The Secretary, Department of Treasury & Finance

Submission on the draft bioenergy vision for Tasmania

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[redacted]

Introduction

While we commend the Tasmanian Government for undertaking a broad industry consultation on the potential for bioenergy development in Tasmania and for providing all stakeholders with an opportunity to comment on the draft Vision, the absence of any outline of the climate and ecological context is of concern. So too is the assumption that all bioenergy is renewable in timeframes relevant for limiting global warming to as close as possible to 1.5 degrees.

A critical fact to understand is that burning biomass results in instant emissions that are not concurrently removed, i.e., there is a significant lag between emissions and the removal from the atmosphere of an equivalent amount of carbon dioxide (CO_2) by future forest growth. As has been starkly stated by the world's governments, including Australia, in the Glasgow Climate Pact: this is the critical decade to achieve deep and rapid cuts in greenhouse gas (GHG) emissions from all sources (UNFCCC 2021).

Use of bioenergy – and taking into account the emissions from harvesting, processing, transport and combustion – produces accumulated emissions in the atmosphere and thus creates a carbon debt over time including this critical decade for mitigation action. We cannot afford to wait for decades for forests to regrow to remove CO_2 from the atmosphere. Producing energy from forest biomass should not be considered as clean energy given the gap between emissions and removals and the timeframe for limiting global warming in line with the Paris Agreement on climate change.

It is important to note that sourcing native forest and land-clearing biomass every year requires on-going logging of native forests and land clearing which are significance sources of anthropogenic emissions. Whereas the climate crisis requires that we rapidly reduce emissions from all sources including fossil fuel, forestry and land use within the next decade. It is not compliant with the climate science and commitments under the Glasgow Climate Pact to commence a form of energy generation dependent on on-going land use activities which produce high emissions and are entirely avoidable.

This submission outlines the global context of the extremely limited time left to rapidly reduce GHG emissions and increase removals to solve the climate crisis. Understanding the short time frames in which to turn around the trajectory of accumulated GHGs in the atmosphere is needed to help decision makers understand the consequences of scaling up large scale bioenergy production in Tasmania.

This submission addresses the consequences of large-scale bioenergy production by:
(1) providing evidence of the environmental impact from introducing large-scale bioenergy markets for wood waste - a term commonly used in Tasmania to describe trees without a higher value or no current market;
(2) identifying the inadequacies in current land and forest GHG accounting practices that obscures the extent of emissions from bioenergy; and
(3) providing robust scientific analysis of the impact on GHG emissions from burning wood, in particular, from native forests.

It is important to note that Tasmania achieved net negative GHG emissions (i.e., more removals than emissions) in the inventory reporting period to 2018. This is due to two factors. First, in preceding years there was a significant decrease in the area of forest logged and thus a reduction in the associated emissions from logging. Second, the ongoing removals by natural growth of native forests, together with the clean energy provided by hydroelectricity and wind, places Tasmanian in the enviable position of being “emissions negative”. It is important in this the critical decade for Tasmania not to jeopardise this unique advantage by increasing emissions through use of bioenergy.

1. Global Context

(a) The Climate Emergency and Global Carbon Budget

It is unequivocal that human activities causing emissions have increased the atmospheric CO_2 concentration and that there is a near linear relationship to atmospheric temperature. This influence has warmed the atmosphere, ocean and land, causing widespread and rapid changes in many systems of the atmosphere, ocean, cryosphere and biosphere. Human-induced climate change is already affecting many weather and climate extremes in every region across the globe (IPCC 2021).

Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO_2 and other GHG emissions occur rapidly in the coming decades, with a global reduction of 45% in emissions by 2030 called for at COP 26. Estimates by the Climate Council in Australia suggest our fair share of this global effort would require a 75% reduction in emissions by 2030 (Climate Council 2021).

Many changes in the climate system are directly related to increasing global warming: increases in the frequency and intensity of hot extremes, marine heatwaves, intense storms, agricultural and ecological droughts, frequency of intense tropical cyclones, and reductions in snow cover and ice sheets. Projected changes in climate extremes are larger in frequency and intensity with every additional increment of global warming.

The time period remaining to limit warming to 1.5 °C can readily be calculated from the current annual rate of emissions and the projected budget of accumulated CO_2 in the atmosphere. The fact that there are uncertainties in the IPCC projections, which are well described, does not change the fact that the remaining carbon budget is small which means that activities to achieve reducing emissions and increasing removals by sinks must be effective rapidly.

