WIND FARMING AND THE ENVIRONMENT

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This document is a background briefing paper discussing issues related to the environment associated with wind farming in Australia. This paper was prepared as background information for the preparation of a fact sheet for dissemination to the general public. As a result this document, any related documents (listed below) and the fact sheet itself attempts to be as non-technical as possible and sometimes goes to great pains to explain what may appear to be quite obvious to someone intimately involved in either wind energy or specific environmental issues.

However, as is often the case, such attempts may unintentionally oversimplify the issue or present information in a distorted way. We may also have made errors or omissions in the preparation of this document. Please do not hesitate to forward any suggested changes or additions to this document to Grant Flynn at Sustainable Energy Australia (Grant@SustainableEnergyAustralia.com.au).

Where possible footnotes have been provided within the text to allow the reader to consult the source article directly.

This document should be read in conjunction with the following sub-documents;

- Greenhouse Effect And Climate Change (Bureau of Meteorology) – 78 pages
- State of the Environment 1 - Atmosphere (CSIRO) – 151 pages

This document has also been distilled into a very brief fact sheet of just 2 pages which can also be downloaded from the Australian Wind Energy Association web site at www.auswea.com.au.

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SOURCES OF INFORMATION

- Portland Wind Energy Project EES
- Toora Wind Farm EES
- Nirranda WF EES
- Climate Warning from the Bush (CANA)
- 10 x 10 campaign poster
- Marion District Council Web Site
  http://www.marion.sa.gov.au/Web/webmar.nsf/Lookup/Sustainability
- Commonwealth Department of Environment and Heritage Web Site
  http://www.deh.gov.au/esd/
- South Australian Department for the Environment Web Site
  http://www.environment.sa.gov.au/sustainability/
- World Business Council for Sustainable Development web site
  http://www.wbcsd.ch
- Various background papers from The Australia Institute
  http://www.tai.org.au
- Environment Australia (Commonwealth) web site
  http://www.ea.gov.au

What is Ecological Sustainable Development (ESD)?

Sustainability is about ensuring quality of life and ensuring that the natural resources which life depends upon can be maintained for the use of present and future generations. It requires the basic understanding of the relationships between environmental, economical and social systems now and in the future.

There have been numerous debates as to the real definition of sustainability and to some degree this has been a stumbling block to the acceptance and implementation of Ecological Sustainable Development principles. The term 'sustainability' or 'sustainable development' originated in the 1987 World Commission on Environment and Development publication, Our Common Future (also known as the Bruntland Report). It defines sustainable development as:

> 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

Australia's National Strategy for Ecologically Sustainable Development 1992 (NSESD) defines ecologically sustainable development (ESD) as -

> 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

The NSESD was signed by all Australian Governments in 1992 and sets out the broad strategic and policy framework under which government will cooperatively make decisions and take actions to pursue ESD in Australia[1].

In essence, Ecological Sustainable Development is about living within our means, to meet the needs and not the wants of present and future generations.

Maintaining our natural resources, such as water, air, food and the biological diversity of living things is essential for human survival and prosperity. Our renewable resources should not be used at a rate greater than the rate of natural replenishment.

The core objectives of Ecological Sustainable Development (ESD) as set out in the NSESD are -

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations
- to provide for equity within and between generations
- to protect biological diversity and maintain essential ecological processes and life-support systems

The guiding principles of ESD are -

- decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations
- where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- the global dimension of environmental impacts of actions and policies should be recognised and considered
- the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised
- the need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised
- cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms
- decisions and actions should provide for broad community involvement on issues which affect them

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[1] You can view the National Strategy for Ecologically Sustainable Development at www.ea.gov.au/esd

These guiding principles and core objectives need to be considered as a package. No objective or principle should predominate over the others. A balanced approach is required that takes into account all these objectives and principles to pursue the goal of ESD.

The principles and objectives of ESD have been embodied in planning and environmental legislation of the Commonwealth and all Australian States. Legislation such as the Commonwealth Environment Protection and Biodiversity Conservation Act contain specific references to ESD objectives and principles,in line with the particular purposes of that Act. Strategies for achieving ESD have also been developed under specific purpose themes, including:

- National Greenhouse Strategy
- National Biodiversity Strategy
- National Heritage Trust
- National Action Plan for Salinity and Water Quality

There is no development that is overtly beneficial in all aspects of ESD. All human endeavours are plagued to some degree by a mixture of desirable outcomes countered by undesirable outcomes. Decisions on whether to proceed with a particular proposal are often based on an evaluation of the compromise between the expected benefits and risks or proceeding or not proceeding.

It is important to note that evaluating the risks involved in not proceeding with a proposed development can be as important as evaluating the risks with proceeding (e.g. construction of a hospital at great expense to a community against the health implications and expense of not having a hospital).

As a consequence of the above a multi-criteria analysis approach is used to evaluate the value of a proposed development. The totality of the proposal is evaluated against the three broad measures of ESD - *economic prosperity*, *environmental sustainability* and *community well-being*.

Economic Prosperity

Economic Prosperity can be defined as the enhancement of community well being by following a path of economic development that safeguards the material welfare of future generations. *Prosperity* is important to the feeling of well-being, providing individuals with the scope to generate an income commensurate with their efforts and which also reflects the capacity to meet essential needs. Economic prosperity can be equated with economic dimensions of human welfare, while the non-economic aspects of welfare are addressed under the principles of Community Well Being and Environmental Sustainability.

Environmental (or ecological) sustainability

Environmental (or ecological) sustainability is defined as using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased (National Strategy for Ecological Sustainability Development, 1992).

COMMUNITY WELL BEING

Community Well Being is defined as an assessment of the desirability and suitability of a particular environment as a place to live. Indicators of whether a particular proposal advances community well-being include its compatibility with existing and proposed land uses, consistency with Government planning policies, strategies and land use controls, the extent to which the community will benefit from the increased economic activity associated with the project and the protection of Aboriginal archaeological and cultural heritage values.

Multi Criteria Analysis[2]

Multi Criteria Analysis (MCA) is a systematic, semi-quantitative approach to decision-making. It involves applying numerical ratings and weightings to a set of principles, goals and objectives (defined in a Sustainability Framework) to enable assessment of the overall net advantages/disadvantages.

The development of a Sustainability Framework is central to the MCA technique. Descriptive analysis of the performance of the proposed development against principles, goals and objectives of the Sustainability Framework is supplemented by applying ratings and weightings to assist in distinguishing important features of a proposal and to undertake sensitivity analyses.

The quantitative components of the MCA process complement the rigorous qualitative assessment of the key environmental impacts of each aspect of the development as well as the overall development.

KEY STEPS

Key steps involved in MCA are:

- Identify range of relevant issues.
- Group issues into the three broad sustainability principles of economic prosperity, environmental sustainability and community well-being and identify goals and objectives within each principle, with reference to existing and emerging Government policies, strategies and planning scheme requirements.
- Consider the objectives of each principle and analyse the degree (rating) to which the proposed development is consistent with the identified objective.
- Assess the consistency of the proposed development with the relevant sustainability objective using a five point scale – excellent consistency, good consistency, fair consistency and low consistency and inconsistent.
- Assess the consistency of the proposed development with sustainability by assigning values or weightings to the over-riding principles and their objectives and combining with the identified ratings.
- Sensitivity testing using varied weightings.

PRINCIPLES, GOALS AND OBJECTIVES

The range of goals and objectives derived from each principle, including community and stakeholder feedback are derived with consideration of existing and emerging Government policies, strategies and planning scheme requirements.

Elements of the framework are:

- **Principles** – the identified principles of Economic Prosperity, Environmental Sustainability and Community Well-Being were derived as a cohesive philosophical framework through reference to the concept of ecological sustainable development (ESD). The goal of ESD implies that human activity, including economic growth, must be adjusted to the extent necessary to come within the longer-term capacity of global ecosystems to sustain life.
- **Goals** – provide the context within which a set of objectives can be grouped.
- **Objectives** – describe the principal means by which the goals can be achieved. The objectives (and in some cases, associated criteria) provide a means to systematically evaluate the extent to which a particular objective is likely to be achieved.

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[2] taken from Portland Wind Energy Project Environment Effects Statement; "Sustainability Assessment", a report prepared for Panel, March 2002 by Philip Heath of Sinclair Knight Merz

EVALUATION BY MCA

It is important that the Sustainability Framework is based on agreed goals and objectives. Equally important is the weighting applied to each of these objectives (e.g. are jobs more important than protecting cultural heritage or endangered flora and fauna or vice versa or is economic prosperity more important than community well being, etc). The detailed goals and objectives, as well as their relative weightings, are usually quite specific to each site and proposal.

While appropriately trained and experienced professional can assist in developing the sustainability framework, in determining the relative weightings of each objective and in the evaluation of the proposal against this framework, it is critical that the community in which the development will be located is consulted and engaged in the evaluation process. This consultation will, by its very nature, mean that disparate views will need to be integrated by decision makers. Decision makers can be assisted by scenario analysis which essentially takes the approach "We believe these are the weightings and scores against the sustainability framework however if we change the weightings and scores against these objectives the overall outcome changes to …."

Such scenario analysis becomes particularly important when a small number of benefits of allegedly significant importance are being balanced against a large number of allegedly less significant risks or dis-benefits.

Wind Energy - An Ecological Sustainable Development

Wind energy, by its very nature, is able to rate very highly in a multi criteria analysis. With careful and sensitive planning, a wind energy development can play an important role in allowing us to achieve a sustainable future.

As examples of some of the issues that need to be considered in a multi-criteria analysis of a wind energy development, the following list is provided to show how they might be classified under the three sustainability evaluation categories. It is by no means an exhaustive list.

