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SUSTAINABILITY NETWORK

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Feature thought:

"I have been impressed with the urgency of doing. Knowing is not enough; we must apply. Being willing is not enough; we must do."

Attributed to Leonardo da Vinci

Dear Networkers:

SUSTAINABILITY NETWORK UPDATE – No. 54E

Energy options for the future are again a high-profile topic. In the first feature, Mark Diesendorf of the University of NSW argues that existing renewable energy technologies are indeed capable of substituting for coal-fired power stations while reducing greenhouse gas emissions to the levels needed to enable the longer-term transition to sustainability.

In the second feature, Helen Scott-Orr of the NSW Department of Primary Industries promotes the concept of more extensive recycling of organic waste to restore of Australia's agricultural soils and wean ourselves off fossil-fuel-based chemical fertilisers. And in the third feature, we hear from a group of graduate students, concerned about reducing the ecological footprint of their workplace.

Energy, including nuclear energy, is also a hot topic in the "Feedback" section, along with related issues of food production, soil fertility, population and consumption.

A Sustainable Energy Future for Australia

Dr Mark Diesendorf – m.diesendorf@unsw.edu.au – is based at the Institute of Environmental Studies at the University of New South Wales, where he teaches *inter alia* an intensive interdisciplinary short postgraduate course on *Managing Greenhouse Gases* for both on-campus and distance learners. He is also Director of Sustainability Centre Pty Ltd.

In a nutshell: Results of recent studies show that existing renewable energy resources are capable of substituting for coal-fired power stations, in spite of claims to the contrary. Further, they show that combinations of energy efficiency, renewable energy, and gas as an interim bridging fuel, may be less expensive than continuing to build coal-fired plants, even without considering the environmental and health costs of burning coal.

In the face of global climate change from the enhanced greenhouse effect, it is essential that Australia and all other countries implement energy systems that are based primarily upon the efficient use of renewable energy sources. But, in the debate about commencing the transition to such a sustainable energy future, it is claimed by some, without adequate justification, that existing renewable energy sources – such as wind, solar or biomass – are not capable of substituting for coal-fired power stations.

This notion is refuted by a recent set of scenario studies for Australia and its States (see Further Reading at end of this feature). Furthermore, the results of these studies indicate that combinations of efficient energy use, renewable energy and, as a transitional fuel, natural gas, may be less expensive than continuing to build coal-fired power stations, even without taking into account the environmental and health costs of the latter.

National scenario study

The national study, *A Clean Energy Future for Australia*, had the challenging goal of achieving a 50% reduction in CO_2 emissions from stationary energy use (i.e. all energy use except transport) by 2040. This target is similar to official targets in the UK and Denmark. Applied globally this level of reduction is necessary, but possibly not sufficient, to stabilise CO_2 concentrations in the atmosphere at a level that is likely to be safe for future generations.

The study assumes that the economy grows 2.4 times in real terms between its starting date, 2001, and 2040, as set out in the Federal Government's *Intergenerational Report*. The choice of 2040 allows sufficient time for most existing power stations and all energy-using appliances and equipment (apart from buildings) to be phased out at the end of their operating lives and replaced with cleaner, more efficient technologies.

The study was restricted to small improvements to existing technologies. This means that the scenarios have no cheap solar electricity, no hot-rock geothermal energy[1], no storage and transportation of renewable energy in the form of hydrogen[2], no cheap and safe nuclear energy[3], and no cheap capture and geosequestration of CO_2 emissions from coal-fired power stations[4]. Of course, the task will be easier if one or more of these technologies is successful before 2040.

Energy use in 2040 is derived from projections of economic activity and population. The baseline scenario is one in which current modest programs to improve efficient energy use and disseminate renewable energy are projected forward in a 'weak' energy-efficiency scenario. This results in an increase in CO_2 emissions from stationary energy in 2040 of 18%, compared with the 2001 reference year.

Then a large number of additional cost-effective efficient energy use measures are applied across the economy, generating a 'medium' energy-efficiency scenario. Solar hot water also makes a significant reduction to the demand for electricity. These demand-side measures are particularly valuable in economic terms, because they substitute for electricity delivered to customers at 10-16 cents per kilowatt-hour, rather than electricity generated at the power station for (typically) under 4 cents/kWh. The medium-efficiency scenario succeeds in stabilising Australia's CO_2 emissions at a level 14% below the 2001 value by 2040.

The further reduction in emissions to 50% below the 2001 level is then achieved by means of cleaner energy supply (see Figure 1). The main component of CO_2 emissions from stationary

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[1] Drilling to a depth of about 5 km by Geodynamics Ltd shows that there is a very large hot-rock geothermal resource in Australia – see www.geodynamics.com.au (accessed 25/9/2005) – but it may be a few years before the cost of electricity can be determined accurately.

[2] Service, R (2004) 'The hydrogen backlash', Science 13/8/2004, 958-61, summarises the reasons why a hydrogen economy based on renewable energy may be several decades away.

[3] Reserves of *high-grade* uranium are very limited. Van Leeuwen, JWS and P Smith (2003/5), *Nuclear power: the energy balance* – www.stormsmith.nl/ (accessed 21/9/2005) – show that CO_2 emissions from the mining, milling and enrichment of *low-grade* uranium are comparable with those of an equivalent gas-fired power station. Therefore, taking into account the economic collapse of the fast breeder and reprocessing cycle, nuclear power based on existing technologies does not appear to be a solution to the enhanced greenhouse effect.

[4] Saddler, H, C Riedy & R Passey (2004) *Geosequestration: What is it and how much can it contribute to a sustainable energy policy for Australia?* Discussion Paper No. 72, Australia Institute, Canberra - www.tai.org.au/. This paper presents the case that at best it would be at least 25-30 years before coal-fired power with geosequestration could make a significant contribution to Australian electricity generation.

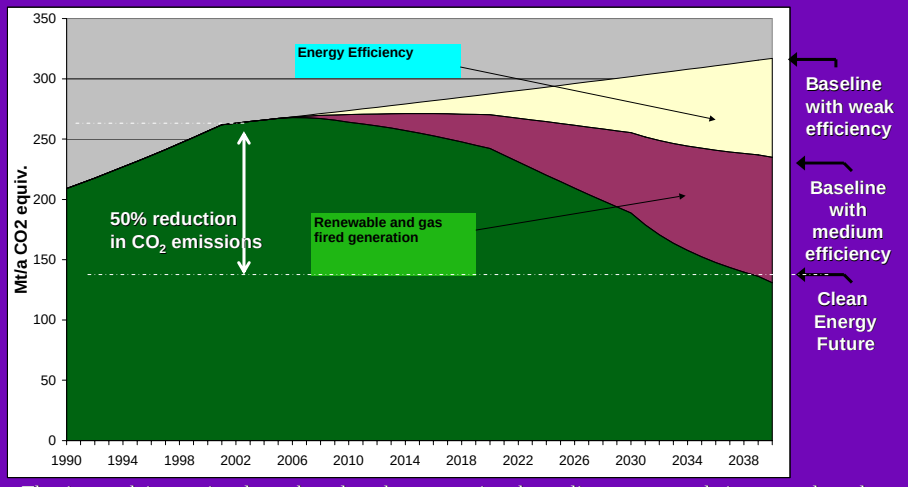
energy comes from electricity generation, followed by industrial heat. The national study actually obtains a reduction of 78% below 2001 in CO_2 emissions from electricity generation by 2040. However, growth in industrial heat, which can only be supplied to a small degree by existing renewable energy technologies[5], returns the total reduction in CO_2 emissions from stationary energy to 50% below 2001.

In the principal clean electricity scenario, the supply side mix is:

- natural gas, the least polluting of the fossil fuels, used in both cogeneration (combined heat and power) and in combined-cycle power stations to supply 30% of electricity;
- bio-electricity generated mainly from crop residues (excluding those from native forests) and contributing 28% of electricity;
- wind power, contributing 20% of electricity;
- coal 9%;
- hydro 7%;
- solar, supplying about 5% of electricity, mainly during peak periods when its economic value is highest;
- petroleum (which could be replaced with biofuels) 1%.

All of the renewable energy sources except solar electricity are already less expensive than the International Energy Agency's projected costs of coal-fired electricity with capture and geosequestration of CO_2 emissions.

Fig. 1: Emissions from stationary energy in Australia, 1990-2040



The time path is a notional one, based on the assumption that policy recommendations are adopted.

Although transport was not part of the recent Australian clean energy futures studies, it is addressed together with stationary energy in a Canadian study with similar assumptions to our own[6]. Once again, based on small improvements to existing cleaner technologies, a 50%

[5] Heat below 200˚C is supplied by solar thermal technologies and higher temperatures mostly by natural gas.

[6] Torrie R, R Parfett and P Steenhof (2002) *Kyoto and beyond: the low emission path to innovation and efficiency*, prepared for the David Suzuki Foundation and Climate Action Network Canada, September. See www.davidsuzuki.org.

reduction in emissions could be achieved with a few decades. The transport component of the Canadian study utilises improvements in urban public transport and further dissemination of fuel-efficient vehicles (hybrids and clean diesels).

Thus, for both stationary energy and transport, 50% reductions in CO_2 emissions can be achieved from existing technologies, buying us time for developing new technologies and greatly improving existing clean technologies in the second half of the Century. During this latter period, it will also be vital for Australia to have achieved zero population growth and to have dematerialised its economic growth.

The transition to a sustainable energy future cannot be driven by the existing market structure and policies. It needs new policies and strategies, whose implementation must be commenced seriously now. One of the most urgently needed policy changes is to stop the construction of new coal-fired power stations. Not only are they Australia's biggest single source of greenhouse gas emissions, but their construction undermines substantial programs for efficient energy use that are incompatible with the economics of bringing on-line 1000-2000 MW power stations.

State studies

While the national study takes a long-term perspective, the separate State studies examine the short-term problem of substituting for the next proposed coal-fired power stations by 2010. At the times of writing the State studies in 2004 and 2005, there were proposals for new coal-fired power stations with total capacities of 530 MW (Western Australia)[7], 1000-1500 MW (New South Wales)[8], and 750 MW (Queensland)[9]. There was also a proposal to extend the operating life of Victoria's most greenhouse polluting old power station, Hazelwood, with 1600 MW of capacity[10]. Despite the rhetoric of carbon capture and geosequestration from the Federal Government and the coal industry, all the proposals are for conventional 'dirty' coal-fired power stations. Here we focus on one of the New South Wales proposals.