If global warming is to be limited to 1.5 °C, this means the allowable remaining global carbon budget is 300-400 Gt CO_2. Current anthropogenic global emissions are around 36 Gt CO_2 (34.8 ± 2 Gt CO_2 in 2020, projection for 2021 is 36.4 ± 2 GtCO_2) (GCP 2021). If current emission levels continue, the remaining global carbon budget will be emitted in 8-11 years. Bending the global emissions trajectory sufficiently requires deep and rapid cuts in emissions from all sources in the next 10-20 years through the rapid transition away from CO_2-emitting energy sources (fossil fuel, biomass) and toward non-carbon energy sources (solar PV, wind, pumped hydro). In addition, emissions from utilising native forests and agriculture need to be avoided where possible and reduced otherwise.

The evidence for the short-timeframe to reduce emissions from all sources (including fossil fuel as well as forest ecosystem stocks) is clear, which is why we now have a climate emergency – a fact formally recognized by 104 local government authorities in Australia, the ACT government, and the Upper House in South Australia.

Importantly, the IPCC Special Report on Land (Jia et al. 2019) in the section on adaptation and mitigation response options emphasised that “While some response options have immediate impact, others take decades to deliver measurable results. Examples of response options with immediate impacts include the conservation of high-carbon ecosystems such as peatlands, wetlands, mangroves and forests.” (High level message B1.2, page 19). Significant reductions in the deforestation and degradation of forest ecosystems reduces GHG emissions and helps maintain large carbon stocks that continue to sequester carbon.

(b) The Biodiversity Crisis

Coupled with the Climate Emergency is a global biodiversity extinction crisis as serious for the future of humanity as the climate crisis.

It is important for decision makers to understand the linkages between the two crises and particularly the often-overlooked functional role of biodiversity in underpinning the integrity and stability of all ecosystems and the quality of every ecosystem service upon which humanity relies – including stable carbon storage.

Naturally evolved patterns of biodiversity (composition, distribution, structure, function and abundance) are the most stable and resilient and, within their system limits, have natural resistance to threats that are increasing with climate change such as pests, disease, drought and fire. So if we maintain and restore biodiversity, we help restore ecosystem integrity and minimise the risk of ecosystems releasing carbon to the atmosphere.

Given the globally significant stock of carbon stored in all ecosystems, especially, native forests, it is important to improve the conservation management of ecosystem carbon stocks to reduce the risk of anthropogenic GHG release to the atmosphere (Mackey et al. 2013). If we do so in conjunction with, not instead of, reducing the burning of fossil fuels we still have a chance of limiting warming to 1.5 °C. By doing so we will avoid multiple climate related risks and irreversible impacts for humans and nature.

Recognition of the linkages between the climate and biodiversity crises and the need for integrated action to solve both challenges is increasing. The first ever joint workshop of the scientific advisory bodies to the CBD and UNFCCC, IPBES and the IPCC, was held in May 2021. The joint IPBES-IPCC (2021) report on biodiversity and climate change concluded that: (i) the mutual reinforcing of climate change and biodiversity loss means that satisfactorily resolving either issue requires consideration of the other; (ii) previous policies have largely tackled the problems of climate change and biodiversity loss independently; (iii) avoiding and reversing the loss and degradation of carbon- and species-rich ecosystems on land and in the ocean is of highest importance for combined biodiversity protection and climate change mitigation with large adaptation co-benefits; and (iv) policies that simultaneously address synergies between mitigating biodiversity loss and climate change, while also considering their societal impacts, offer the opportunity to maximize co-benefits and help meet the development aspirations for all.

Thus, scientific understanding of what constitutes and is necessary for Ecologically Sustainable Development (ESD) has progressed significantly since 1997. In particular, the relationship between human influenced climate change, forests and biodiversity conservation. ESD best practice is now focused on integrated solutions for climate change mitigation and biodiversity conservation.

In this context, forest protection is now recognized as a critically important strategy for integrating climate and biodiversity action with decisions taken at UNFCCC COP 25 and COP 26 encouraging forest and biodiversity protection, namely: 1/CP 25, para 15 which noted *"the* essential contribution of nature to addressing climate change and its impacts and the need to address biodiversity loss and climate change in an integrated manner*"*; and in the mitigation sections of Glasgow Climate Pact CMA/3 and 1/CP 26 (paras 38 and 21) which *"Emphasizes* the importance of protecting, conserving and restoring nature and ecosystems, including forests and other terrestrial and marine ecosystems, to achieve the long-term global goal of the Convention by acting as sinks and reservoirs of greenhouse gases and protecting biodiversity, while ensuring social and environmental safeguards".

