AFCA

Australian Forests & Climate Alliance inc.

The industrial logging of native forests and woodlands and the use of forest biomass as a fossil fuel substitute is disastrous for climate and biodiversity and should end, immediately

Introduction to the evidence: The Paris Climate Agreement that seeks to restrict global warming to no more than 1.5 degrees is not ideal,[1] as 1°C is already too dangerous.[2] 'Tipping points' [3] that compound global warming (summer sea-ice-free Arctic conditions, loss of West Antarctic glaciers and a multi-metre sea-level rise) are likely to have been passed at less than 1°C .[4] Current emission rates could activate other elements, compounding the rate and scale of temperature rise.[5] Our carbon debt [6] is such that the aim must be for zero greenhouse gas emissions across all sectors within the next decade.[7] At the same time, as much carbon-dioxide as possible must be removed from the atmosphere. Some suggest that there are technological solutions to the removal of carbon dioxide from the atmosphere referred to as Carbon Dioxide Removal (**CDR**). [8] As natural systems already do this efficiently they should immediately be protected, restored where degraded and re-connected where fragmented. This is also critical to ensure their resilience to climate change impact so that they will continue functioning. Where possible their resilience to climate change impact should be enhanced by ecological restoration.

Emission reduction strategies focused on the energy and transport sectors include an erroneous assumption that wood biomass combustion is a carbon neutral fossil fuel substitute 'because trees regrow'.[9] The assumption ignores the need for immediate emission reduction and the time it takes to re-absorb released carbon when forests are logged and burnt. This will take decades to centuries as [10] and in some instances forests might not ever fully recover.[11] The logging and burning of trees for energy immediately releases carbon into the atmosphere and suspends a process of carbon capture and storage that would have increased exponentially increasing had that those trees been left standing. The *rate of tree carbon accumulation increases continuously with tree size*.[12]

Warnings of the danger of forest bioenergy that have gone unheeded are summarised in six points, below. [13] They include reasons why native forests and woodlands must be immediately protected.

1. Emissions from forest biomass combustion at the smokestack exceed those of coal per unit of energy produced; it is not carbon neutral'.[14]

2. The opportunity cost of logging forests for bioenergy or fuel is immediate diminution or loss of forests capacity to draw carbon down from the atmosphere and safely store it.

Prepared by Frances Pike May 2019, revised and updated May 2021

The longer trees are left to mature the more carbon they capture and store.[15] Industrial logging intensity and frequency degrades forests to the extent they can begin to emit, rather than capture carbon.[16] The total global stock of forest carbon has been estimated at a minimum of 862 GtC.[17] This represents significant avoided emission potential which, if converted to CO_2 by logging, clearing or other factors, increases the risk that earth will exceed not only 1.5 degree warming, but escalate to above 2,[18] let alone be able to stabilise at 1 degree, irrespective of immediate the cessation of GHG emissions from fossil fuel use.

Forest bioenergy requires an ongoing supply of massive volumes of wood biomass. It is driving deforestation and forest degradation in North America, Europe and Russia. [20,21] Europe is burning 21.7 million tonnes of wood pellets annually, of which 5 million tonnes is exported from the USA.[22] In 2017 global demand for industrial wood pellets exceeded 14 million tonnes and is predicted to increase by more than 250 per cent over the next decade, having already doubled in the last ten years.[23] **Australia is already exporting native forest biomass for combustion and it is planned that this will increase.**[24]

3. Forest biomass for energy is the second major driver of forest logging and degradation[19]

4. Nature Based Solutions: The need to protect and enhance the biological integrity of natural systems to improve resilience to climate change so that carbon dioxide can continue to be drawn down from the atmosphere and stored in natural ecosystems.

Even with emission reduction across all industrial sectors there will be an 'emissions gap' [25] in the 'carbon budget'.[26] This must be closed within a decade to prevent warming beyond an already dangerous 1.5 degrees. Nature Based Solutions which are effective without incurring risk are considered preferable to geo-engineering and/or Bioenergy with Carbon Capture and Storage (BECCS) *within the required timeframe*.[27] For example, protection and targeted reforestation of tropical forests would reduce total emissions by as much as 5 billion tonnes of carbon each year, i.e. a reduced source of 1 billion tonnes and an increased sink of 4 billion tonnes each year. [28] Yet few are aware that Australia has some of the most carbon dense forests in the world capable of storing more carbon per hectare than tropical forests.[29] To protect natural systems so that they can continue to function to capture and store carbon is essential.[30]

5. Flawed emission accounting creates the 'convention' that forest bioenergy is renewable, thereby attracting misinformed social acceptance (social licence) and financial benefits

Emissions from forest biomass combustion are not accounted for in the energy sector. Relegated to the 'Land Use and Land Use Change and Forestry (**LULUCF**) sector, it is assumed they will be accounted for there, as emissions from deforestation and/or forest degradation are quantified. However forest biomass combustion emissions are not adequately accounted for in the LULUCF sector where emission accounting loopholes and reporting gaps exist.[31]

6. Alienation of scarce land resources to log and/or grow forest biomass feedstock

Forest derived bioenergy is placing additional and significant pressure on the global forest resource. There is a push to establish large scale, genetically engineered plantations of native species for BECCS as a modelled climate change strategy. This would impact habitat critical for the retention of terrestrial biodiversity (especially forests) and land required for food production.[32]

Further explication of the six points outlined above

1. Forest biomass energy:

Emits more* CO_2 *than coal per unit of energy produced: "owing to biomass having lower energy density and conversion efficiency".[33] Bioenergy power plants emit approximately 65 percent more CO_2, per MWH than modern coal plants, and approximately 285 percent more than natural gas combined cycle plants.[34]

Is not carbon neutral: Using forests for bioenergy (as wood pellets **or** chips) by logging live forest biomass is simply not carbon neutral.[35] The claim that the CO_2 released is recaptured as trees regrow ignores:

