Submission to AEMO scenarios for power into the eastern grid

Andrew Lang, president Victorian Bioenergy Network & World Bioenergy Association senior consultant, and Daryl Scherger, secretary of the VBN

The three scenarios being proposed are heavily influenced by the option of take-up of a varying capacity of variable electricity sources of wind and solar PV (with one scenario looking to have variable sources supplying up to 90% of all power requirement), and the firming of output from these by use of batteries, pumped hydro, and hydrogen produced by electrolysis. The scenarios differ in scale/rate of the rollout of the variable and intermittent renewable electricity sources.

While there is a parallel objective being discussed connected with the scenario development, of attaining zero net GHG emissions by 2050, the scenarios are mainly focused on the production of electricity, which constitutes about 30% of energy used in region served by the Eastern grid, and up to 50% of GHG emissions in the electricity generation system of about 2005. The options being put forward under the scenarios are generally not so effective at attaining the zero net GHG emissions objective, as they only partially (despite a massive overall cost) eliminate the need for significant backup generation capacity, or of the very high emissions involved in production of particularly the solar PV capacity, or of necessary grid upgrades, and for other parts of providing firming power supply. The scenarios do not appear to consider the approx. 70% of energy consumed that is made up of heat/cooling, and transport fuels, other than by assuming these will be converted to electrical forms of heating and transport, or possibly injection of hydrogen into the gas grid (which generally is not suitable for carrying hydrogen).

This submission suggests that somewhere within this report on scenarios and achievement of the target of zero not emissions, the models and approaches should be looked at that are successfully developed in countries that are actually leading in transitioning away from use of fossil fuels for energy and in reduction of GHG emissions. The models that are relevant are of Sweden, Austria, Finland, Brazil and Lithuania/Latvia. In these countries the actions that are central to their progress to achieving the zero net GHG emissions target are based on development of a bioeconomy, including biomass to energy, biochemical and biomaterials. The countries differ in how they are developing as circular economies, and in which other renewable energy forms they are developing. In general, they are well advanced in utilizing non-recyclable wastes for energy.

The developments in these countries are partly driven by significant national carbon tax on fossil fuels (or some equivalent), and partly by national government policy on energy transition and GHG emission reduction, with delivery often relegated to the municipal and industry level. The developments tend to be based on effectiveness and economics, and initially utilize the more proven, scaleable and mature technologies, are driven by effectiveness in genuinely reducing GHG emissions, and are often national objectives that are ahead of EU objectives imposed on member countries. Improvements in energy efficiency, at all levels and in all sectors, are always a major part of the program. Always the benefits to individuals, families and society are kept at the forefront, with changes in taxes and tax rates used to provide incentives to families and businesses to change practices.

Sweden is one stand-out example, with over 50% of consumed energy now coming from renewable sources (with by far the largest part of this, about 40%, being from biomass including biowastes), and with a very high rate per capita use of wood (meaning a large amount of carbon is annually stored in wood products with sorter or longer life), and with a highly regulated management of forests for carbon sequestration in live trees and for timber production – whether owned privately or by corporations, municipalities, the church or the state. Over 21% of the transport fuels used in Sweden is sourced from biomass, and a major part of this is as upgraded biogas (biomethane), used for buses, municipal fleets and taxis as well as private cars. An increasing fraction of the gas in the national gas grid is biomethane.

Some municipalities in Sweden claim to have the lowest per capita GHG emissions in Europe, with Växjö at under 3.5 tonnes, and Jönköping, being among these. In both cases most power and all heating are sourced from biomass, and putrescible wastes from the municipality go to produce biomethane, used for a major part of the transport fuel used. As well as electricity and heat from MSW and woody biomass in adjoining modern highly efficient municipal-owned plants, Jönköping municipality gets some electricity from two small municipal-owned hydro plants and a small number of wind turbines.

Finland is the first country in the world to adopt a national objective to become a circular economy, and this is being developed on the foundation of Finland's already well-developed bioeconomy. Finland has the national target to have 30% of all diesel being renewable (HEFA) diesel by 2020, and 40% by 2030. The province of Central Finland claims that by 2015 over 50% of all energy consumed was from biomass, and the province has the target of lifting this to about 75% by about 2030. Up to this time development of biomass to energy has been a primary focus in Finland as it is more cost-effective, creates rural and regional jobs, and does not require the massive tax-payer funded spending on infrastructure upgrades, or on backup generation systems and other subsidies, that wind and solar PV are seen to require in order to attract corporate investment in these.