- Economic Prosperity
  - **Financial** – economic viability of the project for investors, revenue to landholders
  - **Tourism** – generate increased or maintain current levels of visitation and financial returns from tourism
  - **Economic Development** - Local participation in manufacturing, maximise local employment creation and maximise benefits to the economies of the region, State and Australia
- Environmental Sustainability
  - **Greenhouse gas abatement** – maximise avoided emissions
  - **Natural Systems and Biodiversity** - Avoid impacts on significant fauna species, minimise potential threats on avifauna, minimise native vegetation clearance, avoid impacts on significant vegetation communities or flora species and minimise loss of wildlife habitat and consider opportunities for habitat enhancement.
  - **Landscape and Visual** - Minimise effect on key views and develop uncluttered aesthetically pleasing arrangement of generators
  - **Noise** – Achieve compliance with agreed criteria
  - **Surface Water and Groundwater** - Maintain and improve existing surface water quality, conserve quality and quantity of groundwater and maintain the quality and agricultural productivity or ecological health of soils.
- Community Well Being
  - **Land Use** – ensure compatibility with existing and proposed land uses
  - **Planning** – ensure consistency with planning objectives
  - **Community** – maximise social benefits from increased economic activity and resolve contentious issues through consultation
  - **Cultural Heritage** – avoid impacts on sites of significant archaeological and historic value
  - **Aviation** – protect operational needs of airports
  - **Traffic and Transport** - Ensure safe operation of road network

A wind energy development is generally about locating a wind farm in a rural area to generate electricity which is then injected into the national electricity grid as distributed generation. This generation needs to be compared to the no change scenario (i.e. generation of electricity from coal fired generation and transmission to the area). However there are numerous other consequences of the wind farm development that need to be considered (some of which are shown in the list above).

The evaluation also needs to consider all three main phases of the project – manufacture / construction, operation and decommissioning.

Manufacture and Construction

Wind energy developments generally occur in rural or regional areas of Australia. While construction periods are very short (12 months or less) there are significant opportunities for local involvement in the construction of the wind farm.

Manufacturing of components is still primarily conducted in Europe or the USA, however significant work is being done to establish manufacturing facilities for the major components in Australia (again mainly in rural or regional Australia).

Consideration needs to be taken of the embodied energy of equipment and the environmental, occupational, health and safety issues associated with manufacture and transport of components.

Operation

Wind energy is a renewable resource derived from the energy of the sun's differential warming of our atmosphere. It is constantly replenished and will be equally available to future generations as to our own. The operation of a wind turbine has no impact on the use of this resource by current or future generations.

Electricity from fossil fuels relies on a non-renewable resource of a finite quantity. The operation of a fossil fuel generator depletes the resource for current and future generations.

The operation of a wind turbine has no gaseous or solid emissions. The operation of a fossil fuel generator has significant gaseous emissions as well as solid emissions (ash and slag) or in the case of fissile fuel generators extremely long-term, high level ionising radiation wastes.

Revenues from the operation of the wind farm flow into the local community through landholder payments as well as through operational and maintenance activities.

Decommissioning

At decommissioning a wind farm site can be returned to a state that is essentially the same as before the wind farm. Consequently if future generations find a better solution to environmentally responsible energy generation the wind farm can be removed without any lasting legacy. By contrast fossil fuel plants necessarily deplete the resource (coal or gas), and leave behind a legacy of pollution that may last many decades after their decommissioning (greenhouse gases, slag heaps, etc) or in the case of nuclear power, a radioactive site and waste dump that will need to be maintained for thousands of years.

The Greenhouse Effect and its Acceleration

The greenhouse effect is a natural process that plays a major part in shaping the earth's climate. It produces the relatively warm and hospitable environment near the earth's surface where humans and other life-forms have been able to develop and prosper. It is one of a large number of physical, chemical and biological processes that combine and interact to determine the earth's climate.

Climate is defined in terms of long-term averages and other statistics of weather conditions, including the frequencies of extreme events. Climate is far from static. Just as weather patterns change from day to day, the climate changes too, over a range of time frames from years, decades, centuries to millennia, and on the longer time-scales corresponding to the geological history of the earth. These naturally occurring changes, driven by factors both internal and external to the climate system, are intrinsic to climate itself.

But not all changes in climate are due to natural processes. Humans have also exerted an influence. Through building cities and altering patterns of land use, people have changed climate at the local scale. Through a range of activities since the industrial era of the mid-19th Century, such as the accelerated use of fossil fuels, broad scale deforestation and land use changes, humans have also contributed to an enhancement or acceleration of the natural greenhouse effect. This enhanced greenhouse effect results from an increase in the atmospheric concentrations of the so-called greenhouse gases, such as carbon dioxide and methane, and is widely believed to be responsible for the observed increase in global mean temperatures through the 20th century.

The relationship between the enhanced greenhouse effect and global climate change is far from simple. Not only do increased concentrations of greenhouse gases affect the atmosphere, but also the temperatures of the oceans, soil and biosphere. These effects are still not completely understood. Also, complex feedback mechanisms within the climate system can act to amplify greenhouse-induced climate changes, or even counteract it.

The following is a brief summary of the greenhouse effect. Please refer to the sub document "Greenhouse Effect And Climate Change" and "State of the Environment – Atmosphere" for detailed analysis of Climate and Greenhouse.

The earth is exposed to the radiation from the sun. This radiation has a broad spectrum from cosmic rays and x-rays through visible light to radio waves. The energy of this radiation is essentially the primary source of all energy on our planet.

The earth has a very thin layer of air (the atmosphere) surrounding it and the interaction of the sun's radiation with this thin layer results in our climate. The layer of air is made up almost completely of nitrogen (78%) and oxygen (21%). Both these gasses are essentially transparent to both the incoming short wave radiation (light) and the outgoing long wave (heat) radiation.

However there are a number of minor constituents of the air that do interact with the radiation. The most significant is water vapour, which is not well mixed and may vary locally from less than 0.01% by volume to more than three per cent. The next most abundant is carbon dioxide (CO_2) which has a long lifetime in the atmosphere and is well mixed around the globe. Other important trace gases are methane, nitrous oxide, ozone and anthropogenic halocarbon compounds, such as the ozone-depleting chlorofluorocarbons and hydro-fluorocarbons.

At very high altitudes, the sun's radiation is so energetic that the gas molecules are broken down into charged atoms (i.e. ionised). These charged atoms form the ionosphere and protect the surface of the planet from cosmic rays and X-rays. It is activity in this layer that gives us the aurora (northern and southern lights) near the poles and allows for the propagation of radio waves around the planet.

At lower altitudes ultra-violet light (which is able to penetrate the ionosphere) interacts with oxygen and has sufficient energy to be able to break the oxygen molecule into two charged oxygen atoms which are highly reactive and quickly combine with other oxygen molecules to form ozone. Ozone absorbs ultra-violet light and so acts to protect the lower layers of the atmosphere from the harmful effects of ultraviolet light.

The radiation that eventually penetrates to the lower parts of the atmosphere and to the surface of the planet (mainly visible light) warms the surface. The heat (infrared radiation) is then re-radiated from the surface in all directions, including back into space. The so-called greenhouse gasses reflect the infrared radiation and so act to trap heat in the near-surface layers of the atmosphere. The result is that the earth's surface to be considerably warmer than if there were no greenhouse effect (it would be about -18^{o}C without the greenhouse effect). The principle natural greenhouse gasses are carbon dioxide and water vapour.

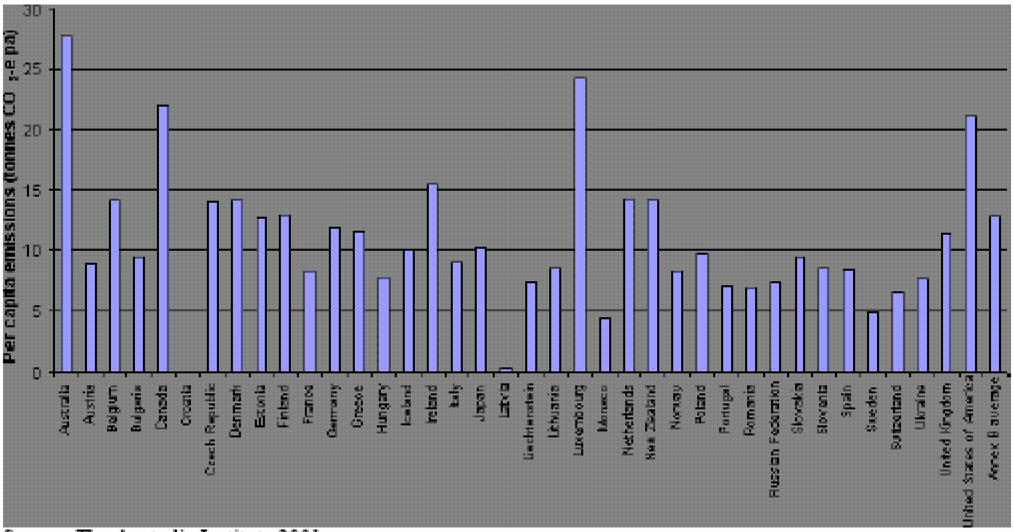
The shape of the earth and tilt of its axis results in differential heating of the atmosphere and geosphere by the sun's radiation; with more energy coming in at the equator and less at the poles. The emission of energy back into space is essentially even around the planet. The resulting imbalance of energy drives the weather and our complex climate system as the energy strives toward equilibrium through the movement of air and water around the surface of the planet.

In common parlance the term "greenhouse effect" (more properly the enhanced greenhouse effect) is used to refer to the warming of the earth's surface caused by certain gases (the principal greenhouse gases being carbon dioxide and methane) in the lower atmosphere. Human activity, particularly the burning of fossil fuels (coal, oil and natural gas) and land clearing are significantly increasing the atmospheric concentration of these gases, resulting in an enhancement of the natural greenhouse effect and has introduced the prospect of significant and potentially dangerous changes to global climate systems.

Stabilisation, and ultimately reduction, in the world-wide emission of greenhouse gases is arguably the most important environmental challenge confronting the world today.

Australia’s Greenhouse Emissions

Australia contributes about 3.5% of greenhouse gas emissions from industrialised countries world-wide and our emissions per capita are the highest in the world. The figure below shows that in 1998, Australia’s greenhouse gas emissions per capita were 30% higher than the United States. Moreover, global climate change is likely to have a more profound effect on Australia (CSIRO, 2001) when compared to other countries. The enhanced greenhouse effect and resulting climate change is a global problem and Australia’s contribution to the problem is not insignificant.