- **time-frames critical to prevent irreversible global warming** (bearing in mind we have one decade in which to restrict all GHG emissions and commence mass drawdown).[36] In the case of regrowth forests, multiple decades are required to restore carbon stocks to pre-industrially logged levels, if indeed the forests regrow at all (increasingly uncertain as extreme weather events increase with associated droughts and fires); for primary forests the timeframe is many centuries. The IPCC has stated that in the case of forest timber turned into wood pellets for bioenergy use the process produces higher CO_2 emissions than fossil fuels for decades to centuries.[37]

- **the nature and scale of carbon sequestration and storage capacity loss;** it is not just a question of the time taken for trees to regrow. Much carbon is lost from roots of big old trees and the soil ecosystems disturbed during logging.[38]

Is subject to flawed and corrupted 'residue' arguments:

The definition of forest biomass as a carbon neutral energy and fuel feedstock extends beyond logging and mill residue to entire trees. Referred to as 'pulp' logs, native forest tree species that have not been allowed to grow to maturity are re-defined by (Australian) state forest agencies as 'residues', to attract subsidisation as 'renewable' energy biomass feedstock.[39]

A presumed regulatory safeguard to ensure forest wood biomass destined for combustion doesn't add to the carbon debt is the requirement that it be sourced from 'sustainably' logged forests. Inadequate as a definition, this descriptor omits to reference principles of ecologically sustainable forest management (ESFM). ESFM is supposed to underpin Australian native forest logging as of 1995.[40] The principles of ESFM are not adequately addressed by any agreed international logging certification standard. With industrial native forest logging continuing to undermine biodiversity and the carbon stock of forests [41], such a standard is not possible. Efforts toward certification of logging that is conducted in accordance with ESFM principles should be confined to the establishment of biodiverse woodlots and/or plantations.

When the more stringent restriction is applied, that logging or mill residue, only, provide feedstock for bioenergy, the argument is made that if such residues were not burnt, they would otherwise decompose, adding to the global CO_2 burden. Rates of decay, biological processes that convert forest floor humus to soil, and the environmental benefits of natural carbon recycling within forest ecosystems are ignored.[42] The residue argument also assumes native forest logging is inevitable, whereas the opposite should be the case at this point in earth's bio-geophysical history.

2. The 'opportunity cost' of burning/using forests for energy/fuel

The carbon stock for intact South Eastern Australian eucalypt forests has been found to be about 640 tonnes per hectare.[43] In some of those forests the carbon stock is particularly high, with a total biomass density of 1,867 tonnes of carbon per hectare,[44] exceeding that of equatorial rainforests

It is negligence of the highest order to continue to allow emission intensive industrial logging of native forests to further deplete these critical carbon stores

Heavy, fossil fuel dependent machinery is needed to log and transport dense product medium and long distances; the logging depletes native forest carbon stores by up to 70 per cent, from both trees and soil, which cannot be recaptured within current logging cycles.[45] Industrial logging rotation cycles degrade forests to the extent they can become sources, not sinks, of carbon.[46] **To protect and not log the native forests and woodlands of Australia is the pathway to the greatest climate change mitigation possible from terrestrial systems.**[47]

3. Forest bioenergy is not a residue based industry and is driving global forest degradation.

In 2011 *The Economist* reported '*Environmental Lunacy in Europe: European firms are scouring the earth for wood.'*[48] Companies operating under the aegis that 'forest bioenergy is carbon neutral', profit from the subsidies it attracts as a supposedly 'renewable' energy. As this is the case in multiple jurisdictions, companies can combine to exert immense pressure at an international level to sanction forest bioenergy expansion at the highest levels. Hence the advice from the European Scientific Union of Scientists, some IPCC panel members and a series of scientific statements signed by hundreds of international scientists at any one time, continues to be ignored by policy makers. Meanwhile global forest carbon stores are being felled to supply an expanding wood pellet trade, predicted to escalate globally from 14 to 36 million tonnes per annum as Europe, Japan and South Korea increase wood combustion.[49]

In Australia, interested industry sectors and government insist logging will not be a driver of native forest logging. The residue argument continues to be invoked.[50] At least three pieces of legislation now facilitate the use of native forest biomass as subsidised energy: NSW drafted the Protection of the Environment Operations (General) Amendment (Native Forest Bio material) Regulation 2013. [51] At a Federal level there was an amendment to the Renewable Energy Target 2015, and in 2018 in NSW the renewed NSW Regional Forest Agreement amended the definition of 'other wood products' to include forest biomass material. Analysis of 2015 legislation passed by the Abbott government reveals definitions that permit **whole trees of native forests to be used for subsidised forest bioenergy/fuel.**[52]

From the mid 2000's the NSW Department of Primary Industries (DPI) has advocated large-scale power generation from native forest wood.[53] In November 2017 the NSW DPI reported a million tonnes of residues available for the bioenergy/fuel trade, the definition of which includes whole trees with no species restrictions. It includes forest compartments that house NSW wildlife threatened with extinction. Contemporaneous publications by the same department define whole trees as the preferred and feasible residue; not branches or leaves left over from logging operations.[54] As large-scale renewable energy credits (subsidies) augment profit of Australian coal-fired power stations substituting (some) native forest biomass for coal, the fossil fuel industry also benefits, and can be prolonged. [55] Where native forest biomass

feedstock is co-generated with other substances that is also subsidised.[56]

Plans to export wood biomass and pellets for bioenergy have been championed by the National Party, in particular, and form federal Coalition policy, now playing out via The National Forest Industries Plan 2018,[57] which restates the corporate plans of the national logging industry this decade.[58] **This has brought Australia to the point where it is marketing its forests as available for export for combustion in Asia.** In December 2018 Australian government representatives met Japanese Government officials and Japanese industry leaders, including bioenergy and paper companies and the Federal Member for Barker and Co-Convenor of the Australian Parliamentary Friends of Forestry and Forest Products group, Mr Tony Pasin MP, announced:

