Sustainable Energy Solutions for Growing the Economy While Cutting Greenhouse Gas Emissions

Alan Pears

Director,Sustainable Solutions Pty Ltd

Policy Committee Convenor, Sustainable Energy Industries Council of Australia

Sustainable Energy, Greenhouse Gas Emissions and GDP

Australians spend around $37 billion on energy each year. We spend many billions of dollars buying inefficient appliances and equipment, and building energy-wasteful buildings. This money is not being invested cost-effectively.

The sustainable energy industry helps abatement of greenhouse gas emissions in two ways, by:

- making energy more productive through energy efficiency improvement - doing more with each unit of energy
- reducing the greenhouse intensity of each unit of delivered energy by
    - switching to renewable energy sources,
    - reducing energy conversion losses (for example, through cogeneration or replacement of fossil fuel-fired electricity generation with efficient direct use of fuels) and,
    - as a bridge to a sustainable future, switching to lower greenhouse intensity fossil fuels such as natural gas

These two effects multiply. For example, if Australia improves its efficiency of energy use by 10%, and the greenhouse intensity of that energy (in emissions per unit of energy) declines by 10%, the overall outcome is a 19% reduction in greenhouse gas emissions (as savings are calculated from: $0.9 \times 0.9 = 0.81$). The combination of these strategies therefore offers an attractive path towards future greenhouse emission reduction targets.

In this paper, I will briefly look at the role sustainable energy can play in reducing Australia's greenhouse gas emissions by addressing:

- the size of the potential contribution from sustainable energy,
- its employment and export creation potential, and
- why its role in future emission reduction is understated in conventional economic analysis and modelling
- the implications of greenhouse reduction targets for the resources and metal processing industries

The Potential of Energy Efficiency and Renewables

The theoretical potential of renewable energy sources to satisfy all of Australia's energy requirements cannot be denied. Each year, solar energy equivalent to 16,000 times our primary energy use falls on the Australian continent - and this ignores our outstanding wind and wave energy resources. So debate about the future role of renewable energy centres on the economics and practicality of its utilisation.

The potential for energy efficiency improvement is less well recognised. Many analysts put the potential for savings in the range of 2 to 30%. This is far from the theoretical potential. Detailed analysis shows that the potential for improving the energy efficiency of service delivery lies in the range of 30 to 99% (see, for example, Pears (1995).

Most activities (including energy-intensive activities such as aluminium and steel production) are carried out at appallingly low energy efficiency in thermodynamic terms (see Headon (1995)). Much of this potential is not recognised, because many analysts fail to correctly identify system boundaries, or to specify accurately the service delivered. So, as with renewable energy sources, the debate about the role of energy efficiency improvement also centres on the economics and practicality of its adoption, and is profoundly influenced by the knowledge base of those entering into the debate.

Economic Potential of Sustainable Energy

The economic potential of sustainable energy solutions is expanding rapidly, as a result of technological innovation and structural change within our society. Thus, any projections based on past data will understate the role of sustainable energy solutions.

Many studies have identified large, cost-effective potential for energy efficiency improvement, for example:

- Minimum Energy Performance Standards for appliances study for ANZMEC (Wilkenfeld, 1993) - net lifecycle saving $310 to $489 million
- Commercial Building Energy Code study (EMTF, 1993) - $886m net lifecycle saving over 30 years
- High efficiency electric motors (BIE, 1996) net annual savings $39m
- Residential and passenger vehicle study (Naughten et al, 1994) - $15.7 to $31.8 billion over 30 years
- State Electricity Commission of Victoria Demand Management Action Plan (ESV, 1994) - large, cost-effective electricity savings demonstrated (interim assessment in mid 1993 indicated net economic benefits of $44.5m)
- experience of Greenhouse Challenge participants

Each week's delay in pursuit of these kinds of savings costs Australians tens of millions of dollars - a cost that is not recognised by most economic modelling (which assumes that our energy use is already efficient), or by governments and business.

Renewable energy is also cost-effective in many applications including:

- cogeneration from bagasse (now estimated at potentially up to 2,000MW of electricity)
- wood heating (providing space heating for more than 20% of Australian homes)
- wind, photovoltaics, micro-hydro etc in remote areas and at the fringe of grids
- solar hot water in many areas in Australia

Clearly, these identified and economic sustainable energy resources are not being exploited at economically-optimum scale. Any rational greenhouse response strategy would aim to overcome the barriers inhibiting their adoption as a matter of urgency. Yet this is not happening.

