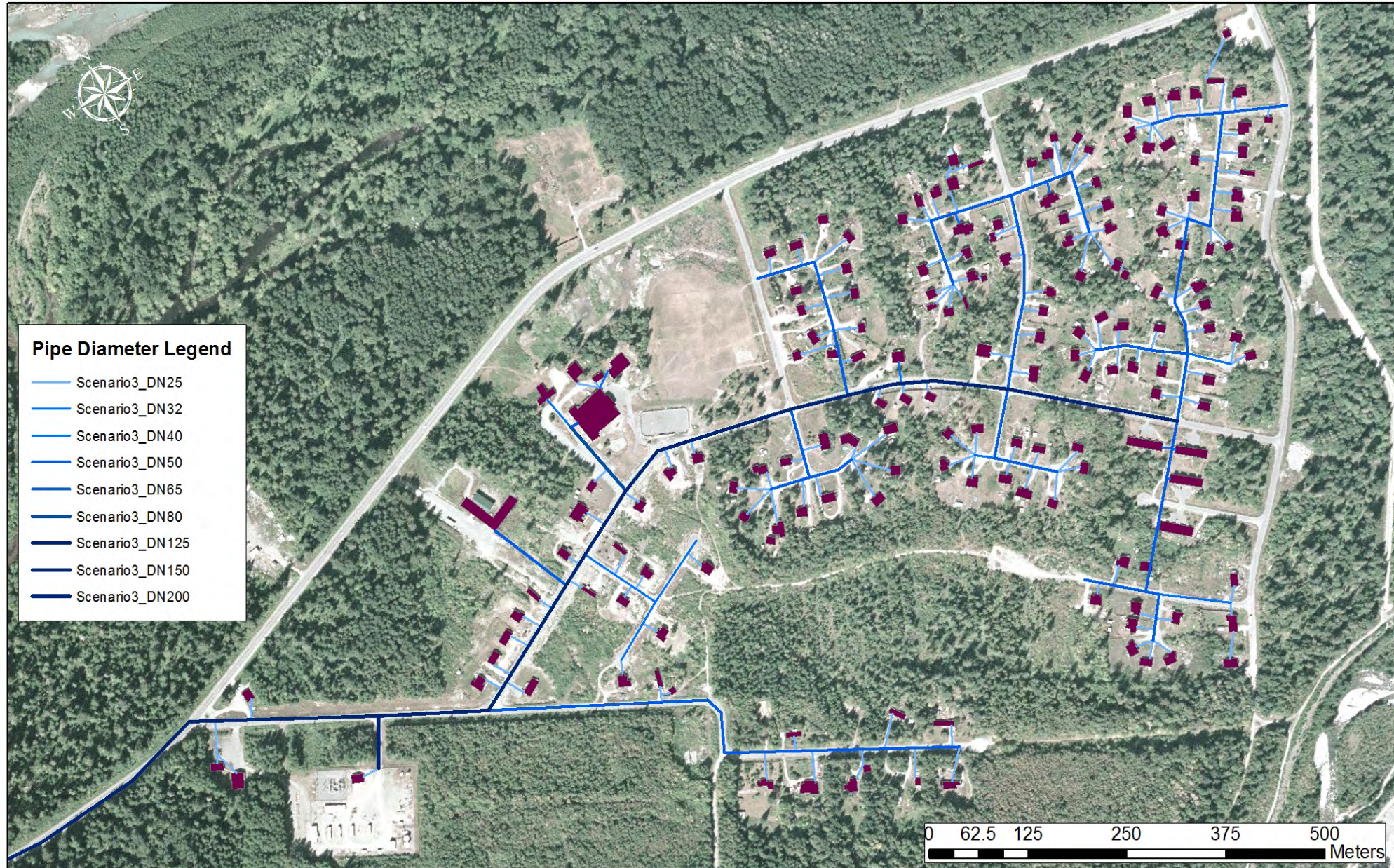


# Bella Coola & Four Mile



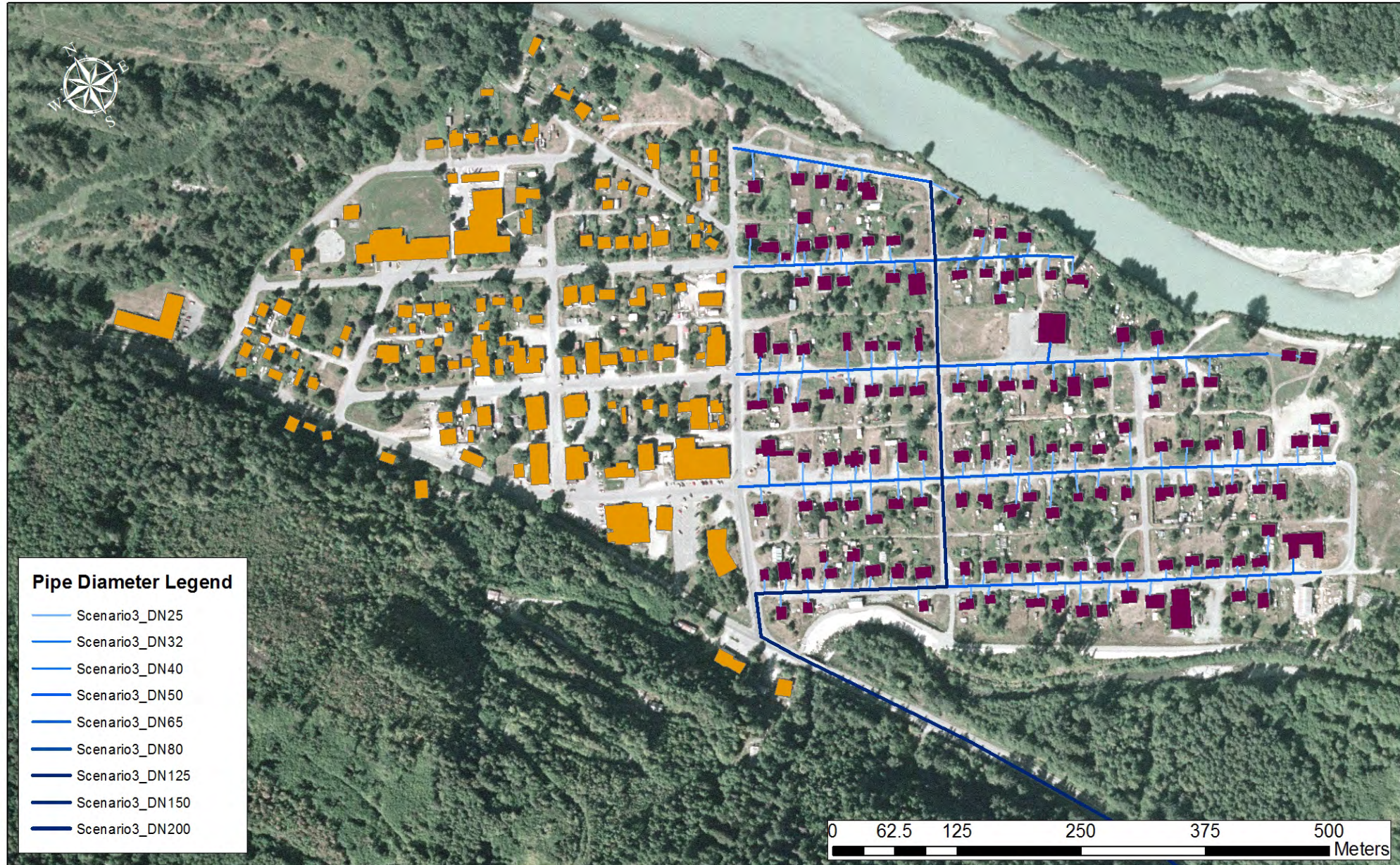


# Four Mile



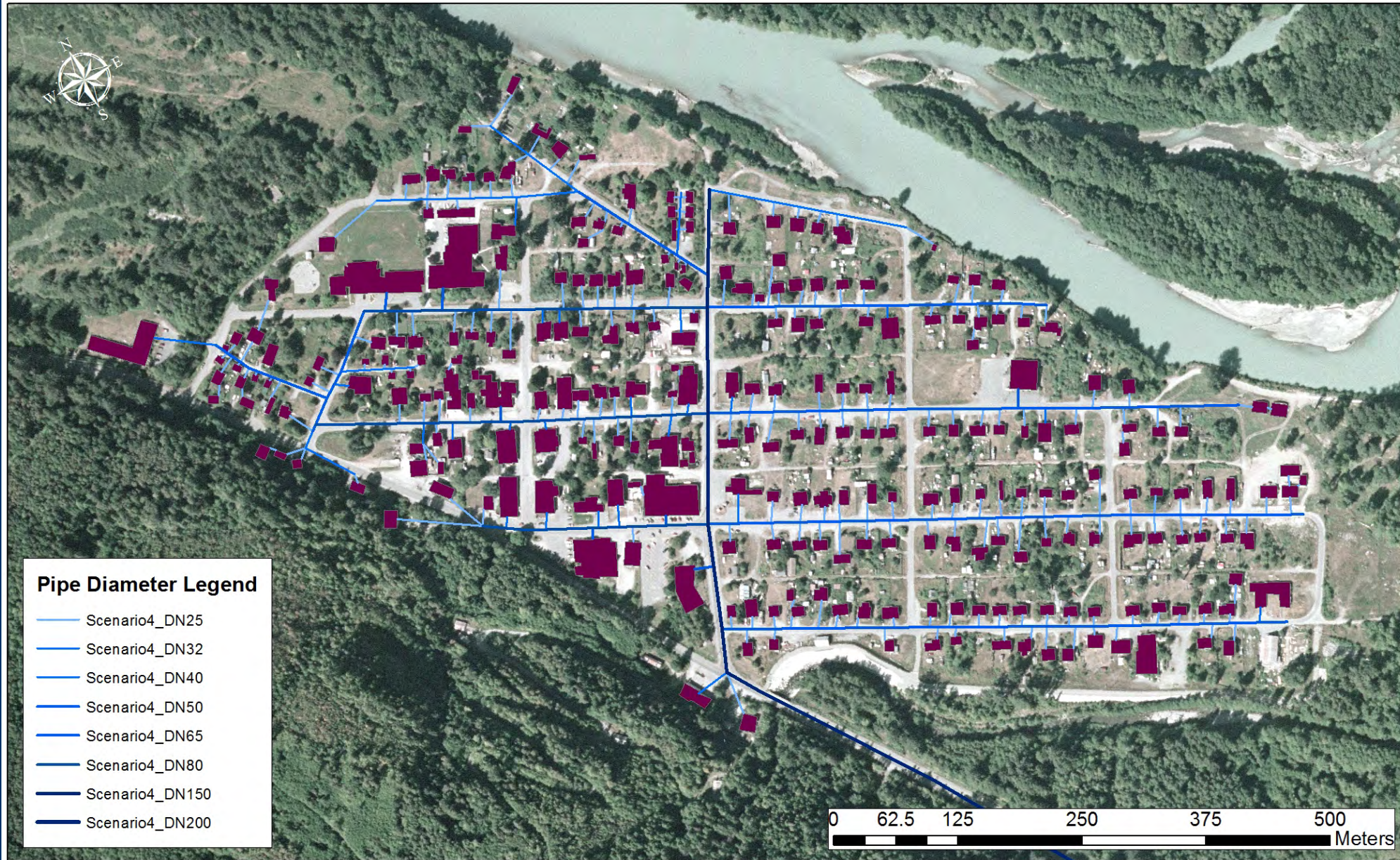


# Bella Coola Village





# Bella Coola Village





# Economics & Risks

## *Summary Results*

### **District Energy System**

- Four scenarios
- 2.1-5.2 MW capacity (relatively flat load curve)
- \$7.8-18.2 M
- Smallest and largest most economical
- \$128-154/MWh (\$38-45/MMBTU)
- Control of fuel supply

### **Decentralized Boilers**

- Three scenarios
- \$2.8-7.2 M
- \$110-127/MWh (\$32-37/MMBTU)
- Still dependent upon fuel imports

