Submission on AEMO draft 2023 Inputs, Assumptions, Scenarios report.

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The primary intent of this submission is to question the lack of informed content on energy from biomass and biowastes, despite the fact that development of this form of energy is central to the transition away from fossil fuels and the reduction of national greenhouse gas emissions in many countries that are relatively comparable to Australia. These countries in general have gone along this path due to the lower capital costs, lower need for costly subsidies and feed-in tariffs (as in the case of wind and solar PV), the significant carbon sequestration potential, and the fact that this pathway results in real economic, social and environmental benefits or stimulus to rural and regional industry, businesses, economies and populations, and this all helps reduce population drift to the cities.

In short, Australia's potential to get up to 15% of our power and up to 30% of energy consumed overall from the array of bioenergy technologies and our massive annual supply of economically available sustainable biomass, does not get the recognition that it should in this report. This deficiency exists despite the fact that information about current use of biomass and biowastes for energy in many other countries is freely available in English. The intention by these countries to further develop and increase this use of biomass for energy, and for other countries to begin to develop along this pathway, is similarly freely accessible.

Power. Biomass presently provides over 14% of the power in Finland, about 12% in Denmark, 10% or more in Germany, Sweden, Austria and several of the Baltic countries (in almost all cases this is accompanied by a supply of industry heat which fully displaces use of heat from gas or electricity). This biomass is mainly woody biomass, but with smaller volumes as straw and biogas from putrescible materials. These countries are all increasing this share of power from sustainably sourced biomass towards or beyond 15%. Germany was getting 5% of its power from biogas alone (plus some significant heat energy) in about 2010. It is noted with concern that this potential of power from biomass in Australia It is effectively unrecognised in this report, despite the fact that reports from both CSIRO and Bioenergy Australia detail the amounts of economically available sustainably-sourced straw and woody biomass, and the fact that Australia has enough suitable biomass to produce approximately 15% of power requirement (in dispatchable form) and about be the source of about 30% of consumed energy overall, including power, heat energy and transport fuels.

Waste to energy. The high fraction of renewable wastes' (or material of organic origin) contained in mixed municipal wastes means that use of this overall non-recyclable combustible fraction of waste for energy means the energy output from these plants is relatively low emission. About 50-65% of municipal solid waste (MSW) is biomass or of organic origin. The conversion of MSW to heat and power at large scale is a well-established practice around the world, with over 2300 WtE plants across many countries. In Europe the details of WtE plants operating there can be found on the website www.cewep.eu. It takes from 6500 to 10,000 t/yr of MSW to produce a megawatt of power (the range is partly due to amount of food wastes and so moisture present, and partly to efficiency of the plants. Modern WtE plants are normally using 300-400,000 t/yr, and so producing from 30-60 MW-e in on-demand form, plus industrial heat of up to double the electrical output figures as MW-th.

Across the EU countries WtE plants produce 4-8% of power needs of the various countries (it is highest in the more industrialised countries including Germany, Sweden and Denmark). Australia has the potential to produce a similar quantity of our electricity (about 2000 MW-e from about 12 million t/yr of suitable solid waste), plus valuable industrial heat, from the non-recyclable fraction of waste that presently goes to landfill, and this will also mean emissions from landfill are dramatically reduced.

Renewable gas and liquid transport fuels. Despite the assumption in this draft report that internal combustion engines for all personal and freight transport and public transport must be replaced by electricity and batteries, etc., this simply is not so. A number of countries that are among world leaders in reducing emissions are demonstrating this. Sweden for example has over 21% of all vehicle fuels now being from renewable sources, including the use of biomethane in city buses, with other buses fueled by fuel ethanol and biodiesel. Finland has a target of 30% of all transport fuel to be from renewable sources by 2030, with this including that 40% of all diesel is to be renewable or 'drop-in' diesel. Brazil has shown for decades that spark ignition vehicles can be equally fueled by ethanol as by petrol, and there all spark-ignition vehicles can use from 20-100% fuel-grade ethanol.

