SUPPORTING ONLINE MATERIAL

ASSESSING TEMPORARY CARBON SEQUESTRATION AND STORAGE PROJECTS THROUGH LAND-USE, LAND-USE CHANGE AND FORESTRY: COMPARISON OF DYNAMIC LIFE CYCLE ASSESSMENT WITH TON-YEAR APPROACHES

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Details of the "fire multi gas scenario"

For the "fire multi gas scenario", the assumptions of the "fire scenario" were adopted, i.e. 74% of the sequestered carbon is released the year following the end of the project. However, the carbon emissions are now assumed to be CO_2 and CH_4. Amiro et al. (2009) have studied the GHG emissions coming from Canadian boreal forest fires. They used emission factors from the database developed by Andreae and Merlet (2001) that express the mass of different gases emitted per unit mass of dry fuel.

For this study, the amount of carbon released by the fire is divided between CO_2 and CH_4 emissions proportionally to their respective emission factor (see Equations 1 and 2).

$$\frac{E_{CO_2}}{E_{CH_4}} = \frac{\varepsilon_{CO_2}}{\varepsilon_{CH_4}} = \frac{1{,}569\ g/kg\ fuel}{4.7\ g/kg\ fuel} \qquad (1)$$

$$E_{CO_2} \times 0.2727 \frac{kg\ C}{kg\ CO_2} + E_{CH_4} \times 0.75 \frac{kg\ C}{kg\ CH_4} = E_c \qquad (2)$$

where E is the total weight emission (kg) and ε is the emission factor (g/kg$_{fuel}$). A dynamic LCI is computed for CO_2 and CH_4 and the time-dependent potential impact on global warming $GWI_{inst}(t)$ is determined for each gas (see Equation 3) and added together to give the total impact.

$$GWI_{inst}(t) = \sum_{i=0}^{t} g(i) \times DCF(t-i) \qquad (3)$$

Details of the "landfill scenario"

The "landfill scenario" is the same than the "exploitation scenario", except that the carbon released by the burning of the wooden residues at t=70 years is divided between CO_2 and $CH_{4,}$ as shown in the previous section, and the building materials are landfilled at t=145 years. Wood in landfills is poorly degraded because of the presence of lignin, and the maximum weight proportion of carbon in wood converted respectively into CO_2 and CH_4 is 1.3 % and 1.9% (Micales and Skog 1997). Sich and Barlaz (2000) propose an equation from a study by SWANA (see Equation 4) to determine the time-dependent emissions of CO_2 and CH_4 coming from landfills for different types of waste. This equation is used to get a dynamic inventory of the end-of-life of the building materials, which is added to "landfill scenario".

$$G_{time} = \left[\left(-(k+s)e^{-k(time-lag)} + k\,(e^{-(k+s)(time-lag)}) + s \right) \times \frac{L_o}{s} \right] \qquad (4)$$

G_{time} [g/g] is the total landfill gas (CO_2 or CH_4) per mass of wood generated over a given time horizon *time*, k [years^{-1}] is the first order decay rate constant, s [years^{-1}] is the first order rise phase constant, *lag* [years] is the time between placement and start of gas generation and L_o [g/g] is the maximum landfill gas yield per unit mass of waste. Table 1 presents the values used for the different parameters in Equation 4.

Table 1 Values of the parameters used in Equation 4

Parameter	Value	Reference
k	0.03 $years^{-1}$	Sich and Barlaz 2000
s	1 $years^{-1}$	
lag	1 year	
L_o (CO_2)	0.0243 g/g	Micales and Skog 1997
L_o (CH_4)	0.0129 g/g	

References

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