

## CORRESPONDENCE:

## Policy institutions and forest carbon

**To the Editor** — Macintosh *et al.*<sup>1</sup> claim to apply a life-cycle assessment (LCA) approach to evaluate the greenhouse gas (GHG) emissions impacts of alternative forest management options. Although we agree with their basic assertion that policy impacts should be considered in such analyses, we identify three issues with their methods and interpretation. Consequently, they fail to quantify the likely GHG emissions impacts of the alternatives compared, and their conclusion overlooks the deficiencies in current policies that are revealed in their results.

As defined by the International Standards Organization<sup>2–3</sup>, LCA aims to examine the full impacts of a process or product, and therefore includes upstream and downstream impacts so that the shifting of burdens between life-cycle stages, impacts and regions of the world do not go unnoticed. In contrast, Macintosh *et al.*<sup>1</sup> apply a constrained model in their ‘basic’ and ‘national’ scenarios, excluding those parts of the life cycle that occur abroad, in order to align with a nation’s GHG emissions obligations. They claim to apply LCA terminology to policy institutions, defining three categories: macro, attributional and consequential. However, only the latter two terms align with recognized LCA methods. The effects of policies can be modelled attributionally<sup>4</sup> or consequentially<sup>5</sup>, but it is not clear to us which approach the authors used, or a mixture thereof. Macintosh *et al.*<sup>1</sup> present 16 scenarios, applying different system boundaries across three different accounting approaches comprising permutations with or without harvest, and with or without bioenergy. It is not clear how these relate to macro, attributional or consequential policy institutions. Furthermore, we find the distinction between consequential and attributional policy institutions unclear. Macintosh *et al.*<sup>1</sup> define attributional policy institutions as the rules and procedures used to assign responsibility for GHG emissions between actors, whereas consequential

policy institutions are those intended to effect behavioural change. They classify GHG accounting rules as attributional, however, these rules are intended to influence behaviour in order to achieve policy objectives<sup>6,7</sup>. Thus, we consider that the methods used do not constitute LCA, and that their application of LCA terminology to classify policy institutions is inaccurate and potentially confusing.

Macintosh *et al.*<sup>1</sup> do not use an analytical approach such as economic modelling<sup>5</sup> to analyse the effects of policy institutions on Australia’s emissions. Rather, they assume these effects. They assume that caps on emissions create a floor and ceiling, so that, whatever the change in the system being modelled, there will be no net effect on emissions. Similarly, they assume that the existence of a renewable energy target means that bioenergy will displace other renewables and not reduce net emissions, as gains from product and fuel substitution are counterbalanced by assumed emission increases in other sectors. We note that any renewable option could be disregarded as non-beneficial with this approach.

Under these constrained assumptions, Macintosh *et al.*<sup>1</sup> show that ceasing harvest in the study region would have very little impact on global GHG emissions. However, their results reveal that the current GHG accounting methods calculate an apparent substantial climate benefit from cessation of native forest harvest, when in fact there may be none. Thus, Australia could earn substantial credit for ceasing native forest harvest despite the lack of true emissions reductions. Such credits would allow other sectors to increase emissions, making it easier for Australia to reach its target without implementing the society-wide systems transformation that is needed to meet longer-term climate stabilization targets. The authors did not comment on these perverse outcomes.

Macintosh *et al.*<sup>1</sup> illustrate that alternative accounting systems significantly affect the apparent climatic impacts of forest

management options. Indeed, the value of their paper is that it shows the sensitivity of results to the choice of system boundary and modelling assumptions. The obvious conclusion to be drawn from their study is that current GHG accounting approaches need revision. We suggest that such revisions should be guided by comprehensive assessments that include full life-cycle emissions, compare equivalent scenarios and reflect market dynamics, in order to analyse the potential impacts of policy institutions. □

## References

1. Macintosh, A., Keith, H. & Lindenmeyer, D. *Nature Clim. Change* **5**, 946–949 (2015).
2. *Environmental Management — Life Cycle Assessment — Principles and Framework* ISO 14040:2006 (International Standards Organization, 2006).
3. *Environmental Management — Life Cycle Assessment — Requirements and Guidelines* ISO 14044:2006 (International Standards Organization, 2006).
4. Wardenaar, T., van Ruijven, T., Beltran, A., Vad, K., Guinée, J. & Heijungs, R. *Int. J. Life Cycle Assess.* **17**, 1059–1067 (2012).
5. Bento, A. & Klotz, R. *Environ. Sci. Technol.* **48**, 5379–5387 (2014).
6. Höhne, N., Wartmann, S., Herold, A. & Freibauer, A. *Environ. Sci. Pol.* **10**, 353–369 (2007).
7. Ellison, D., Lundblad, M. & Petersson, H. *Environ. Sci. Pol.* **14**, 1062–1078 (2011).

Annette Cowie<sup>1,2\*</sup>, Fabiano Ximenes<sup>2,3</sup>, Göran Berndes<sup>4</sup>, Miguel Brandão<sup>5,6</sup>, Patrick Lamers<sup>7</sup> and Gregg Marland<sup>8</sup>

<sup>1</sup>NSW Department of Primary Industries, Armidale, New South Wales 2351, Australia.

<sup>2</sup>University of New England, Armidale, New South Wales 2351, Australia. <sup>3</sup>Forest Science, NSW Department of Industry and Lands, Parramatta, New South Wales 2150, Australia.

<sup>4</sup>Chalmers University of Technology, Gothenburg, SE-412 96 Gothenburg, Sweden. <sup>5</sup>KTH Royal Institute of Technology, Industrial Ecology, S-100 44 Stockholm, Sweden. <sup>6</sup>Department of Bioeconomy and Systems Analysis, Institute of Soil Science and Plant Cultivation, 24-100 Pulawy, Poland.

<sup>7</sup>Idaho National Laboratory (INL), Idaho Falls, Idaho 83415, USA. <sup>8</sup>Research Institute for Environment, Energy and Economics, Appalachian State University, Boone, North Carolina 28608, USA.

\*e-mail: [annette.cowie@dpi.nsw.gov.au](mailto:annette.cowie@dpi.nsw.gov.au)

## Reply to ‘Policy institutions and forest carbon’

**Macintosh *et al.* reply** — Cowie *et al.* make a number of claims about our analysis, all of which we believe to be misguided. For example, they claim our ‘basic scenarios’

excluded “those parts of the life cycle that occur abroad,” even though our article explicitly states otherwise. They also claim it is unclear whether we applied an attributional

or consequential approach to life-cycle assessment (LCA), despite the opening paragraph clearly stating that the article is concerned with consequential LCA (CLCA).