Our report, *Towards New South Wales' Clean Energy Future* (see Further Reading at the end of this feature), shows that both the contribution to peak-load (see box) and annual electricity generation of a 1000 MW base-load coal-fired power station can be replaced by a mix of realistic supply-side and demand-side initiatives by 2010. As in the national study, the proposed supply-side mix involves natural gas, wind power and bio-electricity from organic residues.

The much cleaner energy system would have carbon dioxide emissions of about 4.7 million tonnes per year *less* than the coal option, a reduction of nearly 80%. If adopted, the cleaner system would be cost-effective, with the economic savings from efficient energy use paying for the additional costs of renewable energy and gas-fired electricity. Although the supply-side solution involving cleaner energy sources will increase the average price of a unit of electricity to the NSW community, the demand-side energy efficiency savings will reduce the number of units purchased by most consumers. The net result is that energy bills will either decrease or remain approximately the same, for all except possibly the largest industrial consumers of electricity, who may require special consideration.

Then the challenge in moving onto the clean energy pathway becomes neither technical nor economic, but rather organisational and institutional: namely, how to deliver cost-neutral

[7] In August 2005, the WA Government announced that this power station would be gas-fired. This was stated to be on economic grounds – in WA (unlike the eastern States) coal power is more expensive than gas.

[8] There are two separate proposals to build a 1000 MW station near Ulan NSW, and a proposed extension to the capacity of an existing power station, Mt Piper, near Lithgow, by 1500 MW.

[9] The power station, Kogan Creek, has now been approved by the Qld Government and is already under construction. There are also informal proposals for several additional coal-fired power stations that have not yet been announced officially.

[10] Approved by the Victorian Government in September 2005.

packages of energy efficiency, renewable energy and natural gas to consumers. Since the State Government would have to play the leading role in making organisational and institutional changes, the key issue becomes one of political will.

The proposed substitution would reduce the socio-economic risk faced by NSW as the result of having an electricity supply system that is based 98% upon coal, the most greenhouse-intensive of all fuels. In the likely event that international greenhouse gas emission constraints are tightened over the next decade, this high dependence upon coal could become a major economic and environmental liability. At the current carbon trading price on the EU market of 23 euro (about A$35) per tonne of CO_2, a new 1000 MW coal-fired power station could, over its 40 year lifetime, incur a liability of about A$7.7 billion dollars.

Policies and strategies

Sustainable energy futures can only be achieved as the result of new policies and strategies implemented by all spheres of government. Policy measures required to deliver the cleaner supply mix include:

- A greenhouse intensity limit on all new power stations and on all proposals for major refurbishments and other life-extensions of old power stations. This limit would be set to exclude conventional coal-fired power stations, while including combined-cycle gas-fired power stations. Until such a limit is put in place, State Governments should ensure that the greenhouse gas liability of all new and refurbished coal-fired power stations should be carried by the proponents.
- A requirement that energy retailers submit Renewable Energy Certificates (RECs) annually to State Governments as a licence condition. This would be a separate scheme from the Federal Government's modest existing Mandatory Renewable Energy Target (MRET), which is expected to be fully utilised by the end of 2006. Unlike the situation with MRET, existing hydro-electricity would not be eligible in the proposed State schemes, which are designed to assist the further development of the new renewable energy industries.
- In the longer term, a carbon levy or tradeable emission permits of the cap and trade type, either implemented by the Federal Government or a cooperating group of States.
- Introduction of 'smart' meters and time-of-day electricity pricing for all customers (see box).

Recommended demand-side measures include:

- The extension of energy performance standards, such as BASIX in NSW, from new buildings to several categories of existing buildings, starting with all tenanted buildings. State Government may have to provide some assistance to landlords on low incomes.
- Substantial expansion of the use of solar hot water encouraged by both incentives and by charging the real cost of electric hot water.
- The provision of low-cost packages of energy efficiency measures for householders.

An additional and very important benefit of undertaking the transition to a clean energy future is that the key policies detailed in the report would stimulate job growth and increased economic activity. Per kilowatt-hour of electricity generated, wind power creates 2-3 times the number of *local* jobs as coal, while bio-electricity generates 3.5 times. State Governments could provide incentives to ensure that the major proportion of these new jobs (e.g. in manufacturing components of wind turbines and bio-electricity power stations) would be located in regions most affected by the gradual closure of coal-fired power assets.

To conclude, a sustainable energy future is technically feasible, economically viable, and environmentally essential.

BOX 1

The Reliability of Renewable Energy

Based on the notion that renewable energy is "intermittent", critics of renewable energy often claim erroneously that renewable energy cannot replace base-load power stations, such as those fuelled by coal. However, not all renewable energy is intermittent and no-one is proposing to run a whole electricity grid on intermittent sources alone.

The principal scenario in *A Clean Energy Future for Australia* proposes that in 2040, 28% of Australia's electricity be generated from bioenergy, which is not an intermittent source, 20% from wind power and 5% from solar. The remainder comes from natural gas and demand reduction by means of efficient use of energy and solar hot water. The only intermittent sources in this mix are wind power and solar electricity. Since they have different statistical properties, they are examined separately.

Wind power

The proposed contribution by wind power of 20% of annual electricity generation is same percentage of wind power that was achieved in Denmark in 2003. This has not caused any major problems. Most of the minor problems that have occurred are the result of connecting a very large block of wind power (from off-shore wind farms) to a single point in western Denmark's transmission system. With properly planned dispersal of wind farm sites and reinforcement of the grid where necessary, a 20% (or more) penetration of wind energy is feasible.

It is sometimes claimed that occurrence of a heat wave, during which there is little wind, demonstrates that wind power is unsuitable for providing electricity to the grid. But, if this argument were valid, then a single breakdown of a coal-fired power station would also rule out coal. In practice all types of power station – fossil nuclear and renewable – are only partially reliable and all require some backup. Coal-fired power stations break down less frequently than there are calms in the wind, but when a coal station breaks down, it is generally off-line much longer than a typical wind calm.

Comparison of the reliability of wind and coal power cannot be done deterministically, based on a single peak event. The correct approaches consider the effects of three different probability distributions -- the availability of coal-fired power stations; wind power and electricity demand – and then use mathematical and/or computer models to calculate the reliability of electricity grids with different penetrations of wind power.

This was done by Brian Martin, John Haslett, John Carlin, David Gates and Mark Diesendorf in CSIRO and ANU in the 1980s. Using three different methods[11] we found that wind power is indeed partially reliable. It has economic value in substituting for the capital cost of coal-fired power stations, as well as for the fuel burnt in such stations. In other words, it is incorrect to assume that intermittent sources of electricity are completely unreliable.

For the special case of small penetrations of wind power into an electricity grid[12], the value of wind power as 'firm' (i.e. 100% reliable) capacity[13] is equal to the annual average wind power

[11] (i) Monte Carlo simulation using real hourly data; (ii) convolution of static numerical probability distributions in the special case when there is no correlation between wind power and load; (iii) approximate applied mathematical models.

[12] Typically a few percent in terms of energy generation

generated. As the penetration of wind power into a grid becomes very large, the value of wind power as 'firm' capacity tends towards a limit. At an intermediate degree of wind energy penetration (e.g. 20%), some additional peak-load (hydro or gas turbines) is indeed required to maintain grid reliability. But this peak-load plant is only a fraction of the wind capacity and does not have to be operated frequently. It is equivalent to reliability insurance with a low premium. And it does not diminish significantly wind's ability to reduce CO_2-emissions.

Solar electricity

Like wind power, solar power is considered to be an intermittent source; but, also like wind power, solar power may be considered partially reliable. This is because there is quite a good correlation between the peak demand for air conditioning in summer and the peak output from solar electricity. This correlation becomes even stronger when solar collectors are oriented towards the north-west or west rather than the usual north.

This suggests that a pricing system capable of charging for electricity by time of day, may close a large part of the gap between cost and benefit for solar electricity. The technology to do this, the 'smart' meter, already exists and will be tested in the forthcoming Solar Cities program.

Further reading on Clean Energy Future studies:

All of the following reports can be downloaded from www.wwf.org.au. Go to "Publications" and then scroll back through the numbered links to pages for the respective months of publication.

Saddler, H, M Diesendorf and R Denniss (2004) *A Clean Energy Future for Australia*; Clean Energy Future Group, Sydney & Melbourne, March

Diesendorf, M (2004) *Towards Victoria's Clean Energy Future*; Clean Energy Future Group, Sydney & Melbourne, November

Diesendorf, M (2005) *Towards New South Wales' Clean Energy Future*; Clean Energy Future Group, Sydney & Melbourne, March

Diesendorf, M (2005) *Towards Queensland's Clean Energy Future*; Clean Energy Future Group, Sydney & Melbourne, April

Diesendorf, M (2005) *Towards Western Australia's Clean Energy Future*; Clean Energy Future Group, Sydney & Melbourne, August

Further reading on the reliability of renewable energy:

Martin, B & M Diesendorf (1982) Optimal thermal mix in electricity grids containing wind power, *Electrical Power & Energy Systems* 4: 155-161

Grubb, MJ (1988) The potential for wind energy in Britain, *Energy Policy* 16:594-607

Herig, C (2001) Using photovoltaics to preserve California's electricity capacity reserves; US National Renewable Energy Laboratory: www.nrel.gov/docs/fy01osti/31179.pdf (accessed 26/9/2005)

Grubb, M, L Butler & G E Sinden (2005) Diversity and security in UK electricity generation: The influence of low carbon objectives. Cambridge Working Papers in Economics: www.econ.cam.ac.uk/electricity/publications/wp/ep74.pdf (accessed 26/9/2005)

Organic recycling and sustainable food production

Helen Scott-Orr – helen.scott-orr@agric.nsw.gov.au, Director, Health Science & Strategic Alliances, for the NSW Department of Primary Industries, based in Orange, NSW, has an

[13] Known as the 'capacity credit' (not to be confused with 'capacity factor') and measured by *inter alia* 'equivalent firm capacity' or 'effective load-carrying capability'.

extensive background in agricultural advisory and research services in Australia, the UK and Indonesia. While the main emphasis of her career has been on animal health issues, including the control and eradication of exotic diseases, she has, more recently expanded her focus into agricultural R&D management and organic and sustainable farming. The following feature is adapted from a paper given at the annual conference of the Australian Institute of Food Science & Technology (AIFST), July 2005.