Source: The Australia Institute 2001

Over the 20th century, the increase was approximately 0.6°C. Globally, the 1990s was the warmest decade and 1998 the warmest year on record, since 1861 (IPCC 2001). The increase in carbon emissions correlates closely with the increase in global temperatures

The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) finds that as well as rising global temperatures, sea levels are rising and glaciers are retreating. The IPCC concludes that there is now strong evidence that most of the observed warming is attributable to human activities, principally the burning of fossil fuels. In addition, the IPCC states that 20th century warming has contributed significantly to the observed sea level rise through thermal expansion of seawater and the loss of land ice.

According to the IPCC, the globally averaged surface temperature is projected to increase by between 1.4°C and 5.8°C over the period 1990 to 2100. This range takes into account the uncertainty in the climate system response to enhanced greenhouse gases, in addition to the uncertainty in the amount of emission that we will emit into the atomosphere. The projected rate of warming (0.1°C to 0.5°C per decade) is much larger than the observed changes during the 20th century and is very likely to be without precedent during at least the last 10,000 years, based on palaeoclimate data. Associated with this warming is a projected global mean sea level rise of 9 to 88 centimetres between 1990 and 2100 (0.8 cm to 8.0 cm per decade), due primarily to thermal expansion and loss of mass from glaciers and ice caps. Greater weather extremes (droughts and floods) are also predicted.

The IPCC has warned that Australia will be the worst affected by global warming of all developed nations because the variability of our climate will become even more extreme. Agriculture, catchments and water supplies, biodiversity and human health are all expected to be affected by this changing environment:

- Even in a place where the rainfall does not change we would expect more of the rainfall to fall in heavy precipitation events, and less rainfall in light precipitation events. This means that even in places where no absolute change in rainfall is predicted we would predict more floods, and more droughts. More floods because of the heavy precipitation events, and more droughts because there will be long periods of little light precipitation between heavy precipitation events. (Dr Robert Watson Chair of IPCC)

Climate change predictions for Australia

In May 2001, CSIRO released its projections of the likely extent of climate change in Australia and the expected impacts across the country. These projections incorporate the IPCC findings. CSIRO predicts that by 2030, the annual average warming over most of Australia will be 0.4°C to 2°C greater than in 1990. By 2070, annual average temperatures will have increased by 1°C to 6°C relative to 1990 over most of Australia.

South-western Australia and parts of south-eastern Australia and Queensland can expect decreases in rainfall. Wetter conditions are possible in some inland and eastern coastal areas in summer and some inland areas in autumn.

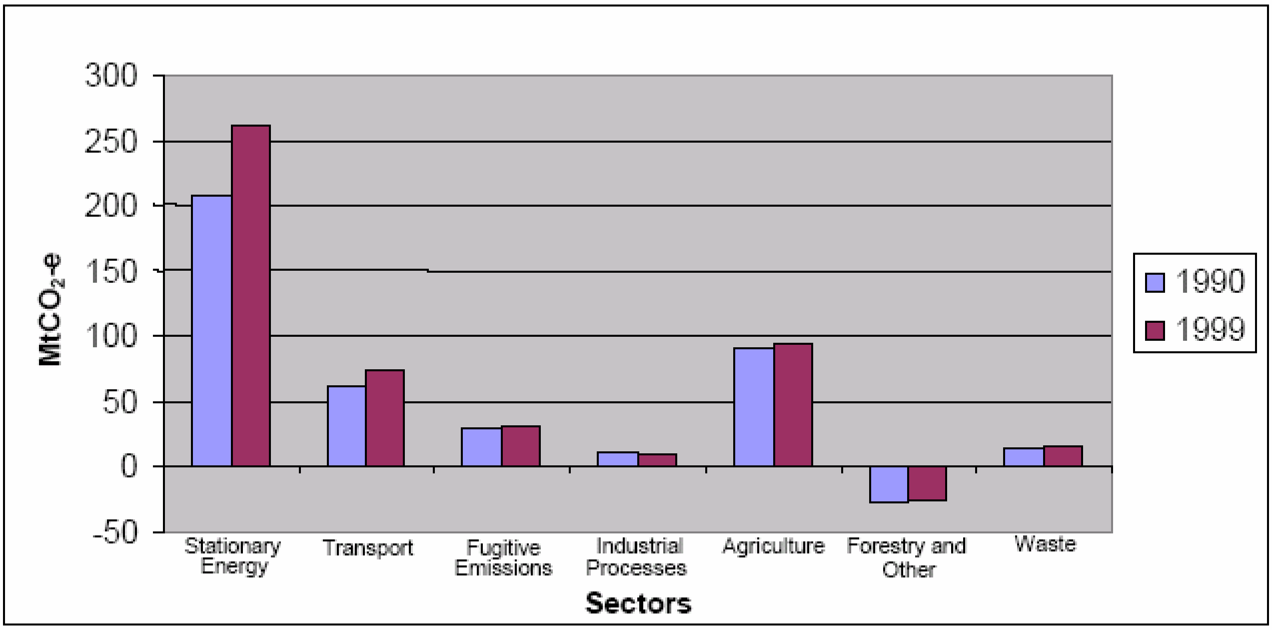
Warmer conditions will lead to increased evaporation and, combined with changes in rainfall, there will be a decrease in available moisture across the country. There may also be more intense tropical cyclones, which may lead to an increase in the number of severe oceanic storm surges in the north. Projected rises in sea level would exacerbate this effect.

The CSIRO (2001) predicts that the natural ecosystems most at risk from the effects of climate change are coral reefs, alpine ecosystems, mangroves and wetlands. Also under threat are tropical forests, savannas, deserts and native grasslands. The IPCC (2001) indicates that the potential effects of climate change (including potential changes to local meteorology and sea level rise) on coastal zones includes; inundation, riverine flooding, saline intrusion, accelerated erosion and wave damage.

THE NATIONAL GREENHOUSE GAS INVENTORY – MEASUREMENT AGAINST TARGETS

Australia's annual National Greenhouse Gas Inventory (NGGI) provides estimates of Australia's greenhouse gas emissions and the removals by sinks according to the international requirements of the FCCC. It reports on human-induced greenhouse gas emissions from six sectors specified by the Intergovernmental Panel on Climate Change: energy (stationary energy, fugitive emissions and transport emissions), industrial processes, solvent and other product use, agriculture, land use change and forestry and waste.

The 1999 NGGI (April 2001) reports that Australia's net greenhouse gas emissions for 1999, not including emissions from land clearing, were 458.2 million tonnes of carbon dioxide equivalents. Net greenhouse gas emissions in 1998 were 453.3 Mt and 390.3 Mt in 1990. This reflects a 1.1% increase since 1998 and a 17.4% increase during the period 1990 to 1999. The Senate Environment, Communication, Information Technology and Arts Committee has recently reported that Australia's current abatement measures are unlikely to achieve our Kyoto targets, with emissions predicted to be more than 123% of 1990 levels by 2010.



Source: Australian Greenhouse Office 2001

The graph above shows emissions by industrial sector. Stationary energy is principally electricity production.

The principal source of our greenhouse gases result from the generation of electricity, principally because of the use of fossil fuels like coal. Since most of Victoria's electricity is produced by power stations fuelled by brown coal (other states use more black coal), the greenhouse intensity of electricity used in Victoria is high compared with other States (VGS Discussion Paper 2000). In Victoria, the greenhouse intensity of electricity delivered to end-users in 1995 was 1.38 kg of greenhouse gas emissions per kilowatt hour. By contrast Tasmania where electricity is derived primarily from large scale use of hydro-generation is very low at 0.002kg/kWh. For comparison, a list of state GHG emissions per kilowatt hour is shown below.

- Victoria 1.38,
- Western Australia 1.08,
- Queensland 1.03,
- South Australia 1.02,
- New South Wales 0.96,
- Northern Territory .... 0.77, and
- Tasmania .... 0.002.

The previous sections highlight the need for urgent action to develop Australia's renewable energy sector, as one means of starting to contain emissions from the generation of electricity. Electricity currently accounts for over 40% of Australia's greenhouse gas emissions and it is showing the strongest growth of any sector.

"*There is a range of reasons why we should do this sooner rather than later. Coal currently accounts for around 44 per cent of our total domestic energy needs. Ninety-four per cent of energy consumed in Australia comes from fossil fuels. Australia's net greenhouse gas emissions were 535.3 million tonnes in the year 2000—that is a six per cent increase, and it has increased since then. Australia's per capita carbon dioxide emissions were more than four times the world average and nearly 50 per cent greater than the average for all OECD countries. It is worth noting, with some shame on our part, that many European countries, such as Germany—which does not share our reputation for nice sunny weather—are already well ahead of us. They are producing more energy from solar and wind than we are.*"

- From a speech made by Senator Lees (South Australia) to the Australian Senate, Matters Of Public Interest: Resources: Renewable Energy made at 1315hrs on 17 September 2003

We are already seeing the impacts of climate change caused by burning fossil fuels. We are into our sixth year of drought, rainfall patterns have changed, and the devastating bushfires last year were made worst by the hotter, drier summer. Scientists report that huge chunks of the Antarctic ice sheet have broken off and are melting, and the Great Barrier Reef is suffering from warmer ocean temperatures. They also says that our coasts will be under threat from rising sea levels and more severe storms, and the habitats of large numbers of plants and animals will be destroyed.

As with the ozone hole, we have to act now, and it will take some time before we see the beneficial effects of our actions. Cleaning up our electricity supply by increasing our use wind energy is an important part of the solution for us and our children's future.

It is only a part of the solution though. Increased energy efficiency and improvements in fossil fuel powered generator emissions are some of the other important activities.