> ***"Japan's appetite for our Aussie woodchips and manufactured bio-pellets has driven the country's move into bio-energy. This means increased demand for our product …"*** **and, with the release of the Federal Government's National Forest Industries Plan,** ***"it's the perfect time to ensure the Japanese Government understands the opportunities that will open for the forestry sector in Australia and what this means for increased trade"*****.**[59]

Japan's wood pellet demand is estimated to increase from 500,000 tonnes in 2017 to 9.5 million tonnes in 2025. Total biomass demand in Japan is expected to increase from 7.6 million tonnes in 2017 to 23 million tonnes in 2025.[60] Japan's need is not so great that it is expanding logging of its own forests to supply this. It is a similar case with China which until a trade war erupted in 2020 imported most Australian wood and which will cease logging any of its own native forests as of 2020.

4. Nature Based Solutions: native forest and woodlands, critical for maximum draw down of atmospheric carbon from terrestrial systems, must be protected; where practical, ecological restoration should occur to enhance forest resilience to climate change so that they can continue to uptake and store carbon.

The draw down of atmospheric carbon by terrestrial systems – forests - is preferred to geo-engineering.[61] 'The most ecologically sound, economical, and scalable ways to accomplish [increasing carbon uptake on land] are by protecting and enhancing natural climate sinks.' [62] Protection of natural (native) forests from logging induced degradation will promote resilience to climate change impact.[63] Where practical, resilience should be enhanced by ecological restoration.[64] Natural Solutions[65] for carbon dioxide removal was on the agenda of the UN Secretary General Summit meeting September 2019 as the best strategy to draw down atmospheric carbon.[66]

Native forests should be protected immediately, as a first priority, with re-afforestation initiatives being in addition to, not instead of native forest protection, because:

- The mitigation value of forest lies in the accumulated stock of ecosystem carbon, not in the short-term rate of forest photosynthesis.
- The biodiversity of natural forests provides forest ecosystems with resilience and adaptive capacity, resulting in more stable carbon stocks.[67]

5. Forest biomass energy/fuel emission accounting is flawed:

If accounted for in the energy sector, bioenergy combustion emissions could be quantified. Relegated to the land use and land use change sector (LULUCF) where accounting involves quantification of emissions arising from deforestation or forest degradation (to provide the biomass feedstock), emission impact can be obscured, minimised or hidden.[68]

Protocols and practice for reporting deforestation and forest degradation are not adequate; reporting is not universal or consistent.[69]

Exposition of forest bioenergy carbon accounting flaws has not resulted in rectification.[70] Legislated loopholes continue. The European Parliament's 2018 renewal of its Renewable Energy Directive (RED 11) will have worse impacts on forests and climate.[71] With the expansion of 'renewables' from 27-35 per cent came LULUCF accounting rule changes: *"Under these revisions, land-use change requirements would apply only to agriculture (Art. 26.2–26.4), and no longer to forestry. Instead, new 'sustainable' forestry-management rules with few biodiversity safeguards have been added, meaning that bioenergy produced from biomass harvested in primary forests, in high-biodiversity non-primary forests, and in forests on peatlands, could now be sold legally as sustainable bioenergy in Europe."* [72] This is also explained here: https://blog.oeko.de/erosion-of-european-sustainability-requirements-for-bioenergy/

This is occurring despite the fact that as large-scale bioenergy has increased in Europe, global forest degradation emissions have roughly doubled.[73]

6. The impact of large-scale forest derived bioenergy on land resources

Despite combustion emissions, forest biomass as 'renewable' energy in Europe has expanded rapidly this century to provide approximately half Europe's 'renewable' energy, with most of the forest biomass from U.S forests.[74] In 15 years U.S wood pellet exports increased from nil to 4.6 million tonnes. The 2017 European directive to double European (forest biomass derived) energy by 2030 would see Europe consuming a forest biomass quantity greater than the combined 2017 European harvest. Resulting (real) emissions would see a proposed 6 per cent emission decrease become a 6 per cent emission increase by 2050. To supply only 3 per cent more global energy, the world would have to double its commercial wood harvests.[75] Land habitat for biodiversity would be severely impacted, at a time when that area requires expansion and protection. Huge areas of land already required for global food supply would be alienated. The IPCC has also acknowledged the difficulties of a bioenergy CDR agenda.[76] The European Academy of Sciences[77] and the respected international 'think tank' Chatham House have both recently critiqued forest bioenergy in relation to land use pressure.[78]

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[1] The Paris Agreement emphasises "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C". Experience of global warming impacts has led to categories of danger: "dangerous" (1-2°C band) and "extremely dangerous" (above 2°C). Spratt, David and Dunlop, Ian, What Lies Beneath: The Understatement of Existential Climate Risk, 2018, Melbourne, Australia

[2] "An expert panel recently concluded that warming would need to be limited to 1.2°C to save the Great Barrier Reef.132 That is probably too optimistic, but with a current warming trend of about 1.1°C and 2016 global average warming above 1.2°C, it also demonstrates that **climate change is already dangerous**". Ibid, referring to Hannam, P 2017, *'Warming limit of 1.2 degrees needed to save Great Barrier Reef: expert panel'*, The Age, 2 August 2017.