NSW DEPARTMENT OF PRIMARY INDUSTRIES

In a nutshell: Food production transfers nutrients from rural soils to urban waste streams – both within Australia and in overseas export destinations. The resulting soil depletion affects the health of ecosystems and human populations. If Australia is to restore depleted soils and reduce dependence on fossil-fuel-based synthetic fertilisers, substantial innovation in the recycling of a wide range of organic wastes will be needed. This is already beginning to be seen in rural and agricultural R&D programs.

Soil nutrients and food

Food production removes nutrients from rural soils and transfers them to urban waste streams, both here in Australia and overseas. In fact most of our soil nutrients finish up in overseas waste streams as Australia exports 60-70% of food production.

Soils impoverished by continuous production and removal of crops and livestock need replenishment, as deficient soils produce deficient food. Organic carbon (C), plus nitrogen (N), phosphorus (P), potassium (K), and micro-nutrients are all critical but, in modern, mechanized agriculture, N, P, K, and other mineral nutrients are largely supplied by the chemical fertilizer industry. Collectively, Australian farmers use around $2 billion per year of such synthetic fertilizers. Organic carbon is less easily supplied as it is the product of soil microbes acting on biological residues, with a rate of production driven by rainfall.

Healthy soils produce healthy food. In fact, according to the US Department of Agriculture (USDA), "agriculture is primary health care". Plant health, however, is more than just nutrients – microbial activity in the root zone also influences plant nutrient uptake and health. Plants grown in "rich" soil with balanced nutrients and biological activity are more nutrient dense. Animals (including humans) that eat these foods are less likely to suffer sub-clinical nutrient deficiencies, and may receive more beneficial anti-oxidants.

Recycling organic materials back into the soil can improve not only the quality and nutrient content of food, but also the structure and water-holding capacity of the soil, as well as the sequestration of carbon in the soil. Incorporation of recycled organics reduces the water and synthetic fertilizer needed for crops, and also reduces soil erosion and polluting runoff to waterways. Using them as fertilizers, soil conditioners and mulches reduces landfill volumes and the resultant pollution of groundwater and waterways caused by this mode of disposal.

What constitutes Recycled Organics (RO)?
These are materials of plant or animal origin, treated to be safely and beneficially re-used in food production and environmental remediation. Treatment usually involves composting various waste streams, either separately or together. There are a number of common sources including:

- Urban garden, park and tree wastes or "green waste" (in which plastic and other non-biodegradable rubbish can cause qu nce issues)
- Human (sewage) bio-solids (which can have issues arising from pathogens, heavy metals, and pharmaceuticals)
- Food processing and grease-trap wastes (which can have issues with composition and water diversion)
- Cattle, piggery and poultry manures (which have high N, P, and K content but can also generate problems with odour)
- Crop stubbles, husks and processing by-products (which tend to have high volume but also high organic C content)

Composting of these source materials – e.g., for twelve weeks with moisture, aeration and microbial action – is highly desirable as it breaks down tough plant matter, pasteurizes the compost, kills pathogenic organisms and weed seeds, and binds nutrients for slow release.

Co-composting of plant and animal materials offers real advantages as they generally complement each other's nutrient profiles. For rural waste, balanced composting can be achieved by co-composting of stubbles and other crop residues with animal manures; and for urban waste, similar balance can be achieved by co-composting garden green waste with human biosolids and/or food processing wastes.

Broadacre recycled organics
Broadacre organic wastes consist of crop residues and animal manures. As they are bulky and expensive to transport, they need to be used near to where they are produced. Co-composting is one way to do this where sources of animal and plant wastes are close together. In extensive cropping zones, however, another way is by conservation farming with zero or minimum tillage and stubble retention – an increasingly popular system now in use on 50-80% of farms. This avoids burning, recycles nutrients directly in situ, and improves soils and production levels.

Urban organic wastes
Sydney alone produces each year: 650,000 tonnes of processed green waste, 40,000 tonnes of bio-solids, and 130,000 tonnes of food processing waste. Previously, all such waste was sent either to costly, polluting landfills or to ocean sewage outfalls. Now, progressively more of these wastes are being diverted into compost, mulches and organic soil conditioners.

In Australian cities, around 85% of recyclable organics are now going onto urban parks and gardens. However, this use is becoming saturated. There could be valuable agricultural uses for this extensive volume of urban waste, but high transport costs currently limit its use to within a radius of about 300 km. Urban landfill costs would need to rise significantly to create the incentive to move waste beyond this perimeter, but transport is not the only factor in the economics of re-use.

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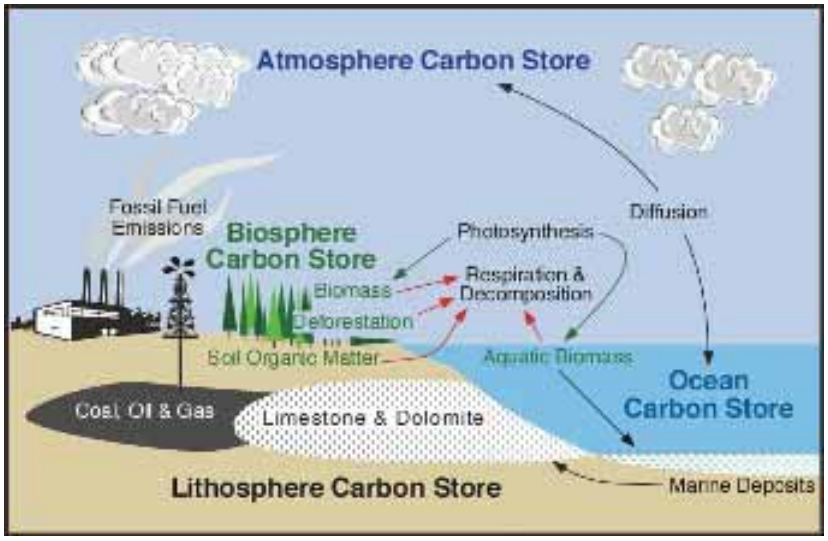
Consideration also needs to be given to increased farmer profitability via the increased yields and soil water retention that result from organic recycling.

Fortunately, thanks to the tradition of building on Australia's coastal fringes of fertile, better watered soils, there are extensive agricultural and horticultural production areas within critical transport distances from our metropolitan centres. Therefore, there is a real opportunity to develop further high-value agricultural applications for urban organic waste within this transport perimeter – e.g., in viticulture, market gardens, and perennial fruit and nut production.



The trials necessary to underpin new systems for safely and beneficially recycling organics are now beginning to be performed within various agricultural research programs – for example, at the NSW Government's Centre for Recycled Organics in Agriculture (CROA).[14] CROA conducts practical research on soil amendments, mulches, organic fertilizers and other biological additives involving recycled organic materials. It has a testing facility near Camden at the Elizabeth Macarthur Agricultural Institute of the NSW Department of Primary Industries (DPI). Current projects at CROA are assessing: composted aquatic weeds, pelletized biosolids, grease-trap waste, heavy metal impacts, and compost from Sydney's new Eastern Creek recycling facility. The work receives funding from the NSW Departments of Primary Industries and Environment & Conservation, and from Catchment Management Authorities. It also performs contract research for food and composting companies.

Conclusion

Earth's soils contain twice as much carbon as the atmosphere. Although agriculture depletes soil carbon, recycling organics restores it while also reducing CO2 emissions. Australia's old, leached and impoverished soils not only require the recycling of organics to maintain quality food production, but they are a ready-made carbon sink.

No organic matter should be considered "waste" – it is a valuable resource and should be thought of as such. Every bit possible should be composted and recycled back into our gardens and production systems.

[It is perhaps a supreme irony that the flush toilet, hailed as the best invention in the field of public health, and the agricultural export trade, credited with supporting Australia's economy, have both been villains when it comes to running down the nutrient status of our soils and foods! We need new systems for reversing their negative impacts. E. G. H.]

[14] See: www.agric.nsw.gov.au/reader/recycledorganics/croa.htm
www.agric.nsw.gov.au/reader/recycledorganics/nswdpi-recycled-organics.htm

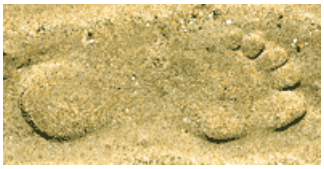
Footprints in the workplace

Where better to find concern over the environmental footprint of working lives than amongst a group of tomorrow's decision makers – the graduate students of today! Here's how one group of post-grads organised their own awareness-building session earlier this year. Thanks to post-grad group coordinator Ryan Farquharson – ryan.farquharson@adelaide.edu.au – for the following summary.[15]

Activities of this type are vitally important to building sustainability awareness and catalysing action throughout the community. Think about holding one in your workplace or student group.

In a nutshell: While individuals can readily make lifestyle choices at home, it is harder to make changes in the workplace, where activities are bound by existing organisational purpose and culture. Here, one group of graduate students considers environmental footprints associated with their work. Transport is a large, intractable component, with other aspects of energy usage, water management and waste control also figuring prominently. The three big issues are (1) the high cost of sustainable options; (2) the need to change 'roadblock' policies; and (3) short-termism in funding for scientific research. Ultimately, however, it comes back to the individual to make the right large and small choices in the workplace – just as in private life.

As a group of Adelaide University post-grads in Soil and Land Systems in the School of Earth and Environmental Science, we had become concerned about the large amount of resources our science consumes, and also about everyday work practices that seem to be environmentally unsound. We decided to have a meeting to discuss the environmental impact of our work, and ways to minimise it.



Before the meeting, we asked participants to go to the Victorian EPA website: www.epa.vic.gov.au/eco-footprint to calculate their own personal ecological footprints. At the start of the meeting, a large map of Adelaide was posted, with a request for everyone to mark their place of residence and record both their footprint and distance to work. Over a morning tea featuring home-made and local produce, we looked at and compared the footprint data

Our footprints

The ecological footprint calculation was an eye-opener for most of us. Everyone consumed and wasted far more than the average 1.8 hectares of productive land available to sustain each member of the global population. Australians have the fourth largest footprints in the world – at 7.7 hectares per person. Overall, our group was essentially on par with this national figure. However, our median value of 6.6 taken together with the fact that 75% of the group were actually below the national average, indicated that a few of us had incredibly large feet. The common factor contributing to very large footprints was travel, particularly air travel. The globe trotters amongst us had footprints in the teens!

