Why Aim For Net Zero CO_2 Emissions by 2050? - Australia Is Already There!

Dr Bill Burrows FTSE

1. Australia has adopted the position that *"for the Paris Agreement all net emissions from all lands (in Australia) will be accounted for – without restriction - using the independent monitoring systems of the national inventory.* (So) *through the national inventory there is complete coverage of the land sector in the Government's target acquittal".* [Emphases added]. {See: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Environment_and_Energy/ClimateBills2020/Submissions #588, p.13}. By way of contrast, for the Kyoto Protocol only c.1% of Australia's land mass was actually taken into account in determining net emissions from the LULUC&F sector {above link: p.12}.

2. France (host of the Paris Agreement negotiations) aims to accelerate the implementation of this Agreement by setting *"a national inventory target of achieving carbon neutrality by 2050 within French territories, this being understood as achieving a balance between anthropogenic emissions and anthropogenic absorption of greenhouse gas, i.e. that which is absorbed by the natural environment managed by man (forest land, grassland, agricultural soils, wetlands, etc.) and certain industrial procedures (carbon capture, storage and reuse)".* In a nutshell this means France, a major EU economy, will utilise sinks from its LULUC&F sector to balance emissions generated by unavoidable consumption of fossil fuels. {See: https://unfccc.int/sites/default/files/resource/en_SNBC-2_summary_compl.pdf p.2; Fig.1 p.3}.

3. The Department of Industry, Science, Energy and Resources states that the Full Carbon Accounting Model (FullCAM) is used for carbon accounting in Australia's land sector of the national inventory. {See: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Environment_and_Energy/ClimateBills2020/Submissions #588, p.9}.

4. Using a model (FullCAM) to estimate C fluxes over all lands in Australia (Point 1 above) – an area of c.769 M ha – is problematic to say the least. Especially so given the lack of validation of the accuracy and precision of the model's outputs over this huge area, combined with the complexity of the soils, vegetation, variable weather patterns and superimposed management – that all impact C flux and the utility of bottom-up biosphere models.
Consider soil organic carbon (SOC). This is a dominant component of C stores and flows. It comprises >50% of all organic C contained within the rooting depth of vegetation together with above + below ground organic matter in the LULUC&F sector. Yet SOC is not evenly distributed within soils, either vertically or horizontally. This means that intense sampling is required to obtain an accurate record of its pool size and flux over even small areas. As the target size increases the sampling error for the estimated C flux commonly exceeds the flux that is claimed. Hence the result is not fit for purpose, certainly at a continental scale.

5. Alternatively, spectral sensors positioned on satellite based platforms (e.g. GOSAT and OCO-2) provide accurate data on the column averaged dry air mole fraction of CO_2 (XCO_2) measured from the top of the atmosphere to the earth's surface. The observations integrate all sources and sinks contributing to the air column from the land beneath. They provide the robustness, spatial coverage and sampling intensity/frequency, as well as the accuracy and precision necessary to determine the Australia wide flux inversion of column averaged CO_2. They also make it possible to estimate the distribution and magnitude of CO_2 in regions that have sparse *in situ* surface atmospheric monitoring (https://doi.org/10.5194/acp-21-6663-2021). See: http://adsabs.harvard.edu/abs/2015EGUGA..1712580M for more insights.

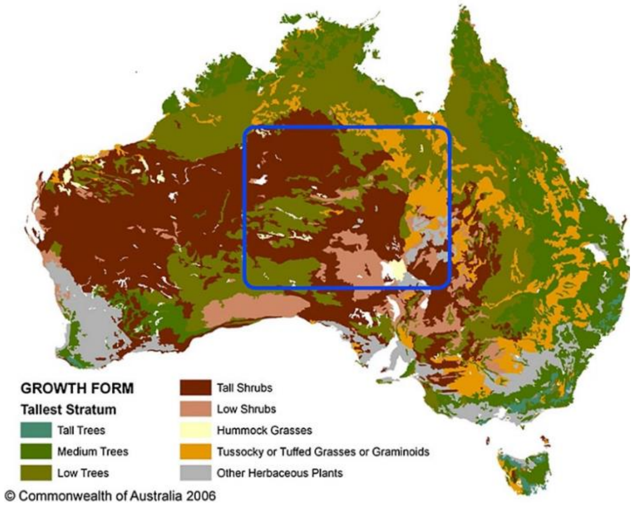
6. The developing methodology underlying this inversion procedure is reported *inter alia*, in Detmers et al. (2015 – updated 23 Jan 2017) {https://doi.org/10.1002/2015GL065161}, Chevallier et al. (2019) {https://doi.org/10.5194/acp-19-14233-2019 } and Yang et al. (2021)

{https://doi.org/10.1007/s00376-021-1179-7}. The first two studies reveal a natural ("managed land") flux in Australia of 770 ± 110 M t CO_2/yr (net sink c.366 Mt CO_2 after subtracting fossil fuel sources in 2011) and a natural flux of c.697 Mt CO_2/yr (net sink c.282 Mt CO_2 after subtracting fossil fuel sources in 2017) respectively. [The inferred natural flux for 2017 is scaled from the OCO-2 inversion in Chevallier et al. Fig. 3].

7. The proximity in value of these two annual net sinks for Australia is somewhat surprising given 2010-11 experienced a strong La Niña, and 2015-16 was a strong El Niño weather phase. It is posited that the former led to massive regeneration of perennial vegetation with surviving recruits entering the steeper slope of sigmoid growth by 2017.

   Rising CO_2 levels in the earth's atmosphere – from Jan 2011 to Jan 2017 CO_2 at Cape Grim rose by 3.6% (3.8% at Mauna Loa) - also improve water use efficiency within vegetation. Further, northern wet season (October–April) rainfall deciles for the 20 years (1998–99 to 2017–18) show wet season rainfall was very much above average for the 20 year period 1998-99 to 2017-18. {See: https://www.csiro.au/en/research/environmental-impacts/climate-change/state-of-the-climate/previous/state-of-the-climate-2018/australias-changing-climate }. Most woody vegetation is located in the northern half of the continent.

8. To understand why Australia has already achieved net zero CO_2 emissions (in terms of the Paris Agreement) the following key points are relevant:
   - in future we will be accounting for all net emissions from all lands in the LULUC&F sector (cf. only c.1% of the land mass included in accounts for the Kyoto Protocol)
   - the only practical way to fully sample net emissions at a continental scale (769 M ha) is via inversions, based on satellite retrievals of the column averaged dry air mole fraction of CO_2 (XCO2) measured from the top of the atmosphere to the land surface
   - inversion studies cited above suggest we are currently a net sink of c.320 Mt CO_2 per year – after averaging La Niña and El Niño year results and deducting fossil fuel emissions for each respective year from the total
   - Australia is the 6th largest nation in area in the world (and in the main has a land mass covered by CO_2 absorbing perennial vegetation), yet it has far fewer people than live in a single world mega city (e.g. Tokyo). Yearly fossil fuel emissions from anthropogenic sources in this country {https://ourworldindata.org/co2/country/australia} are thus more than offset by the ongoing capacity of our LULUC&F sector ('landscape') to absorb them.



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