Employment and Export Potential of Sustainable Energy Solutions

Energy efficiency and renewable energy industries are essentially light manufacturing and service industries. As such, they are characterised by high labour content and relatively low capital investment requirements relative to traditional energy industries. For example, according to a recent DPIE (1997) study, the existing renewable energy industry directly employs around 6,500 people - a tenth as many as the whole Australian electricity, gas and water industry (DEETYA, 1997). And the renewable energy industry is at a very early stage of development!

Energy efficiency improvement involves many labour-intensive activities, including equipment maintenance, sale and installation of equipment, etc. For example, according to an industry association (FARIMA, 1997), the Australian insulation industry alone employs around 5,500 people. And promoting energy efficiency will create more jobs:

- a 1992 NSW Department of State Development study indicated that implementation of mandatory home insulation requirements in NSW would create 900 direct jobs
- production of an additional 50,000 energy-efficient dishwashers per year was estimated by a manufacturer to create a total of 315 additional direct jobs in manufacture of components and the products themselves (Community Energy Network, 1992)
- more broadly, a 1994 analysis (ACF/ACTU, 1994) based on US data indicated that Australia's energy efficiency industry could directly employ around 100,000 people if the then current level of US activity was achieved. When typical multiplier effects are applied to these figures, employment potential could be much larger.

From an export perspective, the DPIE (1997) study estimated that renewable energy exports were already worth around $100m per annum, of which photovoltaics and associated equipment comprised $57m. Various studies have identified enormous export market potential to Asia in the order of tens of billions of dollars (see, for example, DPIE (1997) and ILZRO (1995)).

The potential for exports of energy efficiency is not so well defined. While some Australian energy management consulting groups are becoming active in export markets, the main potential may lie in licensing of technologies and product exports. For example, the recent Victorian Government (1997) *Science and Technology Statement* noted that the development of a leading-edge energy- and water-efficient dishwasher by Victorian-based Dishlex had led to a tripling of export sales, and the manufacturer reports much greater potential as they develop market opportunities. Thus, energy efficiency can underpin growth of manufacturing and service exports.

Sustainable Energy and Greenhouse Response

The above sections have demonstrated that there is substantial potential for sustainable energy solutions to contribute to cost-effective greenhouse response strategies while expanding employment. This potential, in conjunction with structural trends discussed below, is sufficient to allow Australia to reduce energy-related greenhouse gas emissions by at least 20% from 1990 levels by 2020, while maintaining strong economic growth. In the longer term, much larger reductions in emissions are achievable.

Yet Australia is under-achieving in adoption of these beneficial technologies and services. The many reasons for this include:

- effectiveness of vested interest groups in stopping or delaying implementation of programs which have economic benefit for society, but not necessarily for them.
- reluctance of governments to accept that market imperfections exist, and reluctance to act to remove them. This position is based on the views widely held among economic analysts that the Australian economy is already operating as energy-efficiently as is economic, and that energy growth is an essential input to economic growth. So-called 'rebound effects' are used as a basis for claims that energy efficiency improvement would achieve negligible net savings in the long term - thus justifying treatment of energy efficiency as a fringe issue
- a belief within government that restructuring of the energy sector would remove all market imperfections has meant that targetted actions have been 'put on the backburner' so resources could be focused on restructuring. While industry restructuring may overcome market imperfections in the long term, the short term impacts of restructuring have had serious negative impacts on sustainable energy solutions, for example, unsustainably low electricity prices and distorted tariffs have reduced financial incentives for energy efficiency improvement. Interim strategies are needed to deal with existing market failures
- a focus of both government and business on reducing cost per unit of energy (prices or tariffs) instead of total energy costs (bills): this is leading to under-investment in energy-efficiency

  the widely held belief that greenhouse response of any kind would devastate the coal, aluminium and other resource industries and, hence, damage the Australian economy. This is based on fundamentally-flawed economic modelling.

