The unrecognised potential of biomass to energy - to provide a significant fraction of Australia's primary energy, create jobs, mitigate climate change, and provide environmental benefits.

Andrew Lang, World Bioenergy Association board, 01.03.2010

The is real potential for the majority of Australian regions to produce a significant percentage of their energy requirements from presently unutilised biomass and wastes. This is presently the case in many countries, and most particularly in Sweden and Finland. Denmark, the Netherlands, Japan, Taiwan, Switzerland, Brazil and Austria also can provide some useful models. The following points summarise this

1. It is presently the case that mature technology developed over the last twenty years is allowing cities in Sweden and Denmark to provide up to 30% of their electricity needs from sorted municipal solid waste as a fuel for combined heat and power plants. The volumes available here and presently going into landfill are very significant and are of the order of 15-20 million tonnes a year.

2. Anaerobic fermentation of putrescible wastes including sewage, food processing waste and animal manures, in many countries is producing biogas (60-70% methane) that can be used as is to power gas motor-driven generators, or can be upgraded to pure biomethane for dual-fuel cars, or gas-fuelled trucks and buses. In Uppsala in Sweden (200,00 pop) up to a third of the city's large bus fleet is powered by biomethane. The volumes in Australia of putrescible waste presently put in landfill or disposed of with no energy capture and unrestricted GHG emissions are of the order of 15-20 million m3 annually.

3. Woody biomass from forest and plantation harvest waste, native forest peri-urban fuel reduction, timber processing by-product, urban waste wood, and energy crops like oil mallee, can be used to replace coal or be co-fired with coal, or formed into wood pellets and used for institutional and commercial boilers to replace natural gas or fuel oil. The volumes available in Australia annually are vast (12-15 million tonnes/yr) and are presently allowed to rot in the forest, are burned in an unrestricted way, or for urban waste wood are put in landfill. This equivalent material in cities of Sweden, Finland or the Baltic countries provides cities with up to half of the peak winter heating needs plus 20% or more of city electricity needs – often in some combination with MSW or straw. Plants may be of scales from 4MW-e up to 300 MW-e.

4. Australia's farmers produce large areas of cereal crops and also in their enterprises produce large volumes of other agricultural residues that potentially have energy value and also a cost of disposal. Straw production is in the order of about a tonne of straw per tonne of grain. Cereal crops will often yield 2-3 tonnes of grain per ha. So annually up to some 300 million tonnes of straw is produced. Much of this is not economical to retrieve but it is likely that 50 -100 million tonnes of straw could be available for energy if there was a reliable price driver. Plants in the UK, Spain, Germany, Denmark, Poland, China and Sweden are utilising straw as the sole fuel. Electricity

output from these regional plants is usually in the range 10-30 MW-e (and from 40-100 MW of utilised heat energy), so such plants each use 50,000-250,000 tonnes of straw annually, depending on efficiency. Increasingly the field burning of straw is now illegal and this utilisation as fuel is a viable disposal option.

All of these forms of biomass have an energy value equivalent or greater than brown coal (2.5 MWh/tonne). In the case of dry MSW, straw or dry wood chip the energy content is 4-4.5 MWh/tonne. They all are suitable for fuelling regional energy plants or for producing fuels via one of several processes. In general these processes are either already cost-competitive for heat production, and will be competitive for electricity production in a regime with a carbon tax of over $25/tonne CO2 (they are already normally significantly cheaper in capital costs than for wind, solar PV, solar therml electric or geothermal in captial costs/MW of electricity produced).
There are several other important issues that need to be included –

- Use of sorted MSW as fuel obviously means far less landfill and less contamination of groundwater and less leakage of methane into the atmosphere. It also means a higher recycling rate and far greater re-use of materials, meaning less net energy going into production of materials.

- Use of straw and woody biomass as a fuel in a regional furnace boiler or gasification-boiler plant produces a volume of ash (usually 0.5 to 3% of dry weight of fuel) which can be spread back on fields or into forest.

- Straw and woody biomass can be the feedstock for slow-pyolysis plants that can produce heat, electricity and biochar, with the biochar used for biosequestration of carbon, and the heat used for industrial or commercial processes.

- Straw and woody biomass can be the feedstock for fast pyrolysis or flash pyrolysis processes to produce synthesis gas or pyrolysis oil that can be further processed into a range of second generation biofuels - vehicle fuels. Appropriately sorted MSW can also be used for a similar process.