2. Forests, Waste, Carbon Accounting and GHG Emissions

(a) The impacts of creating a new market for wood

Any form of human activity, including production of forest-based bioenergy, that increases emissions during the next decade is counter to the ambition to halt temperature increases to near 1.5°C. So, when assessing bioenergy potential and especially wood-based bioenergy potential, it is important to understand the impact that this new market will have as a driver of emissions from existing wood, as well as intensification of biomass extraction. This is particularly relevant in the case of forests for two reasons. First, forests take a long time to regrow and hence sequester the carbon that was emitted by processing and combusting the bioenergy. Second, various products are derived from forests and how these are distinguished depends partly on market demand. The viability of harvesting depends on the combined demand from markets of all these products.

While it is re-assuring that the draft vision states that "harvesting of native forests specifically for renewable energy production is not currently required or anticipated to be a part of the Tasmanian Renewable Energy Target (TRET)" and that "producing bioenergy from higher value products such as food crops and high value wood…is unlikely to be economically, socially or environmentally sound", it does not rule out using low or no current value logs, often referred to as 'forest residues' or 'waste logs' - leaving open the possibility of creating a new market for trees that currently have no or lower value markets.

As economists, Treasury officials will be acutely aware of the relationship between 'demand' and 'supply'. They may however be less aware of the impact on logging practices and the area and kinds of forest logged, arising from market changes. There can be no guarantee that providing a market for forest residues will not change the harvesting regime. Like all other industries, the timber industry is subject to market forces. Creating an additional market would have two effects: (i) improve the economic viability of logging and thereby support and prolong low profitability or otherwise uneconomic sections of the industry; and (ii) make it feasible and attractive to increase the area of forest logged and/or the intensity and frequency of harvesting - thereby increasing economic subsidisation of logging and increasing GHG emissions.

Past evidence demonstrates that creating a market for forest residues influences the area, amount, intensity, and type of forests able to be logged. The export woodchip industry that was established to provide a market for so called forest waste improved the economic viability of native forest logging and provided a new market for whole logs. Post-logging waste vastly increased with stumps, branches and small trees left on the forest floor and burned in post-logging regeneration burns. Woodchipping rapidly became the economic driver of logging practices in Tasmania and many other parts of Australia (Dargavel 1995). The woodchip market for pulp and paper increased harvesting intensity and resulted in re-classification of logs from sawlogs to pulp or residue (Ajani 2007).

Given that increases in area, intensity and frequency of logging would directly increase emissions, any assessment of wood-based bioenergy proposals must include the likely increase in emissions created by a new market for wood that demands large and consistent annual volumes of timber. The costs and benefits of alternative forest management strategies should also be assessed - including the mitigation, adaptation and biodiversity benefits of increased forest protection and long-term forest ecosystem recovery- in order to assess fully the opportunity costs associated with large-scale wood-based bioenergy.

(b) Carbon accounting issues in land and forests

Australia's carbon accounting

The Full Carbon Accounting Model (FullCAM) is a calculation tool for modelling Australia's GHG emissions from the land sector. FullCAM is used to produce the annual totals for Australia's National Inventory Reports for the land use, land use change and forestry sector (LULUCF) (Australian Government 2021b). The FullCAM model is not calibrated adequately for native forests that have not been disturbed by logging which means it underestimates the carbon stock in these forests (Keith et al. 2010). The recent revision of the maximum biomass layer (Roxburgh et al. 2019) did improve calibration of native forest ecosystem types but maintained the assumption that maximum biomass could be represented by forests at harvest maturity, and thus not acknowledging that carbon accumulation continues as forests grow older beyond the age of a logging rotation, with carbon stored in growing trees, dead standing trees, coarse woody debris, litter and soil organic matter. Simulations using this model have shortcomings for the purposes of estimating: (i) the potential gain in carbon stock of currently harvested forests if they were allowed to continue growing; (ii) the foregone loss of carbon stock by managing forests on a harvesting regime; and (iii) the loss of carbon stock from the initial harvesting of a forest that is never regained under a harvesting regime. Hence, the FullCAM model was not designed to assess the mitigation benefits of different forest management strategies, in this case harvesting for wood products or forest protection, nor the cumulative impact on the atmospheric stock of carbon.

Many people think that logging forests is carbon neutral because the IPCC guidelines applied in Australia's GHG inventory allow for net accounting within and between sectors. Disaggregated accounts are rarely available and so people fail to appreciate the range and benefits of different management options.

