

Greenhouse gas emission calculations for forest operations involving residues

Reid Miner, NCASI
Research Triangle Park, NC

Presented to workshop on
Incorporating Bioenergy into Sustainable Landscape Designs
March 4-6, 2014
New Bern, North Carolina

Calculation frameworks

- Attributional
 - What are *actual net emissions* over a given time and area from a “system” using forest residues for energy?
- Consequential
 - What is the consequence, in terms of GHG emissions, of using forest residues for energy?
 - One consequence is that you avoid the emissions associated with whatever fate awaited the residues had they not been used for energy
 - Requires selecting and modeling of a “counterfactual” scenario

Forest Residues: Only biogenic GHGs

- Attributional results (actual emissions)
 - Net zero emissions of biogenic carbon and biogenic CO₂ if carbon stocks are stable
 - spatial scale and time period are important
 - Emissions include small amounts of biogenic CH₄
- Consequential results (emissions compared to non-use)
 - Long-term net emissions of biogenic GHGs
 - close to zero if almost all carbon returns to atmosphere as CO₂
 - less than zero if CH₄ is produced by decomposing residues
 - Timing of emissions (“carbon debt”)
 - Depends primarily on alternative fate (burn in forest or leave to decay)
 - If alternative fate is leaving in forest to decompose, depends on decay rate and amount of methane formed during decomposition
 - Timing is very uncertain when based only on biogenic GHGs

Forest Residues: All GHGs

- Attributional results (actual emissions)
 - Net zero emissions of biogenic CO₂ if carbon stocks are stable
 - Combustion produces small amounts of biogenic CH₄ and N₂O
 - Fossil fuel-related emissions from forest management, transport and processing
- Consequential results (emissions compared to non-use)
 - *Long-term* net emissions of all GHGs (incl. fossil fuel for energy)
 - Total of all GHGs is less than zero (i.e. alternative system using fossil fuel for energy essentially always has higher long-term emissions)
 - Timing of emissions (“carbon debt”)
 - Still uncertain but less so when considering all GHGs
 - Depends primarily on conversion efficiencies (fuel to energy) and alternative fate of residues
 - If alternative fate is leaving in forest to decompose, depends on decay rate and amount of methane formed during decomposition
 - Debt period for forest residues typically zero years to several years
 - Long debt periods only for analyses involving alternative scenarios where residues decay in the forest, and decay rates are slow and there is no methane formed in the decomposition process