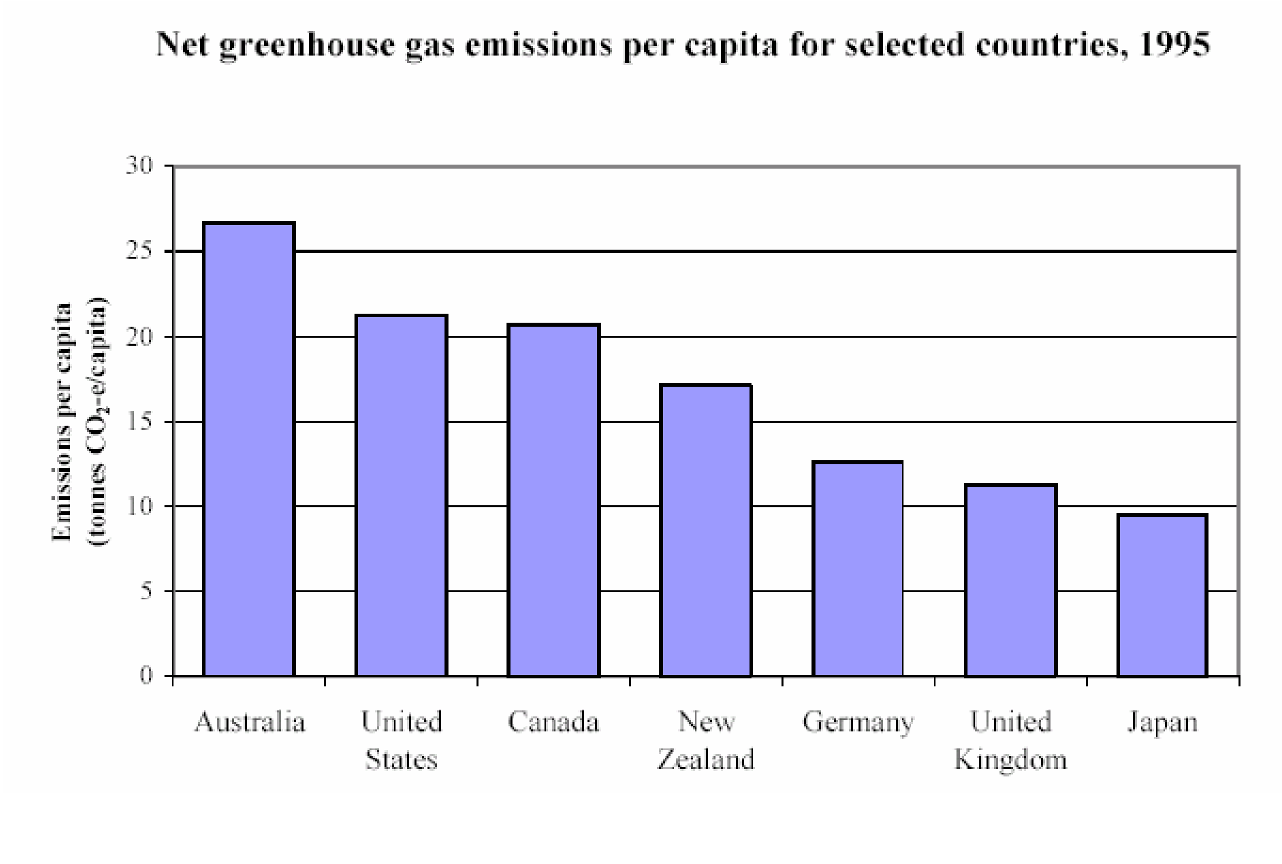
EMISSION LEVELS COMPARED ON PER CAPITA BASIS[3]

The international debate on climate change is heavily influenced by notions of fairness and justice. One of the most important principles referred to internationally is that of polluter pays. The most common interpretation of polluter pays is that national targets for the reduction of greenhouse gas emissions should be based on the level of emissions per person.

Based on the official communications submitted by the various nations to the UN it is possible to compare the greenhouse gas emissions per person for all 35 of the Annex B parties (i.e. industrialised countries) to the Kyoto Protocol.

The results show that in 1995 Australia has the world's highest greenhouse gas emissions per person at 26.7 tonnes; this is twice the average level for all other industrialised countries (13.4 tonnes) and 25% higher than emissions per person in the USA (21.2 tonnes).

While the USA has higher emissions per capita from energy (20.6 tonnes compared to Australia's 17.6 tonnes), Australia has much higher levels of emissions from agriculture and land-use change. Australia's emissions from land clearing fell sharply between 1990 and 1995, and it is likely that the difference between Australia and the USA in the earlier years would have been greater than in 1995. The year 1990 is especially important because it is the base year for calculating mandatory emission targets in the commitment period 2008-2012 under the Kyoto Protocol.



[3] From The Australia Institute Background Paper No. 19 "Greenhouse Gas Emissions Per Capita of Annex B Parties to the Kyoto Protocol" By Hal Turton and Clive Hamilton November 1999

The information presented in “Table 1” (shown immediately below) is based on submitted year 1998 inventory data for Annex B (industrialised) countries, and has been reproduced as reported by the UNFCCC[4].

Table 1 Greenhouse gas emissions of Annex B countries (Mt CO_2-e)

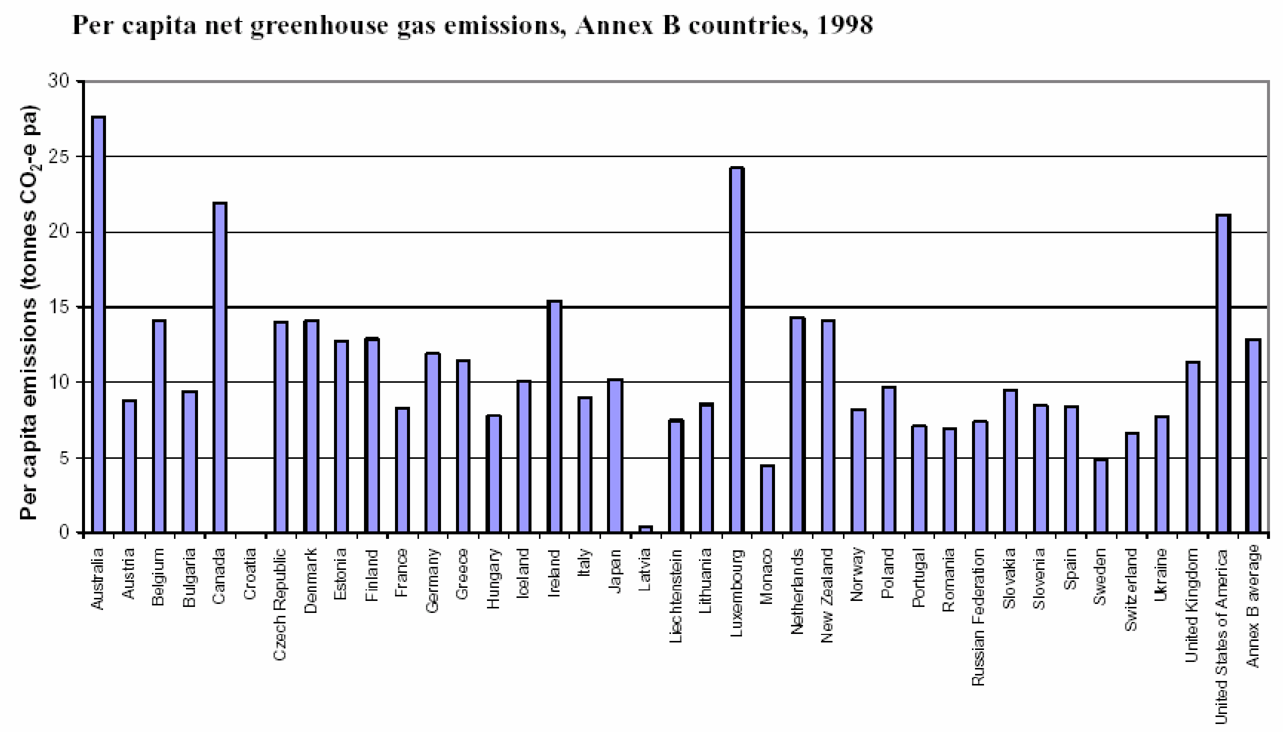
Country	Year	Energy		Industry & Solvents	Agricult-ure	LUCF*	Waste & Other	Total	Population	Per capita emissions
		Combustion	Fugitive						(millions)	(t CO_2-e)
Australia	1998	331.3	31.5	8.4	92.2	39.5	15.5	**518.5**	18.75	27.6
Austria	1998	52.6	2.9	12.7	5.0	-7.6	5.3	**70.9**	8.08	8.8
Belgium	1998	117.0	0.8	12.2	10.7	-1.0	3.9	**143.7**	10.20	14.1
Bulgaria	1998	54.2	3.6	4.8	13.3	-6.2	7.8	**77.4**	8.26	9.4
Canada	1998	492.7	52.4	44.4	69.5	-20.1	23.1	**662.0**	30.25	21.9
Croatia	na	na	na	na	na	na	na	**na**	na	na
Czech Rep.	1998	126.3	6.3	4.5	7.9	-3.7	2.6	**144.0**	10.29	14.0
Denmark	1998	59.7	0.7	1.6	12.4	-1.0	1.2	**74.6**	5.30	14.1
Estonia	1998	19.0	0.6	0.3	1.0	-3.4	0.8	**18.4**	1.45	12.7
Finland	1998	60.3	3.6	2.4	7.1	-9.7	2.7	**66.3**	5.15	12.9
France	1998	395.8	9.0	36.7	87.2	-62.1	15.0	**481.6**	58.40	8.2
Germany	1998	875.5	22.0	35.9	58.7	-33.5	16.8	**975.4**	82.05	11.9
Greece	1998	95.1	1.1	9.0	12.0	0.0	3.3	**120.5**	10.52	11.5
Hungary	1998	55.5	8.4	2.2	13.2	-4.4	3.5	**78.3**	10.11	7.7
Iceland	1995	1.8	0.1	0.5	0.3	0.0	0.0	**2.7**	0.27	10.0
Ireland	1998	39.2	0.1	3.1	19.7	-6.4	1.6	**57.3**	3.71	15.4
Italy	1998	439.2	7.2	31.8	44.0	-23.6	17.1	**515.8**	57.59	9.0
Japan	1997	1159.1	2.9	69.7	18.6	0.0	30.1	**1280.4**	126.09	10.2
Latvia	1998	8.4	0.5	0.2	1.7	-10.5	0.6	**1.0**	2.45	0.4
Liechtenstein	1990	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.03	7.4
Lithuania	1998	14.2	0.4	5.4	2.3	7.7	1.6	**31.6**	3.70	8.5
Luxembourg	1995	9.2	0.0	0.4	0.5	-0.3	0.1	**9.9**	0.41	24.2
Monaco	1998	0.1	0.0	0.0	0.0	0.0	0.0	**0.1**	0.03	4.4
Netherlands	1998	179.6	4.0	12.2	17.2	-1.7	13.0	**224.2**	15.70	14.3
New Zealand	1998	26.0	1.6	2.7	41.2	-20.8	2.8	**53.5**	3.79	14.1
Norway	1998	32.6	2.6	9.7	5.1	-17.6	4.2	**36.5**	4.43	8.2
Poland	1998	330.3	17.4	14.7	21.9	-29.8	18.3	**372.7**	38.67	9.6
Portugal	1998	50.6	0.3	5.2	8.1	-3.6	9.6	**70.2**	9.97	7.0
Romania	1994	125.7	17.8	6.1	9.6	-6.6	4.8	**157.4**	22.73	6.9
Russian Fed.	1996	1469.2	284.1	19.7	103.2	-830.7	40.7	**1086.3**	147.74	7.4
Slovakia	1998	39.4	2.6	4.8	4.2	-1.7	1.7	**51.1**	5.39	9.5
Slovenia	1990	13.6	1.1	0.6	2.3	-2.3	1.6	**16.9**	2.00	8.5
Spain	1998	252.6	5.9	27.1	56.2	-29.3	18.6	**331.2**	39.37	8.4
Sweden	1998	55.7	0.0	5.1	8.2	-27.7	1.3	**42.6**	8.85	4.8
Switzerland	1998	42.0	0.3	2.4	5.5	-6.1	2.8	**46.9**	7.11	6.6
Ukraine	1998	298.9	92.1	18.6	27.1	-68.7	18.2	**386.2**	50.30	7.7
UK	1998	532.6	23.5	33.9	50.6	15.0	17.1	**672.7**	59.26	11.4
USA	1998	5475.3	225.7	97.4	540.7	-773.0	240.1	**5806.2**	274.89	21.1
EU	1998	3205.7	80.9	229.0	396.9	-192.1	126.6	**3847.0**	374.57	10.3
Annex B		13330.6	832.7	546.6	1378.1	-1950.7	547.5	**14685.2**	1143.29	12.8

