Common Definitions in Bioenergy and How They Relate to My Forest

Green Heat Initiative
BC Community Forest Association AGM

June 10 2010, 100 Mile House, BC

Welcome

- History of Northern Rural and Remote Communities Green Heat Initiative
- Funding Provided by:
  - Cariboo Chilcotin Beetle Action Coalition (CCBAC)
  - Southern Interior Beetle Action Coalition (SIBAC)
  - Province of BC Mountain Pine Beetle Response Division
  - Community Futures REDI Program

Goals of GHI

- Help Develop Green Heat Systems
- Raise awareness and educate around heating with biomass
- Help develop *bioenergy* heating industry in BC
- MoU with BC Bioenergy Network anc Community Energy Association

Men are from Mars and Women are from Venus

- Most forest professionals deal with saw log volumes
- Most Heating system designers deal with the absolute amount of energy regardless of moisture, bark, needles, etc.
  - Bone Dry Tonnes (BDT)
  - Oven Dry Tonnes (ODT)
  - Bone Dry Unit (BDU)

Converting Cubic Metres to Tonnes

- Simple Equation
  Weight = Volume X Density
- What is the density of my wood?
- Density depends on Moisture Content (MC), species mix, bark content, etc.
- What is the Moisture Content (MC) of my wood?

Solid Wood Densities

Species	Density kg/m³		Specific Gravity at 12 % MC
	Green	Air Dry	
Lodgepole Pine	410	430	.41
Ponderosa Pine	438	459	.44
Sitka Spruce	347	387	.35
Douglas Fir	450	487	.45
Hemlock	420	429	.42

Source: Province of BC, website http://www.naturallywood.com/resources

Moisture Content

Dry Basis vs. Wet Basis

MC_{dry} = 100% X (wet weight – dry weight) / dry weight

MC_{wet} = 100% X (wet weight – dry weight) / wet weight

Converting between Wet and Dry Basis

MC_{dry} = 100% X MC_{wet} / (1 - MC_{wet})

MC_{wet} = 100% X MC_{dry} / (1 + MC_{dry})

Reference Points

50% MC_{wet} = 100 % MC_{dry}

20% MC_{wet} = 25 % MC_{dry}

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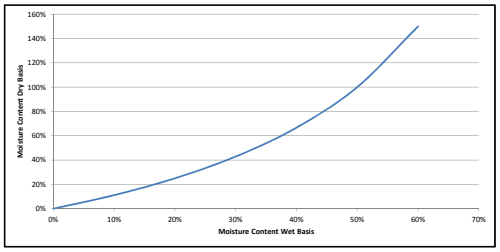
Moisture Content - Wet vs. Dry



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CAUTION

"In extensive online research for reference sources that could provide guidance on estimating biomass per unit area from volume data (eg m^3, ft^3, or board feet), several sources of conversion factors and "rules of thumb" were found that provided insufficient information to discern whether the reference was applicable to estimation of biomass availability. These "rule of thumb" guides can be useful when fully understood by the user, but they can be easily misinterpreted by someone not understanding the guides intent"

– Biomass Energy Data Book 2010
http://cta.ornl.gov/bedb

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Energy by the Numbers

- Absolute measures of Energy
  - **1 gigajoule (GJ) = 278 kilowatt hours (kWh) = 948,000 British Thermal Units (BTU)**
- Heating System Outputs are expressed as a measure of energy over time i.e. BTU's/hr, kW or Horse Power (typically industrial steam applications)
- Energy is sold in various forms i.e. GJ (natural gas), l (Propane, fuel oil), kWh (electricity), m^3 (natural gas), kg (pellets), cords (firewood)

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Important Energy Terms

Lower Heating Value = Net Calorific Value

"The amount of heat released by combusting a specified quantity (initially at 25°C) and returning the temperature of the combustion products to 150 °C, which assumes the latent heat of vaporization of water in the reaction products is not recovered. Frequently used in Europe"

Higher Heating Value = Gross Calorific Value = Gross Energy Value

"The amount of heat released by a specified quantity (initially at 25°C) once it is combusted and the products have returned to a temperature of 25°C, which takes into account the latent heat of vaporization of water in the combustion products. These values are only derived under laboratory conditions and are frequently used in the US for Solid Fuels"

Source: Biomass Energy Data Book – 2010 – Http://cta.ornl.gov/bedb

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Energy Content of Softwood

- Most Wood species have similar energy content on a mass basis
- Higher Heating Value 18.6 – 21.1 GJ/tonne
- Lower Heating Value 17.5 - 20.8 GJ/tonne
- Based 6 reference sources
- Typical higher heating value at 0 % MC is 19.8 GJ/tonne