Also: "Global temperatures have risen 1°C in the era following mass industrialisation and this has directly affected Australians". *Climate Council Joint Statement: Australia Needs New Policy Effort To Get On Track To Meet Its 2030 Target*, 4th March, 2019

[3] https://www.researchgate.net/publication/326876618_Trajectories_of_the_Earth_System_in_the_Anthropocene

[4] Spratt, David and Dunlop, Ian, *What Lies Beneath: The Understatement of Existential Climate Risk*, 2018

[5] Evidence is accumulating that at the current level of warming other elements could be disrupted with compounding impacts on global warming, i.e. the slowing of the Thermohaline Circulation (the Atlantic

conveyor); accelerating ice-mass loss from Greenland and Antarctica; declining carbon efficiency of the Amazon forests and other sinks; and the vulnerability of Arctic permafrost stores. Spratt, David and Dunlop, Ian, *What Lies Beneath: The Understatement of Existential Climate Risk*, 2018

[6] A carbon budget is an estimate of greenhouse gas emissions, in tons of carbon consistent with limiting global warming to a specified figure. We have exceeded the budget for limiting warming to 2 degrees, creating a 'carbon debt'. To close the 'emissions gap', maximum draw down of atmospheric carbon is 'non-negotiable'.

[7] 2019 climate modelling indicates 2018 IPCC limits understate urgency: https://www.nature.com/articles/s41558-019-0426-8 but IPCC recommendations that *'Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems … and imply deep emissions reductions in all sectors.* ***https://www.ipcc.c/summary-for-policy-makers/*** *is still true.*

[8] More CDR is needed to restrain temperature increase. *All pathways that limit global warming to 1.5°C with limited or no overshoot project the use of carbon dioxide removal (CDR) on the order of 100–1000 GtCO2 over the 21st century*. **https://www.ipcc.c/summary-for-policy-makers/**

[9] "bioenergy systems have often been assessed (e. g., in LCA studies, integrated models, policy directives, etc.) under the assumption that the CO2 emitted from biomass combustion is climate neutral14 because the carbon that was previously sequestered from the atmosphere will be re-sequestered if the bioenergy system is managed sustainably (Chum et al., 2011; Creutzig et al., 2012a; b). The shortcomings of this assumption have been extensively discussed in environmental impact studies and emission accounting mechanisms (Searchinger et al., 2009; Searchinger, 2010; Cherubini et al., 2011; Haberl, 2013)." This is extracted from Smith, et al., (2014). *Agriculture, Forestry, and Other Land Use (AFOLU). Intergovernmental Panel on Climate Change(IPCC)*. Accessed: https://archive.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf

[10] 'For example, in the specific case of existing forests that may continue to grow if not used for bioenergy, some studies employing counterfactual baselines show that forest bioenergy systems can temporarily have higher cumulative CO2 emissions than a fossil reference system (for a time period ranging from a few decades up to several centuries; (Repo et al., 2011; Mitchell et al., 2012; Pingoud et al., 2012; Bernier and Paré, 2013; Guest et al., 2013; Helin et al., 2013; Holtsmark, 2013)', this extracted from Smith, et al., (2014). *Agriculture, Forestry, and Other Land Use (AFOLU). Intergovernmental Panel on Climate Change(IPCC).* Accessed: https://archive.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf

[11] Given logged forests' vulnerability to climate change impact, impacts of ongoing logging cycles, and land use change (conversion of a forest to other uses) that is often the consequence of severe forest degradation.

[12] N. L. Stephenson, A. J. Das, R. Condit, S. E. Russo, P. J. Baker, N. G. Beckman, D. A. Coomes, E. R. Lines, W. K. Morris, N. Rüger, E. Álvarez, C. Blundo, S. Bunyavejchewin, G. Chuyong, S. J. Davies, Á. Duque, C. N. Ewango, O. Flores, J. F. Franklin, H. R. Grau, Z. Hao, M. E. Harmon, S. P. Hubbell, D. Kenfack, Y. Lin, J.-R. Makana, A. Malizia, L. R. Malizia, R. J. Pabst, N. Pongpattananurak, S.-H. Su, I-F. Sun, S. Tan, D. Thomas, P. J. van Mantgem, X. Wang, S. K. Wiser[…]M. A. Zavala, *Rate of tree carbon accumulation increases continuously with tree size* Nature volume 507, pages 90–93 (06 March 2014), https://doi.org/10.1038/nature12914

[13] A small sample only of the many reports and letters from scientists (and economists) to policy makers against legitimising forest derived biomass energy and fuel. Australian scientists have also written to Australian policy makers and politicians urging them not to adopt forest derived biomass as feedstock for energy and fuel.

International Warnings

Letter from 600 scientists to the EU Parliament Regarding Forest Biomass, 2018

Letter from the European Academies Science Advisory Council (EASAC) to the President of the European Commission, https://easac.eu/news/details/easacs-correspondence-with-the-president-of-the-european-commission-on-the-role-of-biomass-energy/

https://www.euractiv.com/wp-content/uploads/sites/2/2018/01/Letter-of-Scientists-on-Use-of-Forest-Biomass-for-Bioenergy-January-12-2018.pdf

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https://www.chathamhouse.org/publication/woody-biomass-power-and-heat-impacts-global-climate *Opinion of the European Environment Agency Scientific Committee on Greenhouse Gas Accounting in relation to Bioenergy*, 2011, https://www.eea.europa.eu/about-us/governance/scientific-committee/sc-opinions/opinions-on-scientific-issues/sc-opinion-on-greenhouse-gas/view

Scientists' letter from the Cary Institute of Ecosystem Studies, US to the British Secretary of State for Energy and Climate Change and the Chief Scientific Advisor to the Department of Energy and Climate Change, 2014

Agostini, A., et al. 2014. *Carbon accounting of forest bioenergy JRC Scientific and Policy Reports.* Ispra, Joint Research Centre, Institute for Energy and Transport, Italy

US Scientists to the EU Commission, 2013

US Scientists to the Speaker of the U.S. House of Representatives and the Majority Leader in the U.S. Senate, 2010Scientists letter to Honorable Roy A. Cooper, North Carolina Office of the Governor,