The outcome of these and other barriers has been that Australia has continuously trailed the OECD average rate of performance in energy efficiency and adoption of renewable energy (IEA 1997). It is possible to work through all these issues, demonstrating their lack of validity, but there is insufficient time in this short presentation. However, the following analysis of ABARE's most recent published study of the cost of greenhouse response highlights some of the shortcomings of existing studies.

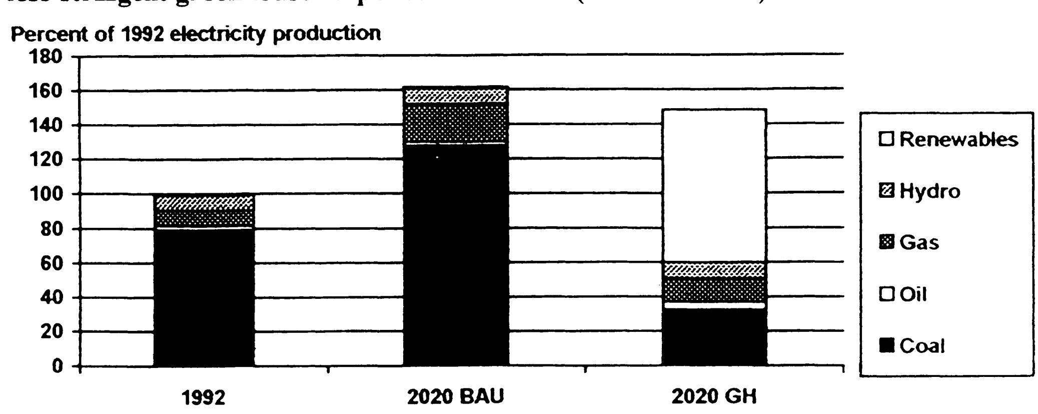
MEGABARE Scenarios for Electricity

In the recent ABARE (1997) study of the economic impact of international climate change policy (Report 97.4), the mixes of fuels for electricity generation are shown on p.98 of the report. Figure 1 shows the relative quantities of various fuels used to generate electricity in 2020 under MEGABARE's business as usual (BAU) and greenhouse response scenarios.

As can be seen from Figure 1, the model predicts a 60 percent increase in the quantity of electricity generated from coal under BAU conditions, while power generation from gas will increase by 137%. This is not consistent with the views of a number of experts. For example, ESAA, in its latest study (DPIE 1997a), expects a tripling of gas generation capacity to 14,500 MW (mostly cogeneration) - which would involve a much larger increase in power generated from gas, as cogeneration plant would supply baseload power, while existing gas plant mostly supplies peak and intermediate loads. The net increase in power generation capacity of 10,000 MW estimated by ESAA implies that 4,500 MW of existing plant - mostly coal-fired - will be retired and replaced by gas - in contrast to the 60% increase in coal-fired generation predicted by MEGABARE under BAU conditions. Not only does this difference throw into question the MEGABARE BAU estimate of greenhouse gas emissions, but it also raises questions about the accuracy of estimates of generation costs of coal and gas incorporated into the modelling.

MEGABARE's greenhouse response scenario also provides a few surprises. Price-induced energy-efficiency improvement driven by large carbon taxes only reduces electricity consumption by 8% below the BAU value for 2020, while the model seems to suggest that non-hydro renewables will satisfy 60% of electricity requirements. Since the model is attempting to select a 'least cost' solution, it can be inferred that its input data specify that renewable energy is less expensive than most energy efficiency improvements. Clearly, the model incorporates a very pessimistic set of assumptions regarding the potential for energy efficiency improvement, and an extraordinarily optimistic view of the speed with which new renewables could be deployed.

Figure 1. Fuel mix and relative amount of electricity generated in 1990 and 2020 under BAU and "less stringent greenhouse response" scenarios (ABARE 1997)



The mix of fuels for electricity in the greenhouse response scenario leads to a 48% reduction in greenhouse gas emissions from electricity generation by 2020 compared with 1992. This suggests that the model is trying to achieve a disproportionately large reduction in emissions from electricity generation, instead of transport or other fuel use. It also relies heavily on supply-side solutions instead of demand-side ones. Yet there are very large opportunities for cost-effective energy-efficiency improvement across the economy.