In 2019, Australia's total GHG emissions were 529.3 million t $CO_{2\_equivalent}$ while emissions from LULUCF were -25 million t CO_{2_e}. The negative number here indicates the quantity of removals from the atmosphere into the land and forests. Yet, in the same year, native forest logging resulted in around 36 million t CO_{2_e} of emissions. (Australian Government 2021a).

So why is so much more CO_2 sequestered in the land and forests than emitted from logging native forests? The explanation is buried in an accounting sleight of hand: the area of native forest that is available for logging is much larger than the area logged annually. In this extensive area of native forests, the trees continue to grow and remove carbon from the atmosphere where it is stored in the forest ecosystem. In the accounting spreadsheet, the removals from the naturally growing forest undisturbed by logging are used to offset the emissions from the portion of the forest that is logged.

If we "do the maths", it is clear that Australia's native forests that are managed for logging remove around 61 million t CO_{2_e} a year from the atmosphere and if logging ceased emissions of around 36 million t CO_{2_e} a year would also be prevented.

However, because of net accounting and using removals from the whole forest estate to offset emissions from logging, around 1/3 of the potential mitigation benefits are hidden, meaning decision makers never see the mitigation benefits of ceasing native forest logging and protecting forests.

Understanding natural forest ecosystem carbon

Analyses that suggest CO_2 emissions from bioenergy are climate neutral are flawed because they do not include assessment of all relevant components of forest ecosystems nor sufficient data on older natural forests. Critically, there is a difference between 'carbon neutral' and 'climate neutral'. A system such as forest harvesting and regrowth may be carbon neutral over a long time period, but because the CO_2 emitted through combustion of bioenergy remains in the atmosphere for many decades before it is taken up by the regrowing forest or the equivalent emissions occurred over decades of decomposition in the forest. This system, however, is not climate neutral (Bloomer et al. 2022, Keith et al. 2022) for the following reasons.

First, all carbon pools affected by harvesting need to be included in modelling, including dead biomass, residues, and soil carbon (Holtsmark 2015). In Tasmanian native forests, soil and coarse woody debris can contain at least as much carbon as in living biomass and these carbon stocks in unlogged forests far exceed those in regularly harvested forests. For example, comprehensive, site-based measurements in Tasmania revealed that old growth mountain ash forests can store up to 1200 tonnes of carbon per hectare in the total carbon stock; but the same forest ecosystem logged on an 80 year rotation contains an average of 400 tonnes of carbon per hectare – 60% below the natural carbon stock; and that on average soil carbon was 670 tonnes per ha in unlogged forests and 97 tonnes per ha in harvested areas (Dean et al 2003).

Second, the reference level should not be the carbon stock in a forest at the age of harvesting. It can be seen from the statistics noted in the paragraph above that these carbon stocks are much lower than in the forest's natural state. This is because forests continue to accumulate carbon for hundreds of years after the age at which they are logged. Reference levels should always include forest in their natural state, i.e., the counterfactual "no harvest case" which includes accumulation of carbon from continued growth (Holtsmark 2013a, b; Ter Mikaelian et al 2015). Tasmanian forests are not unique in their carbon storage potential. The carbon stock of logged forest in the Central Highlands of Victoria is 55% of the stock in old growth forest, i.e. 45% of the stock has been emitted to the atmosphere permanently under a harvesting regime. (Keith et al. 2015).

The impact of a forest management system on the storage of carbon in ecosystems and the atmospheric CO_2 concentration should be assessed against the "natural forest reference level". This enables the net effect of harvesting to be compared with foregoing the larger ecosystem carbon stocks in a natural forest plus the atmospheric removals of CO_2 from the continued growth of the forest undisrupted by logging. The carbon stock in a harvested forest is not an equilibrium value, but a stock reduced from its potential.

Forest carbon model assumptions

Carbon models used by proponents of generating energy from wood have a number of significant weakness, including that: (i) the initial carbon stock is often assumed to be zero; (ii) the stock achieved at logging age is assumed to be the maximum carbon stock achievable in a forest; and that (iii) successive harvests have no adverse impact on soil carbon and dead biomass, which are very large carbon pools in Tasmania's cool wet temperate forests. Some models also make the incorrect assumption that (iv) logs left on the forest floor to decompose result in little organic material entering the soil. However, the incorrect assumption of most relevance for decision making is that (v) all models fail to use the counterfactual baseline of the 'natural carbon stock' in forests never subjected to industrial scale harvesting.

