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Comment

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Comment on "Australian wood heaters currently increase global warming and health costs"

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The recent article by Robinson (2011) "Australian wood heaters currently increase global warming and health costs" compared emissions of greenhouse gases sourced from firewood with heating associated with fossil fuels. The paper challenged the commonly accepted view that because wood heaters use a renewable resource they are greenhouse neutral or potentially greenhouse positive if substitution for fossil fuel is included. Robinson (2011) draws conclusions to the contrary stating that "Claims that wood heating is greenhouse neutral are incorrect", "…global warming from methane emissions of a wood heater in the living room… are similar to carbon dioxide (CO_2) emissions from heating an entire 160 m^2 house with gas' and that, "…wood heating could be considered to cause more than 10 times as much global warming as gas or reverse cycle–air conditioning". Below we show these conclusions are incorrect, primarily due to an incomplete life cycle assessment of biomass–based feedstocks. Assumptions on the atmospheric impact of these emissions are also critical to the calculated result.

Robinson (2011) compared emissions of greenhouse gases from firewood with those from fossil fuel sources for an average household of 160 m^2 across five of the capital cities in Australia. Results were presented as tonnes of greenhouse gases emitted per household with greenhouse gas mass normalized to CO_2 equivalents (CO_2–e) as defined by IPCC. The main methodology and assumptions were:

(1) Methane (CH_4) and carbon monoxide (CO) were included as greenhouse gases emitted during burning rather than just CO_2.

(2) Only gross greenhouse gas emissions were considered from wood heating. Robinson stated that "It could be argued that the depletion of this non–renewable resource (degrading woodland) is equivalent to the depletion of fossil fuel reserves".

(3) Wood heaters were assumed to require supplementary heating. This is based on the argument that wood heaters were highly inefficient, not well regulated and therefore more energy is released to have the same desired heating effect compared with thermostatically controlled heating.

(4) The global warming potential (GWP) of CO_2 and CH_4 was varied to consider a 20–year time frame in addition to the accepted 100–year standard of the IPCC.

The first three assumptions relate to the boundaries of the lifecycle analysis, while the fourth relates to the impacts on future climate. Robinson's conclusions are sensitive to all four. Our previous analyses (Paul et al., 2006) calculated net emissions of CO_2 from three types of firewood production systems in Australia (degrading woodland, native forest sustainably managed for saw–logs and new plantations established on cleared land for firewood production). These systems were modeled to reflect the realistic range of firewood sources in Australia and were developed with reference to the extensive report of Driscoll et al. (2000) that provided the most up–to–date information of national patterns of firewood production (sources of wood, species, method of collection, etc) and consumption. Following IPPC conventions, we accounted for all CO_2 fluxes over a 100–year time frame including on–site forest carbon balance, emissions from harvesting and transport and release during combustion. Methane and CO emissions were not considered in our original analysis but are included below.

Our original results showed that, on average, net CO_2 emissions ranged from –0.17 to 0.11 kg CO_2/kW hr depending on the firewood system examined, where a negative number indicates net sequestration of CO_2. This is less than net emissions of 0.31 to 1.0 kg CO_2/kW hr for heating sourced from a range of fossil fuel types (AGO, 2002). To allow for the impacts of CH_4 and CO emissions from wood heaters we adjusted our initial results of Paul et al. (2006) to include Robinson's estimate of 848 g CO_2–e per kg of wood burnt for CH_4 and CO combined. This increased our calculated emissions to –0.01 to 0.27 kg CO_2–e/KW hr which is still equivalent to, or less than, fossil fuel sources of energy. This calculation also conservatively assumes that no CH_4 or CO is ever released by wood left in the field if not collected for home heating. Therefore, we conclude that inclusion on CH_4 and CO makes only a modest difference to calculated results.

The most critical of Robinson's assumptions is likening firewood to fossil fuels. This explicitly assumes that wood is inert and never releases greenhouse gases until it is burnt in a wood heater. Driscoll et al. (2000) reported that of the about 5 million tonnes of firewood used annually in Australia, 76% is sourced as fallen timber and 18% as standing dead trees. Some fuel is residue from forest logging or clearing activities. Thus, by far the majority of wood is dead and would emit greenhouse gases anyway through natural decay or as a result forest burning, including prescribed fuel reduction, forest regeneration fires following timber harvesting, and wildfire. In many of the firewood systems in Australia, there is constant mortality and regrowth (Driscoll et al. 2000), carbon therefore being continually emitted to the atmosphere and sequestered in live vegetation. The key question that needs to be answered is: "What is the difference between emissions due to firewood collection for home heating and those which would have occurred anyway if the wood was left in the field to decompose or be burnt?"

To compare our results from a more complete life cycle assessment with those of Robinson (2011), we revised our calculations to express results on a per household basis, included CH_4 rather than just CO_2 and used standard IPCC global warming potentials (100 years) and greenhouse gas accounting methodology. Emissions of greenhouse gases from wood heating ranged from being about 10 times less than burning fossil fuels (such as when the wood residues were burnt in the field anyway to release CH_4) to being about on par with fossil fuels (assuming no CH_4 release from residues left in the field). We did not include any possible benefit of substituting firewood for, say, natural gas (e.g. Marland and Schlamadinger, 1997) which increases the green–house gas benefit. In contrast, Robinson (2011) assumes that, for all of Australia, all of the wood collected and burnt in home heaters would never emit greenhouse gases if left in the field.

When undertaking life cycle assessment, standard methodology is to consider long time frames so that an average condition is accounted for which reflects past events as well as current and future. Robinson argues that, given the possibility that the scientific consensus impacts from climate warming presented in the most recent IPCC assessment (AR5) is conservative, 20–year global warming potentials may be more appropriate for lifecycle analysis. The assumption has a large impact on the conclusions with respect to magnitude and possibly sign.

Finally, there seems little justification for using supplementary heating as an assumption. This is undoubtedly true for some households but for others it clearly would not be the case. Using a constant proportion of supplementary heating that is applied to all households with wood heating therefore seems inappropriate.

The conclusions of Robinson (2011) cannot be supported. The aggregated emissions from using firewood in Australia will largely depend on the forest systems from which the wood is sourced and the baseline condition for their natural decay and regrowth. Calculating net emissions, like all modeling exercises, relies on the veracity of many input assumptions and internal model parameters. There may be some instances where use of firewood emits relatively large amounts of greenhouse gases compared to a reference condition such that fossil fuels are the better alternative. This, for example, would be where living trees are specifically harvested for firewood (that is, trees that would otherwise have been left in ground) and those trees are not replaced by new growth, or if the wood is burnt in an inefficient heater. However, the evidence suggests that for most firewood systems (regions) in Australia where wood decomposes anyway or is burnt in the field, fewer greenhouse gases are emitted in home heating than from use of fossil fuel alternatives. The impact is magnified if wood heating substitutes for use of fossil fuels.

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