Australian Warnings:

Scientists' *Open Letter to The Australian Parliament, Senators and Members*, re inclusion native forest biomass in the Renewable Energy Target, 2015

"*The Climate Change Authority's Forestry Fumble"*, Andrew MacIntosh and Richard Denniss, The Australia Institute, 2012,http://www.climatespectator.com.au/commentary/ccas-forestry-fumble

Scientists' Open Letter of Concern - incentives for native forest biomass burning to MP Rob Oakeshott and Members of the Australian Parliament, 2012

[14] Wood that reaches a power plant can displace fossil emissions but per kWh of electricity typically emits 1.5x the CO2 of coal and 3x the CO2 of natural gas because of wood's carbon bonds, water content (Table 2.2 of ref. 17) and lower burning temperature (and pelletizing wood provides no net advantages) (Supplementary Note 1) 6,16 (extracted from) *Europe's renewable energy directive poised to harm global forests*, Timothy D. Searchinger, Tim Beringer, Bjart Holtsmark, Daniel M. Kammen, Eric F. Lambin, Wolfgang Lucht, Peter Raven and Jean-Pascal van Ypersele, and also see: http://ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief7.pdf, http://www.ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief8.pdf

[15] Stephenson, N.L. et al. *Rate of tree carbon accumulation increases continuously with tree size*. Nature 507, 90–93 (06 March 2014) doi:10.1038/nature12914

[16] Popkin, G. *Tropical forests may be carbon sources, not sinks*. Nature. doi:10.1038/nature.2017.22692. (2017).

[17] Fact Sheet No 4. *Primary Forests and Carbon*, Intact, International Action for Primary Forests

[18] Presentation for Land use and Forests in the Paris Agreement, real world implications of negative emissions and Bioenergy CCS (BECCS),May 12th & 13th2016, Brussels by Professor Brendan Mackey, Director, Griffith Climate Change Response Program

[19] Expanding human population being the first

[20] https://www.birdlife.org/europe-and-central-asia/black-book

[21] http://www.ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief8.pdf

[22] Kuhlmann, Wolfgang and Putt, Peg *Are Forests the New Coal – a Global Threat Map of Biomass Energy Development.* Environmental Paper Network. November 2018

[23] http://environmentalpaper.org/wp-content/uploads/2018/11/Threat-Map-Briefing-Are-Forests-the-New-Coal-01.pdf

[24] Australian Forests & Timber News, *Australia-Japan forest products trade strengthened*, 20 December 2018

[25] i.e. an excess of atmospheric carbon that would make possible limiting global warming to the already 'risky' 1.5 degrees mandatory to avoid climate change catastrophe)

[26] A carbon budget is an estimate of the total future human-caused greenhouse gas emissions, in tons of carbon, CO_2 or CO_2 equivalent, that would be consistent with limiting warming to a specified figure, such as 1.5°C or 2°C, with a given risk of exceeding the target, such as a 50, 33 or 10 per cent chance. The carbon budget for limiting global warming to 2 degrees has already been exceeded. To close the 'emissions gap' maximum removal of atmospheric carbon is now 'non-negotiable'.

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'The most ecologically sound, economical, and scalable ways to accomplish [increasing carbon uptake on land] are by protecting and enhancing natural climate sinks.' John M. DeCiccoa, and William H. Schlesinger, "*Reconsidering bioenergy given the urgency of climate protection*", 9642–9645 | PNAS | September 25, 2018 | vol. 115 | no. 39, www.pnas.org/cgi/doi/10.1073/pnas.1814120115

28 Presentation for Land use and Forests in the Paris Agreement, real world implications of negative emissions and Bioenergy CCS (BECCS),May 12th & 13th2016, Brussels by Professor Brendan Mackey, Director, Griffity Climate Change Response Program

[29] From analysis of published global site biomass data (*n* _ 136) from primary forests, we discovered (*i*) the world's highest known total biomass carbon density (living plus dead) of 1,867 tonnes carbon per ha (average value from 13 sites) occurs in Australian temperate moist *Eucalyptus regnans* forests, and (*ii*) average values of the global site biomass data were higher for sampled temperate moist forests (*n* _44) than for sampled tropical (*n* _ 36) and boreal (*n* _ 52) forests (*n* is number of sites per forest biome). Heather Keith, Brendan G. Mackey, and David B. Lindenmayer, *Re-evaluation of forest biomass carbon stocks*

[30] Since global deforestation has resulted in about a third of total anthropogenic CO_2 emissions since 1850 it is obvious that stopping this process will be fundamental to emission reduction and CDR. Bagley, J.E. (2011*) Impacts of land cover change: energy regulation, breadbasket production, and precipitation*. Phd., Atmospheric and Oceanic Sciences, University of Winconsin-Madison.

[31] 'few countries provide annual figures for their land use-related emissions', The LULUCF Sector: Ever-Difficult Estimations, Climate Chance (2018) Sector-Based Action, Book 1 of *The Annual Report Of The Global Observatory On Non-State Climate Action*

[32] Modelled 2 °C pathways assume a level of bioenergy production by 2050 that would require doubling the current harvest of all global biomass for all uses (food, feed and fibre) (Dooley et al., 2018; Searchinger etal., 2015).
Field and Mach (2017,p.707) highlight the issues at stake, suggesting that converting land scale required for bioenergy in many modelled climate change mitigation scenarios would "pit climate change responses against food security and biodiversity protection". Extracted from "The role of the land sector in ambitious climate action: **Missing Pathways to 1.5°C**, **CLARA,** Climate ambition that safeguards land rights, biodiversity and food sovereignty
Climate Land Ambition and Rights Alliance. Lead authors: Kate Dooley, Doreen Stabinsky. Contributing authors: Kelly Stone, Shefali Sharma, Teresa Anderson, Doug Gurian-Sherman, Peter Riggs. Also see: van Vuuren DP, van Vliet J, Stehfest E (2009) Future bio-energy potential under various natural constraints. Energy Policy 37:4220–4230.