The decomposition rate of coarse woody debris in the forest needs to reflect Australian data, which shows that the longevity of logs can easily be 40 years. Because of the difference in timing of emissions between decomposition of residues in the forest over many decades compared with immediate emissions by combustion of biomass, there is always a "payback period". The critical factor is the "cumulative net emissions" (i.e., the additional CO_2 emitted and accumulated in the atmosphere over time by burning biomass), compared to its alternative fate of being left to remain incorporated into the forest ecosystem, including the component which is incorporated into the soil carbon pool (Keith et al. 2022). It is the relative timing of emissions and removals that results in an imbalance, thus determining the cumulative CO_2 concentration in the atmosphere, and hence the climate impact. For every pulse of anthropogenic CO_2 emissions, their removals follow a decay function over many decades and centuries (Archer, 2005), and a forest harvesting regime is represented as the aggregate accumulation over multiple years of emissions (Holtsmark 2014). The only use of residues that would not incur this payback period is that of mill residues that would have been combusted as waste within a year, but this combustion could be utilised for energy.

Some models assume that soil carbon is protected by debarking trees in the forest, which if the volume of woodchips produced in the past are anything to go by seems implausible for the millions of tonnes of wood that might be harvested to fuel a bioenergy industry. Declining soil carbon and increasing compaction over the decades impacts not only the carbon balance of the ecosystem, but also other elements of soil fertility and water holding capacity related to organic matter content that ultimately will influence forest growth and health. Removing biomass residues from the forest will reduce inputs of organic matter to the soil (both carbon and nutrients).

Sustainable forest management

There is no evidence that sustainable forest management has been implemented successfully in Australia. There are a number of indicators suggesting failure, but an increasingly important factor is that wood supply models have not provided sufficient margin to allow for the impact of catastrophic wildfires, such as the mega-fires of south-eastern Australia in 2019- 2020. These wildfires burned 5.7 million ha of native forest and woodland including around 670,000 ha at high severity (Mackey et al. 2021) with catastrophic impacts on not only wildlife habitat and populations but also wood supply.

Importantly, it has been established that historical and contemporary logging of forests has had profound effects on the risk, severity and frequency of fires (Lindenmayer et al. 2020). The mean number of years since the last fire has decreased consecutively in each of the past four decades, while the frequency of forest megafire years (>1 Mha burned) has markedly increased since 2000. The increase in area of forest burned is consistent with increasingly more dangerous fire weather conditions, increased risk factors associated with pyroconvection, including fire-generated thunderstorms, and increased ignitions from dry lightning, all associated to varying degrees with anthropogenic climate change (Canadell et al. 2021).

Changes needed to forest carbon accounting

Significant problems result from assessing climate effects of the use of bioenergy using the "whole forest estate" because the impact of harvesting wood on the carbon balance of the forest is averaged out over a greater area thus fails to reveal the significant impact on harvested areas.

This is analogous to spending all the money in one's bank account and then insisting that the bank replenish the account with interest being earned by other account-holders. It is little more than an accounting sleight-of-hand to appropriate other areas of forest to compensate carbon loss in a particular location. The assessment and presentation of results of the carbon balance should be based on the forest area that is harvested each year. This would mean that analysis at the estate level should be for the area of forest that is harvested each year over a defined rotation period, for example by specific coupe boundaries. It should not include the whole forest area, much of which is not harvested. Assessment of the whole forest area hides the impact of harvesting.

Coal stocks do not naturally de-gas into the atmosphere, so all emissions are from human use. Therefore, flow-based accounts are appropriate and adequate for tracking these one-way flows into the atmosphere. It is now well documented, however, that flow-based, GHG net accounting systems are inadequate and misleading for understanding the impact of human activities on carbon emissions from ecosystems into the atmosphere and removals from the atmosphere into ecosystems. The inadequacies of the current accounting system are seen in the perverse outcomes that have occurred as a result of activities that cause degradation, such as: converting carbon-dense forests and peatlands into fast-growing plantations; preventing forests from reaching maturity because of the false accounting preference for young, fast-growing forests; harvesting forests for wood products and bioenergy that results in loss of carbon stocks where replacement of these stocks will only occur decades into the future, thus creating a carbon debt; and erroneously considering carbon stocks in reservoirs of different longevities and risk of loss as fungible. What is needed is a comprehensive stock and flow accounting system. It is the final carbon stock in the atmosphere that is critical in determining the impact on the climate. Using data only for the annual rates of flow between the biosphere (i.e., forests and other terrestrial ecosystems, but also marine ecosystems) and atmosphere is not adequate to assess the mitigation outcome (Keith et al. 2021).