* Land-use change and forestry

Source: UNFCCC 2001a; UNFCCC 2001b; World Bank 2001

The largest per capita emitters are Australia (27.6 tonnes), Luxembourg (24.2), Canada (21.9), the USA (21.1) and Ireland (15.4). The average for the European Union is 10.3 tonnes, a figure heavily influenced by its largest members, Germany (11.9), UK (11.4), France (8.2) and Italy (9.0).

[4] From The Australia Institute report “Comprehensive emissions per capita for industrialised countries” By Hal Turton and Clive Hamilton September 2001



It is apparent that the USA generates the largest emissions per capita from fuel combustion, but falls behind Australia and Canada when emissions and removals from all sources are compared. Canada's per capita emissions exceed those of the USA due to higher per capita fugitive emissions and a lower contribution from sinks.

Australia's emissions per capita are especially high because land-use change remains a net source of emissions, and emissions from agriculture are high. As a result, Australia continues in this report to have the highest per capita emissions of any industrialised country.

The same data for the year 1999 is shown in Table 1[5] immediately below. This shows that Annex B countries produced total net emissions of almost 14.7 billion tonnes CO2-e in 1999.

Table 1 Greenhouse gas emissions from Annex B countries (Mt CO_2-e), 1999

	Year	Fuel combustion	Fugitive fuel	Industrial processes	Agriculture	Other	LUCF[a] (CO_2)	Total	Population (millions)	Per capita emissions (t CO_2-e)
Australia	1999	333.7	30.8	9.7	93.8	21.0	40.8	**529.9**	19.0	27.9
Austria	1999	51.8	2.8	13.8	5.0	6.0	-7.6	**71.6**	8.1	8.8
Belgium	1999	113.7	0.8	20.1	12.4	4.1	-1.8	**149.3**	10.2	14.6
Bulgaria	1999	47.0	2.7	4.9	18.0	5.1	-6.6	**71.1**	8.2	8.7
Canada	1999	508.0	52.8	50.7	60.7	26.4	-20.3	**678.3**	30.5	22.2
Croatia	na	na	na	na	na	na	na	**na**	na	na
Czech Rep.	1999	119.3	5.9	4.0	7.8	3.5	-3.4	**137.2**	10.3	13.3
Denmark	1999	56.3	1.2	2.3	12.0	1.2	-1.0	**72.2**	5.3	13.6
Estonia	1999	16.6	0.6	0.6	0.9	1.3	-8.1	**11.8**	1.4	8.2
Finland	1999	59.7	3.6	2.8	7.6	2.5	-10.8	**65.4**	5.2	12.7
France	1999	388.9	8.6	37.5	86.5	30.7	-69.0	**483.2**	58.6	8.2
Germany	1999	845.9	19.5	42.0	55.3	19.8	-33.4	**949.0**	82.1	11.6
Greece	1999	94.5	1.1	12.2	11.8	3.7	0.2	**123.4**	10.5	11.7
Hungary	1999	57.3	8.0	3.9	13.2	4.2	-4.5	**82.0**	10.1	8.1
Iceland	1999	2.0	0.0	0.9	0.4	0.1	0.0	**3.3**	0.3	11.9
Ireland	1999	41.2	0.1	3.0	19.4	1.6	-6.7	**58.6**	3.8	15.6
Italy	1999	439.2	7.1	31.8	44.3	18.7	-16.1	**525.0**	57.6	9.1
Japan	1999	1,157.0	2.8	94.6	19.2	33.8	0.0	**1,307.4**	126.6	10.3
Latvia	1999	7.7	0.3	2.4	1.7	1.5	-10.7	**2.9**	2.4	1.2
Liechtenstein	1990	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	7.4
Lithuania	1998	14.2	0.4	5.4	2.3	1.6	7.7	**31.6**	3.7	8.5
Luxembourg	1999	4.8	0.0	0.7	0.4	0.1	-0.3	**5.7**	0.4	13.2
Monaco	1999	0.1	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	4.2
Netherlands	1999	173.3	4.6	24.6	16.8	10.8	-1.7	**228.4**	15.8	14.5
New Zealand	1999	27.4	1.6	3.2	41.7	2.9	-22.1	**54.7**	3.8	14.4
Norway	1999	32.7	2.9	11.2	5.0	4.3	-17.7	**38.4**	4.5	8.6
Poland	1999	322.3	16.4	14.5	27.9	19.0	-43.5	**356.7**	38.7	9.2
Portugal	1999	54.0	0.4	5.5	11.9	7.5	-4.7	**74.6**	10.0	7.5
Romania	1994	125.7	17.8	6.1	9.6	4.8	-6.6	**157.4**	22.7	6.9
Russia	1996	1,469.2	284.1	19.7	103.2	40.7	-830.7	**1,086.3**	147.7	7.4
Slovakia	1999	41.2	1.3	3.7	3.7	1.8	-2.6	**49.2**	5.4	9.1
Slovenia	1990	13.6	1.1	0.6	2.3	1.6	-2.3	**16.9**	2.0	8.5
Spain	1999	263.9	6.4	32.8	56.8	20.3	-29.3	**350.9**	39.4	8.9
Sweden	1999	54.4	0.3	6.1	7.6	2.3	-24.3	**46.4**	8.9	5.2
Switzerland	1999	41.9	0.3	2.8	5.4	2.9	-4.2	**49.2**	7.1	6.9
Ukraine	1998	298.9	92.1	18.6	27.1	18.2	-68.7	**386.2**	50.3	7.7
UK	1999	520.7	24.3	25.4	50.6	16.9	4.7	**642.6**	59.5	10.8
USA	1999	5,544.8	217.2	234.0	488.8	261.3	-990.4	**5,755.7**	278.2	20.7
Annex B		13,343.2	819.8	752.1	1,331.4	602.2	-2,195.9	**14,653.2**	1,148.4	12.8
EU	1999	3,160.6	80.5	252.8	397.0	146.2	-201.0	**3,836.2**	375.5	10.2

a. Land-use change and forestry. Note, this column includes only CO_2 from LUCF, with emissions of other gases included under 'Other' (see SBI 2001, Table A.1, footnote b). Iceland and Monaco have not reported any emissions from LUCF.

na: not available.

Note: per capita figures for years other than 1999 exclude emissions of HFCs, PFCs and SF_6. This is only relevant to Russia, where emissions of these gases were reported to be 36,177 Gg CO_2-e in 1999 (although data from other sectors were missing for this year, hence 1996 data are reported) (SBI 2001, Table A.13).

Source: SBI 2001, Table A.1; UNFCCC 2001a; UNFCCC 2001b; World Bank 2001

[5] From THE AUSTRALIA INSTITUTE Report "Updating per capita emissions for industrialised countries" By Hal Turton and Clive Hamilton The Australia Institute 1 August 2002.

Australia is shown as still having the highest level of per capita greenhouse gas emissions in the industrialised world, with emissions of 27.9 tonnes of CO2-e per person in 1999. This is over twice the industrialised country average of 12.8 tonnes CO2-e, 25 per cent higher than the next highest per capita emitter, Canada, and 35 per cent higher than the world's largest polluter, the USA. In comparison, per capita emissions in major industrialised European countries, such as France (8.2 tonnes per capita), Germany (11.6), Italy (9.1) and the UK (10.8) are substantially lower.

It has often been argued that although Australia has high per capita emissions, the country's small population means that in absolute terms it is not a major greenhouse polluter. However, this is not the case. While Australia accounts for 3.6 per cent of total Annex B emissions, Australia's total emissions exceed those of major European G8 economies, such as France and Italy, each of which have a little more than three times the population of Australia. Moreover, Australia's total emissions are roughly the same as the sum of emissions from Austria, Denmark, Finland, Ireland, New Zealand, Norway, Portugal, Sweden and Switzerland. Among the industrialised countries presented in Table 1, Australia has the 13th largest population, but is the 7th largest emitter, exceeded only by the USA, Japan, Russia, Germany, the United Kingdom and Canada.