Given the nature of the scenarios produced by the MEGABARE model, it is not surprising that the modellers have concluded that greenhouse response would be very expensive for Australia. By utilising very little low cost energy efficiency improvement, while installing huge amounts of relatively expensive renewable electricity and shutting down 60% of coal-fired power generation, the model has clearly chosen a high cost, unworkable strategy. There is an urgent need for external scrutiny of ABARE's economic modelling of the costs of greenhouse response, and review of assumptions and data used. With more realistic data inputs, very different costs - and possibly even benefits, could be estimated by the model.

Greenhouse Response and the Future of Resource and Resource-processing Industries

It is widely-believed that, for Australia to reduce greenhouse gas emissions, the mining and resource-processing industries - particularly the aluminium industry - will be devastated, and that this will severely damage the Australian economy. This view is based on economic modelling that seriously underestimates the rates of technological change in industries. In reality, competent managers in these industries will be able to maintain profitability.

For the aluminium industry, a number of factors will allow ongoing growth in output to be combined with reduction in greenhouse emissions. These include:

- smelters will benefit from the decline in greenhouse intensity of Australian electricity, probably reducing greenhouse emissions per tonne of aluminium by around 25% by 2020
- Comalco's improved smelting technology is expected to reduce electricity consumption per tonne of aluminium by 15% or more from around the turn of the century, and it can be retrofitted to existing smelters. Further improvements are under development
- dramatic reductions in PFC emissions since 1990 are contributing a 10% reduction in emissions per tonne of aluminium
- conversion of the coal-fired Worsley alumina refinery, and other oil-fired refineries (eg Gove) to natural gas, along with process efficiency improvements and increased cogeneration provide substantial potential for reduction in emissions per tonne of alumina

Overall, emissions per tonne of aluminium could be reduced by more than 40%. Since the industry has no plans to build new smelters in Australia (as our electricity prices cannot compete with other potential hosts without subsidies), this reduction would allow substantial expansion of much less energy-intensive alumina refining while achieving overall emission reductions.

The steel industry is moving from greenhouse-intensive blast furnaces to much lower greenhouse intensity electric arc furnaces, Hot Briquetted Iron (HBI) and other advanced iron and steel production technologies. Emission savings from closure of the Newcastle steel works would allow at least twice as much steel to be produced from a mix of scrap and HBI, using the latest technologies, without any increase in total greenhouse emissions. At the extreme, production of a tonne of steel from recycled scrap using an electric arc furnace generates a fifth to a tenth as much greenhouse gas per tonne as production from Newcastle.

Mount Isa Mines has demonstrated the enormous potential for energy-efficiency improvement in mining and smelting by reducing the energy consumed per tonne of output by 35% since 1991. And conversion of its electricity supply and fuel use from coal to gas will soon lead to further reductions, leading to an overall halving of greenhouse gas emissions per tonne. That is, they could double output without exceeding their 1990 emissions. Mines in Western Australia will reduce emissions as they shift from diesel-powered electricity generation to higher efficiency, lower greenhouse intensity natural gas-fired power using gas from the Goldfields pipeline.

The future of Australia's coal industry will not be closely tied to Australian greenhouse targets, as coal mining is not particularly energy-intensive. Instead, it will be linked to the industry's success on world markets for thermal coal, and trends in steel making (the main consumer of coking coal). This industry has a history of poor financial returns, and investors are responding to this history, rather than potential impacts of greenhouse policies. Within Australia, most analysts expect little or no expansion of coal-fired electricity generation, regardless of greenhouse policies (see DPIE 1997a), because gas-fired generation is much less risky and at least comparable in cost.

What about the impacts of greenhouse response on the Australian economy? As noted above, there is plenty of scope for resource and resource processing industries to continue to develop within a greenhouse emission reduction framework. Active pursuit of emission reductions across the rest of the economy would leave further room for these sectors to grow, if this proves to be the best path for Australia.