A variety of modelling studies have shown that "regrowing the forest" to offset emissions from biomass takes decades to centuries. This is because it is not just the first year's harvested wood that must be regrown, but that of every year thereafter. The net emissions – i.e., emissions from all years of operation, minus carbon uptake from forest regrowth over all years of operation – can exceed those from fossil fuels for decades to even centuries. See for instance the online configurable model of Laganiere et al (2017). The timing of emissions – a pulse of emissions now or later - is important in determining the impact on the atmospheric CO_2 concentration (i.e., the stock of carbon in the atmosphere) because of the very long (millennial) life time of the pulse of CO_2 in the atmosphere which is about 100 years for the first 60% and many thousands of years for the remaining 40% (Archer 2005).

The mitigation benefit of forests

The main mitigation role of forests is in their ongoing capacity to sequester and store carbon in the total ecosystem stock, consisting of living biomass, dead biomass, and soil carbon (Mackey et al. 2013). The "carbon retention value" of forests is crucially important as has now been recognized by the U.N. System of Environmental Economic Accounting Ecosystems Accounts (UNSEEA-EA, United Nations et al. 2021). Utilising the UNSEEA-EA would help operationalise the ecosystem provisions of both the UNFCCC and Paris Agreement (Article 4.1(d) and Article 5, respectively) and enable decision makers to see the superior mitigation and economic benefits of maintaining and restoring natural forest ecosystem carbon stocks. Importantly UNSEEA-EA recognises that the reference level against which to assess the integrity and stability of ecosystems and their carbon retention value, is their natural, pre-industrial condition.

All economists understand the importance of assessing opportunity costs. This is especially important given the relatively low cost, low risk and substantial carbon and associated biodiversity and ecosystem service benefits from allowing previously logged forests to regenerate naturally to recover their carbon stocks equivalent to pre-human disturbance, as well as their biodiversity and overall integrity and stability.

As the Glasgow Climate Pact makes clear, "net outcomes" are no longer sufficient as the priority is to reduce emissions rapidly by front-loading action by 2030. A better mitigation strategy – as recognized in Article 38 of the Glasgow Climate Pact – is through forest protection thereby preventing emissions from logging and instead sequestering additional carbon by allowing forests to naturally continue to grow and store carbon for hundreds of years beyond the age at which they are harvested.

The bottom line is that a forest managed for wood products and bioenergy production cannot be climate or biodiversity neutral at temporal scales relevant for effective climate mitigation and biodiversity conservation.

(c) GHG emissions from wood-based bioenergy

If dedicated wood-based biomass power stations are proposed for Tasmania, it is important to understand that because a power station operates continuously, and harvesting is conducted continuously, the payback period for carbon will be decades to more than a century. Cumulative emissions from continuous harvesting result in permanent elevation of the atmospheric CO_2 concentration and hence impacts on the climate (Keith et al. 2022).

As noted above, emissions reduction targets over the next decade to 2030 are critical, as has been made evident in the Glasgow Climate Pact see in particular:

- Article 21 recognizes that the impacts of climate change will be much lower at the temperature increase of 1.5 °C compared with 2 °C and resolves to pursue efforts to limit the temperature increase to 1.5 °C;
- Article 22 recognizes that limiting global warming to 1.5 °C requires rapid, deep and sustained reductions in global greenhouse gas emissions, including reducing global carbon dioxide emissions by 45 per cent by 2030 relative to the 2010 level and to net zero around mid-century, as well as deep reductions in other greenhouse gases; and
- Article 23 recognizes that accelerated action is required in this critical decade.

The processes underlying the interaction between net emissions, global warming and climate stabilisation may be complex, but the result is a simple near-linear relationship between cumulative CO_2 emissions and the increase in global surface temperature, with the clear message that every tonne of CO_2 emitted adds to global warming (Figure SPM.10 IPCC WG1 2021). Introducing new energy systems, such as bioenergy, which will increase emissions in the near-term with only the potential for removals decades in the future, is a course of action that is contradictory to what science prescribes is now needed and what our national government and the world community have agreed to under the Glasgow Climate Pact.

