FIRST Heat – A Simple Tool that Estimates DE Costs and Benefits for Communities at Risk of Wildfire

David Dubois – Chief of Engineering and Technical Outreach Specialist
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www.communityenergy.bc.ca
Community Energy Association Purpose

- CEA is charitable non-profit society
- CEA is the trusted independent advisor to local governments
- We are helping local governments close the implementation gap

Accelerate Climate Action with People and Projects

Awareness & Recognition
- Workshops & Presentations
- Research & Publications
- Collaboration
- Climate & Energy Action Awards

Projects
- Planning
- Implementation
- Technology Acceleration
Energy Cost Comparison

Cost / GJ

- Wood chip: $65/tonne
- Natural Gas: $10/GJ
- Wood pellets: $243/ton
- Electricity: $0.10/kWh
- Propane: $0.79/l
- Heating Oil: $1.30/l
- Mobility Fuels: $1.30/l

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This is District Heating

Source: Vital Energi Utilities
Enderby District Heating System

- Tony's Tire: 35 kW
- Edwin D.: 15 kW
- Enderby Autobody: 35 kW
- Pool: 80 kW (Summer only)
- Fink Machine: 85 kW
- ENFAB: 90 kW
- Marvin's Mechanical: 20 kW
- Royal Inn: 15 kW (DHW)
- Park View Place: 120 kW
- Cedar Solution: 60 kW
- CNC: 45 kW

Boiler House
- Pyrot 540 kW
- Fuel: Chips / Pellets
- Back-Up: Gas

Images of the heating system and facility.
Telkwa District Heating

Pub & Store  Village Office  School

~ 100 m
How much do I need?
How much do I need?

Typical Biomass Consumption by Usage

- Pellet Plant: 12,000 Truck Loads
- Power Plant: 5,000 Truck Loads
- 5MW Community Electricity: 5,000 Truck Loads
- Enderby: 0 Truck Loads

Tonnes of Biomass per Year

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How much do I need?

Typical Biomass Consumption by Usage

- Pellet Plant: 12,000 Truck Loads
- Power Plant: 5,000 Truck Loads
- 5 MW Community Electricity: 1,000 Truck Loads
- Enderby: 20 Truck Loads

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Fire Interface Rural Screening Tool for Heating (FIRST Heat)

Designed for non-technical people to evaluate biomass heating using fuel derived from Wildfire Abatement – a Local Fuel

• Joint project funded by PICS Carbon Management in BC Forests program.
  Multidisciplinary approach:

  • **University of British Columbia**: Ecological modelling and spatial mapping
  • **Community Energy Association**: Economics
  • **Green Heat Initiative**: Technical

[Images and logos of UBC, Community Energy Association, and Green Heat Initiative]

[Website link: www.communityenergy.bc.ca]
Selecting Model Communities

1. Surrounded by forests under wildfire risk management.
2. In different eco-climatic zones of BC.
3. Not connected to the natural gas grid or paying higher price.
4. No district heating systems.
Wildfire Abatement = Fuel

- Guidelines for reducing fire risk in the urban / forest interface have been created:
  
  → Gradient of increasing management intensity from the forest to the urban area:

  - Reduction of tree density (**thinning**)
  - Reduction of fuel ladders (**pruning**)
  - Reduction of **fuel load** (Coarse Woody Debris - CWD)
  - **Substitution** of conifers by broadleaves
  - Building fire-proofing
Determining Available Biomass

• For each community, forest inventories were used to create **analysis units**.
  → A specific combination of site fertility, tree species composition, tree density, and forest age
    (i.e., poor site, spruce + pine, 2000 trees / ha, mature forest)

• Forest management scenarios were created for each community following the **FireSmart** guidelines
  → **High wildfire risk**: High tree density, 10 years between tree re-growth control operations
  → **Moderate wildfire risk**: Low tree density, 10 years between tree re-growth operations, removal some CWD
  → **Low wildfire risk**: Low tree density, 5 years between tree re-growth operations, removal most CWD
Determining Available Biomass

- For each community, all the combinations of analysis units and forest management regimes were simulated with FORECAST for 50 years.