Other countries and regions moving along this path include the UK, Scotland, Japan, Spain, and China. It is clear that Australia has a similarly great potential for development in comparison with the first group including Sweden and Austria. The utilization of urban biowastes is made possible by our concentration of population in a small number of sizeable growth centres, the agriculture sector is the annual source of many millions of tonnes of residues, and our timber industry is the source of many millions of tonnes annually of woody biomass. Reports from authoritative sources suggest that Australia could be getting up to 20% of its power requirement (in dispatchable form) from biomass, and about 30% of all consumed energy. Yet this potential, demonstrated already by a number of countries, is not indicated anywhere in the scenarios.

If Copenhagen can achieve 100% biomethane in its gas grid by 2022 (produced from food wastes and sewage) then so can Melbourne or Sydney by 2035. If Austria can achieve 100% of space heating and (largely on-demand) electricity from renewables by 2030, then so can Victoria by 2040. Some consideration of such options should be in the AEMO scenarios. As yet nowhere in the scenarios is the use of non-recyclable combustible municipal wastes (usually known as MSW) to produce 5-8% of our power and signicant industry process heat. In the EU 15 countries this is the source of 4-8% of power plus considerable utilized heat energy (www.cewep.eu). It is also used in many industries including for cement production. Since MSW is usually 50-60% biomass this is a lower emissions source of energy than natural gas. Since conversion of fuel energy to utilized energy in a modern MSW-fueled energy plant can be up to 90%, this source of energy should get some mention in scenarios. Denmark uses about 3.5 million tonnes a year of this form of material, produced from its population of about 5.5 million, plus industry, commerce and tourism. By that measure Australia might produce at least 12 million tonnes a year of this quality of wastes, able to produce 2000 megawatts of baseload power, plus over 2000 MW of industry process heat.

It has to be repeated that the real figures for capital cost of a biomass fueled condensing plant are significantly less than the figures given within the draft GENCOST report, or being used by AEMO. As stated previously, the industry figures for plants recently built in Europe and also within Australia, are in the range of A$4000-4500/kW-e for a biomass-fueled condensing plant, and (mainly due to the lower electrical output for the same thermal capacity of boilers) about A$5500/kW-e for a biomass-fueled combined heat and power plant.

For anaerobic digesters the capex can vary widely per kW-e, as this depends on scale, feedstock and various design features, but A$6500/kW-e is a general figure for a basic mesophyllic plant with insulated above ground reactors fed with higher biogas output feedstocks, and so producing enough biogas to run gas engine gensets with a steady output of about 1MW-e. Capex per kW-e reduces as scale increases, though this levels off after an optimum scale is reached, and increases in size is by adding units of this scale. For a waste to energy (WtE) plant with capacity of about 30 MW-e, capex is in the range A7500-8000/kW-e.

The amount of electricity demand that could be avoided by shifting to bioenergy for space heating and hot water (preferably via district heating systems) is very significant. Below is an example of the potential reduction in demand in a typical all electric Melbourne home.

Melbourne All Electric Home - Solar and Storage

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Electricity Use - kWh	1,357	1,116	788	507	462	414	628	386	340	543	808	1,022	**8,371**
Solar PV Output per kW	51	72	97	132	160	179	181	157	122	84	57	44	**1,336**
Output of 6.5 kW PV System	332	468	631	858	1,040	1,164	1,177	1,021	793	546	371	286	**8,684**
Energy Balance - Solar Output minus Home Electricity Use - kWh	-1,026	-648	-158	351	578	749	549	635	453	3	-437	-736	
Storage Required - kWh	1,026	648	158								437	736	**3,005**
Surplus Solar Output into				351	578	749	549	365	453	3			**3,048**

Storage													

Storage Required - kWh	**3,005**

The figures above represent a typical all electric home in Melbourne.

Melbourne Home Solar and Storage using Bioenergy for Heat

Month	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Total**
Electricity Use - kWh	502	413	292	187	171	153	232	143	126	201	299	378	**3,097**
Solar PV Output per kW	51	72	97	132	160	179	181	157	122	84	57	44	**1,336**
Output of 2.5 kW PV System	128	180	243	330	400	448	453	393	305	210	143	110	**3,340**
Energy Balance - Solar Output minus Home Electricity Use - kWh	-375	-233	-49	143	229	294	220	250	179	9	-156	-268	
Storage Required - kWh	375	233	49								156	268	**1,081**
Surplus Solar Output into Storage				143	229	294	220	250	179	9			**1,324**

Storage Required - kWh	**1,081**

The figures represent electricity use in a typical Melbourne home using bioenergy for heating and hot water.

In this examples, annual home electricity consumption was reduced by 63% by replacing electricity use for space heating and hot water. Using bioenergy to meet commercial and domestic heating demand would also avoid the major peaks in energy use during winter when solar output is at a minimum.

Avoiding electricity consumption is the lowest cost option.