Biomass Estimations

Unit conversions

$ha := 0.01\ km^2$
$t := 1000\ kg$
$kJ := 1000\ J$
$MJ := 1000\ kJ$ $MWh := 3600\ MJ$
$GJ := 1000\ MJ$ $kWh := 0.001\ MWh$ $GWh := 1000\ MWh$

Energy Calculations

$RotYrs := 60$ Rotation period for Spruce[2]
$A := 130\ ha$ Estimated Area [3]
$ForDens := 4 \cdot RotYrs \cdot m^3\ ha^{-1}$ Vol production/yr on peaty soil[2]
$VolEiggForest := ForDens \cdot A$
$VolEiggForest = (3.12 \cdot 10^4)\ m^3$ *This is the total volume of wood in Eigg's forest after 60 years (full unmanaged growth)*

Method 1 - BMEC by weight & Calorific Value [1]

$C1 := 1.3\ MWh \cdot m^{-3}$ [4]
$Energy1 := C1 \cdot VolEiggForest$
$Energy1 = 40.56\ GWh$

$C2 := 4.6\ GJ \cdot m^{-3}$ [4]
$Energy2 := C2 \cdot VolEiggForest$
$Energy2 = 39.867\ GWh$

Method 2 - From SFA guide (from green and dry weight)

$EnergyDens := 1705\ kWh \cdot t^{-1}$ Energy Densty per green tonne [6]
$GreenDens := 920\ kg \cdot m^{-3}$ Density for Sitka Spruce [5]
$W1 := GreenDens \cdot VolEiggForest$ Wet weight
$W1 = (2.87 \cdot 10^7)\ kg$
$MC1 := 0.60$ [4]
$MC2 := 0.2$ [4]

$W2 := \frac{W1 \cdot (1 - MC1)}{1 - MC2}$ [4] Dried Weight
$W2 = (1.435 \cdot 10^7)\ kg$

$Energy3 := W1 \cdot EnergyDens$
$Energy3 = 48.94\ GWh$

$ED := 12 \cdot MJ \cdot kg^{-1}$
$Energy4 := ED \cdot W2$
$Energy4 = 47.84\ GWh$

How much is this?

$yrDem := 466\ MWh$ Yearly Energy Demand = 466MWh on Eigg with insulated houses (630MWh without, 23.7%)

$pessimistic := 0.225\ Energy2$ 20-25% efficient stoves usually for space heating, the rest goes up flume/chimney as discussed - (20% for fireplace, 25 for wood stove. Assume at least half the homes have stoves.) [7,8]

$pessimistic = 8.97\ GWh$ 8.97 GWh by burning whole forest, must stretch this over 40 years!

$EnergyPerYr := \frac{pessimistic}{RotYrs} = 149.5\ MWh$ The amount of evergy available per year.

$YrsFromWhole := \frac{pessimistic}{yrDem} = 19.249$ How many years can whole forest supply?

$$\frac{EnergyPerYr}{yrDem} = 0.321$$

30% of space heating demand can be supplied each year.

References

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