Carbon uptake by growing vegetation, such as that assumed to offset CO_2 emissions from burning biomass, does not distinguish between CO_2 molecules from the "short-term carbon cycle" and other CO_2 emissions. What matters for the net impact of burning biomass versus fossil fuels is not how recently the carbon was sequestered, but the amount of carbon released per unit energy and the relative rate at which vegetation grows and takes up carbon. It is a simple scientific fact that anthropogenic emissions from all sources add to the accumulated stock of atmospheric carbon and there is a near-linear relationship between cumulative CO_2 emissions and the increase in global surface temperature (IPCC 2021, Figure SPM.10). The confusion around "short" versus "long" term emissions arises from the simple ecological fact that forest ecosystems naturally exchange CO_2, water and energy with their surrounding environment. In reality, the global carbon cycle comprises multiple "cycles within cycles" spanning seconds to millennia and geological epochs.

The use of bioenergy is detrimental in the short-term by creating emissions, and detrimental in the long-term by maintaining forests at reduced carbons stock below their natural potential. Investment in bioenergy now will reduce the potential for investment in non-carbon renewable energy sources and forest protection and recovery that are actually and immediately of direct climate benefit. Any emissions reduction that may be achieved through substituting biomass for fossil fuels will rapidly become irrelevant as energy systems will have been transformed in the next several decades. What is far less sure, given the spiral relationship between the climate and biodiversity crises, is whether replanting trees to restore carbon and species rich natural ecosystems, including forests will be feasible over any time frame. What is sure is that allowing 30+ yr old forests to recover will be a far more viable restoration and climate mitigation pathway than planting new trees (Lindenmayer et al. 2021).

Emissions from burning wood

There is strong empirical evidence that burning wood chips emits greater than 50% more CO_2 per megawatt- hour than burning coal. The exact emissions rate depends on two factors - the chemistry of the fuels, but even more on the efficiency of the facility.

Table 1 below is drawn from a US report, so uses American units, but the comparison is clear. The heat input value for the biomass actually exceeds the value for coal in this table but nonetheless, CO_2 emissions per megawatt-hour are 45% greater because it requires additional energy to boil off water from the wood, reducing the "useful" energy output, assuming a biomass moisture content of 45%.

Table 1. Biomass power plants emit more CO_2 than coal or gas plants

Technology	Fuel CO_2 emissions (lb/MMBtu heat input)	Facility efficiency	MMBtu required to produce one MWh	Lb CO_2 emitted per MWh
Gas combined cycle	117.1	45%	7.54	883
Gas steam turbine	117.1	33%	10.40	1,218
Coal steam turbine	206	34%	10.15	2,086
Biomass steam turbine	213	24%	14.22	3,029

Table 1: CO_2 emissions from biomass power plants versus fossil-fuel power plants.[13] The relatively low inherent energy density of biomass fuels, combined with the low efficiency of bioenergy plants, mean that per megawatt-hour (MWh), a biomass power plant emits about 145% the CO_2 of a coal plant, and 340% the CO_2 of a combined cycle natural gas plant.

Source: Booth M. S. (2014)

Woody Biomass fuel in nature contains moisture ranging from about 15% to 25% for seasoned air-dried logs to over 50% for freshly cut green timber. Wet wood may dry to 20 to 30% moisture if left to dry outdoors. The drying time for logs may be in the order of 10 – 15 days for summer conditions, to weeks or months in winter conditions. If the majority of the fuel is residues on the forest floor, moisture content of can be above 50%. At a moisture content of 45%, burning forest wood emits just over one tonne of CO_2 for every tonne of wood burned, a significant and avoidable anthropogenic GHG emission.

The transfer of CO_2 to the atmosphere is equivalent irrespective of whether the source is from burning biomass or fossil fuels. Biomass power plants emit more CO_2 than fossil fueled plants per MWh, hence net emissions from bioenergy can exceed emissions from fossil fuels for decades (Booth 2018). The reference to sustainably-sourced forest biomass does not account for the foregone carbon accumulation if the forest were allowed to continue growing, nor does it account for the loss of carbon from the original harvest event (Bloomer et al. 2022). Estimates of the reduction in forest carbon stock in a harvested system compared with unlogged forest vary between 30-70%. As noted above, analyses from Tasmania and Victoria reveal that logging has resulted in 60% and 45%, respectively, of the natural forest carbon stock being emitted to the atmosphere – a permanent reduction while ever those forests remain under a harvesting regime (Dean et al 2003; Keith et al 2015)