Source: Biomass Energy Data Book – 2010 – Http://cta.ornl.gov/bedb

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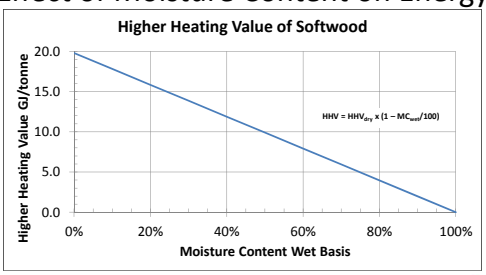
Effect of Moisture Content on Energy



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Comparing Different Types of Energy[1]

Fuel Type	Unit Sale size	Energy Content of Unit	Units required for 1 GJ	Retail Price	Typical cost in BC[2]
Natural Gas	GJ	1 GJ/GJ	1 GJ	$11-19/GJ	$11-19/GJ
Propane	Litres	0.0253 GJ/l	39.5 l/GJ	$0.48-0.63/l	$19-25/GJ
Electricity	kWh	0.0036 GJ/kWh	278 kWh/GJ	¢6.8-8.3/kWh	$19-23/GJ
Heating Oil	Litres	0.0387 GJ/l	25.8 l/GJ	$0.74-0.97/l	$19-25/GJ
Ponderosa Pine [3]	Cord	17.9 GJ/cord	0.056 cord/GJ	$200-250/cord	$11-14/GJ
Pellets (Retail)	Tonne	19.2 GJ/tonne	0.052 tonne/GJ	$175-210/tonne	$9-11/GJ

Source: Reeb, J.E; "Comparing Other Energy Sources with Firewood and with Wood Pellets, Jan. 2009
Government of Canada, National Energy Board , energy conversion tables"http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/sttstc/nrgyconvrsntbl/nrgyconvrsntbl-eng.html" Accessed September 2010
1) Energy Values are reference values only
2) Based on GHI observations and assessments
3) Approximate values for wood based on a cord of firewood equal to 85 cubic feet and 20 % Moisture wet basis and $200-250/cord

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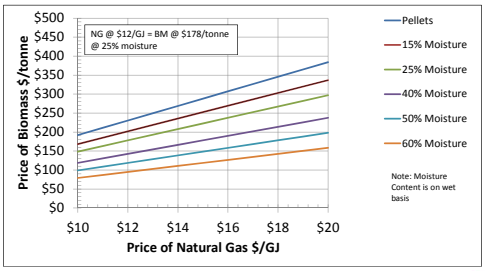
Cost of Natural Gas to Biomass



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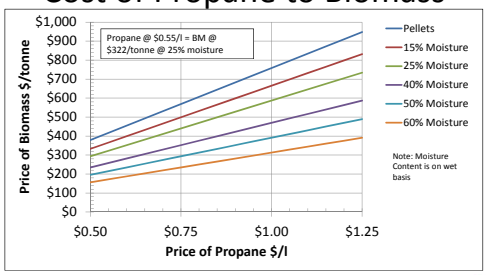
Cost of Propane to Biomass



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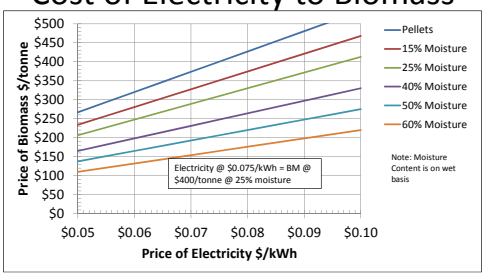
Cost of Electricity to Biomass



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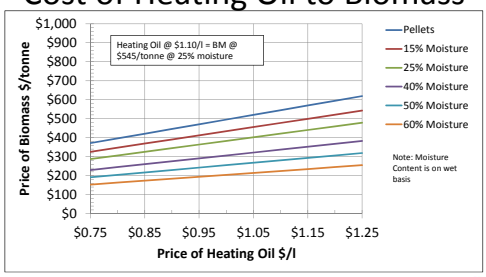
Cost of Heating Oil to Biomass



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Final Thoughts

1) There are some large projects but most commercial biomass heating projects in BC will be 100 kW – 1500 kW
2) These projects will consume 50 – 1000 bone dry tonnes
3) Approximately 70% of total energy usage in residential and commercial sector in BC is for Space Heating and domestic hot water
4) Currently 5% of this energy is biomass
5) Increasing to 15% would require 1,000,000 Bone Dry Tonnes of biomass
6) This 10% increase currently costs consumers $340,000,000/year
7) This $340,000,000 is spread out across BC and is in your local area
8) **BC needs to develop the fuel supply infrastructure**

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Connecting to GHI

www.greenheatinitiative.com

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