[33] John D. Sterman, Lori Siegel, and Juliette N. Rooney-Varga, "Does Replacing Coal with Wood Lower CO 2 Emissions? Dynamic Lifecycle Analysis of Wood Bioenergy," Environmental Research Letters 13, no. 1 (2018): 015007, https://doi.org/10.1088/1748-9326/aaa512

[34] William R. Moomaw, EU bioenergy policies will increase carbon dioxide concentrations, Climate Policy Brief No. 7: Tufts University 2018, http://ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief7.pdf and Booth, Mary, Biomass Amendments in Recent Federal Legislation, Presentation, Partnership for Policy Integrity, 2016.

[35] (DeCicco and Schlesinger, 2018; Searchinger et al., 2017; Smyth et al., 2014; Sterman et al., 2018) and https://www.chathamhouse.org/publication/woody-biomass-power-and-heat-impacts-global-climate, https://www.chathamhouse.org/publication/impacts-demand-woody-biomass-power-and-heat-climate-and-forests

[36] Increased atmospheric concentrations from burning bioenergy will worsen irreversible impacts of climate change before forests eventually grow back to compensate (Booth, 2018; Courvoisier et al., 2017 Schlesinger, 2018).

[37] Smith, et al., (2014). Agriculture, Forestry, and Other Land Use (AFOLU). Intergovernmental Panel on Climate Change(IPCC). Accessed: https://archive.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf

[38] Christopher Dean, James B. Kirkpatrick, Andrew J. Friedland, *Conventional intensive logging promotes loss of organic carbon from the mineral soil*, 2016,https://doi.org/10.1111/gcb.13387

[39] Carbon neutral residue rhetoric promulgated by state forest agencies:

Within the same document Department of Primary Industry researchers advise **their studies focused on quantities of forest biomass available from whole trees** (due to the inefficiencies of transporting actual logging residue) yet counter criticism of using forestry residues for energy generation by arguing that

"The greenhouse gas balance carried out here clearly shows that, from a climate perspective, using biomass that **would have otherwise been left in the forest to burn and/or decay** for bioenergy generation results in positive outcomes, especially if biomass is used to produce electricity displacing the use of coal. This is true even when the carbon dioxide emissions from burning the biomass to generate energy are included in the calculations. In practice, the CO2 released will be reabsorbed by the growing trees in a sustainable harvest system, eventually negating the impact of such emissions, p.3. Later, (on p.6), **forest residues again become whole logs**: **1.2 Forest harvest residues: 1.2.1 Native forests – Public:**

> *"For native forests, residue estimations were conservative, as we only considered logs that met the specifications for pulpwood as available for extraction (typically 10 cm small end diameter overbark, and a minimum of 2.5 m in length – no species restrictions – and the crown was typically left in the forest). This was partly due to the fact that the local industry already has experience harvesting and transporting pulpwood from the forest."* North Coast Residues: A project undertaken as part of the 2023 North Coast Forestry Project

Published by the NSW Department of Primary Industries, November 2017. Authors: Fabiano Ximenes, Rebecca Coburn, Michael McLean, John Samuel, Nick Cameron, Brad Law, Caragh Threllfall, Kate Wright and Shane Macintosh

[40] Australian National Forest Policy Statement, Commonwealth of Australia 1992, 1995

[41] Under ESFM principles, Australian forest management should:

1. *Maintain the ecological processes within forests (the formation of soil, energy flows and the carbon, nutrient and water cycles);*
2. *Maintain the biological diversity of forests; and*
3. *Optimise the environmental, economic and social benefits to the community within ecological constraints.*

[42] Ignored also is the fact that net emissions from forestry residues burned as fuel are also significant over the mid-term (20-40 years). Partnership for Policy Integrity.

[43] Brendan G. Mackey, Heather Keith, Sandra L. Berry and David B. Lindenmayer, Green Carbon: The role of natural forests in carbon storage: Part 1. A green carbon account of Australia's south-eastern Eucalypt forests, and policy implications, The Fenner School of Environment & Society, The Australian National University, 2008

[44] From analysis of published global site biomass data (*n* _ 136) from primary forests, we discovered (*i*) the world's highest known total biomass carbon density (living plus dead) of 1,867 tonnes carbon per ha (average value from 13 sites) occurs in Australian temperate moist *Eucalyptus regnans* forests, and (*ii*) average values of the global site biomass data were higher for sampled temperate moist forests (*n* _44) than for sampled tropical (*n* _ 36) and boreal (*n* _ 52) forests (*n* is number of sites per forest biome). Heather Keith, Brendan G. Mackey, and David B. Lindenmayer, *Re-evaluation of forest biomass carbon stocks*

[45] Bowd, E.J., Banks, C.S., Strong, C.L. and Lindenmayer, D.B. (2018). *Long-term impacts of wildfire and logging on forest soils.* Nature geoscience www.nature.com/naturegeoscience

[46] Logging rotations in NSW are now routinely less than 20 years. This is a global phenomenon. https://www.carbonbrief.org/tropical-forests-no-longer-carbon-sinks-because-human-activity.