The IPCC has made it clear that the combustion of biomass generates gross GHG emissions per unit energy generated roughly equivalent or more than from the combustion of fossil fuels. Hence, the net cumulative impact on the atmosphere of burning biomass is greater than the impact of burning coal. If bioenergy production is to generate a net reduction in emissions, it must do so by offsetting those emissions through **increased** net carbon uptake by biota and soils (IPCC 2014). The additionality requirement is important – because the biota takes up both fossil carbon and biomass carbon. The complexity of the issue was highlighted recently by the IPCC (Jia et al. 2019) which stated: "Wood can be harvested and used for bioenergy substituting for fossil fuels (with or without carbon capture and storage) (Section 2.6.1.5), for long- lived products such as timber (see below), to be buried as biochar (Section 2.6.1.1) or for use in the wider bioeconomy, enabling areas of land to be used continuously for mitigation. This leads to initial carbon loss and lower carbon stocks but with each harvest cycle, the carbon loss (debt) can be paid back and after a parity time, result in net savings …The trade-off between maximising forest carbon stocks and maximising substitution is highly dependent on the counterfactual assumption (no-use vs extrapolation of current management), initial forest conditions and site-specific contexts (such as regrowth rates and the displacement factors and efficiency of substitution), and relative differences in emissions released during extraction, transport and processing of the biomass- or fossil- based resources, as well as assumptions about emission associated with the product or energy source that is substituted …This leads to uncertainty about optimum mitigation strategies in managed forests, while high carbon ecosystems such as primary forests would have large initial carbon losses and long pay-back times, and thus protection of stocks would be more optimal". This quote makes it clear that any contention that bioenergy can be instantaneously carbon neutral, based on appropriating ongoing carbon sequestration elsewhere on the landscape level is inappropriate.

From the perspective of ecological scientific understanding, there is actually no such thing as "residue" in a native forest as all biomass carbon, living and dead, is part of the ecosystem carbon stock. In fact, there is increasing evidence that removing forestry residues significantly depletes soil and ecosystem carbon stocks (Achat et al. 2015; Hamburg et al. 2019). The biomass residues would have a longer residence time as stored carbon in the native forest ecosystem and were not used for bioenergy. Combusting biomass produces emissions each year. If biomass residues remain in the forest to decompose, and in the case of cool temperate regions like Tasmania, cycle carbon slowly into the soil, they would slowly emit less CO_2 over many decades. Using the residues for bioenergy represents bringing forward significantly higher emissions.

Other considerations

It has been demonstrated that forest protection provides maximum mitigation benefits, even when the mitigation benefits of wood products are taken into account (Keith et al. 2015, 2022).

Modelling based on forest biomass that displaces fossil fuels including coal is spurious because biomass energy will be competing with non-carbon renewable energy sources (solar PV and wind). If investment in bioenergy was instead directed towards non-carbon clean energy, especially solar PV and wind, this would achieve a mitigation benefit in line with the science-based emission reductions required by our international agreements.

It is no more legitimate to subtract out the "displaced" coal emissions from a new biomass plant and count that as a "reduction" in emissions than it is to subtract out displaced coal emissions from operation of a new gas plant. If one did this with a gas plant, one would end up with negative emissions, because coal plants emit more CO_2 per megawatt-hour than gas plants. This kind of flawed accounting is not acceptable.

The substitution of bio-based products to displace construction materials like steel, cement, etc. because they are GHG intensive to produce is a spurious argument because the energy input for processing of these materials can be changed to clean sources, e.g., solar, wind or pumped hydro (Leturcq 2020). The GHG investment in manufacturing renewable energy products, such as solar panels or wind turbines, only creates emissions if the energy source is from fossil fuels. The more rapidly energy systems are converted to clean sources, the less GHG investment will be needed to develop the infrastructure. In contrast, the emissions from bioenergy occur on an on-going basis, i.e., they are a continuous source of CO_2 emissions.

3. Climate Resilient Sustainable Development

The 2019/20 fires and subsequent extreme flooding events gave Australians an early taste of the climate extremes we will face in the years ahead. Protecting and restoring natural ecosystems has a critical role to play in improving the adaptive capacity of landscapes, ecosystems, wildlife and communities and thus ensuring the continued provision of the ecosystem services upon which human society depends.

Avoiding and reversing the loss and degradation of carbon and species-rich ecosystems on land and in the ocean is of highest importance not just for meeting the goals and targets of the UNFCCC and CBD but for maintaining a livable future for all. By combining biodiversity protection and climate change mitigation actions, Tasmania would also secure large adaptation co-benefits and thereby facilitate climate resilient sustainable development. In this context, Tasmania should join global leaders by embracing forest protection as a critically important strategy for achieving integrated solutions to the global challenges we face.

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