Comments on Low-emissions economy report from Productivity Commission

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Summary

Some key points that I would like to raise;

- Forests are stored energy not just stored carbon
- Biomass is low carbon
- Biomass to energy has flexibility; as it can be used to make heat, power, combined heat and power, liquid fuels
- Biomass substation for coal for high temperature heat is a valid route to low carbon heat, which will be substantially cheaper than electricity
- Gas supply is likely to be constrained within the next 10 years
- Liquid biofuels are developing globally with interest within New Zealand
- Solid biofuels for combined heat and power is a viable route to low carbon electricity

My overall impression is that the report does both forestry and bioenergy a disservice and fails to see or acknowledge the substantial contribution that both can make. Forestry seems to be relegated to sequestration without any recognition that it can be much more than that. Bioenergy seems to be regarded as technically to difficult (even for combustion for process heat) which seems to show a marked lack of technical understanding. Other options, including hydrogen, are deemed plausible, without significant acknowledgment of the substantial technical and financial challenges that this route faces.

This bias extends all the way through the report and starts in the list of commonly used terms; agriculture is the first term listed, forestry is not listed at all; except as part of the description of sequestration.

Comments

Overview, Page 3, Fig 0.2 – a key point is that all the sub-parts of this (laws, regulation etc.) need to have cross-party support, otherwise we risk low levels of progress as society waits for, or votes for, a change of government to repeal those laws etc. that negatively affect them.

Overview page 4. Forestry should be included in the land-use change, agriculture and emissions pricing section title. Further, there is no mention of the previous work which have come to similar areas of forestry establishment being of value; Royal Society, Landcare Research / Scion.

Overview, page 5. The climate commission needs to have legislative / regulatory authority and be able to direct government policy and action, in order to achieve the necessary emissions targets.

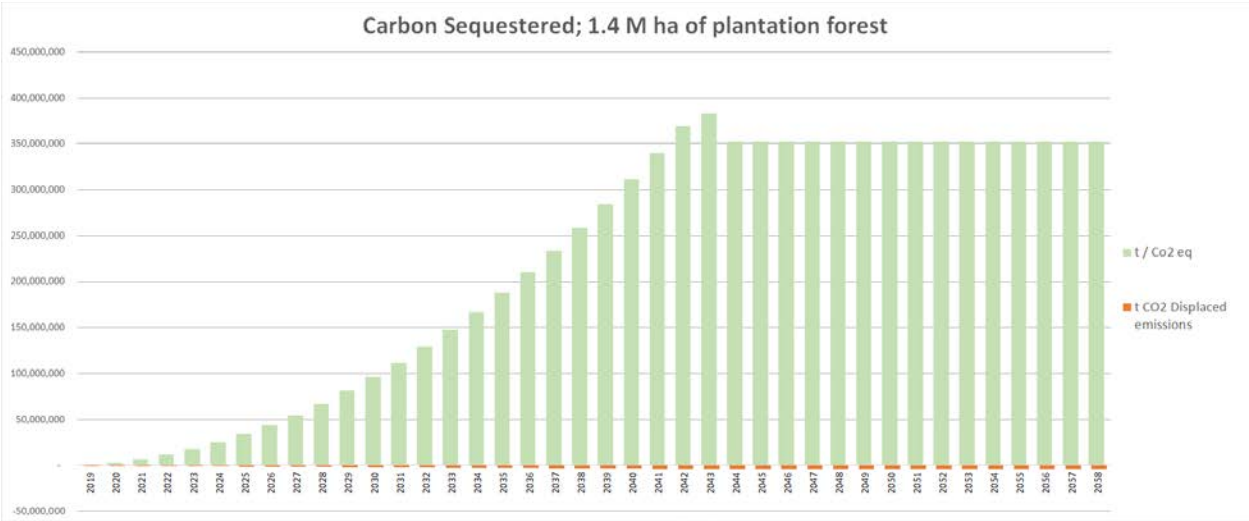
Overview page 6. There is an assumption here that suitable EV's will be available (new or used) - this is problematic. They are not, Tesla has consistently failed to deliver and the % of total manufactured volumes that are EVs is low. *In 2016, Japanese people bought about 20,000 EVs, and by 2030 that number will increase to 210,000 out of a projected total of 5 million cars sold, according to the Economist. Only two Japanese companies sell EVs: Nissan and Mitsubishi. Toyota* (NZs biggest seller) *announced that it would be putting an EV on the market by 2022 (1).* Many EVs lack the flexibility that many vehicle owners expect and uptake in some sectors is likely to be driven by this as much as price, which in most cases is still too high for it to make sense for a normal household to buy one. The sales of EVs in Japan is important as it is one of the few countries that manufacture right hand drive cars as standard.