Renewable gas. In connection with decarbonizing the gas grid, there is great potential for anaerobic digestion of all forms of putrescible wastes, much of which currently goes to landfill. As an example of this potential, in Denmark presently up to 40% of the gas in its natural gas grid is biomethane, and almost 100% of the gas in the grid of the city of Copenhagen is biomethane. Yet, while the potential for production of biomethane as an energy source in Australia is very large, this is almost unrecognized, though it does get some mention in this draft report. In contrast, the potential for hydrogen to be the major gas for decarbonizing the gas grid or providing energy for households, industry and transport, seems to be accepted on faith, despite requirement for installing a massive and massively costly over-capacity of variable renewable electricity sources, high costs of production, massive costs of conversion of the existing gas grid reticulation infrastructure, and the many major technical and safety difficulties.

Improvements in recycling, and diversion of non-recyclable wastes to use for energy production (mainly by anaerobic digestion and combustion), means that the amount of waste presently going to landfill in Australia can be reduced to almost zero, and consequently the GHG emissions leaking from landfill cells can also reduce to near zero.

In summary. The situation is that producing our energy from biomass is one of the best and lowest cost ways for reducing emissions, by replacing coal and gas-fired generators with a renewable form of on-demand generation for meeting shoulder or peak demand (or responding to the need to fill gaps in supply due to the variable and intermittent nature of wind and solar PV). In light of this, the remarkably low awareness of the potential of biomass to energy shown by the people who have developed this draft report is of major concern.

Some points of terminology that need attention in this draft report.

The use of the term 'energy' in this report can mean either electricity only, or all forms of energy combined. It is a concern that a report at this level perpetuates this sloppiness in terminology.

Comment on scenarios

Feedback on scenarios. Regarding the names (mainly expressed as average temperatures increases) for scenarios, in light of the fact that the emissions from China, India, Russia, and some other regions including the Gulf States, will continue to rise and drive climate change, it needs to be stated clearly in this report that the actions of Australia alone, or even all of the countries that have zero net emission targets, will have little significant impact on the rise in global GHG emissions. It presently seems likely that, despite the best efforts of Australia and other concerned countries, that the world will heat by over 2.6 C or more, if current models are remotely accurate. There will be many challenges arising from this, to do with water conservation, managing wildfire, food production, building design, and energy.

In my view we need to follow the lead of countries like Finland and look at how we can improve energy security, jobs and manufacturing and exports in association with net GHG emissions reduction and net atmospheric GHG level reduction, in this scenario of uncomfortably high average temperatures. This may include developing technologies around lower rainfall forestry and the bioeconomy, water harvesting and storage, undercover food production, and lifting our manufacturing expertise.

2.2.1 1.5C Green Energy Exports. This scenario, as it presently is, suggests that production, use and export of 'green' hydrogen is central to bringing Australia's emissions down as quickly as possible. In reality, the requirement for the massive oversupply of capacity of wind and solar to produce the necessary amount of 'green' hydrogen is a key issue with the development of this approach for hydrogen to be the solution. This is even while ignoring the other major issues, including cost of compression, storage, transfer, and development of the whole range of systems for utilisation of 'green' hydrogen. The overall assumption, that development of consumer energy resources (CER) including solar PV, storage batteries and electric vehicles, is critical to reduction of Australia's emissions, is most questionable, even though it is currently accepted as an article of faith in many circles – including by CSIRO's Gencost team, Victorian state government's policy development, AEMO, and many climate think-tanks.

However, the pathway many other countries have taken that are far ahead of Australia in reducing emissions and transitioning toward renewable sources of energy, shows there is another, arguably far better, pathway. Finland, for example, is well advanced to its target of reaching zero net carbon by 2035, based largely on carbon sequestration in forests managed for sustainable harvesting to produce wood, woodfibre products and biochemicals, and with the woody biomass residues from forestry harvesting and timber processing being the country's largest single source of energy consumed (including heat, power and transport biofuels).

The far more feasible approach for rapidly reducing emissions, and the one that countries including the Nordic countries, the Baltic countries, Austria, and others now including New Zealand and Canada, are developing, is where biomass-to-energy is an integral part of a developed bioeconomy, along with expansion of managed forestry (including forestry plantings integrated into conventional agriculture) to provide much of the raw material for the bioeconomy. In this approach there is diversion of as much putrescible waste as possible to anaerobic digestion, with the upgrading of major fraction of the biogas production to biomethane. If we took this approach here this potentially could supply 25% of our present domestic (household) use of natural gas usage, or more.