Figure 2. Trends in percentage contributions to GDP, by industry. Source ABS (1996 Aust Yearbook) ABARE (1994) for basic metals

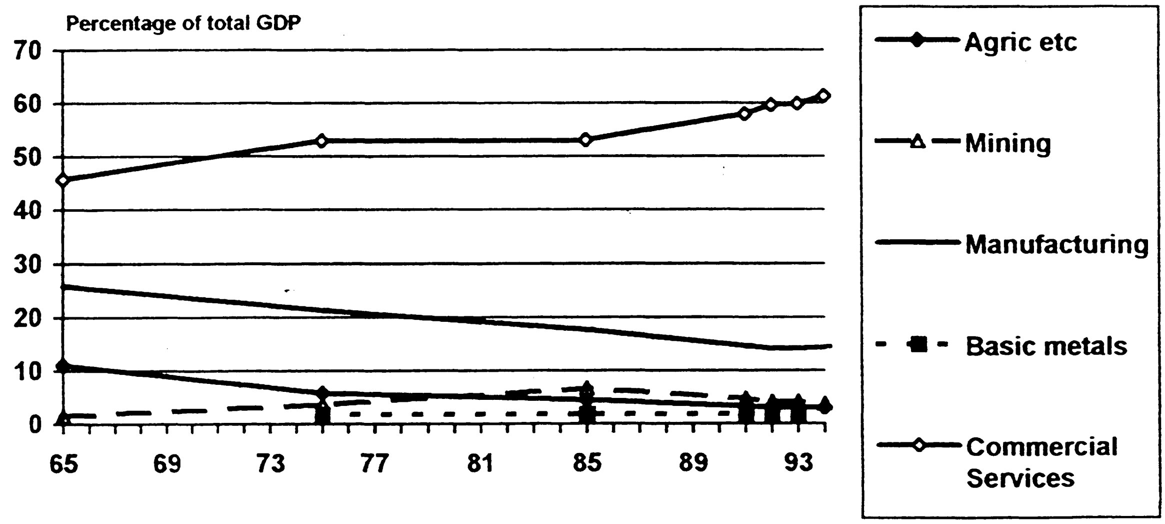
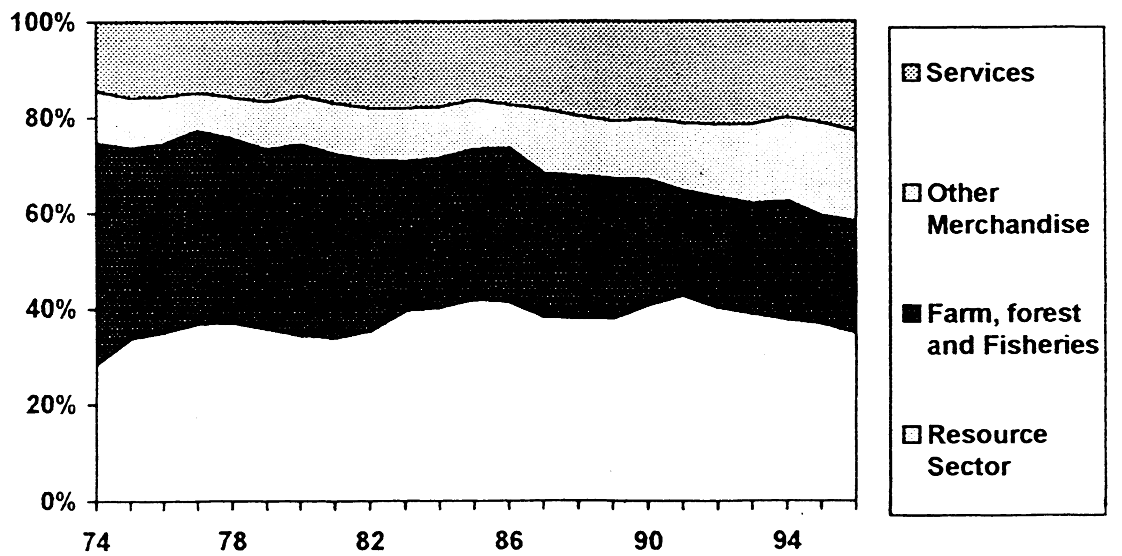
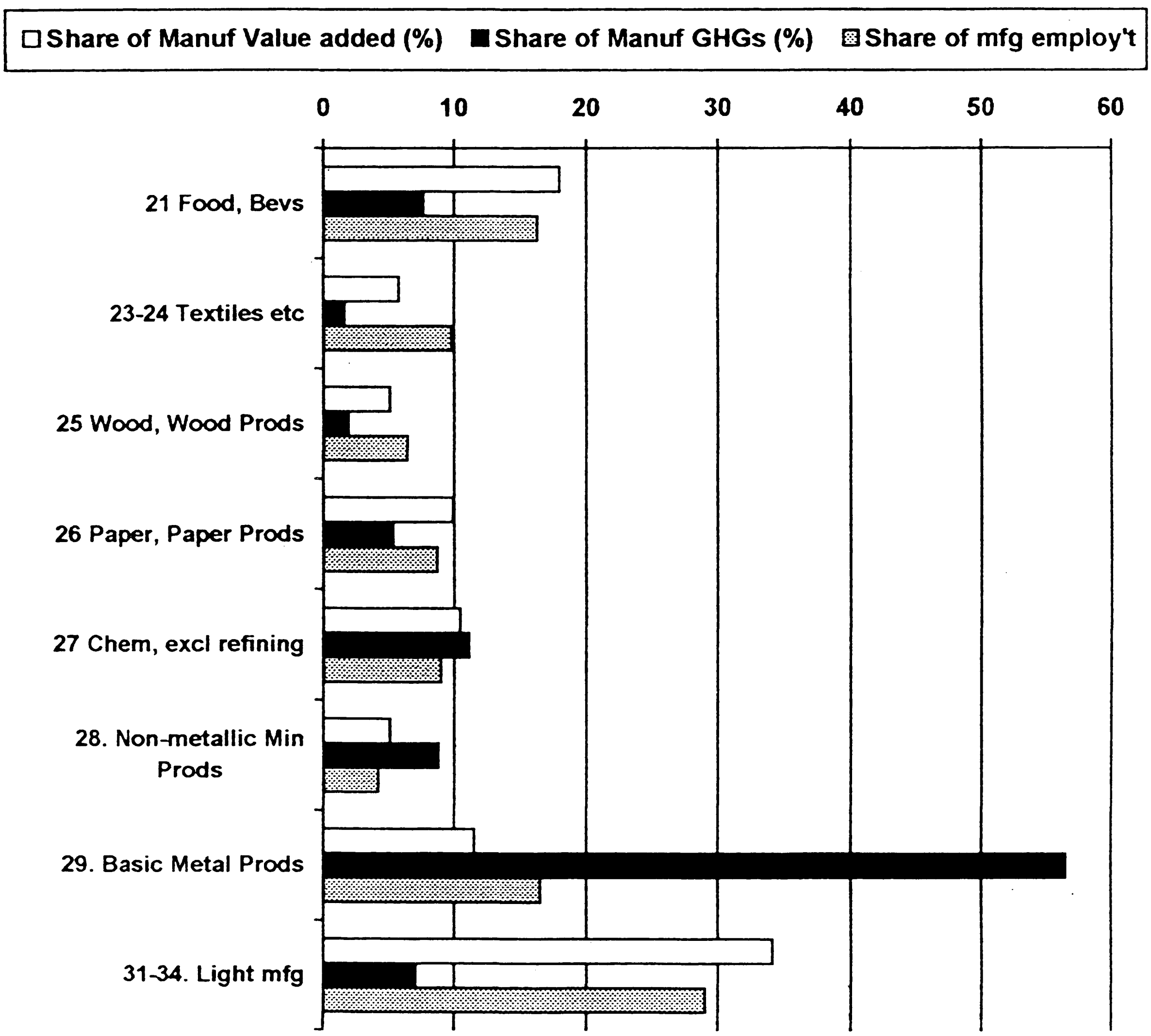