I think there needs to be much greater depth of analysis of what the source of EV's is going to be and where the demand is in NZ; which consumers, what type of vehicle. NZ imports lots of second hand cars, many ex-Japan. Are there going to be large numbers of second hand EV's? (from where?), EV uptake in Japan is very low – so that seems to be a gap in the future supply of second hand EVs. There needs to be substantial change before we see large scale purchase of new or second hand EVs in terms of price, availability and performance. Pointing at the data in uptake that has occurred over the last few years as an indicator of the future is flawed as it does not address any of the above.

Overview page 7. Accelerating afforestation – what is the definition of short to medium term? Further why is it limited too short to medium term? Forestry is a long term business, and many of our plantation forests are now on their third and in some cases fourth rotation (that is in the order of 100 years successful sustainable forest management). There is no reason to think that this should not be applied to new forests.

Large scale afforestation is something to be encouraged and will have multiple benefits. In my view the report does not take account of these other benefits. If managed properly a new forest estate could supply a massive amount of wood for processing, energy and export. There are significant employment, GDP and export earnings associated with this. Further, forests are proven to reduce erosion, improve water quality and increase biodiversity, whilst accumulating carbon, and forming a potential low emission bioenergy source.

The graph below shows (in simple terms) the amount of CO2e sequestered in a 1.4 million ha estate. It allows for the harvest of 1/25 of the area established, at a point 25 years after the forest establishment began, and assumes that there will be an ongoing harvest of 56,000 ha per annum. There is a maximum amount sequestered (but even if you don't harvest sequestration will decline in rate). If you managed the harvest sustainably there will be a resource of ~39 million cubic metres per annum with a primary energy value of 270 PJ. This is substantial (NZs consumer energy consumption in 2017 was 970 PJ, (2) MBIE 2018))



Overview page 7. Balancing costs and emissions etc.
There are no zero emissions electricity generation options. Anywhere, of any kind. They all have a carbon footprint– including hydro, wind and solar PV. They have to be built.
Further there is no mention of bio-electricity – there is no reason why we cannot have substantial electricity generation from biomass by 2050, especially if there are supporting policies and clear supplies of biomass available (from expanded afforestation and wood processing). Co-generation of electricity and heat should not be considered separately; to quote an American engineer whose paper I have

mislaid – “making electricity and heat separately is insanity”. We already have gas cogen (Te Rapa, Contact / Fonterra) associated with an industrial heat demand and there are several example of large scale wood fuelled cogen aligned with wood processing heat demand (Red Stag / Rotorua, OJI Kinleith, PanPac Hawkes Bay).

Overview Page 9. There is limited R & D on CCS opportunities in New Zealand. It is problematic at best. There needs to be recognition of the sequestration in timber products in buildings.

Overview page 11. This seems to miss the point that whilst forests are indeed limited in their ability to continually sequester carbon, they can be a perpetual source of low carbon fuels that are available to displace coal and gas.

General on Overview

The clear support of forestry as a means to sequester carbon is welcomed.
What is concerning is that there is little acknowledgement of the substantial role that the forest resource could play in the long term as supply of low carbon bioenergy that could be used to generate process heat, electricity and liquid fuels for transport.