Baccini et al. (2017) *Tropical forests are a net carbon source based on aboveground measurements of gain and loss.* Science. http://science.sciencemag.org/content/early/2017/09/27/science.aam5962

Raupach et al. (2014). *Biogeosciences*, 11, 3453–3475. https://www.biogeosciences.net/11/3453/2014/bg-11-3453-2014.pdf

[47] Keith H, Lindenmayer D, Macintosh A, Mackey B (2015) *Under What Circumstances Do Wood Products from Native Forests Benefit Climate Change Mitigation?* PLoS ONE 10(10): e0139640. doi:10.1371/journal.pone.0139640

[48] https://www.economist.com/business/2013/04/06/the-fuel-of-the-future

[49] http://environmentalpaper.org/wp-content/uploads/2018/11/Threat-Map-Briefing-Are-Forests-the-New-Coal-01.pdf

[50] Debating the exclusion from the national Renewable Energy Target of native forest biomass in 2012, and then its inclusion in 2015, the arguments were that the legislation and regulatory mechanisms would ensure that residue based operations only would be eligible for subsidy as 'renewable'.

[51] whereby "material resulting from forestry operations carried out on land to which an Integrated Forestry Operations Approval (IFOA) applies under Part 5B of the Forestry Act 2012" is eligible for subsidy when burnt. That's most material from most public forests in NSW logged under a Commonwealth State Regional Forest Agreement, (which is most logging mass from public forests in NSW)

[52] The RET regulation states:

> *4. Biomass from a native forest must be:*
>
> *a. harvested primarily for a purpose other than biomass for energy production; and*
>
> *b. either:*
>
> *i. (i) by-product or waste product of a harvesting operation, approved under relevant Commonwealth, State or Territory planning and approval processes, for which a high-value process is the primary purpose of the harvesting;*

However, when a sawmill processes a sawlog, less than a third ends up as sawn timber, a high value product. What looks like a safeguard is a legal ambiguity: (3) For subparagraph (2) (b) (i), the primary purpose of a harvesting operation is taken to be a high-value process only if the total financial value of the products of the high-value process is higher than the financial value of other products of the harvesting operation.

[53] DPI 'forest' scientist Fabiano Ximenes argues NSW is well positioned to lead the nation in the adoption of bioenergy as a cost-effective and climate friendly energy solution. *"Biomass from forestry residues has great potential for large-scale electricity generation, industrial heat, biofuels and valuable natural chemicals, all within NSW regional communities."* https://www.dpi.nsw.gov.au/about-us/media-centre/releases/2017/north-coast-forests-offer-untapped-bioenergy-opportunity

[54] From *North Coast Residues: A project undertaken as part of the 2023 North Coast Forestry Project*,

> *1.2 Forest harvest residues: 1.2.1 Native forests - Public*
>
> ***"For native forests, residue estimations were conservative, as** we only considered logs that met the specifications for pulpwood as available for extraction (typically 10 cm small end diameter overbark, and a minimum of 2.5 m in length – no species restrictions **– and the crown was typically left in the forest). This was partly due to the fact that the local industry already has experience harvesting and transporting pulpwood from the forest."***

Though it is made clear that whole trees are defined as residue, in the same document claims are made that using *"biomass that would have otherwise been left in the forest to burn and/or decay"* demonstrates the GHG benefits of this technology. A 'carbon neutral/ residue' argument is promulgated by state forest agencies to draw attention away from the intention to use whole trees to supply the bioenergy market.

> *"Although many studies demonstrate the GHG benefits of using forestry residues for energy generation, others argue that this practice does not result in GHG benefits, with some claiming worse outcomes than the use of coal for electricity generation. The greenhouse gas balance carried out here clearly shows that, from a climate perspective, using biomass that would have otherwise been left in the forest to burn and/or decay for bioenergy generation results in positive outcomes, especially if biomass is used to produce electricity displacing the use of coal. This is true even when the carbon dioxide emissions from burning the biomass to generate energy are included in the calculations. In practice, the CO2 released will be reabsorbed by the growing of trees in a sustainable harvest system, eventually negating the impact of such emissions". p.3, North Coast Residues: A project undertaken as part of the 2023 North Coast Forestry Project, Published by the NSW Department of Primary Industries, November 2017. Authors: Fabiano Ximenes, Rebecca Coburn, Michael McLean, John Samuel, Nick Cameron, Brad Law, Caragh Threllfall, Kate Wright and Shane Macintosh*

[55] Vales Point Power Station receiving native forest woodchip via Mid North Coast NSW as Delta Power 2013-4 40.9 KT (forest biomass delivered), 31.5 KT consumed, 2015-6 14.7 KT (delivered), 16.5 KT consumed (presumably carry over stock)

[56] A grant based culture is enjoyed by the logging industry entering the renewable energy and fuel markets. BORAL received a .5 million dollar grant from the Australian Renewable Energy Agency in 2018 to explore a

'bio-bitumen' and 'bio-diesel' facility to power its truck fleet. North Coast NSW sugar mills at Condong and Broadwater which traditionally burnt bagasse (cane residue) for refining processes now enjoy subsidies for combusting logs from both plantations and private native forest logging operations; wood biomass input is increasing.

[57] Department of Agriculture and Water Resources 2018, *Growing a better Australia – A billion trees for jobs and growth* is the current national forest plan that re-states a series of industry/ government documents which culminated in a 'new' national forest policy: *Transforming Australia's forest products industry, Recommendations from the Forest Industry Advisory Council*, 2016, (FIAC). The public are largely unaware that the national forest policy has changed, having been developed and written by FIAC, an industry dominated legislated departmental partner of Australian Primary Industries, with industry co-chairing the council with the Federal Minister since at least 2016.