Average per capita emissions in industrialised countries as a whole declined by nearly 14 per cent between 1990 and 1999. Much of this decline can be attributed to the changes affecting Eastern Europe and the former Soviet Union.

However, average per capita emissions in the European Union also declined, by over 7 per cent. In contrast, per capita emissions increased roughly 4 per cent in the USA, 13 per cent in Canada and 2 per cent in Japan.

For Australia, per capita emissions declined by just over 3 per cent between 1990 and 1999. It is surprising that Australia's emissions declined so little over this period when the inventories show that the reduction in land-clearing alone reduced per capita emissions by around 2 tonnes CO2-e (or close to 7 per cent)7 between 1990 and 1995.

However, closer examination reveals that Australia's per capita emissions grew by over 7 per cent between 1995 and 1999 (see Table 2). Figure 2 presents trends in total emissions (not per capita) for selected industrialised countries.

Australia's total and per capita emissions fell significantly in the early 1990s as emissions from land clearing declined, but this was soon offset by rapid growth in emissions from the energy sectors as Australia emerged from the recession of the early 1990s. However, rapid and sustained growth in emissions in the late 1990s was driven by reforms to the electricity market that saw the expansion of brown-coal fired generation at the expense of black coal and natural gas (Hamilton and Denniss 2001).

It is expected that the effects of market liberalisation will have tailed off by the year 2000 and emissions growth will return to 'normal' in the inventory for that year

Table 2 Trends in per capita emissions (tonnes CO_2-e per capita), 1990-1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Australia	28.9	27.0	26.6	26.3	26.0	26.5	26.8	26.9	28.0	27.9
Austria	8.8	8.6	8.3	8.1	8.4	8.8	9.2	9.1	8.9	8.8
Belgium	13.5	14.2	14.1	13.9	14.4	14.6	15.0	14.1	15.0	14.6
Bulgaria	17.5	12.5	11.2	11.2	10.1	10.8	11.3	10.1	9.1	8.7
Canada	19.6	19.0	19.9	20.1	20.8	21.8	21.9	22.1	22.1	22.2
Croatia	na	na	na	na	na	na	na	na	na	na
Czech Republic	18.1	16.5	15.0	14.4	13.9	13.8	14.5	14.9	14.0	13.3
Denmark	13.4	15.5	14.3	14.6	15.3	14.6	17.0	15.0	14.3	13.6
Estonia	18.7	18.7	18.7	18.7	9.2	6.3	6.3	21.3	12.7	8.2
Finland	10.7	7.3	7.8	8.4	11.9	11.8	11.6	13.0	13.0	12.7
France	8.7	9.1	8.8	8.2	8.1	8.3	8.5	8.3	8.5	8.2
Germany	14.8	14.0	13.3	12.9	12.6	12.6	12.7	12.3	12.0	11.6
Greece	10.5	10.3	10.5	10.5	10.6	10.6	10.9	11.4	12.1	11.7
Hungary	9.5	8.2	7.3	7.2	7.1	7.1	7.4	7.2	7.8	8.1
Iceland	11.5	10.9	10.7	10.7	10.5	10.7	10.9	11.2	11.4	11.9
Ireland	13.8	13.9	13.9	13.7	14.2	14.3	14.6	15.0	15.4	15.6
Italy	8.8	8.9	8.8	8.5	8.4	8.9	8.8	8.9	9.0	9.1
Japan	9.3	9.5	9.7	9.5	10.1	9.7	9.9	9.8	9.4	9.6
Latvia	7.6	5.3	3.6	2.3	1.8	1.2	0.9	0.6	0.7	1.2
Liechtenstein	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Lithuania	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	4.4	4.4
Luxembourg	34.4	34.4	34.4	34.4	30.7	24.2	24.2	24.2	24.2	13.2
Monaco	3.1	3.6	3.9	3.9	4.0	3.9	4.0	4.1	3.9	4.2
Netherlands	14.3	14.7	14.4	14.4	14.5	15.0	15.4	15.1	15.0	14.5
New Zealand	15.0	15.0	15.8	15.9	16.1	15.7	15.7	15.4	14.3	14.4
Norway	10.0	8.9	8.1	8.5	8.4	8.8	8.5	8.8	8.6	8.6
Poland	13.9	10.3	10.4	10.1	10.3	9.7	10.2	10.0	9.6	9.2
Portugal	6.1	6.4	6.7	6.5	6.6	6.9	6.7	6.9	7.3	7.5
Romania	11.3	7.5	7.3	7.1	6.9	6.9	6.9	6.9	6.9	6.9
Russia	17.9	17.9	17.9	17.9	10.7	8.3	7.6	7.6	7.6	7.6
Slovakia	13.3	11.6	10.7	9.9	9.1	9.5	9.2	9.2	9.0	9.1
Slovenia	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Spain	7.1	7.3	7.5	7.1	7.5	7.8	7.7	8.1	8.4	8.9
Sweden	5.8	4.8	5.3	4.6	5.4	5.8	6.2	5.0	5.4	5.2
Switzerland	7.4	7.6	7.5	6.9	6.7	6.8	6.8	6.7	6.9	6.9
Ukraine	16.7	14.1	13.7	12.0	10.0	9.4	8.5	7.8	7.7	7.7
United Kingdom	13.0	13.0	12.5	12.1	12.0	11.8	12.1	11.7	11.6	10.8
USA	20.0	19.6	20.0	20.1	20.3	20.3	20.8	21.0	20.7	20.7
Annex B	14.7	14.1	14.1	13.9	13.0	12.7	12.8	12.8	12.7	12.6
European Union	11.0	10.9	10.6	10.3	10.4	10.5	10.6	10.4	10.5	10.2

Note: some countries did not provide data to the UNFCCC for every year. Where this is the case, the previous year's per capita figure has been used.

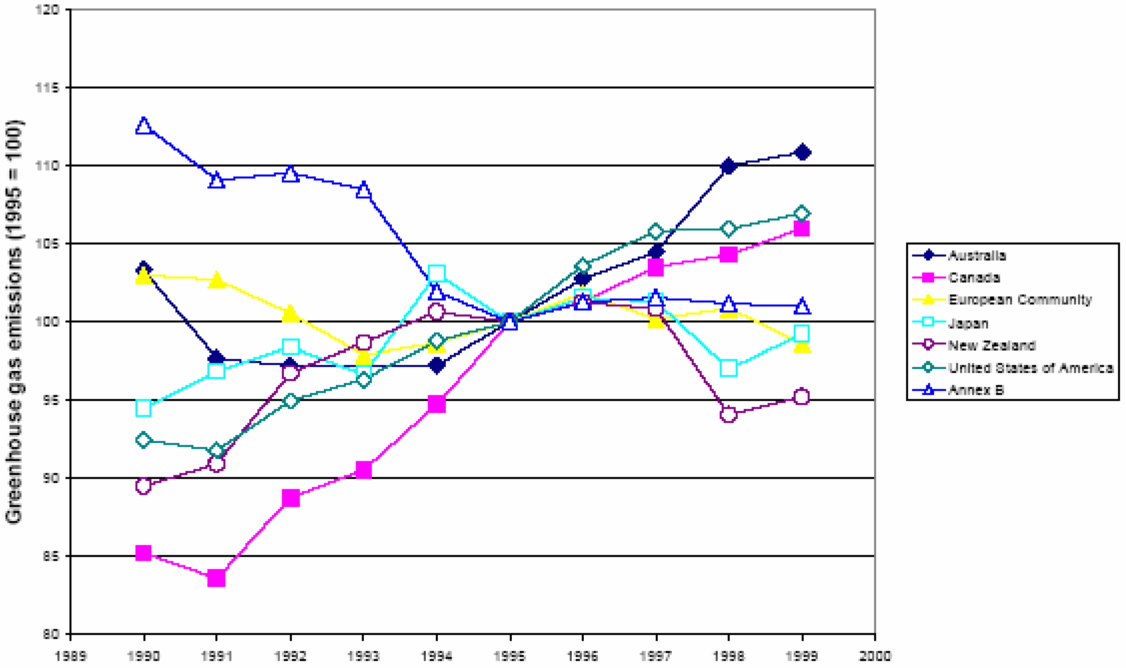
When comparing data in Tables 1 and 2, note the discussion of emissions of HFCs, PFCs and SF_6 in the footnote to Table 1.

Japan reported emissions from LUCF from 1990 to 1995, but has not reported them since (SBI 2001, Table B.8). In the construction of Table 2, it has been assumed that Japan's LUCF emissions in 1996 to 1999 were the same as in 1995.

There are also some inconsistencies in the data used for Lithuania and presented in Tables 1 and 2. In latest data compendium from the UNFCCC, LUCF was reported to be a net sink in 1998, sequestering 7,712 Gg CO_2-e (SBI 2001, Table B.8), in contrast to the previous UNFCCC dataset which reported net *emissions* of 7,712 Gg CO_2-e (UNFCCC 2001a).

Source: SBI 2001, Tables B.1, B.2; World Bank 2001

Figure 2 Trends in total net greenhouse gas emissions for selected countries, 1990-1999



Note: Net LUCF emissions for Japan for 1996 to 1999 are assumed to be the same as in 1995.
Source: SBI 2001, Tables B.1 and B.2

International Climate Change Policy Initiatives

The Framework Convention on Climate Change (FCCC) was agreed at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992. The FCCC provides the framework for international action to address climate change.

At the first Conference of the Parties (CoP) to the FCCC in 1995, attendees negotiated the establishment of a protocol to strengthen the commitments of developed countries post-2000 and discussed measures to further the implementation of the FCCC by all countries.

Australia ratified the FCCC in December 1992. The Convention entered into force in March 1994 and more than 150 countries are now signatories to it.

By CoP3, which was held in Kyoto, Japan in 1997, preliminary agreement was reached on a Protocol for the reduction of greenhouse gas emissions by developed countries - the so called "Kyoto Protocol".

The Kyoto Protocol

The Kyoto Protocol was a landmark in international environmental policy initiatives. For the first time, developed countries made legally binding commitments to reduce their greenhouse gas emissions and to address the threat of climate change.

Australia achieved an outcome that allows us to assume emission limitation commitments in line with the unique features of our economy.