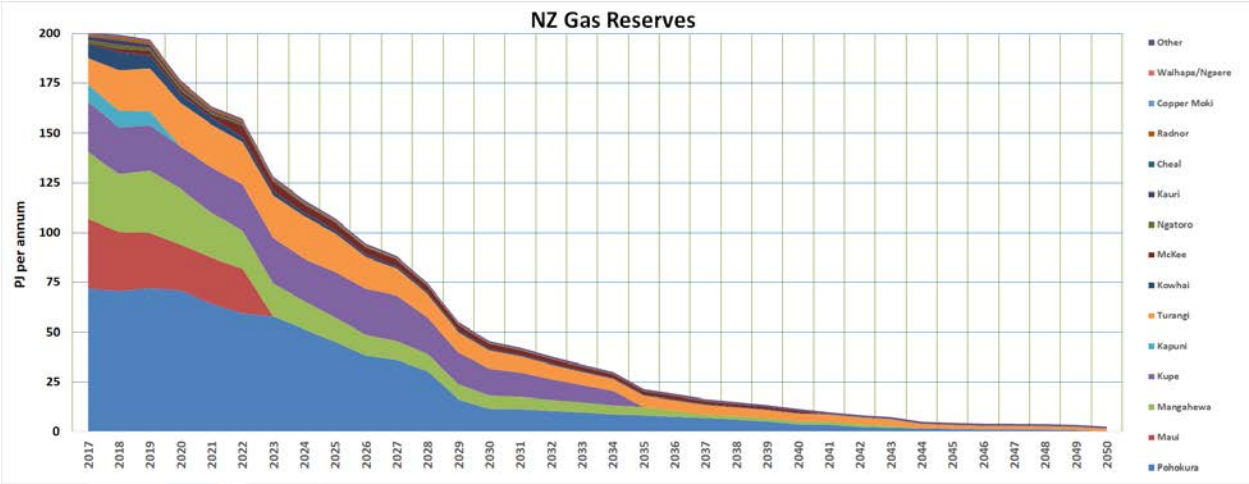
Other sections

Page 34 – liquid biofuels need to be mentioned as an option to reduce emissions from transport

Page 49 – the expectation that the Tiwai point smelter will close is something that has been talked about since the day it opened in 1971. It recently contracted for another 50MWe out to 2022 and reopened its mothballed 4th pot line. This is not a sign of imminent closure in my view. Aluminium from this smelter may well attract a premium due to its low carbon footprint. Assuming it is going to close is bold. At the very least it should be considered that it might not, and as it takes 14% of NZs electricity this needs to be included as a scenario. Assuming both the steel mill (Glenbrook) and the aluminium smelter will close in 2025 seems to be likely to skew the results of the modelling.

Page 55 Table 3.2
In the transport section there is apparently no consideration of biofuels in the scenarios. This seems to be ignoring the potential of liquid biofuels associated with the afforestation. More modelling should include this opportunity. Where are the assumptions about afforestation? – they do not appear to be in the table. If they are not considered to be available as a source of bioenergy then this is a substantial oversight.

Page 60. There is no mention of the potential for bio-electricity from combined heat and power (CHP) systems. There is a substantial opportunity here. Further, there seems to be a no recognition of the looming gas shortfall as NZs existing gas fields decline (3) MBIE)). If we run out of gas the closure of the CCGTs will be enforced. As a consequence of low gas supplies a possible scenario is that Huntly continues to run, on coal for a substantial period, the closure of its two remaining units has already been delayed.



Page 61. Transport. There is no mention of the potential of liquid biofuels to fuel the continuing demand from ICEs or PHEVs This appears to be a significant gap in the analysis.

Page 71. Transitioning from forestry sequestration. As mentioned above the analysis ignores the issue of the potential of the new forests to provide products of any kind, including biomass for bioenergy. The potential is substantial.

Overlooking the potential to sustainably manage the new resource is a serious gap in the analysis. Acknowledging that some of the new forests may be planted on land that is steep, erosion prone and remote, this analysis still needs to be done. There is plenty of opportunity for GIS analysis to look at the land area specifically and take out the worst of it from production plantation and make it permanent forest cover. This would still leave a significant area that has potential for production forestry, particularly in scenarios with larger areas of afforestation. Further, there seems to be an assumption that the current forest roading and harvesting options we use are the only ones available. They are not. There are many systems that could be used to reduce impacts of logging prior to, during and post-harvest. Some of the current post harvest impacts from forest harvesting on steep terrain are the result of poor practices. Just as agriculture may need to change to reduce it impacts, so to for forestry. Included in this is the post-harvest management of landings and the often substantial quantities of wood debris left around landings – which is a source of wood fuel.

Page 240. Figure 10.2 and following page (241). The land use change figures do not balance, by a substantial margin. There seems to be a missing area of around 1.7 M ha. To what use did this go? (pasture to ???).

Page 251. Which species, which regime?
Planting P radiata and leaving it in the hope that it will revert to native is a poor choice and shows limited analysis of the options, and no clarity on the desired outcome. If you want permanent exotic forests as a carbon sink then plant Redwoods or Douglas fir (they will both outlive P radiata by centuries), Redwoods in particular. If you want to have a store of carbon in native species then manage for that. Doing it under a canopy of radiata may work but it won't happen by itself. There will have to be a plan and management of both the radiata and the native vegetation. To get substantial volumes of carbon stored per hectare you need to have climax species with a high canopy, native scrub will not hold as much carbon per ha as a beech or podocarp forest as it is simply not tall enough to do so.