Commuting and personal transport

Walking and cycling: Of interest was how close many of us live to campus. Most of us live less than 10 km away. People forget that it only takes 30 minutes to walk 2.5 km or cycle 10km. And once you get fit, it's even quicker. We found that a third of us live within an hour's walk and three quarters of us live with an hour's bike ride, but few of us were actually walking or biking. You only have to walk or ride once a week to reduce by 20% the greenhouse emissions, fuel consumption, and vehicle running costs associated with commuting. Traffic congestion is not an issue, and you arrive at work with the blood flowing and feeling alive. Most of Adelaide is relatively flat and the climate is ideal. In a 20km round trip, a cyclist uses 2,000 kJ of energy (food) and is carbon-neutral, where as an average-sized car uses 45,000

[15] As co-facilitator of the group on the day, I have also added a few observations from my own notes – *E.G.H.*

kJ of non-renewable fossil fuel, and emits a range of pollutants. We agreed that Adelaide would be an ideal cycling city, were it not for inept, discourteous drivers and a lack of dedicated bicycle lanes.

Car pooling: Car pooling was not popular at all as everyone appears to prefer their independence. It is frustrating to realise that the vast majority of commuter cars on the road don't carry any passengers. Our map indicated some potential for car pooling but – call it laziness, selfishness, or whatever you like – people were just not prepared to car pool. We recognised that scientific research often means an unpredictable schedule and odd working hours but, once again, even if we could car-pool only once a week, it would still make a difference.

Telecommuting: Elizabeth is a telecommuter, working from home and generally coming to campus only once a week. We recognised telecommuting as a valuable way to reduce travel impacts, and a real possibility for students, particularly during periods of writing up.

Fleet vehicles: The management of organisational car fleets is another place to look for savings in transport emissions. The local car industry produces only large, conventional vehicles, which, thanks in part to government promotion pressures, form the majority of such fleets. Changes to fleet specifications are starting to emerge. For example, the university has some smaller cars and CSIRO has some hybrid vehicles. Switching appropriate vehicles to LPG or CNG also has environmental and economic benefits. There are also schemes beginning to be introduced – e.g., by Green-Fleet, www.greenfleet.com.au/ – which allow organisations and businesses to off-set fleet CO2 emissions by subscribing to tree plantings.

Public transport: People expressed their dissatisfaction with the public transport system. This seems to be a favourite local pastime – not without basis – but I wonder how many people try it more than once or twice. Our campus is serviced by several bus routes within short walking distances (though it's often quicker to ride your bike!). A big issue for the group was whether governments or people should drive change in public versus private transport usage.

Conferences, meetings and fieldwork

Air travel: Long-distance air travel to conferences and meetings was one of the big footprint contributors for many group members. Flying interstate and overseas to attend major national and international conferences is pretty much normal for scientists, and was recognised as one of the "perks" of being a PhD student. While it was agreed that sometimes it might be better for only a senior scientist to travel to represent their research group rather than the whole cohort going, the problem for our environmental footprints is that attendance at these major national and international meetings is seen as necessary for career building and networking. How much emphasis is given to this aspect is also, to some extent, a matter of choice. There was consensus, however, that smaller conferences are actually better for networking and, if really relevant, need not be more frequent than once every 3 years to accommodate the pace of science progress.

Tele-conferencing and video-conferencing: Telephone hook-ups were mentioned as an effective alternative to physical travel for some types of small meetings, and are used regularly in CSIRO for discussions across sites. While the University's current lack of success with inter-campus video-links for seminars was also noted, this technology is working well in some places, and could be used much more extensively.

Field work: For many of us, research involves field work, often at very long distances from campus. This factor can give our work an even larger travel component. As computer and communications technologies advance, remote electronic data loggers and telemetry are becoming more popular, but a major associated issue is the funding of such expensive scientific equipment for short-term projects. Thought is obviously needed around such trade-offs in designing experimental programs.

Energy

Standby and "idle" power: Standby power was identified as one type of energy consumption that is still not widely recognised. Elizabeth gave an example of a photocopier she had tested while turned on at the wall but off at the machine. Its standby costs were estimated at $86 per year. How many such workplace machines are left turned on at the wall? It is not unusual to find the wall switch is completely inaccessible without moving the machine!

When I first arrived in the group, it amazed me how many computers were left turned on overnight. Indeed, people have been advised in the past not to turn their computers off. Most users, however, don't require the high-powered machines whose performance can be compromised by repeatedly switching them on or off. Furthermore, many of today's newer computers have efficient standby and power-down modes. Such features can be sought and checked when purchasing.

Working hours: Students and scientists often seem to work odd hours, sometimes simply as a matter of preference. Working outside regular hours, however, can consume a lot of energy, as lights and air conditioning are turned on for only a handful of people. For example, it is unnecessary to have all the corridor lights or building heating on when working after hours. The use of small desk lamps and personal heaters should be considered if working odd hours is a common occurrence.

Lighting: If you are the last to leave an office or building, turn the lights out. Even during normal working hours, if a light can be off for more than 15 minutes, it's more efficient to turn it off. Do you actually need the light on at all? On clear days, our north-facing offices have sufficient natural lighting for most normal work purposes.

Heating and cooling: Air conditioning has been a contentious issue in our buildings, although most of us are happy enough to have it. There is a lot of potential, however, for fine tuning temperature settings to achieve energy savings, as the buildings are often too hot for winter clothes in winter and too cold for summer clothes in summer.

Water heating: On-call boiling water, in our own tea-room for example, also consumes a lot of energy – and I don't understand people who run the hot tap to wash their hands after using toilet facilities.

Sterilisers and other major appliances: Autoclaves (sterilisers) are big energy users. Autoclaving just a few items at a time is wasteful. All it takes is a bit of forward thinking and organisation to accumulate a full load – by saving items up, and/or sharing a run with others. The same goes for washing laboratory equipment in the dishwasher.

Efficient, energy-rated fridges and freezers can have a huge impact over their lifespan. Since fridges, freezers and coldrooms tend to accumulate a lot of old research materials that are not actually needed any more, regular clean-outs might allow us to get rid of some of this expensive storage, particularly the old, inefficient appliances.

Controlled environment facilities: Quite a bit of our research involves using controlled environment rooms – e.g., for growing plants or working on soil biology. It might seem logical at first sight to match the day and night cycles inside these rooms to the outside environment; but it is actually more efficient to reverse the cycle so the rooms have their "day" during the night – i.e., a reversed diurnal cycle. In summer, having the high-energy lights in these rooms off during the day reduces heat load and cooling costs, and takes advantage of off-peak electricity at night.

Commitment to "green power": A commitment by the organisation to "green power" can also reduce the workplace footprint. CSIRO has initiated this type of greenhouse action with a first-stage commitment to purchase 5% of its electricity from renewable sources.

Water

High-purity water in laboratories: For every litre of purified RO (Reverse Osmosis) water used in our research, 3 litres of normal town-supply water has gone straight down the drain. This came as bad news to most of us. There is obviously potential to recover this wasted water (which contains only slightly higher levels of salts and impurities than tap water) for alternative uses where extreme purity is not critical – e.g. for toilet flushing. CSIRO is considering a substantial investment to improve the RO systems in its facilities.

Water-saving options: Around our campus, use of water on lawns and gardens is being improved using moisture probes rather than simple automatic scheduling, and by establishing dry-zone gardens. Older toilets are being replaced with dual flush versions, and redirecting lower quality water for toilet flushing is being considered. In the longer term, on site storage of rainwater will be implemented.

Recycling and waste disposal

Waste reduction: Our group acknowledged that the best way to address waste disposal is not to create waste in the first place – for example, by limiting the single use of disposable laboratory supplies. And do you really need to print out or copy that document? How about printing double sided? Imagine the University-wide savings if student handouts and booklets were double sided. How about printing on the second sides of the pages of obsolete documents? And what about reducing the size and putting 2 pages per side of A4 paper?

Recycling: Since our campus is a multi-organisational one, recycling policies and facilities can be a bit confusing. However, we do have the ability to recycle paper and cardboard, plastic, cans, glass, PET bottles, aluminium, and general plastic waste. We have proper waste disposal procedures for chemicals, oil, batteries, and so on.

Thoughtful disposal: Throwing something away should not be just a mindless act. We need to think about when, how and where we discard things. Are we using correct procedures for specific types of waste? Does it really need to go into medical waste, which is incinerated using energy and polluting the atmosphere? Does it really need to be autoclaved? Are we throwing away something that could be used again, or used for a different purpose?

Other miscellaneous footprint factors

Cooperative procurement: Cooperation with others can cut waste. For example, often an experiment requires only a small amount of a chemical, or it may be just a small-scale test of a new technique. It makes sense to use an organisational chemical register, which lets you locate a shared supply in a lab nearby.

Local food production: Most students rent limited accommodation and don't have the ability to grow their own produce. A campus-based community co-op vegetable garden was suggested, as has been implemented on some other Australian campuses. It could incorporate permaculture principles to ensure a cheap, sustainable supply of fresh produce to co-op members.

Champions for change: The importance was noted of individuals who can drive change in the workplace. They may be staff members specifically tasked with reducing the environmental footprint of an organisation, or simply informal activists who are prepared to champion greater awareness to colleagues at all levels on an ongoing basis. Our own 'School of *Earth and Environmental* Science' should be setting an example within the University.

The 'Big issues'

Cost of sustainable options: The up-front cost of implementing sustainable practice is often prohibitive. Foresight is required to see that a sustainable option is better in the long term. Unfortunately, we generally fail to acknowledge the true cost of our goods and services, and are not sufficiently aware that today's monetary price often neglects the environmental subsidy provided by the planet's natural resources.

Changing "roadblock" policies: In seeking to reduce environmental impacts, we often come up against a policy roadblock – be it institutional or governmental. Policy changes will be needed at all levels in society. However, we are the next generation of leaders and, in the future, will have the opportunity – and responsibility – to help remove these roadblocks from the path to sustainability. We should not be afraid to speak up and be active.