Ecosystem-level model

Long-term comparison of alternative management plans

Three main limiting factors for tree growth:

Climate
Nutrients
Management


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Sample Output Map

Sicamous: Harvested biomass available annually from years 1-11 (intermediate mgmt scenario)

• Polygon-based GIS maps
• Maps are generated for two periods:
  o Density intervention
  o Re-growth control

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Sample Output Map

**Sicamous:** Harvested biomass available annually from years 1-11 (intermediate mgmt scenario)

- Total metric tonnes of non-merchantable biomass + total harvested merchantable biomass stems harvested
- **Map legend:**
  - District of Sicamous

Ownership and availability:
- Schedule B* land - Tree Farm Licence (Crown Land)
- Land not available for long-term integrated res. mgmt

- **Total harvested biomass within 25km of Sicamous (tonnes/yr):**
  - 1 - 100
  - 100 - 200
  - 200 - 300
  - 300 - 400

**Polyon-based GIS maps**

**Maps are generated for two periods:**
- Density intervention
- Re-growth control

<table>
<thead>
<tr>
<th>Study area</th>
<th>Legend</th>
<th>Min. mgmt (tonnes/yr)</th>
<th>Int. mgmt (tonnes/yr)</th>
<th>Max. mgmt (tonnes/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All forest stands &lt;25km from district of Sicamous</td>
<td>![Legend]</td>
<td>Year 1-11: 1,842,999</td>
<td>Year 1-11: 3,266,118</td>
<td>Year 1-11: 3,382,763</td>
</tr>
<tr>
<td>All forest stands &lt;25km from district of Sicamous excluding land not available for long-term integrated resource management</td>
<td>![Legend]</td>
<td>Year 12-50: 102,868</td>
<td>Year 12-50: 106,914</td>
<td>Year 12-50: 123,057</td>
</tr>
<tr>
<td>All forest stands &lt;25km from district of Sicamous excluding land not available for long-term integrated resource management</td>
<td>![Legend]</td>
<td>Year 11-1: 1,541,069</td>
<td>Year 11-1: 2,641,481</td>
<td>Year 11-1: 2,742,819</td>
</tr>
<tr>
<td>Stands at high risk to wildfire &lt;25km from district of Sicamous, excluding land not available for long-term integrated resource management</td>
<td>![Legend]</td>
<td>Year 12-50: 89,384</td>
<td>Year 12-50: 88,486</td>
<td>Year 12-50: 100,073</td>
</tr>
<tr>
<td>Stands at high risk to wildfire &lt;25km from district of Sicamous, excluding land not available for long-term integrated resource management</td>
<td>![Legend]</td>
<td>Year 1-11: 590,966</td>
<td>Year 1-11: 1,060,770</td>
<td>Year 1-11: 1,097,874</td>
</tr>
<tr>
<td>Stands at high risk to wildfire &lt;25km from district of Sicamous, excluding land not available for long-term integrated resource management</td>
<td>![Legend]</td>
<td>Year 12-50: 29,618</td>
<td>Year 12-50: 26,525</td>
<td>Year 12-50: 31,723</td>
</tr>
</tbody>
</table>

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Engineering Considerations

• Use best available **proven technology** with emissions approaching Natural Gas. Replicate not Innovate.

• Assumes **all biomass generated** from wildfire abatement is used in a **single heat plant**
  - In reality there might multiple heat plants that may or may not be connected

• Biomass is designed for **average heat demand and supply 80-90% of Total Heat Load**. Other fuels for peak heat demand
Engineering Considerations

- Use best available **proven technology** with emissions approaching Natural Gas. Replicate not Innovate.
- Assumes **all biomass generated** from wildfire abatement is used in a **single heat plant**
  - In reality there might multiple heat plants that may or may not be connected
- Biomass is designed for **average heat demand and supply 80-90% of Total Heat Load**. Other fuels for peak heat demand

*FIRST Heat should only be used as proof of concept*
Financial Considerations

- Economic calculations conducted using **Levelised Cost of Energy LCOE**
- LCOE expresses the **lifecycle cost of energy** from a system per unit of energy delivered.
- Typically **competitive with or lower than conventional energy** in communities with no or restricted access to natural gas

<table>
<thead>
<tr>
<th>Cost of Energy</th>
<th>$/GJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>20.9</td>
</tr>
<tr>
<td>Propane (commercial supply)</td>
<td>19.5</td>
</tr>
<tr>
<td>Heating oil</td>
<td>31.0</td>
</tr>
<tr>
<td>LCOE for biomass district heat system (typical)</td>
<td>13-18</td>
</tr>
</tbody>
</table>

- Biomass is a low cost fuel, but the **high capital cost** of district energy systems raises the cost of delivered energy
# FIRST Heat Dashboard

## Community Energy Systems Data Table

<table>
<thead>
<tr>
<th>Year</th>
<th>Data</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2023</td>
<td>kWh</td>
<td>Total Energy Use</td>
</tr>
<tr>
<td>2024</td>
<td>kW</td>
<td>Total Heat Production</td>
</tr>
</tbody>
</table>

## Energy Savings Opportunities

- **District Energy Systems**: Cost savings estimated at $50,000.
- **Site Energy Systems**: Potential for 20% energy reduction.
- **Energy Efficiency Measures**: Potential for 15% energy reduction.

## Energy Consumption

- **Electricity**: 20% reduction expected.
- **Natural Gas**: 15% reduction expected.