Page 252. The option of sterile hybrids needs to be considered in areas where wildings are considered to be an issue.

The issue of forests reducing water out of a catchment needs to be considered in a broader context. Most of NZ used to be covered in forests, pasture on hill country is a recent development. The reduction in water flows would be going back to a more natural state. Forests reduce peak flows and erosion in storm events. The water coming out of a forest, whilst it might be less in quantity, will be superior in quality as it will have less sediment and animal induced pollutants. It is therefore more useable.

Miscanthus is not a carbon sequestering species. It could be regarded as a perennial plant as it develops a rhizome, but Miscanthus requires annual harvest as the above ground dry matter dies off every winter. Whilst it grows quickly it does not sequester large volumes of carbon on site. To harvest with current technology it needs to be grown on land with a slope of less than 20 degrees.

Page 281. There is an assumption that hydrogen routes will develop, in the following sentence there is mention of biofuels for marine, aviation etc., but this is qualified by the statement that there are challenges in large scale production of these biofuels. Whilst this is correct, there is substantial investment in R & D around the world to solve these issues. These technical and cost challenges also apply to hydrogen. Hydrogen energy as an economically viable option is not a given. Making hydrogen, whilst a known process, has a very poor energy return on energy invested (around 0.5), making it inevitably challenged from a cost and efficiency point of view.

Page 293. Should NZ aim to phase out fossil fuel vehicle imports?
A resounding – No. To be replaced with what? This is problematic at this point. What is the definition of a vehicle (does that include helicopters, earth movers and ships?). The transition away from ICEs may occur but forcing it in this way is not the way to go. The unintended consequences are likely to be sunstantial.

Page 297. One of the barriers to EV uptake is their lack of flexibility. Many cars do make a great many short journeys with one passenger. However, the same vehicle is often used on the weekend to tow a boat / caravan / trailer / horse float or travel with skis / surfboards / mountain bikes etc. on the roof. EVs simply cannot do this. There may be issues with warranties being void if a tow bar is fitted (e.g only the 4th generation Prius can be fitted with a tow bar). Further, the range issue blows out if the vehicle is heavily loaded or has extra aero-dynamic drag (roof racks). A key issue is that the EVs simply do not have the level of performance and flexibility to multitask that a much cheaper ICE vehicle has. Paying more for less is generally an unattractive proposition.

Page 305 to 307 biofuels.
Biofuels are critiqued for being currently non-commercially viable. This could also be said of EVs (they are simply too expensive for most people to buy for what they deliver in terms of capability), hydrogen and fuel cells (not commercially proven or available). The solution to the biofuels financial viability issue can to some extent be addressed by the cost of carbon and support for R & D on drop in fuels from wood.

The report seems to miss the link between it's advocacy for the establishment of new forests to accumulate and sequester carbon, the limits on this due to land area and the opportunity to manage this estate for a sustained yield for biomass that can be used to produce low carbon fuels (solid, liquid and gaseous and multiple other products including low carbon construction materials.

The specifications for marine fuel are much less demanding than for Jet or diesel, so this fuel (ferries and coastal shipping) should be a target for the development of a first step on the route to renewable low carbon liquid biofuels.

Page 333. Box 12.4. The fact that forests are stored energy is missed. This material can be mobilised sufficiently quickly to be a viable energy source for dry year generation. Huntly could be reconfigured to take a proportion of its fuel as biomass, especially if the biomass has been torrefied. Torrefaction has

been being researched globally and is nearing commercial viability, with the target use being in (pulverised) coal fired power generation.

Page 337. The fact that biomass can be used in combined heat and power (CHP) at a distributed level is overlooked. This technology exists and government could lead this with bio-CHPs in facilities such as hospitals.