Short-termism in science funding: – Science as an intellectual pursuit, and as a career, is becoming more uncertain. Projects are funded only in short blocks, and tenure is difficult to come by. This makes the implementation of sustainable practices more difficult. Not only is there a lack of continuity of effort, but the ability to invest up-front for the longer term is reduced. In this context it is significant that Australia's political terms are so short. Politicians are very good at buying votes for the next three years, but not so good at looking ahead into the next 30 or more years.

The 'little things'

It's difficult to summarize without the usual clichés. But it is so very true that each of us can improve on our daily practices to minimise our impact on the planet. And it is also true that all the little things add up.

A lot of it comes down to awareness – being aware of the impact of what we consume, throw away, and what we do – and being aware of our place in the grand scheme of things. There are a few billion other individuals on the planet, and there are countless future generations to come. If the way we work and the way we live are unsustainable, by definition we are stealing from future generations. That's our own children, our children's children, and so on. With awareness comes the ability to make all the individual choices that form the basis of sustainability. Governments and organizations can and should do more, but the real opportunities for positive change come from the choices that each of us makes every day.

Feedback

Let's not kid ourselves about the sustainability challenge ahead!

Andrew Jeeves – andrewjeeves@aapt.net.au – of Earthlink Australia Pty Ltd sees a bigger challenge ahead of society than we are acknowledging. Here he prods me (nicely) about the complexity of the problems and the need for greater, more rapid, and more radical efforts to solve them. His initial comments are in response to my short feature "New ethics and the agrifood industries" (pp 9-11 in Update 52), with following comments directed at other recent topics. Among other activities, Andrew teaches courses in Sustainable Soils – see: www.farmbis.ruralfinance.com.au/

Responding to "new-ethical" consumers

Responding to pressures from what is still a minority of "green" consumers is a big ask for the Australian food industries, which are virtually held to ransom by the "big two" national food retailers. My own past experience in developing a sustainability certification for farming and foods[16] was that Coles specifically was not at all interested. They were solely interested in maximising profit and returns for their shareholders and maintaining control over their suppliers.[17] In effect, they stated that they have absolutely no interest in their farmer suppliers, or in securing a sustainable supply chain, as "there will always be someone who will supply what we need at the right price no matter where it comes from". In other words, they wouldn't care if Australian farmers went to the wall because the Chileans or the Chinese or someone else would supply.

All this is evidenced by the fact that they dislike a proliferation of brands in their stores because they have less control. They are, for example, in the midst of introducing a three-level (price) home-brand system to better control their profitability and decrease the market presence and influence of other brands. It is also evidenced by the ongoing gradual build up of foods imported from other countries. Coles actually does have an organic home brand but the food is imported (processed or canned) on the cheap from overseas. They also use predatory pricing systems to eliminate small retail competitors in each location, despite the protests of local residents.[18]

The sustainable certification 'brand' that I helped to develop in Gippsland/Melbourne failed, in large part due to lack of scale and ability to grow the business – and also due to the stress and complexity of working at the cutting edge of innovation in business process. However, the brand/Sustainability Classification System/farm sustainability audit system is still sitting in hibernation – ready for the right buyer, or for the situation to take off as its market potential steadily increases year by year. (Purchasers of our sustainability branded beef, for example, were mostly thrilled by our products and certification – there really is a market now.)

Food Quality

For the past few years I have been training farmers in sustainable/biological soil management with great success and, in researching and developing the curriculum for this training package, I found that food

[16] Based on The Natural Step/ISO 14001, and in partnership with the Victorian EPA and the Australia Centre for Cleaner Production during 1996 – 2001.
[17] As revealed in a meeting with Coles head office marketing department in 1999.
[18] As seen in recent grocery wars in Maleny, Queensland.

quality has been deteriorating over the last century as soil quality has declined. Studies in the UK and the USA have shown, for example, a drop of 35-70% in levels of nutrients such as calcium in various vegetables in the period 1963-1992. In effect we have to eat roughly 2-3 times more fruit and vegetables than our grandparents to get the same nutrition! No wonder we have obesity problems.

Energy and Agriculture

It is clear that we are in for a rough ride over the next 20-50 years as we go through the decline in energy (liquid fuels). It takes about 1,000 litres/ha of fuel to produce a crop of corn or wheat (including all inputs), 95% of which is oil and natural gas. We have only 30-50 years of oil and gas left, so what will we use to fuel agriculture? If all land used to grow export grains went to biofuels (ethanol, biodiesel, etc) we could produce only about 6% of our present Australian fuel usage.[19] Therein lies the drama: we have no real alternative to fossil-fuel oil and gas – not hydrogen, not biofuels. Nor is nuclear an option (unless fusion is a possibility – and we won't know that for sure for about 50 years, according to the world-wide coalition working on research and commercialization of such technology. Even if nuclear were to become feasible, the transtion to an electric system for running all farm machinery would take a further 10-20 years after that. There simply may not be the time to make the transition.

Energy, Food and Population

Two billion members of the global population are alive today solely because we can make synthetic nitrogen fertilisers from natural gas using the Haber Bosch process. Without this option – gone within 50 years – we will have to get all nitrogen from legumes, manures and composts. So, the population will likely have to drop by two billion from present levels. This brings in the whole energy-population balance, and energy is the absolute ruler of natural and human systems on our planet. Our human population has been able to proliferate because of the availability of cheap and abundant fuels. As these decline, the population will either decline, or will have to cope with a significantly lower standard of living.

David Pimentel and others have estimated the sustainable global human population at about 2 billion – at the living standard of the USA with some restrictions on technology in a 'renewable/sustainable' system. Similar estimates for Australia have suggested a sustainable population level of 8-10 million.

So the real issue is, in a systems context, how do we make the transition to these smaller population sizes and renewable systems over the next 50-100 years? How do we 'lose' say 9 - 7 = 2 billion people over that time? An average reduction of 7 billion people over 100 years is about 1,350,000 per week! That's equivalent to 4 Indonesian tsunamis a week, every week for 100 years! You can see the enormity of the situation.

The planet could, of course, support 9 billion people, but their living standard would be round about today's standard of living in Mexico. There would be incredible strictures on certain activities, with health and other taken-for-granted features of today's society becoming major issues.

As another example, take your community at Aldinga. It has around 142 housing lots, on 34.5 ha in a region with an annual average of 500 mm rainfall. Its physical footprint is 34.5 ha but its 'Ecological Footprint' (EF) as a part of today's society is approximately 3408 ha (at 142 lots x 3 people average x 8 ha Australian average EF). Even if you and your fellow community members achieve environmental performance that is twice as good as the average Australian, the EF would be about 1700 ha, or about 50 times 'overshoot'.

If we look at food only, David Pimentel and coworkers estimate that, to sustainably feed a person an average diet, it takes about 5,000 m2 of land with good soil and adequate rainfall (say 36" or about 900mm). If your community at Aldinga were to be sustainable and self-sufficient you'd need about 142 x 3 people x 5,000 m2 or 213 ha (plus irrigation - from where?) to feed yourselves. (I lived in coastal Adelaide for a time after moving from South Gippsland, and it was quite a shock to not be able to grow lettuces and tomatoes, for example, because the soil was 'stuffed' and the tap water too salty!)

Your community's plans include 12-15 ha of food production on common land, depending on the amount of food grown in back yards. Incidentally, Australia had available per capita about 2,600 m2 of arable land

[19] Data given to my wife during study for a Masters in Sustainable Agriculture at Sydney University, Orange.

in 1998 (about 50% of the requirement), and the estimate for 2050 is 1,500m2 per capita (or only about 30% of the requirement).

Now I'm not implying that your community was set up to be fully self sufficient but, considering the above, you couldn't call it "environmentally sustainable" – even with the inclusion of some permaculture principles and admittedly admirable environmental design – especially on those hungry, sandy soils with 500mm or less of rainfall. When petrol is $3/litre within the next 5 years, how will this affect the ability of your community members to travel to work in the city, afford more expensive food, sustain the community, etc?

We face difficult times when even suburbs at the cutting edge of 'eco-design' face real challenges to sustain themselves. The future is probably a balance between agrarian community/villages and some urbanism (surrounded by intensive agricultural lands).

Required Action
To get anywhere near surviving, let alone prospering, in a sustainable way without severe disruption to our communities, we need to act soon – with the commitment of a 'war footing' or at least a 'Colombo Plan'. The far-flung suburbs of Adelaide on its dry plains face tremendous dislocation, and yet land is still being sold for further sub-division on 600 m2 lots, often with no area to grow food, salty water out of the tap, and difficult sandy or clay soils to boot! And each time I come over the Adelaide Hills (traveling from Victoria) and see the lights of Adelaide spread out before me, I am appalled at our use of/waste of energy

I think anything less than the above level of commitment will lead to tragedy (the parable of the cooked frog in the gradually heated water comes to mind). We see the early signs of stress (oil prices, water scarcity, drought affected by global warming, etc). Unfortunately, at the peak of civilisation (in energy availability terms), with everything now so easy, we are unlikely to look ahead to the dramas we face – especially with our present, short-term thinking, and adversarial political process. Some cultural shifts are beginning to take place with "down-shifters", "sea-changers", farmers markets, etc but, if we leave the mainstream action needed to deal with our un-sustainability until it is really apparent that we all ***have*** to change, it we be too little, too late.

So, whilst your newsletter is a good one, and a good sign that agencies like the CSIRO see the writing on the wall, I don't think the urgency is spelt out clearly enough. As *Homo sapiens* may well be genetically programmed, it could be as Kenneth Boulding stated (Three Principles of Sustainablility):[20]

First Theorem: ***"The Dismal Theorem"*** If the only ultimate check on the growth of population is misery, then the population will grow [and consume][21] until it is miserable enough to stop its growth.

Second Theorem: "***The Utterly Dismal Theorem"*** Any technical improvement [e.g., nuclear power] can only relieve misery for a while, for so long as misery is the only check on population, the (technical) improvement will enable population to grow, and will soon enable more people to live in misery than before. The final result of (technical) improvements, therefore, is to increase the equilibrium population which is to increase the total sum of human misery.

Third Theorem: ***"The Moderately Cheerful Form of the Dismal Theorem"*** Fortunately, it is not too difficult to restate the Dismal Theorem in a moderately cheerful form, which states that if something else, other than misery and starvation, can be found which will keep a prosperous population in check [e.g., an embodied energy and resources tax instead of a GST], the population does not have to grow until it is miserable and starves, and it can be stably prosperous.