Under the Kyoto Protocol, developed countries as a whole agreed to reduce their collective greenhouse gas emissions to at least 5% below their 1990 levels over the first commitment period 2008 - 2012. Different economic circumstances and differing capacities to make emissions reduction meant each developed country was given a specific target under the Protocol.

European Union (EU) countries agreed to a collective target of 92% of 1990 levels, though some countries within the EU have targets that allow their emission levels to rise above or remain level with 1990 levels (e.g. Portugal, Greece, Ireland and Spain). Australia's target is to limit the growth of its emissions to 108% of 1990 levels by 2008 - 2012.

Australia is one of only three countries allowed to increase its emissions from the 1990 baseline (Iceland and Norway are the other two). However, the Kyoto Protocol target still requires Australia to take substantive action to reduce its emissions from the business-as-usual projected growth. Without targeted and effective response action, Australia's emissions, based on a comprehensive approach excluding land use change, were expected to grow to around 128% of 1990 levels by 2010. Emissions from the energy sector alone were expected to grow by some 40%.

Australia argued that more than 80% of our exports are greenhouse gas intensive products (e.g. aluminium, high grade steel and agricultural products) and in a sense is emitting greenhouse gasses on behalf of the export destinations. Added to this was our claim that we have limited opportunities to switch to less greenhouse gas intensive energy sources because we have no nuclear energy and limited scope for expanded hydroelectricity.

Australia also argued that it had a long history of land clearing for farming and other uses which release carbon dioxide. Over 20% of Australia's greenhouse emissions can be attributed to land clearing whereas for other countries the forestry sector acts as a sink for emissions because they are planting trees and revegetation rather than clearing. The "Australia Clause" in the Kyoto protocol gives us leave to include the emissions from land clearing in the calculations of our target thereby providing us with additional scope for cost effective mitigation action (i.e. by reducing land clearing).

KEY FEATURES OF THE KYOTO PROTOCOL

The protocol allows for

- Flexible approaches and does not stipulate any domestic action that countries must take to reduce emissions.
- Emission budgets and banking of "excess" reductions between commitment periods
- Establishment of a system for trading of emissions credits between countries – the International Emissions Trading (IET) system
- Clean Development Mechanism (CDM) where developing countries are assisted to participate in reducing greenhouse gas emissions through cooperative project activities with developed countries who can then use the emissions reductions to meet with targets
- Joint Implementation (JI) between countries on emissions reduction projects

The greenhouse gases covered by the Kyoto Protocol are;

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs) and
- Sulphur Hexafluoride (SF_6)

The Protocol will enter into force and become legally binding after it has been ratified by at least 55 Parties to the Convention, including industrialized countries representing at least 55% of the total 1990 carbon dioxide emissions from this group. So far, more than 120 countries have ratified the Kyoto Protocol but represent only about 44% of total emissions. Of the Annex 1 countries only Australia, Croatia, Monaco, Russian Federation. Ukraine and the USA have not ratified the Protocol. A list of signatories to the Kyoto Protocol can be found at http://unfccc.int/resource/kpstats.pdf.

WHAT HAS HAPPENED SINCE KYOTO

The Marrakesh Accords were developed at CoP7 held in Marrakesh in 2001 and represent a second level of detail to the Kyoto Protocol. Technically the Marrakesh Accords are draft rules, which will not become final until the Protocol has entered into force and the rules have been passed by the Conference of the Parties serving as the Meeting of the Parties to the Protocol (COP/MOP).

A third level of detail is still required to establish technical guidelines for some activities and institutions. These guidelines will be developed at subsequent conferences and meetings. Australia continues to be closely involved with international organisations, particularly the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC).

The Australian Commonwealth Government has decided to not ratify the Kyoto Protocol at present because it believes it is currently not in Australia's national interest to do so on the basis that Kyoto does not offer a clear pathway for commitments by developing countries and also that the United States will not ratify. Australia's position on the Kyoto Protocol raises some particular considerations when it comes to participation of Australian businesses in the Kyoto carbon trading mechanisms.

As a consequence of the decision not to ratify Kyoto, Australia is now a non-Party. This means the Australian Government cannot participate directly in the Kyoto mechanisms. However the rules agreed at Marrakesh in November 2001 do not discriminate between firms from countries that have and those that have not ratified the Protocol.

Australian businesses may wish to participate in international greenhouse projects under the Kyoto market-based mechanisms. While this has been made more difficult and complex by the

Goernment's decision the Government believes there are still some avenues for Australian Businesses to participate.

(See http://www.greenhouse.gov.au/international/kyoto/mechanisms.html for more detail)

AFTER KYOTO - FUTURE COMMITMENT PERIODS

The Kyoto Protocol is not the end of the road. It does not address the key issue of commitments by developing countries to reduce their emissions and only deals with developing countries' emissions up to the end of the first commitment period of 2008 to 2012. Negotiations will commence in 2005 for a new Protocol for the period beyond 2012.

Seven Silly Excuses Used by the Australian Government To Not Ratify the Kyoto Protocol[6]

Silly Excuse No. 1

"Unlike most developed countries, Australia is a net exporter of energy and that puts us in a very special position." (Prime Minister Howard)

The greenhouse gas emissions from our energy exports have no bearing on Australia's obligations at all. The emissions from our exports of coal, gas and oil are counted in the country where they burned.

Other countries may decide to import less fossil fuels, but there is nothing Australia can do about that, except try to sabotage the Kyoto Protocol. This has been pointed out repeatedly to the Prime Minister but he still doesn't get it.

Quite apart from the irrelevance of the excuse, it is simply wrong to claim that Australia is in a special position. Canada, Norway, the United Kingdom and Russia are also net exporters of energy, and all have either ratified the Kyoto Protocol or have indicated their intention to do so.

The Government says that it is not in Australia's economic interests to ratify. The ABARE economic modelling the Government used to rely on has been discredited. Why does it not make public the results of the new economic modelling it commissioned after the Marrakech climate change conference?

Silly Excuse No. 2

Australian firms will shift off-shore if we ratify.

The Government never says which industries it is talking about, because if they did in each case it could be challenged. The industry that makes the loudest threats to move offshore is the foreign-owned aluminium smelting industry. Aluminium smelting uses 16% of Australia's electricity and is responsible for 6% of total greenhouse gas emissions.

The six aluminium smelters enjoy very cheap electricity from long-term contracts signed with State governments. They receive a subsidy of around $250 million each year, and enjoy access to abundant raw materials, a skilled labour supply and political stability.

Why would an aluminium company shift a smelter with a 30-40 year life span to a developing country to escape greenhouse restrictions in Australia, when everyone accepts that developing countries too will have to take on emission-reduction obligations within a decade? Are their CEOs so short-sighted?

The aluminium industry is so worried about the implications of Kyoto that it has just committed $3 billion to build a brand new smelter and refinery at Gladstone in Queensland with a 30-40 year lifespan.

While the Australian Aluminium Council has mobilized more anti-Kyoto lobbying power than any other industry group, the parent companies of the biggest smelters in Australia – including Alcoa and Rio Tinto – have signed up to the US Pew Center on Climate Change's Business Environmental Leadership Council which favours implementing the Kyoto Protocol as a first step in addressing climate change.

While it is unlikely any firms will shift off-shore if we ratify, several have already announced that they plan to shift off-shore if we do not ratify.

Silly Excuse No. 3

"Any shift of production off-shore would … undoubtedly… increase global greenhouse gas emissions." (Foreign Minister Alexander Downer, Media release 15 August 2002)

Apart from recycling the erroneous belief that all developing countries are dirty, polluted and inefficient, just which firms is the Government talking about? Vague ideas about aluminium smelters seem to float around the Government. But what are the facts?

Fact 1: Australian smelters produce more greenhouse gases per tonne of aluminium than smelters anywhere else in the world. Australian smelters' emissions from electricity consumption are 13.6 tonnes of CO_2 per tonne of aluminium, around 2.5 times the world average. They are so high because Australian smelters rely almost wholly on electricity from coal burning.

[6] Taken from The Australia Institute web site

Fact 2: According to the International Aluminium Institute, smelters in developing countries are cleaner than those in developed countries, producing lower direct greenhouse gas emissions per unit of output.

So if Australian smelters shifted anywhere else, global greenhouse gas emissions would fall.

Besides, respectable corporations nowadays don't threaten to take their dirty factories to poor countries so they can exploit lax environmental laws. Yet that is how the Federal Government seems to view them.

SILLY EXCUSE NO. 4

"Kyoto is going to make barely 1 per cent difference to global greenhouse gas emissions." (Environment Minister Kemp, 'Lateline', ABC TV, 3 September 2002)

Everybody understands that the Kyoto Protocol is only a first, small step on the road to very large reductions in global greenhouse gas emissions. The second and subsequent commitment periods will require deeper cuts in emissions.

Environment Minister David Kemp concedes we need to cut by 60% in the longer term. Any scheme to cut by 60% will begin by cutting the first 1%. The Federal Government's alternative – the Australia-US Climate Action Partnership – does even less than Kyoto.

The Howard Government displays astonishing hypocrisy in making these statements. Before, during and after the Kyoto conference, it worked tirelessly to water down the environmental effectiveness of the Kyoto Protocol. Yet now it says that Kyoto does not go far enough!

Former Environment Minister Robert Hill publicly acknowledged that any internationally agreed replacement for the Kyoto Protocol would not give Australia such a lenient target. Now the international debate is turning to the concept of 'equal per capita emissions', which would mean a bigger proportional cut for Australia than any other country.

Is this the Government's preferred model? If so, environmentalists would support the Government.

SILLY EXCUSE NO. 5

Developing countries are 'exempted' from the Protocol and this is unfair on countries like Australia. "[I]t is no solution at all … if China and India and Brazil can go ahead and pollute the environment to their heart's content because we're all feeling a bit sorry for them." (Alexander Downer, AFR, 26 March 2001)

Apart from the gratuitous insult to some of the world's poorest people, the Government's argument ignores some vital facts.

Fact 1: Climate change is caused by increased concentrations of greenhouse gases in the atmosphere and 80% of the increased concentrations have been put there by developed countries. It will be 50 years or more before developing countries are responsible for half of the increased concentrations.