- Straw and woody biomass can be the feedstock to produce ethanol via hydrolysis or enzymatic breakdown of cellulose, and subsequent fermentation.

- Emissions from biomass-fuelled plants with proper flue gas filtration systems in place are very low, and far lower than from black or brown coal-fired plants. Emissions from properly equiped and monitored MSW-fuelled plants are also normally well below EU or WHO-specified emissions limits for heavy metals and dioxins, etc.

Overall these presently unutilised forms of biomass and waste could provide a significant amount of Australia's electricity, industrial and commercial heat and cooling, and a range of liquid and gas fuels. In addition pellets of wood and straw elsewhere are being used to co-fire black coal plants at up to 45%, and green wood chip used to co-fire brown coal plants at up to 35%. Pellets can also be used to more cost-effectively fuel smaller heat plants for institutions and businesses than LPG or other fossil fuels. This economics of pellet firing would obviously significantly improve after introduction of RECs that recognise conversion of heat production.

Regional bioenergy plants producing electricity and heat can approach 90% conversion efficiency of fuels to energy, and if heat is effectively utilised will at the same time not require (and waste) large amounts of water for evaporative cooling of steam. So economics of regional plants located for heat utilisation can be impressive as efficiency is 85-90% (compared with 25-35% with large centralised coal-fired condensing power plants) while reducing or nearly eliminating the water wastage associated with large centralised power plants. Concurrently transmission line power leakage is reduced from its present 5-10%.

The development of energy crop plantings and farm forestry as dispersed woodlots integrated into convetional farming enterprises toward a total of 5-10 million ha results in other benefits. While for energy crops the main product is wood chip for energy, for farm forestry in many regions this is a minor by-product though of significant volume. Benefits from farm forestry include significant carbon sequestration, significant production of round wood and sawlog, significant production of firewood and mulch, and environmental effects including salinity mitigation. Significant permanent employment creation in rural areas is another clear bonus.

So overall we are talking about an unrealised potential from biomass and MSW for production of 20% or more of electricity in the urbanised coastal fringe and inland cities. The heat from these plants can be used by industry, including for biofuels production. Alternatively, as increasingly in Scandinavia and southern Europe it can be cost-effectively used to produce summertime commercial cooling or year-round industrial cooling. The biofuels produced can replace a significant volume of imported fuels, or could be exported into premium markets. The total of all this is a significant drop in national GHG emissions, as the use of fuel produced from carbon-neutral biomass technically does not add to GHG emissions. It also significantly reduces expenditure on imported crude oil and reduces energy used in the import transport, the refining process, and reduces transport involved in distribution.

The capital cost of CHP bioenergy plants per MW-e produced, at about $3.5 million/MW-e, is more than for gas-fired turbine closed-cycle plants, but it is significantly less than the capital cost of wind, solar thermal electric or geothermal per MW-e produced. It is also significantly less than the capital cost per MW-e of retrofitted condensing coal-fired power plants to enable efficient carbon capture and storage.

A clear advantage of bioenergy is that, as in the countries where they are common, the plants can be relatively small (25-50 MW-e) and located close to industry, close to sources of biomass or waste, and close to end-users. The second clear advantage is that where they are able to sell the heat produced they are even more cost-effective in capital cost per MW of combined energy produced.

These things are easier to quantify and value than the positive benefits of significant salinity mitigation, reduced bushfire hazard in peri-urban areas, reduced loss of soil, nutrient and surface moisture from unrestricted wind across farm land, and from improved habitat and water quality. However, as with creation of permanent jobs in regional and rural areas and in improved productivity and diversification of farms, they are real and important.

All this potential can be realised, as it has been in numerous other countries. It requires acceptance of the potential of bioenergy as part of the suite of renewable energy options, intelligent planning and policy development, and it requires bi-partisan support for legislation at federal and state level. It requires a long (50 year?) outlook, and involvement of all stakeholders. It clearly requires the market to be so confident in the solidity of these policies that investors, including landholders, will commit land, time and funds in an ongoing process.

Andrew Lang
Board member – World bioenergy Association (www.worldbioenergy.org)
Convenor The Wood Energy Group (www.woodenergy.net.au)
Member of Central Highlands Agribusiness Forum (CHAF – www.chaf.org.au)
Director of SMARTimbers Cooperative (www.smartimbers.com.au)