Boulding continues: "*Until we know more, the Cheerful Theorem remains a question mark. Misery we know will do the trick. This is the only sure-fire automatic method of bringing population to an equilibrium. Other things may do it*." '

So it is possible we, *Homo sapiens*, need to become much more miserable before we will change. Unfortunately, this implies great disruption, environmental damage and much more difficult lives for our children and their children.

[20] Excerpts from Albert A. Bartlett's 1998 Revision of: Reflections on Sustainability, Population Growth, and the Environment - Revisited www.mnforsustain.org/bartlett_a_reflections_on_sustainability.htm
[21] My addition. AJ

Certainly, the introduction of a tax on energy and resources (as suggested in the book *Natural Capitalism*) could ward off this fate. In such a scenario, all taxes on money are decreased and eventually eliminated, while a progressive tax on the energy and resources used in each product and service is gradually introduced over 10-20 years (enabling business to adjust). With the system in place, you would be able to earn as much money as you liked tax-free, but when you came to spend it, the high-impact goods and services would be expensive – e.g., a flight to the Bahamas would likely cost 10 times as much as now, but a sail-boat journey through the Whitsundays would invoke zero tax.

Whether we choose to act or not, there are massive changes ahead of us. We should ensure they are the ones of our own choosing!

Right on, Andrew. I couldn't agree with you more. Even at the so-called cutting edge of current development in Australia, we are nowhere near sustainable. Even where we are adopting "more sustainable" practices, we have a long, long way to go if we are to reach equilibrium in a fossil-fuel-depleted world. BUT – every little action in the right direction helps. Giving up because it is all too hard and complicated is not an option. E.G.H.

Nuclear power – can we afford to ignore it?

Bill Rourke – brourke@pcug.org.au, Network member and Fellow of the Academy of Technological Sciences and Engineering (ATSE) is concerned to ensure that Australia does not render itself economically uncompetitive in the future by ignoring the potential benefits of nuclear power. In response to a request from ATSE, he has recently prepared a paper on nuclear power and is expecting its publication soon. Responding to the feature "Nuclear energy: We don't need it" from Mike Smith and the TNEP team that appeared in the last newsletter (No. 53, pp 7-11), Bill makes the following point:

I believe some of the references quoted in the feature are unsound in their analysis. For example, it is stated in the feature that Van Leeuwin's paper has not been challenged. Well, it has been now, and I refer you to the August 2005 paper of the World Nuclear Association on this topic. It is available at: http://world-nuclear.org/info/inf11.htm.

It would, I agree, be good news if wind power could provide economically for our energy needs but, setting aside Antarctica where it is doing a good job, it seems unlikely that wind power can provide an economic solution.

I wonder how you would rate the nuclear programmes of France and Sweden, and their general support by their national populations? It seems to me that the French policy for the past forty years or so, and the Swedish policy for the last decade or so, are testimony to the possible preference for nuclear power.

I think the debate over nuclear power is one that needs to be had – and is far from finished. Any rush to implement nuclear power in Australia, or to write it off without a satisfactory debate, risks entrenching 'pro' and 'con' camps in bunkers where they will just continue to snipe at each other. This is an issue on which we need to talk to each other – and the paper Bill mentions should certainly be consulted in the interest of balance.

And, for the sake of transparency, I should state that I, personally, am still not convinced that we need nuclear power. With some creativity in approach, huge power savings are possible in each and every domestic home, and we have barely scratched the surface of energy efficiency in workplaces and industries. Modest progressive changes to patterns of consumption, combined with ongoing innovation in "right-scale" technologies should go a long way towards helping society to adjust. I have read a number of arguments for installing nuclear power in Australia and, it seems to me, that they all ultimately depend on the assumption that it's worth the extra

cost and extra risk to maintain business-as-usual to avoid "impacting the economy". If we are to have any chance of becoming a sustainable society, however, the economy needs to be "impacted" and restructured over time anyway. CO2 from coal-fired electricity generation is one issue but, if we switch to nuclear power and continue business-as-usual, it will be very hard on the environment and natural resources in other ways. Some other factor, such as water or soil fertility, etc, will become limiting. I also worry about countries such as France or Sweden, etc, where nuclear power is entrenched, as it appears they import the necessary raw resources, which must embed considerable fossil fuel transport energy. To me it would seem preferable in the long term for such countries to turn to renewable energy solutions that come closer to using local resources locally. E.G.H.

"Little Morsels" – Food for Thought

Wine quality up – ecosystem down!

Those readers who enjoy a drop of wine now and then cannot have failed to notice the gradual replacement of wine bottle corks with alternative seals of various kinds. While some may lament the loss of the venerable cork culture, with its stylized removal and sniffing of the cork, the change is promoted in the interests of wine quality – avoiding spoilage of a significant fraction of bottled wine by "cork taint" and oxidation. After all, whoever heard of "sticking a lump of bark in the neck of a bottle" and expecting the contents to stay fresh indefinitely!

There is an unexpected downside to the change, however, as one might expect if everything is connected to everything else in our complex global world. The more we replace corks with alternative seals, the less demand there is for the bark of the cork oak tree, a product that is still harvested in Portugal from a managed but naturally endemic cork-oak woodland ecosystem. As demand from the biggest dependent industry falls, it threatens the livelihoods of the local residents who tend the trees and harvest their bark in a non-lethal rotation system. When a primary production system fails financially, the obvious answer is to rip out the crop and plant something else. We have seen it happen for grapevines, citrus trees and many other crops here in Australia as market forces have evolved in a global trading environment. The difference is that, in Portugal, we are talking about the natural, albeit managed, vegetation of the region. The early signs of woodland replacement are already being seen. What a shame for the natural environment. Viva la cork!

Other Information Resources and Links of Interest

ECOS, Australia's most authoritative magazine on sustainability in the environment, industry and community is published bi-monthly by CSIRO – in print and online. See: www.publish.csiro.au/ecos.

BUSINESS & INDUSTRY
The Sustainable Way – Book
http://intergon.net/tsw/tswindex.html

This book by **Dr Lionel J Boxer** deals with important, underlying cultural issues in business workplaces that influence the ability of the organisation to introduce change – particularly the changes necessary for sustainability. From observations of CEOs known for dealing effectively with sustainability issues, the author demonstrates how those businesses that do succeed at dealing with these issues make it happen, and presents a simple framework to articulate what leaders need to do. The book condenses an important message into an easily absorbed novel. Its objectives are to (1) help people understand how to deal with sustainability issues, (2) initiate positive discourse about sustainability (i.e., links with appreciative inquiry), and (3) help people apply knowledge about themselves and others. Check the above website for a longer summary of the book and the interesting theory behind successful change. In fact, if you are dealing with any sort of change in any sort of organisation, this book provides valuable insight into the nature of organisational culture and social interactions.

CLIMATE CHANGE

Climate Change: Turning up the Heat – Book

www.publish.csiro.au/pid/4992.htm

Is climate change really happening and does it matter? The answer from the scientific community is a resounding yes, yet debates about the reality of climate change and what measures to take are slowing our response. Barrie Pittock, one of the world's leading climate researchers, argues that we need to act urgently to avoid increasingly severe climate change. He looks at the controversy around global warming and other predicted changes, examining the scientific basis of the changes observed to date, how they relate to natural variations and why the evidence points to larger changes later this century. The effect of these changes on our natural systems and our lifestyles will be considerable and could include wild weather, shifts in global ocean circulation, decreases in crop yields and sea-level rises. But the impacts won't be distributed evenly: some countries will suffer more than others. The book explains how our attitudes to risk and uncertainty influence our decision making and, ultimately, how much we and future generations stand to lose from rapid climate change. Our climate takes a long time to alter so what we do now will have impacts decades later; we must encourage market forces to think long term. The book outlines the current concerns of the major international players and reviews the response to date, detailing national interests. Importantly, it shows there is real hope of managing climate change and minimising the risk of disaster if we step up efforts to develop and apply innovative technological and policy solutions. [Published Oct 2005 by CSIRO Publishing; ISBN 0643069313]

ENERGY

The Centre for Low Emission Technology (cLET) – National Research Program

www.csiro.au/news/newsletters/0509_energy/story3.htm

It is a reality that Australia will continue to be reliant on coal for energy and power generation for many years to come. This means that work on cleaner coal technologies is critically important. cLet, under the umbrella of the National Research Flagship, Energy Transformed, will continue to develop cost-effective new clean coal technologies that, when combined with CO2 capture and storage, will dramatically reduce emissions, helping to protect our environment and Australia 's future. The primary focus of the Centre is on R&D for the next generation low-emission technologies with an emphasis on improved gas cleaning, gas separation and gas conditioning technologies. This research focus will lead to the development of Pulverised Coal (PC), Integrated Gasification Combined Cycle (IGCC) and hydrogen/synfuels production technologies.

Thermodynamics of the Corn-Ethanol Biofuel Cycle – Paper & discussion analysis

http://petroleum.berkeley.edu/papers/patzek/CRPS416-Patzek-Web.pdf

In this comprehensive scientific paper, originally published in *Critical Reviews in Plant Sciences* 23(6):519-567, author **Tad W. Patzek**, uses the basic laws of physics to prove that the corn-ethanol biofuel cycle is unsustainable – a net energy user, depleting and polluting natural resources. The only plausible answer to the growth of this industry lies in politics, and the massive transfer of subsidy monies from the collective pocket of taxpayers to corn producers. The author laments the fact that the US scientific community seems preoccupied with illusions of a future global energy bliss brought about by new and sexy, but inherently unsustainable technologies, while it should be advocating the simpler and less expensive, but painful, real solutions based on energy conservation and increased reliance on the only renewable source

of energy, the sun, and its weak derivative, the wind. Also see the further analysis of Patzek's paper by Brian Fleay posted at **http://stcwa.org.au/journal/161005/1128864197_30304.html**.

HOUSING

The Queensland Sustainable Homes Program

www.sustainable-homes.org.au

The Sustainable Homes program aims to provide communities throughout Queensland with display homes that incorporate principles of sustainable design and performance. Key objectives are (1) to demonstrate and promote the importance of investment in sustainable design at household and community level; and (2) to increase the demand from home owners, builders and developers for sustainability practices. The homes will be unique because they will provide practical examples of dwellings that aim to meet the triple-bottom-line requirements of sustainability – environmental, social and economic. The program, a national first, is a collaborative partnership between State and local governments and housing industry organisations.