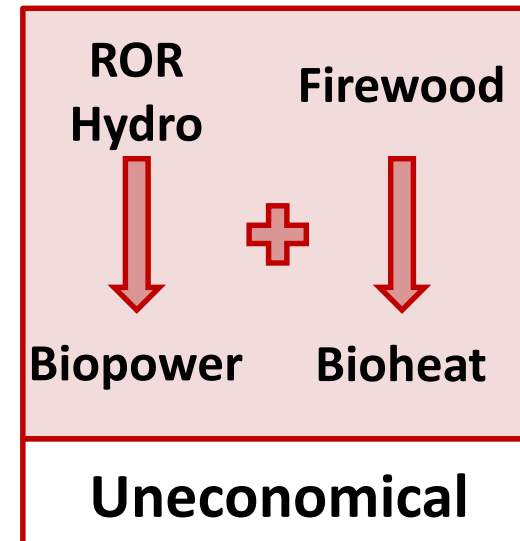
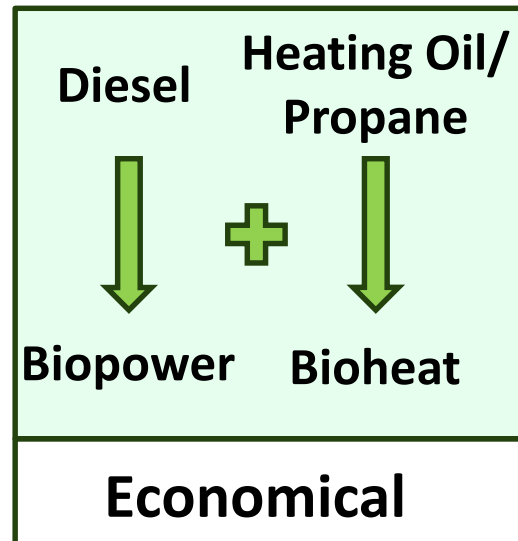
# Economics & Risks

## *Policy and Community Considerations*

- **Electricity is subsidized**
  - Pay \$0.13-0.17/kWh; diesel cost = \$0.41/kWh
  - BC Hydro has incentive to reduce electrical space and hot water heating
- **Low cost firewood**
  - Pellet boilers/DES higher cost
  - Isolated community, little travel
  - Stay at home
  - Firewood boilers may be best option
- **No sewage system**
  - DES installation more economically competitive if installed at same time
  - Flooding in Bella Coola – septic problems

# Co-generation

- Sister study compared ORC & gasification/ICE
  - 300 kW ORC could fit load profile of community
  - Need heat revenue (DES) – match e-/heat load
  - Competitive with BAU (assuming no subsidy)



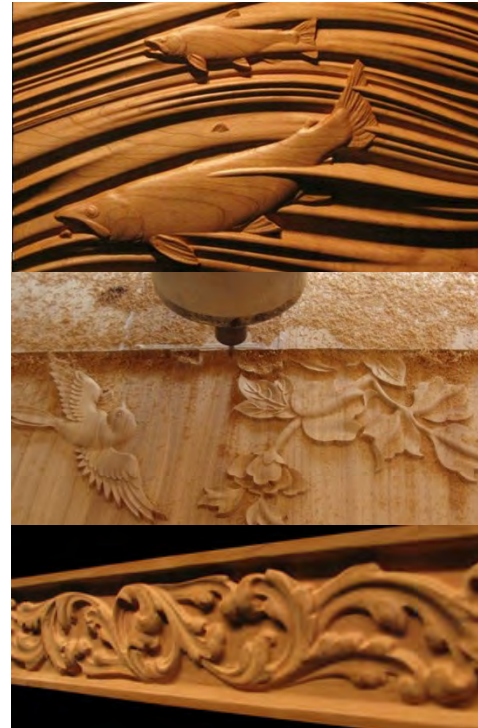
- TorchLight and QIEEP completed study on small-scale (<3 MWe) biomass CHP technologies for NRCan
  - 40 companies/technologies assessed