Figure 3. Trends in value of Australian exports, percentage by sector. Source ABARE



But recent evidence shows that resource-based industries are playing a declining role in Australia's economy. Figure 2 shows trends in shares of GDP, while Figure 3 shows that exports of services and manufactured goods are growing strongly, reducing our economy's dependence on resource-based industries. Strong growth is projected for information technology industry exports (up to $10 billion pa by year 2000 from $0.5b in 1990 - exceeding total coal export value). In manufacturing, strong export growth is projected for industries that are low in greenhouse intensity and high in employment intensity, as shown in Figure 4. So the conventional wisdom reflected in economic modelling does not seem to be consistent with recent trends, or visions of Australia's future.

Figure 4. Manufacturing sector greenhouse gas emissions, Value Added and employment by industry ASIC Codes, 1990 (Wilkenfeld 1996 and ABS 8221.0)



Conclusion

Australia now has a clear choice: to actively pursue cost-effective sustainable energy solutions and catch up to other developed countries, while limiting greenhouse gas emissions and increasing employment; or to waste money (and inevitably jobs) while increasing greenhouse gas emissions and risking international criticism.

The next few months will show whether Australia is going to back a winner or a loser.

References

Australian Bureau of Agricultural and Resource Economics (1994), *Commodity Statistical Bulletin 1994*, Canberra

Australian Bureau of Agricultural and Resource Economics (1997), *The Economic Impact of International Climate Change Policy*, Research Report 97.4, Canberra

Australian Bureau of Statistics (1996), *Yearbook, Australia*,, Canberra

Australian Bureau of Statistics(1996a) *Manufacturing Industry* Cat No 8221.0, Canberra

Australian Conservation Foundation/Australian Council of Trade Unions (1994), *Green Jobs in Industry*, Fitzroy/Melbourne Melbourne

Bureau of Industry Economics (1994), *Energy Labelling and Standards* Research Report 57, AGPS Canberra

Bureau of Industry Economics (1996) *Energy Efficiency and Greenhouse Gas Abatement* Report 96/5, AGPS Canberra

Community Energy Network (1992), *Jobs through Energy Efficiency Initiatives*, Environment Victoria, North Melbourne

DEETYA (1997) *Job Futures 6* June, Department of Employment, Education, Training and Youth Affairs Analysis and Evaluation Division, CanberraDepartment of Primary Industries and Energy (1997), *Renewable Energy Industry - survey on present and future contribution to the Australian economy*, AGPS Canberra

Department of Primary Industries and Energy (1997a), *Electricity Australia's Fiftieth Issue a TimelyPointer to Change*, in **Australian Energy News**, Sept, Canberra

Electricity Services Victoria (1994), *Final Report, Demand Management Action Plan*, Melbourne

Energy Management Task Force (1993), *Commercial Building Energy Code: Discussion Paper*, Australian and New Zealand Minerals and Energy Council, Canberra

FARIMA (pers comm), from a report by K Herbert, Sydney

Government of Victoria (1997), *Science and Technology Statement*, East Melbourne

Headon K (1995), *More Effective Use of Energy in Industrial Processing*, Australian Institute of Energy News Journal, 13 (3), Sydney

International Energy Agency (1997), *Energy Policies of IEA Countries: Australia 1997 Review*, OECD, Paris

International Lead Zinc Research Organisation (1995), *Market Survey and Technology Assessment for RAPS that Produce Electricity and Utilise Batteries for Energy Storage*,, North Carolina

Naughten B, Pakravan P, Duglosz J and Dickson A (1994), *Reductions in greenhouse gas emissions from the Australian energy system: a report on modelling experiments using ABARE's MENSA model*, prepared for the Australian Department of the Environment, Sport and Territories, Canberra

NSW Department of State Development (1992), *Examination of Mandatory Home Insulation in New South Wales*, Sydney

Pears A (1995), *Energy Efficiency - closing the gap between reality and perception*, ABARE Outlook '95 Conference, Canberra

Pears A (1996), *Australian Non-transport Energy Consumption: Where from .... and Where to?*, Discussion paper for the Department of the Environment, Sport and Territories, Canberra

Pears A (1997), *Directions for Development of an Ecologically Sustainable Industry in Australia as a Basis for an Ecologically Sustainable, Successful Economy*, paper presented to ANZSEE Melbourne seminar, March

Wilkenfeld G (1993), *Benefits and Costs of Implementing Minimum Energy Performance Standards for Household Electrical Appliances*, report to Energy Management Task Force, ANZMEC, Canberra

Wilkenfeld G et al (1996), *Australia's National Greenhouse Gas Inventory 1988 and 1990: Cross-sectoral Analysis of Emissions*, with Woodlots and Wetlands, Dames and Moore and Dr G Faichney. Report to the Department of the Environment, Sport and Territories, Canberra