OIL DECLINE & SUBURBIA

San Francisco in a post-oil future

www.energybulletin.net/9622.html

Acres of chard and lettuce in Golden Gate Park? The Marina Green with community gardens? Wind turbines on top of the Bank of America Building? Welcome to the post-oil future! In this article (originally published 2/10/05 by the San Francisco Chronicle, **Tim Holt** shows how the suburban dream may well become a nightmare for those who are not thinking ahead in response to the early indicators of oil decline. Depending on which expert you believe, we have already reached, or will reach in the next few years, the point when worldwide oil demand starts to exceed supply – and gas prices really go through the roof. If cities like San Francisco (and our own sprawling Australian cities) are to survive as viable places to live, they will have to redesign themselves in ways barely imaginable now. The article looks ahead and challenges citizens to prepare before they are overtaken by the unimaginable – being stranded in the suburbs as production systems collapse due to rising fuel prices.

Living Too Large in Exurbia

http://businessweek.com/magazine/content/05_42/b3955060.htm

Big houses. Big cars. Now bigger bills. A lifestyle built on cheap energy and cheap credit is in jeopardy. For those who made the exodus to the rolling farmland of Loudoun County, Virginia, USA, over the past decade, the trade-offs were well understood. Stake a claim to the exurban dream in newly sprouted developments with bucolic names like Farmington on the Green and Hirst Farms (going price: $600,000 and up), and you got a brand new house on a quarter acre. Excellent schools, the small-town charm of antique shops, and historic courthouses were also part of the package. And just watch your home value soar, by an average 23% in the past two years. These days, though, a chill is sweeping through the fast-growing exurbs that have popped up like mushrooms on the outskirts of established cities and suburbs all across America. A lifestyle built on cheap energy costs and low mortgage rates is in jeopardy. Consumers who hardly gave a thought to gassing up when regular was $1.50 a gallon are abandoning their hulking sport-utility vehicles and pickups, signing up for carpools, and leaving the motorboat in the backyard now that prices are stuck at nearly twice that. And with heating bills expected to jump as much as 70% for many this winter, more pain is on the way….! If you have trouble accessing the original Business Week article, it has been reprinted by the Sustainable Transport Coalition, WA, at: **http://stcwa.org.au/journal/161005/1129271457_25693.html**.

SOCIAL SUSTAINABILITY

Not Quite to the Manner Born – Article on road rage and social stress in modern life

www.brisinst.org.au/resources/brisbane_institute_manners.html

In this readable but confronting article, Alan Murray laments the loss of civility as he observes an angry army of Mad Maxes flow onto Brisbane's highways and byways every morning leaving, he says, any notion of civility in the sink with the soiled breakfast plates. Is the complexity and frustration of our car-dependent society finally catching up with us? Are we biting each other like too many rats crowded into the same cage? What sort of example are our leaders in politics and business setting us. Working towards sustainability will demand a higher level of cooperation, locally, nationally and internationally, than any of us have ever experienced before. The signs are not good!

TECHNOLOGICAL CHANGE

The Law of Accelerating Returns – web article

www.kurzweilai.net/meme/frame.html?main=/articles/art0134.html

An analysis of the history of technology shows that technological change is exponential, contrary to the common-sense "intuitive linear" view. So we won't experience 100 years of progress in the 21st century -- it will be more like 20,000 years of progress (at today's rate). The "returns," such as chip speed and cost-effectiveness, also increase exponentially. There's even exponential growth in the rate of exponential growth. Within a few decades, machine intelligence will surpass human intelligence, leading to The Singularity – technological change so rapid and profound it represents a rupture in the fabric of human history. The implications include the merger of biological and nonbiological intelligence, immortal software-based humans, and ultra-high levels of intelligence that expand outward in the universe at the speed of light. ***[Now here's a controversial view of the future. Could it happen, or is it an example of what David Holmgren, in an earlier feature termed "techno-fantasy"? You decide! E.G.H.]***

TRANSPORT

Road versus rail – Fuel consumption

www.transwatch.co.uk/transport-fact-sheet-5.htm

This facts sheet (2004) compares energy consumption for National Rail in the UK with equivalent road transport. Contrary to what many might expect, the data do not support the "Greens" belief that rail is environmentally kind compared with road transport. Instead, if express coaches and trucks were to carry out the national rail function there would be an energy saving of 20-25%. Other headline data is that the energy consumed by rail passengers is nearly double that used by express coach passengers, and is no better than a diesel-powered car containing two people. The latter is consistent with a recent report that high-speed trains had a heavier fuel consumption per seat-mile than does an efficient modern car. Road versus rail is obviously a complex issue, with the change to modern, fuel-efficient rail systems evidently just as important as greater efficiency for road transport. For a longer summary, see also: **http://stcwa.org.au/journal/161005/1128864021_29918.html**.

WAR & THE MILITARY

Battling Fuel Waste in the Military

www.rmi.org/sitepages/pid939.php

In this article by Amory B. Lovins of the Rocky Mountain Institute (RMI) Lovins summarises the Institute's work with the American Military to conserve resources. Most Americans are only too aware that their tax dollars support a massive military machine. The Department of Defense's annual budget is over $291 billion and rising. DOD has three million people, 36 million acres, over 250 major installations, 40,000 additional properties, 550 public utility systems, over 150,000 land vehicles, 22,000 aircraft, and over 300 ocean-going vessels. Around $5+ billion of the military budget buys energy. Most of DOD's five billion gallons of annual petroleum use fuels weapons platforms—land, sea, and air—that are manifestly inefficient. To add a little irony, much of the fuel used by the military is exhausted moving fuel around. Of the gross tonnage moved when the Army deploys, 70 percent is fuel. The US armed forces are variously adopting green design – not just to save money, but also to improve the quality of service life, which is critical to recruitment, retention, and operational effectiveness. And energy efficiency in the military, just as in any area of public service, slows the conversion of tax dollars into climate change – perhaps the gravest threat to global security.

[Personally, I find it a tragic waste – one that future generations will no doubt blame us for – that much of the world's precious supply of fossil fuel is being wasted to support fighting forces and war machines. These are, after all, the ultimate expression of vandalism towards people, cultures and the environment. Surely the least intelligent way to deal with a declining resource is to use it up by fighting! E.G.H.]

WATER

Water for a Healthy Country – CSIRO National Research Flagship Program

www.cmis.csiro.au/healthycountry

Water for a Healthy Country's goal is to achieve a tenfold increase in the social, economic and environmental benefits from water by 2025. The program aims to achieve the following outcomes: (1) Information to support improved water and natural resources policy; (2) Water allocation decisions, based on water use benefits and opportunities; (3) Best-practice farming and urban water uses; (4) Investment strategies that build on a systems understanding of catchments, rivers and estuaries; and (5) Inclusion of climate variability and climate change as a component of all water management decisions. You can access news updates from the program at: www.cmis.csiro.au/healthycountry/publications.htm. The latest (September) issue provides insights into how the southern region of Western Australia has become steadily drier since the 1960s, and how climate modeling can help with identifying the underlying causes and trends.

Calls for input / participation

Reducing the Destruction of Ecosystems – Call for contributions to a book
http://bin.tec-hh.net/sd/pub/Books/Book_ecosystems.pdf

It has long been argued that preservation of habitats is needed in order to ensure long-term sustainable use of natural resources. But if one considers the impact and extent of recent environmental problems and catastrophes, combined with the increasing threat many animal and plant species face due to uncontrolled economic growth, one fact becomes clear: global environment action plans such as the UN Millennium Development Goals cannot be achieved without first reducing the destruction of ecosystems. The book will combine both empirical research and critical assessments of the extent to which habitat destruction is taking place, and will examine this information against evidence of the direct link between biodiversity and human health and well-being. It will report experiences, projects and practical initiatives related to habitat protection and conservation, offering a picture of the state-of-the art in the field across the world. The book is an initiative of the European Reference Centre for Technology Transfer for Sustainable Development - www.tutech.de/sd - in cooperation with the UN Environment Programme - www.unep.org.

Bouquets

savewater! awards

Hats off to the recently announced winners of the 2005 **savewater! awards** ® for remarkable efforts in making precious water go further. Joint winners of the Award for Excellence were Ms Kim Thien Truong, winner in the "Community Action" category, and carpet manufacturer Godfrey Hirst Australia, winner in the "Manufacturing" category. Ms Thien Truong was recognised for helping Melbourne's Vietnamese community to achieve water savings of up to 25 Olympic sized swimming pools and 6,000 buckets of harvested rainwater. Godfrey Hirst Australia was honoured for developing a system to capture and treat seal water used in the carpet dying process, which can then be reused in a closed-loop, continuous basis. This innovation is saving more than 232 kilolitres of water per day – equivalent to 85 Olympic sized swimming pools a year. Read more at www.savewater.com.au.

The savewater! ® Alliance, initiated by Victorian water authorities, has taken a first step to becoming a national organisation by signing up its first member outside Victoria. Its goal is to give Australians water conservation ideas and solutions that are credible, effective and easy to implement.

And a bouquet for Rosie: There is real hope for our future when we can entrust it to talented young people like Rosie Sheb'a of Urrbrae Agricultural High School in Adelaide. Rosie has won the 2005 national Future Leaders Environment Award –given annually to a young Australian, at Year-12 level, who has shown leadership skills, a passion for the environment and ideas for change in the future of Australia. Well done, Rosie we need many more like you! See www.futureleaders.com.au. As a winner, Rosie will receive a fully funded Fellowship to participate in an Earthwatch Expedition to Australia or New Zealand.

Courses in Sustainable Development

Marking the UN Decade of Education for Sustainable Development 2005-2014

ANU: SRES Intensive short courses in Eco-Innovation and Sustainable Development

At Kioloa Coastal Campus: Eco-Design and Innovation: 9-14 January 2006 – in conjunction with a one-day seminar on 13 January on "Zero Waste: making it happen"; Greening the Built Environment: 23-28 January 2006. Contact Janis.Birkeland@anu.edu.au or http://sres.anu.edu.au/programs/postgrad.html.