2.2.2 1.8 C Diverse Step Change. The need for a large and extremely costly electrification of transport (and of space and industrial heat being produced from electricity) is far reduced by development of bioenergy. Denmark for instance has a target of all energy consumed coming from renewable sources by 2050, with half of this to come from biomass, and the other half almost all from wind (being the majority of electricity needs), with some from solar PV and solar heat collectors. It needs to be stated that in this example, Denmark's large scale use of wind power is only possible due to access via AC and DC interconnectors with Norway and Sweden to a very rapid supply of dispatchable electricity from hydro dams, meaning that imported hydropower is critical to 'firm up' Denmark's variable power supply from wind.

The very debateable assumption that 'rapid transformation of the energy sector' is enabled by 'cost reductions for battery storage (aka: storage in batteries of electricity from variable electricity generation systems) and variable renewable energy…'. And that, 'Consumer preference and manufacturing strategies lead to high uptake of electrified vehicles, and ICE vehicles are eventually removed from the roads entirely'. These are illegitimate assumptions and it is a surprise to find them put forward as the only pathway. Similarly with observations in the previous scenario, it is negligent to omit to mention the pathway (previously detailed) that much more advanced countries are taking to get to net zero faster and at lower cost and with more benefits to the national economy, to jobs, to rural and regional economies, and with more environmental and other social benefits.

The assumption that the only way to smelt metals without using fossil fuels such as thermal coal, natural gaas and electricity produced in coal or gas-fueled power plants, is to use 'green' hydrogen, is flawed. While it may be feasible technically to produce steel from iron ore using only hydrogen, for decades the Brazilians have been smelting ores using charcoal produced largely from plantation eucalyptus in an increasingly efficient way that produces almost no net emissions, but on the contrary uses the volatile gases from the pyrolysing wood to produce power. Brazil in about 2012 was producing about 5 million tonnes a year of charcoal for smelting.

2.4 So, in answer to the question- Are the scenarios plausible and internally consistent? In my view (and surely in the view of any well-informed person) the scenarios are plausible and internally consistent only if the AEMO assumptions are accepted. In fact, since they are not able to be accepted, then neither are the scenarios plausible or internally consistent.

2.5 In regards to 'Sensitivities', again since the Assumptions are flawed then the discussion of 'Sensitivities' in largely meaningless, as the modelling is done using reliance on these flawed assumptions.

Social License. This is a critical issue, as 'social license' can be manipulated by any group that has enough reach or influence to support some things (solar PV) or blackball others (bioenergy). The example of the Greens (and all their allied bodies) and their deep antipathy to bioenergy can be used to illustrate this. The Greens and their allied bodies have campaigned consistently for twenty years against any development of bioenergy, as they are agitated about the potential for use of native forest material to produce energy, despite this being most uneconomic. However this blinkered but effective campaigning has had an insidious influence on the thinking of people in many spheres, including the media, public servants, school teachers and students, and even energy companies.

In reality, the 'social license' of some other forms of renewable electricity including solar PV is under review, due to the issues of shorter life and lower than advised output capacity of some brands, lack of recycling facilities, high embedded energy in manufacturing, and reduced output over time and in hot weather of all brands. Similarly the 'social license' of wind turbines is being reviewed, as the information about impact on communities and host landowners, on birds including brolgas and raptors, on bats, and as the issues of disposal of non-recyclable blades are better known, along with the higher rates of turbine failure, including catching alight.

The 'social license' of storage batteries is now also under review, due to fires in batteries, issues of firefighters dealing safely with combusting batteries, toxic smoke affecting urban locations, major issues during wildfire when houses combust and batteries catch fire, accidents to EV's, and so on.

3 Inputs and Assumptions

This draft report should be based on what is rational, sensible, cost-effective and science based (and preferably also well aware of what has been demonstrated to work elsewhere in comparable countries). Aspects that are being put forward only with the assurance that 'modelling' has supported the approach should be treated with real suspicion when there is no other reason why this approach is robust.

The quest and rush to adopt zero-net emissions targets by state and local government by a quite early date (by 2030 in the case of many municipalities, including the city of Ballarat) is a worrying knee-jerk response, and in most cases this target is completely unachievable and ill-informed. It seems not so different to the psychology where local government areas in China under Mao competed with each other to adopt some utterly unrealistic target for production of wheat or pig iron. It is a serious issue that some Australian states now seem to be doing the same thing. Victoria is an obvious example, with commitment to hydrogen, EVs, wind, solar, batteries, and major new power lines, but almost no action on biomass to energy, or to putting biomethane into the gas grid, or any apparent consideration of development of transport biofuels.