[58] http://www.agriculture.gov.au/forestry/industries/fiac/transforming-australias-forest-industry

[59] *Australian Forests & Timber News, Australia-Japan forest products trade strengthened*, 20 December 2018

[60] Japan changes biomass subsidies in response to rapid demand growth, FutureMetrics, January 25, 2018

https://www.canadianbiomassmagazine.ca/pellets/japan-changes-biomass-subsidies-in-response-to-rapid-demand-growth-6691

[61] 'Geo-engineering is a catch-all term, better broken down into two main categories, carbon dioxide removal (CDR) and solar radiation modification (SRM) (IPCC 2018, 544, 558). The latter, such as seeding the atmosphere with fine particles to reduce temperatures, has been largely eschewed by the international community, as it does not do anything to actively remove emissions, with UNEP and the Convention on Biological Diversity (CBD) recommending a precautionary principle approach (CBD 2016). CDR has some policy traction primarily through the concept of bio-energy, carbon capture and storage (BECCS). The solution promotes the burning of forest biomass whilst capturing emissions through various sequestration technologies.' *From Paris to Poland: A Postmortem of The Climate Change Negotiations*, Tim Cadman, Research Fellow, Griffith University, Klaus Radunsky, Austria Federal Environment Agency, Andrea Simonelli, Assistant Professor, Virginia Commonwealth University, Tek Maraseni, Associate Professor, University of Southern Queensland

[62] John M. DeCiccoa, and William H. Schlesinger, *Reconsidering bioenergy given the urgency of climate protection*, 9642–9645 | PNAS | September 25, 2018 | vol. 115 | no. 39, www.pnas.org/cgi/doi/10.1073/pnas.1814120115

[63] Half the world's terrestrial vegetation cover has been lost over the past 200 years *(Erb et al., 2017)*, precipitating a global crisis of biodiversity loss *(IPBES, 2018)*. Feedback loops between biodiversity and climate change flow both ways— the more ecosystems are degraded the more carbon is released into the atmosphere, and the harder it will be to mitigate climate change *(CBD, 2014)*.

[64] Thompson, I.; Mackey, B.; McNulty, S.; Mosseler, A. 2009. Forest Resilience, *Biodiversity, and Climate Change: a synthesis of the biodiversity/resilience/stability relationship in forest ecosystems*. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43. 1-67.

[65] https://www.nature.com/articles/d41586-019-01026-8

[66] P19, Section C.3.2 of the IPCC, 2018: *Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

[67] *http://www.upi.com/Science_New s/2017/02/28/Diverse-forests- tend-to-be-healthier-more- resilient-Study/3151488295356/ ?utm_source=sec&utm_campaign= sl&utm_medium=12*

[68] The flaw in current bioenergy emission accounting originates from a misapplication of guidance provided for the national-level carbon accounting under UNFCCC. In the land use sector forest clearing is not adequately accounted for, because when forests are replaced by some other form of vegetation it is no longer considered 'deforestation' and is regarded as 'carbon neutral'. Thus, in the case of industrial logging of native forests

neither biodiversity nor the vast range of environmental goods and services provided by native forests are taken into account. The immense carbon storing capacity lost when forest ground ecosystems are disrupted by industrial logging is completely ignored.

[69] 'few countries provide annual figures for their land use-related emissions', The LULUCF Sector: Ever-Difficult Estimations, Climate Chance (2018) Sector-Based Action, Book 1 of *The Annual Report Of The Global Observatory On Non-State Climate Action*

[70] Timothy D. Searchinger,* Steven P. Hamburg,* Jerry Melillo, William Chameides, Peter Havlik, Daniel M. Kammen, Gene E. Likens, Ruben N. Lubowski, Michael Obersteiner, Michael Oppenheimer, G. Philip Robertson, William H. Schlesinger, G. David Tilman, *Fixing a Critical Climate Accounting Error*, 2009

[71] "*In response to this latest EU decision, 796 lead scientists from around the world, including two Nobel Laureates, wrote detailed letters to the EU Parliament condemning the recent decision regarding forest biomass*." Moomaw, W. (2018) EU Bioenergy Policies Will Increase Carbon Dioxide Concentrations. GDAE Climate Policy Brief #7 http://www.ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief7.pdf

[72] Klaus Josef Hennenberg1*, Hannes Böttcher and Corey J. A. Bradshaw, Revised European Union renewable-energy policies erode nature protection. Letter to Editor, in Nature, Ecology and Evolution, https://doi.org/10.1038/s41559-018-0659-3

[73] From an average of 0.4 Gt CO_2 yr^{-1} in the period 1991–2000 to an average of 1.0 Gt CO_2 yr^{-1} for 2011–2015Ibid, http://www.fao.org/docrep/009/j9345e/j9345e07.htm. Note, this is unrelated to deforestation for agriculture.

[74] https://www.statista.com/statistics/748707/wood-pellet-exports-in-us/

[75] Modelled 2 °C pathways assume a level of bioenergy production by 2050 that would require doubling the current harvest of all global biomass for all uses (food, feed and fibre) (Dooley et al., 2018; Searchinger etal., 2015).

Field and Mach (2017,p.707) highlight the issues at stake, suggesting that converting land scale required for bioenergy in many modelled climate change mitigation scenarios would "pit climate change responses against food security and biodiversity protection". Extracted from "The role of the land sector in ambitious climate action: **Missing Pathways to 1.5°C**, **CLARA,** Climate ambition that safeguards land rights, biodiversity and food sovereignty
Climate Land Ambition and Rights Alliance. Lead authors: Kate Dooley, Doreen Stabinsky. Contributing authors: Kelly Stone, Shefali Sharma, Teresa Anderson, Doug Gurian-Sherman, Peter Riggs. Also see: van Vuuren DP, van Vliet J, Stehfest E (2009) Future bio-energy potential under various natural constraints. Energy Policy 37:4220–4230.

[76] C.3.4 Most current and potential CDR measures could have significant impacts on land, energy, water or nutrients if deployed at large scale (high confidence). Afforestation and bioenergy may compete with other land uses and may have significant impacts on agricultural and food systems, biodiversity, and other ecosystem functions and services (high confidence). *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp. https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers/

[77] Forest bioenergy, carbon capture and storage, and carbon dioxide removal: an update | EASAC - Science Advice for the Benefit of Europe

[78] Bioenergy, Carbon Capture and Storage (BECCS) | Chatham House – International Affairs Think Tank