## Energy Validation

- **Data Validation**: All data verified by trusted sources.
- **Accuracy**: Data accuracy verified at ±5%.

## Contact Information

For further information, please contact:

- **Community Energy Coordinator**
  - Email: communityenergy@bc.ca
  - Phone: 123-456-7890

Visit our website for more information:

www.communityenergy.bc.ca
FIRST Heat Dashboard

Characterize your forest: Select the most similar from the options below

**Forest Type**
A. SBS: Cold Sub-Boreal Spruce / pine (like Burns Lake)
B. Mature (80-160 years) forest
C. Minimum tree density recommended by FireSmart

**Fire Risk Management Level**
C. forests stands at high risk to wildfire and available for long term management

**Management Zone (within 25 km of Community)**

**Area of Management Zone (Ha)**
10,000
**FIRST Heat Dashboard**

### PRELIMINARY RESULTS

#### BIOENERGY

<table>
<thead>
<tr>
<th>AVAILABLE</th>
<th>Yr 1-11</th>
<th>Yr 12-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass from fire management</td>
<td>427,620 t/yr</td>
<td>1,010 t/yr</td>
</tr>
<tr>
<td>Biomass available for heating</td>
<td>299,334 t/yr</td>
<td>707 t/yr</td>
</tr>
<tr>
<td><strong>Bioenergy available</strong></td>
<td><strong>3,343,562 GJ/yr</strong></td>
<td><strong>7,900 GJ/yr</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor</th>
<th>Yr 1-11</th>
<th>Yr 12-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Fossil energy heating use</td>
<td>Needs opt. data</td>
<td>GI/yr</td>
</tr>
<tr>
<td>Available bioenergy as % of community fossil heating</td>
<td>Needs opt. data</td>
<td>GJ/yr</td>
</tr>
<tr>
<td>Proposed bioenergy consumption as % of available</td>
<td>0.24%</td>
<td>100.00%</td>
</tr>
<tr>
<td>Potential Annual export revenue (no local bioenergy)</td>
<td>$1,339,902</td>
<td>$3,166</td>
</tr>
</tbody>
</table>

#### Bioenergy considerations

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential of soil fertility loss in 50 yrs</td>
<td>MODERATE</td>
</tr>
</tbody>
</table>
## Maximum bioenergy systems size, based on yrs 11-50

### Overview
- Max sustainable thermal output by bioenergy systems: 6,715 GJ/yr
- Thermal output for corresponding peaking systems: 746 GJ/yr
- Total DH thermal output, inc. efficiency losses: 6,584 GJ/yr
- Max thermal rated capacity of bioenergy systems: 500 kW

### Capital Cost - energy systems
- $1,310,000

### Jobs from energy systems construction phase
- 8 FTE's

### Jobs at energy systems, from energy systems operation
- 0.3 FTE's

### Jobs from harvesting fuel
- 0.7 FTE's

### $ spent on biomass by bioenergy systems
- $35,364

### Max commercial m² heatable by biomass, yrs 11-50
- 9,167 m²/yr

### Economics & GHGs

<table>
<thead>
<tr>
<th>Levelized Cost of District Heat</th>
<th>$/GJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(natural gas peaking)</td>
<td>$20.82</td>
</tr>
<tr>
<td>(electricity peaking)</td>
<td>$22.27</td>
</tr>
<tr>
<td>(propane peaking)</td>
<td>$22.09</td>
</tr>
<tr>
<td>(heating oil peaking)</td>
<td>$23.62</td>
</tr>
</tbody>
</table>

### Local energy savings

<table>
<thead>
<tr>
<th>Annual local energy savings</th>
<th>Needs opt. data</th>
</tr>
</thead>
<tbody>
<tr>
<td>(natural gas peaking)</td>
<td>$0</td>
</tr>
<tr>
<td>(electricity peaking)</td>
<td>$6,709</td>
</tr>
<tr>
<td>(propane peaking)</td>
<td>$5,518</td>
</tr>
<tr>
<td>(heating oil peaking)</td>
<td>$15,583</td>
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</tbody>
</table>

### GHG reduction

<table>
<thead>
<tr>
<th>GHG reduction</th>
<th>Needs opt. data</th>
</tr>
</thead>
<tbody>
<tr>
<td>(natural gas peaking)</td>
<td>321</td>
</tr>
<tr>
<td>(electricity peaking)</td>
<td>359</td>
</tr>
<tr>
<td>(propane peaking)</td>
<td>312</td>
</tr>
<tr>
<td>(heating oil peaking)</td>
<td>294</td>
</tr>
</tbody>
</table>
Conclusions

- Biomass energy can benefit rural and remote communities
- FIRST Heat tool is a simple and scientific means of determining the viability of biomass heating in local communities.
- FIRST Heat
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