Page 347. Bullet point 4. This statement is substantially incorrect. The technology to do this exists now, off the shelf. The cost of biomass as a delivered fuel would be in the order of $10 per GJ at many heat using sites. Gas already costs this depending on the size of the demand. Coal is cheaper at some sites, but transport is a factor that varies. For many the cost of coal would be in the order of $6 to 7 per GJ, more if transport distance are in excess of 100km. The cost of coal will rise per around $1 per GJ for every $10 of carbon price. A significant driver is that industrial users have not been paying for their carbon emissions and have effectively been a getting a two for one deal. If the playing field is levelled and the cost of carbon gets to around $50, then biomass as heat fuel will be able to compete. Further there is the long term issue of gas supply, which as expressed earlier is in decline. The South Island has no gas option, so they burn coal. There is an alternative, and it is developing (Wood Energy South, Fonterra Brightwater etc.). A little support could see substantial shifts from coal to biomass. There is a significant amount of unused biomass in most regions of New Zealand that could be used for process heat (4). The bulk of this would come from existing plantation forests, its extraction and use would provide a low carbon heat source and help solve the post-harvest management issues that sometimes occur on steep sites. Electricity to heat makes little sense at current prices – industrial electricity supplied at $0.10 to $0.12 per Kwh is equivalent to $28 to $33 per GJ.

Page 349. **Little scope for high temperature heat**. This section contains a contradiction, followed by a gross simplification which leads to the idea that high temp heat users do not have a low carbon option. There is a sentence that says that wood is used to produce high temperature heat (correct). The next sentence says that converting to low carbon biomass would carry significant costs. Wood is biomass. It is already used, and its expanded use is frankly a no brainer. Given the reports advocacy for an expanded forest resource, which can be sustainably harvested, use of some of this material as a fuel seems obvious.

Page 350. Table 13.1. Lovely concept, unlikely to happen. NZ gas supplies are in decline with little immediate prospect (in the next 10 years) of improvement. The cost of gas is going to rise from 2020. (NZ Gas Company, Radio NZ interview). Why would a large user shift from coal to gas when the supply is uncertain and costs are predicted to rise?

Page 352. Error. The statement that you need 7 to 10 trucks loads of biomass to get the equivalent of 1 truckload of coal is incorrect. It is closer to 3. Assuming a truck has a max payload of 29 tonnes (44 tonne GVM) carrying coal with a NCV of 21GJ tonne (optimistic) it will deliver 609 GJ. A typical chip truck (with a high volume configuration, not requiring any special permits) can deliver 29 tonnes of wood chip at 6.9 GJ per tonne or 203 GJ per load. The direct connection in the report between volume and truck loads is flawed. The limiting factor for the trucks is weight not volume.

Page 367. Figure 14.3. The wood and paper going to landfill could be considered a source of biofuels.

Page 432. F11.12 Hydrogen technology is not proven at a commercial scale and the infrastructure investment is beyond substantial, it's enormous. Production of hydrogen will only be viable if you have spare electricity generation capacity. There doesn't seem to be any analysis of how much hydrogen is needed and where it's going to come from, how, at what cost. Electricity to hydrogen to electricity is relatively inefficient.
and,

If it's valid to say that the technologies for liquid biofuels are not commercially proven then the same should said about hydrogen

Page 435.
F13.1. Statements that high temp heat users have no viable short term economic abatement opportunities is a gross simplification. There is a viable fuel available to many users – wood. Longer term, as the proposed expanded forest estate matures this opportunity is substantial

F13.2. Does not take into account declining gas supply. Further it dismisses biomass opportunities in the South Island. Fonterra Brightwater is moving its 7MW coal boiler to co-firing with wood – demonstrating that this route is viable.

Summary

The report completely fails to join the dots between the expansion of the forest estate and the opportunity to utilise the consequent large scale supply of woody biomass for low carbon energy and other low carbon products. This is a significant flaw.

There is significant focus on the challenges that bioenergy faces in terms of technologies. In the case of liquid fuels by 2050 many of these will likely be overcome.

In the case of biomass to heat or heat and power these barriers are substantially overstated. There is ample evidence that we can and do burn wood to generate heat and power and have done for many years at multiple sites.

Further, the opportunities that exist to fit biomass / bioenergy into the current infrastructure have been overlooked; for example wood can be gasified and the product-gas upgraded to synthetic natural gas (methane), this can be done at large sites as a one off or as a feeder into the existing pipeline network.

References

(1). https://www.japantimes.co.jp/news/2018/01/12/national/electric-vehicles-practical-economical/#.Wu0ac6KkuGA

(2). http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand/documents-images/energy-in-nz-2017.pdf

(3). http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand

(4.) Residual biomass fuel projections for New Zealand – indicative availability by source and region. Scion Report for the Bioenergy Association. (Hall P. 2017).