ACEL Courses in Environmental Law

A selection of courses can be taken as PD short courses or as part of a graduate degree in the Law Faculty at the Australian Centre for Environmental Law (ACEL), ANU. See: http://law.anu.edu.au/acel. From July, courses in Environmental Law will also be taught in Melbourne. See http://law.anu.edu.au/postgraduate

Central Queensland University – Graduate courses in sustainable environmental management

Postgraduate programs in the Institute for Sustainable Regional Development and the Centre for Environmental Management: www.isrd.cqu.edu.au

Charles Sturt University

Distance Education postgraduate courses are available in: Ecotourism; Environmental Conservation; Environmental Management; Parks, Recreation & Heritage; Restoration Ecology; River Restoration & Management; Sustainable Agriculture; and Sustainable Management. See www.csu.edu.au/courses/ and follows the links for postgraduate courses in the Faculty of Science and Agriculture; or email enquiry@csu.edu.au.

Curtin University of Technology – Courses in Sustainability Management & Cleaner Production

The Centre of Excellence in Cleaner Production offers two world-class, multidisciplinary professional Masters programs – Sustainability Management and Cleaner Production – in addition to specialized undergraduate units in sustainable production & consumption and engineering sustainable development:
See http://cleanerproduction.curtin.edu.au

Flinders University of SA – Postgraduate Environmental Qualifications

A range of courses are offered towards Bachelors and Masters Degrees and Graduate Diploma and Certificate in the School of Geography, Population & Environmental Management. See: www.ssn.flinders.edu.au/geog/

Monash University: Linked Postgraduate Coursework Programs in Environment and Sustainability

Each offers opportunities for students to study electives and undertake projects in topics of special interest. [For more information contact Sharron.Pfueller@arts.monash.edu.au] (a) Master of Environment & Sustainability – www.arts.monash.edu.au/ges/postgrad/mes.html; (b) Master of International Development & Environmental Analysis – www.arts.monash.edu.au/ges/postgrad/midea.html; (c) Master of Corporate & Environmental Sustainability Management – www.arts.monash.edu.au/ges/postgrad/mcesm.html; (d) Postgraduate Diploma & Graduate Certificate in Geographical Information Systems (GIS) – www.arts.monash.edu.au/ges/research/Gis/public/info.html

Murdoch University – The Institute for Sustainability Technology & Policy (ISTP)

Undergraduate Degrees in Sustainable Development, Masters by Coursework Degree in Ecologically Sustainable Development, an associated Masters in City Policy, and PhD programs covering a wide variety of sustainability issues from a policy perspective. A feature of the ISTP approach is the involvement of students in practical applications of sustainability (e.g., the recently developed WA State Sustainability Strategy). See: http://wwwistp.murdoch.edu.au/ or contact ISTP Head, Professor Peter Newman – P.Newman@murdoch.edu.au or email wwwistp@murdoch.edu.au

Rangelands Australia – at the University of Queensland, Gatton Campus

Australia's only postgraduate coursework programs in Rangelands Management for land managers, government advisors and facilitators. Qualifications include a Graduate Certificate, Graduate Diploma, and Masters of Rangelands Management. For information visit www.rangelands-australia.com.au or contact rangelands@uqg.uq.edu.au or Janet Kieseker – j.kieseker@uq.edu.au

RMIT: Graduate programs in Rural & Regional Sustainability

www.rmit.edu.au (Use "Rural & regional sustainability" in the search facility.)

Swinburne University of Technology: Graduate Certificate in Sustainability

Courses developed at the National Centre for Sustainability Technology in response to industry demand for staff able to address the key sustainability challenges - www.ncsustainability.com.au/?id=courses

University of New South Wales

Institute of Environmental Studies: Masters, Graduate Diploma & Graduate Certificate in Environmental Management, based on a sustainable development framework. Visit http://www.ies.unsw.edu.au or contact Mark Diesendorf – m.diesendorf@unsw.edu.au.

Mining Research Institute: A range of graduate diploma and certificate courses with relevant sustainability conten. Contact Kim Russel – K.Russell@unsw.edu.au or visit www.mining.unsw.edu.au

University of Sydney – Orange Campus – Postgraduate courses in Sustainable Management
Degrees, diplomas and certificates in Sustainable Management & Sustainable Agriculture
www.orange.usyd.edu.au

Conferences, Workshops & Events

Water Conferences listed by the International Water Association (IWA):
See: www.iwahq.org.uk/template.cfm?name=events

Conferences and courses listed by the Australian Centre for Groundwater Studies
See: www.groundwater.com.au/ or http://groundwater.com.au/conferences.html

International Events listed by the Harvard University Forum on Science & Technology for Sustainability
See: http://sustainabilityscience.org/events.htm or http://sustsci.harvard.edu/events.htm

Is your Business a Large Energy User? Australian Governement Energy Efficiency Opportunities Program – Information & Consultation Sessions for Businesses with High Energy Usage
Melbourne, 8 November; Sydney 11 November. www.industry.gov.au/energyefficiencyopportunities

Greenhouse 2005 – Action on Climate Change (convened by CSIRO)
Melbourne, 13-17 November. Info: infor@greenhouse2005.com or (03) 9239 4661

Native Title & Cultural Heritage
Brisbane, 29-30 November. www.iir.com.au/resources or Glenda McGuinness (02) 9923 5004

3rd Intl. Conf. on Plants & Environmental Pollution (ICPEP) – Intl. Soc. Environ. Botanists
Lucknow, India, 29 November-2 December. www.geocities.com/isebindia/index.html

CSR Summit 2005
Sydney, 30 November – 2 December. www.iamevents.com.au/csr

The Business of Sustainability – Conference & Trade Fair
Adelaide, 30 November – 1 December. Info: chagi@sa.propertyoz.com.au

International Media & Environment Summit
Sarawak, Malaysia, 30 November – 2 December. www.newsworldnature.com

Reducing the Load – Energy efficient air conditioning systems in commercial buildings – Public Seminar
Adelaide, 8 December. Info & register: Albert Thompson 0403 070 530 or aat@internode.on.net

Hawaii International Conference on System Sciences (HICSS-39)
Hawaii, 4-7 January 2006. www.hicss.hawaii.edu/HICSS39/apahome39.htm or www.hicss.hawaii.edu

Environmental Online Communication – Minitrack at HICSS-39
Hawaii, 4-7 January 2006. www.ecoresearch.net/hicss

2nd International Conference on Environmental, Cultural, Economic & Social Sustainability
Hanoi & Long Bay, Vietnam, 9-12 January 2006. www.sustainabilityconference.com

Zero Waste: making it happen
Kioloa Coastal Campus of ANU, 13 January 2006. Info: janis.birkeland@anu.edu.au or http://sres.anu.edu.au/programs/ecoinnovation_susdevelopment/pdfs/zero_waste.pdf

Australia-New Zealand Climate Change and Business 2006
Adelaide, 20-21 February 2006. www.climateandbusiness.com

Hydrological Sciences for Managing Water Resources in the Asian Developing World
Guangzhou, China, 8-10 June 2006. http://cwre.zsu.edu.cn/mwra

4th World Water Forum – Local Actions for a Global Challenge
Mexico, 16-22 March 2006. www.worldwaterforum4.org.mx

Globe 2006 – 9th International Conference & Trade Fair on Business & the Environment
Vancouver, Canada, 29-31 March 2006. www.globe2006.com

Enviro 06 – Building Sustainable Cities
Melbourne, 9-11 May 2006. www.enviroaust.net

7th ICTC Conference – Society for International Cities, Town Centres & Communities
Newcastle, NSW, 6-9 June 2006. www.ictcsociety.org/conf2006/index.htm

National Greenbuild & Eco Show 2006
Sydney, 7-9 July 2006. www.ecoshow.com.au

7th International Conference on Hydroinformatics – HIC 2006
France, 4-8 September 2006. www.hic2006.org

Managing Environmental Knowledge – 20th Intl. Conf. on Informatics for Environmental Protection
Graz, Austria, 6-8 September 2006. www.enviroinfo.net

Sustainable Water Management Practices – IWA World Water Congress & Exhibition

Beijing, China, 10-14 September 2006. www.iwa2006beijing.com

And Finally – Notes and Reminders

Our web site at www.bml.csiro.au/sustnet.htm has CSIRO's "P@NOPTIC" search facility installed – and now also has contents summaries for archived newsletters.

The *SustNet* website is maintained by Lyndon Hirst at CSIRO's Black Mountain Library – Comments and suggestions welcome. Contact Lyndon at Lyndon.Hirst@csiro.au

- **To SUBSCRIBE to the Sustainability Network, visit www.bml.csiro.au/SNabout.htm or send me an email request: Elizabeth.Heij@csiro.au**
- **To find back issues of Sustainability Network newsletters directly, go to our web archive at: www.bml.csiro.au/SNnewsletters.htm**
- **Pass it on!** The Sustainability Network is intended to be inclusive rather than exclusive. If you know someone who might be interested in this newsletter, by all means forward it to them or give them our web address.
- **Want to make contact with scientists?** If you can see an application for the science featured in these newsletters and need to contact the scientists involved, let me know by email.
- **Want to see a particular area of sustainability science featured?** If there is a particular area of sustainability-related science that you would like to see featured as a "spot" in a future newsletter, send me an email or call me by phone to discuss it.
- **Give me your feedback.** I would be interested in your comments as to whether these newsletters are interesting, useful, and pitched at the right level for your particular purposes. Do you have suggestions? Thanks to all those who have already sent in comments and alerts.

Network Milestone:
Our Sustainability Network has over a thousand members.

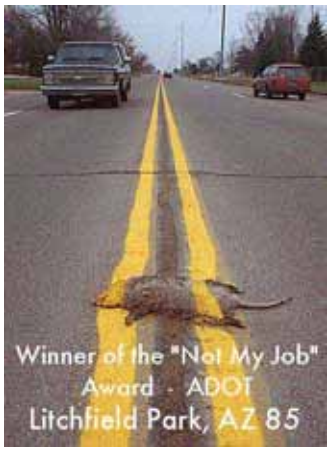
Sincerely,

Elizabeth Heij

Network Facilitator

Parting Shot

Now, this is not a very nice picture, so **apologies to anyone who may be distressed by the image**. It does, however, lend itself to an important and relevant thought for which no apologies are needed:



**If we continue to regard sustainability as "Not my job",
the future will roll right over us!**