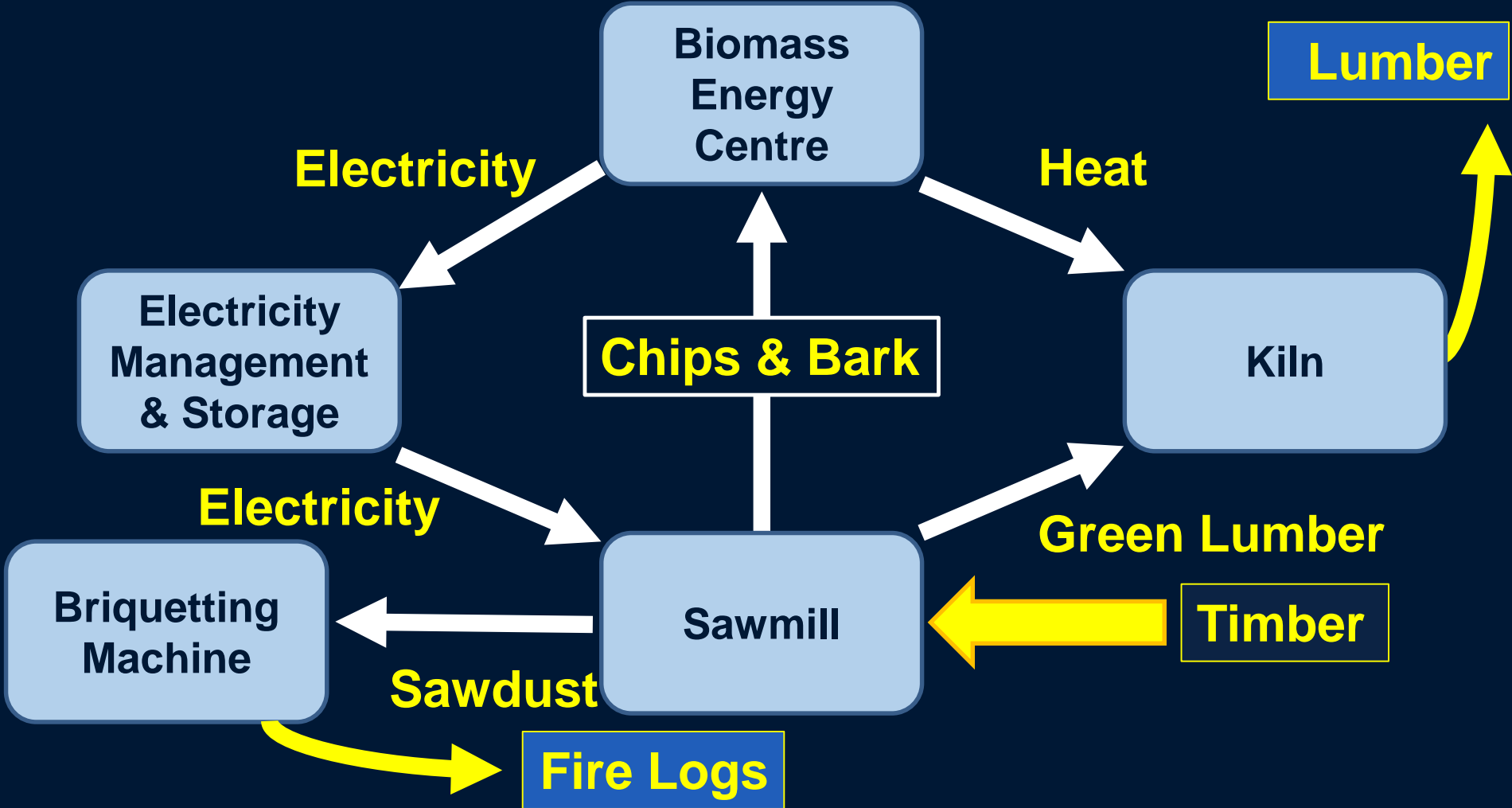
# Wood Products Cluster

## *Examining the Role of Bioheat*

- Integration of bioheat with other forest products
  - Community-scale sawmill
  - CHP, briquettes, pellets
  - Solid wood products – digital technologies, CNC



# FOREST PRODUCTS CLUSTER



# Conclusion

- High cost of energy in remote communities
- BAU fuel will impact viability of DES and pellets
- Heat load density critical for DES
- Co-generation can be possible at small-scale if displacing diesel/heating oil and regulations are supportive
- Bulk purchase of boilers can improve economics
- Integration with solid wood products cluster
- Solid wood products create jobs and increases income, bioheat reduces operating costs
- Community priorities determine best option

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# Thank you!

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