In answer to questions on P35 of the draft report. I repeat that some core assumptions are questionable or invalid and that there are some important issues or options that continue to be ignored. Unfortunately these are also missed or understated in most state policies. It seems to be a repeating cycle of ignorance at how other countries that are ahead of Australia are managing their actions and strategies. So in Victoria there is no development of straw to energy, no state support for anaerobic digestion of putrescible wastes, or policy for injection of biomethane into the grid, no development of biofuels or any mandated target for their use. Some other states are better but at the federal level there is little policy recognition of these options, or of development of a bioeconomy.

3.2 Emissions and Climate Assumptions

If the aim is to rapidly cut emissions toward a net zero status and even preferably to become a net sink of carbon by whatever pathways, then the actions being put forward by AEMO are more costly and less effective than the actions being considered and taken by many other countries. Australia has the scope to plant up to 10 million ha of managed plantation forestry integrated across the at least 100 million ha of land cleared since settlement for agriculture. In Victoria it is identified that at least 500,000 ha can be established in this model of integrated farm forestry by 2050, with no significant impact on production of food or fibre, or on catchment flows, but with major sequestration of carbon dioxide from the atmosphere, and with a significant amount of energy (heat and power) being able to be produced from the biomass from thinnings, heads and milling processing residues.

In the carbon sequestration outlook across NEM states (P44) figures for sequestration via land based processes are mentioned for each scenario. The present reality is that soil carbon is not a significant option so this sector of land sequestration will be as trees, and with these being in a continual state of optimal growth (i.e, being thinned and harvested and replanted in a timely way). Theamount of agricultural land in the NEM region is arguably not enough to allow the highest figures (142 mt CO_2-e by 2035) to be achieved, though if native forest was able to be managed in a rotational harvest and thinning regime this figure is readily achieved. What is missing in that carbon sequestration figure is the energy from biomass that will be produced from this management. The fact that this is not being considered and factored in, raises the question of why not.

In the note on fuel switching, again there is the assumption that hydrogen is cheap and that it is the leading substitute for natural gas. In reality the production of biogas can begin within a few years, with significant production of biomethane by 2030, and injection into the grid and use for transport fuel and domestic cooking and heating. In the two 1.8 degree scenarios it is mentioned that biomethane production will require significant subsidies, but there is no mention of subsidy for hydrogen production, even though obviously there is massive subsidy already in the system, and it is a by-product of massive subsidy of the necessary overcapacity of wind and solar power. To affect to ignore this, or suggest otherwise, seems duplicitous. The levels of biomethane production in Fig 14 are not acceptable or sensible, in light of what has been achieved in relatively short time periods in countries including Germany, Denmark, Sweden and Lithuania. In most cases thishas been on the basis of encouraging anaerobic digestion of putrescible waste to produce biogas for heat and power (5% of power supply in Germany in 2012), and then to have policies encouraging the upgrading of biogas that is already being produced.

In all of this, the approach of energy efficiency and energy reductions is of course important, and needs to be a core process in any event. The countries of Austria, Germany, and the Nordic countries are leaders in this approach, along with farm greater use of wood in buildings and all structures.

3.3.6 Electrification

As previously stated, the assumption that electrification is a key part of the best pathway to achieving reduction of GHG emissions, is fallacious. Electrification of all heating and transport as well as current electricity supply means the requirement of installing a massive over-capacity of wind and solar power systems, and of new power lines and grid connectors in order to achieve this. For AEMO to ignore the option of having little increase in electricity requirements by the eastern market, and with heat and transport fuels and some power coming from biomass, at far less cost overall, with far greater economic and environmental benefits, seems negligent in the extreme. This is the approach developed in Finland and Sweden, Brazil, Denmark and the Baltic countries, with many others on early stages of this pathway – Spain, New Zealand, Canada, the UK and France.

Biomethane

As previously stated in this submission, the potential for production of biogas and biomethane is far greater than suggested in this report and in some state studies. Some indication of this might come from the examples of Germany, France, Lithuania, Sweden and Denmark, among others. Denmark is one leader, with about 6 million people in a country of area of about 43,000 sq km (about half the area of Tasmania). Copenhagen presently has almost 100% of the gas in its city grid being biomethane, produced from sewage and food wastes of the Greater Copenhagen residents, commerce and food processing industries. Denmark itself already had 25% of the gas in the national gas grid being biomethane by 2021 and aims to reach 100% by 2035.

The high utilization of manures, sewage and food wastes going into anaerobic digestion also means production of very large volumes of nutrient-rich pasteurized digestate, that can be utilized in agriculture to replace imported nitrogenous fertilisers, produced from natural gas or guano. It also means that much of the putrescible feedstock is not simply put to landfill, or otherwise disposed of, to break down with free emissions of greenhouse gases to the atmosphere. The economics of production of biomethane in this report needs to factor in these potential environmental and economic benefits.

Matters for consultation P66.

'No' is the answer to the first question. It is worth noting that the forecast mapping of CER by various 'expert' bodies (Table 14) omits energy from biomass technologies, including biogas fueled gas engine driven generators, small and larger gasification plants to power, and other systems utilising wood, horticultural residues or other biomass residues, to generate heat and power.

Question 2 – Yes. The near total omission of biomass to energy including from the carbon sequestration land sector means most of the assumptions and inputs in the report need to be reassessed and revised.

On P80 there is mention of adjustments to the 'biomass emissions factor'. Is there an emissions factor for solar PV or wind turbines or hydrogen electrolysis plant and fuel cell considered in the modelling and assumptions? This may seem a facetious question, but the emissions from at least solar PV are significant (up to five years for the embedded energy in manufacture of PV cells to be repaid by output in use) but rarely mentioned. Biomass by contrast (and the form of biomass is not specified but if is assumed the biomass is chipped residues from milling of plantation timbers) then the emissions would effectively be zero.

I note on P 90 in Fig 34, that the use of MW of capacity in the vertical axis is potentially misleading. So 50,000 MW capacity of solar PV may only be 10,000 MW of production and probably less due to heat, dirt and ageing. While the biomass to power plant capacity has a capacity factor of 80% and more biomass to power may be behind the meter, while other biomass-to-heat production displaces natural gas usage but is invisible.

Question Page 92, is the AEMO candidate list of technologies reasonable? No

At least one other bioenergy technology needs to be added, this being anaerobic digestion, to produce biogas, possibly to fuel gas engine-driven generators. The biogas can alternatively be upgraded to biomethane for injection into the gas grid or used directly as a transport fuel for light or heavy transport. The production of transport fuels other than biomethane could be included, though there are currently at least two technologies for this in commercial use, including fermentation of feedstock like straw or sawdust to produce ethanol, and pyrolysis of wood or straw to produce pyrolysis oil. Production of renewable diesel and biojet can be done by another pathway and while this is a topic of importance it may not be so relevant to AEMO.

The mention of Biomass to <u>electricity and steam</u> in Table 22 should be changed to 'electricity and heat'. In the very many biomass fueled combined-heat-and-power (CHP) plants in Europe and elsewhere, the economics of he plant is enhanced by sale of heat which commonly is as low grade heat of 80-105 C. To only specify steam is too restrictive, and while this may be the case in a pulping plant or some other industry plant (i.e., Visy P&P plant at Tumbarumba) it is not the usual practice with a stand-alone CHP plant.

The graphics (Fig 35) indicating the declining costs in wind and solar go against the current rises in capital costs per MW capacity.

Table 24 Technology cost breakdown figures – the costings for 'biomass' do not reflect the fact that a biomass to power (or combined heat and power) plant is often within a manufacturing site (i.e., a sugar mill) and can be of any scale, and can use a wide range of feedstocks, some of which may be produced from the mill or adjacent plant.

In general the capital costs for representative biomass fueled CHP plants are given in the Gencost reports as being significantly higher (20-40%) than the world and Australian built examples. Also th absence of anaerobic digestion (source of up to 5% of Germany's power, and of over 25% of Denmark's circulating gas in its grid) is a real indicator of lack of good understanding of the potential contribution to the NEM and to reduction in emissions of this bioenergy technology.

3.5.4 Technical and other cost parameters

3.6.2 Renewable Resources.

The lack of information about the array of biomass resources here has to be noted with concern, as indicating a blinkered approach by AEMO draft report writers.

3.9.2 REZ Social license and Resource limits

Social license is a really complex issue, and can be manipulated and managed. In my region we have seen proposed wind farms seriously delayed and in one case completely blocked. We have seen a 200 mW capacity solar farm blocked. But meanwhile the various lobby groups work tirelessly against development of bioenergy, regardless of the feedstock or technology.

No time left to do more on this.