Fact 2: In per capita terms developing countries typically have one tenth to one twentieth of the emissions of the USA and Australia. Australia's annual per capita emissions are 27.9 tonnes of CO2-e, the highest in the industrialised world. Australia's 19 million people produce more greenhouse pollution than Indonesia's 200 million.

Fact 3: According to the IPCC, poor countries will suffer most of the impacts of climate change, including decreased crop yields (leading to starvation), sea-level rise, and increased incidence of tropical diseases such as malaria, dengue and yellow fever.

Fact 4: The principles of polluter pays and ability to pay are accepted as fair by the international community, including in other contexts the Australian Government. The principles mean that a wealthy country like Australia with high emissions should do much more.

Fact 5: Every international agreement on climate change – the 1992 Framework Convention, the 1995 Berlin Mandate and the 1997 Kyoto protocol – explicitly recognises that developing countries will be required to cut their emissions, but only after rich countries have led the way.

Fact 6: US Energy Department analysis shows that between 1997 and 2000, China reduced its greenhouse gas emissions from fuel combustion by 6%. In the same period, Australia's emissions grew by 9%.

SILLY EXCUSE NO. 6

"… we don't know what the obligations in the next two assessment periods [of the Kyoto Protocol] are …" (Prime Minister Howard)

Nobody knows what targets the world community will set for the period beyond 2012. But the Kyoto Protocol states that the Parties will negotiate these targets in 2005, seven years before the end of the first commitment period.

• By refusing to ratify, does the Australian Government intend to play no role in determining what the obligations will be in subsequent commitment periods?

• Does it imagine that Australia will be able to refuse to be part of the international process indefinitely? It is widely expected that developing countries will sign up to legal obligations in the second commitment period, after 2012. Yet China and India have been willing to ratify even though they, like everyone else, have no clear idea what their future obligations will be.

SILLY EXCUSE NO. 7

If we don't ratify, Australia will still be able to participate in world greenhouse markets.

This claim, made several times by Environment Minister David Kemp, suggests that the Government still has not come to grips with the implications of the Kyoto Protocol.

If Australia does not ratify there will be no obligation on Australian polluters to limit their emissions. In that case there would be no need for any firm in Australia to buy an emissions permit. Nor would they have any permits to sell as they would not have been allocated any.

Australian firms would be unable to generate credits from investments in developing countries under the Clean Development Mechanism.

Earlier this year European Union officials went out of their way to confirm that emission credits generated by Australian companies will not be saleable in countries that have ratified, including Europe and Japan.

• Why would the rest of the world allow Australia to benefit from the Protocol's mechanisms when we refuse to accept our obligations? Reports are now appearing in the press of Australian firms with investment in clean energy in developing countries saying that, after the PM's announcement that Australia would not ratify, they are now looking to move offshore in order to validate their CDM credits. The companies include Advanced Energy Systems, Global Renewables and Envirostar, some of the most innovative in the country.

The Prime Minister's own Science, Engineering and Innovation Council noted that "Kyoto has created a new business environment in which new industries, markets and technologies can flourish". It told the Prime Minister: "If we wait for ratification while other countries act, Australia runs the risk of missing out on global opportunities…."

What is renewable energy? How is it different to the energy I use now?

Renewable energy can be defined as any source of energy that can be used without depleting its reserves. Sources of renewable energy include solar, wind, wave, biomass and hydro energy along with tidal power. Sources of non-renewable energy include fossil fuels (coal, natural gas, mineral oil) and fissile fuels (e.g. uranium).

It is a common misconception that "renewable" is synonymous with "everlasting" or "replenishing". In part this is true but even renewable resources will run out eventually for one reason or another and non-renewable resources may be replenished but at time scales beyond that which is useful to humans.

We look at their rate of replenishment in the human context in determining if a resource is renewable or non-renewable. For example coal takes in the order of tens to hundreds of millions of years to form from its original organic matter. So while it may be replenished in a few million years, in the human context it is non-renewable.

Green Power™ is electricity that is derived from a renewable energy source in a manner that is environmentally sustainable.

Renewable energy projects typically generate very low levels of greenhouse gas emissions with virtually zero emissions during operation. Emissions during construction are 'paid back' in a very short period. In contrast, the use of fossil fuels emits large amounts of the greenhouse gas carbon dioxide to the atmosphere. Promoting the use of renewable energy is therefore an extremely important part of the international response to the enhanced greenhouse effect.

In Australia, 6% of energy generation capacity currently comes from renewable energy, largely from biomass in the form of bagasse (sugar cane waste) used to generate electricity, and wood which is used mainly for home heating (AGO 1999). In the electricity sector, renewable energy contributes about 10.7%, most of which is generated from large-scale hydro electricity schemes (AGO 1999) such as the Snowy Mountains and Tasmanian schemes.

Why Use Renewable Energy

Human society already uses large quantities of renewable energy in various ways. Usually we only think about hydro-electricity, wood and the small amount used by solar water heating. Usually we ignore the very large amounts used in such activities as drying salt, clothes or agricultural products and the passive solar heating of buildings.

The rationale for using renewable energy as our prime commercial energy source is that we would be temporarily borrowing a very small part of an existing, clean energy flow and therefore would be unlikely to perturb the global energy system. In operation most renewable energy systems produce very little troublesome waste. On the other hand the use of fossil fuels, while also small in relation to total global energy flows, produce waste products which can seriously disrupt other atmospheric processes and impact on the health of humans and other species.

Most renewable energy forms have little or no local effects on the environment during operation; possible exceptions are large dams, through inundation and water flow restriction and the large scale use of biomass. Whether global or local the environmental and health impacts of operation of renewable energy systems are generally comparatively small and the impacts of constructing the conversion systems are at worst roughly comparable with equivalent systems for fossil fuels.

There are concerns expressed about renewable systems based around aesthetics and land usage. Some have objected to the appearance of large installations but these could be compared to the smoke stacks, open-cut mines and waste dumps of conventional technologies. Contrary to popular myth the land used by most renewable technologies is comparable to fossil fuels.

Flavin and Lenssen (1991:p36) reported data from USA for land occupation by different technologies in square metres per gigaWatt-hour for a thirty year plant life;

- Coal 3642
- Solar thermal electric 3561
- Photovoltaics 3237
- Wind 1335
- Geothermal 404

It is difficult to put a price on the damage caused by polluting energy sources. While renewable energy technologies are close to competitive with traditional fossil fuels decision makers should not be afraid of attempting to calculate and include such externalities as urban pollution and global warming in the costing process. They are the real costs which we all must pay.

There are other advantages of renewable energy. One is that they come in small modules which can be advantageous when there are uncertainties in future demand by allowing flexibility and more rapid response to emerging needs. There is also significant potential for employment.

The Advantages and Disadvantages of Other Electricity Generation Technologies[7]

FOSSIL FUELS

ADVANTAGES

- Using fossil fuels for electricity generation is the cheapest method in use today. Most generating stations are large so they can provide economies of scale; the cost per kW of electricity produced drops as the size of the generating plant increases.
- Thermal-generating stations are often built near the source of fuel and cooling water providing savings on transport costs; for example, Eraring Power Station, NSW is located within 5km of its two coal mines, and is on the shores of Lake Macquarie.
- Using fossil fuels for electricity generation provides a large amount of energy per unit weight; for example, one tonne of coal provides a lot more heat energy than one tonne of wood.
- The production of electricity from fossil fuels is not dependent on the time of day, weather variations or seasonal effects. Thermal power stations can produce electricity continuously.
- Natural gas and oil-thermal power stations cost up to 30 per cent less to design and construct than coal-thermal power stations. They are also better for the environment. Natural gas thermal stations produce only 50 per cent CO_2 as coal, and do not produce any SO_2. Oil-thermal stations produce 70 to 75 per cent the CO_2 of coal stations.
- Existing thermal plants can have equipment installed to reduce the amount of pollutants entering the atmosphere.

DISADVANTAGES

- Fossil fuels are non renewable and will eventually run out.
- Carbon dioxide (CO_2) is produced when coal is burnt and is a greenhouse gas that has been linked to global warming.
- Sulphur dioxide (SO_2) is produced when coal is burnt and contributes to acid rain.
- Acid rain can contribute to deforestation and pollution of the river and lake systems. The amount of SO_2 emitted by burning coal can be reduced by 90 per cent using desulphurisation techniques.
    - A coal plant can release dust and fly ash when burning. Filters, like large vacuum cleaners, are used to catch these particles before they enter the air. The dust and ash can be later used with concrete in road building projects.
    - Thermal-generating plants are often large and unattractive to look at.
    - When the water that was used for cooling the steam in a thermal-electricity generating plant is returned to its natural source it is warm and contains little air or oxygen. Plants and animals living in water require oxygen to survive so this can have a harmful effect the local ecosystem.
    - Large thermal-generating stations have economies of scale, but do not use energy efficiently. Only 30 to 35 per cent of the energy put in to the boiler is converted to electrical energy.
    - Exploration and mining have a major impact on the environment.
    - Open-cut mining methods destroy large areas of land.
    - Underground coal mining is dangerous; around the world many lives have been lost through explosions and cave-ins.
    - Oil spills during oil drilling cause major damage to ecosystems both on land and at sea.

[7] From http://www.actewagl.com.au/education/electricity/

Nuclear Power

Advantages

- Small quantities of fuel are required to produce very large amounts of electrical energy.
- A generation plant operating normally is very clean with little pollution to the environment. Nuclear generators do not produce CO_2, and produce very small amounts of other air pollutants.
- Nuclear power stations are not dependent upon time of day, weather or seasonal variations. They can generate electricity day in, day out.
- Fuel can be easily transported to plants.

Disadvantages

- The mining and processing of uranium, for use in reactors, releases low-level radiation into the environment.
- Nuclear power stations may take several days to start up. They cannot be used to meet a sudden increase in electricity demand.
- The operation of nuclear reactors can cause major environmental problems if the reaction process gets out of control.
- The fuel, after it has been used, is highly radioactive and is dangerous to living things. It will remain radioactive for thousands of years and needs to be disposed of in strong lead and concrete-lined containers located in areas relatively free of natural disasters such as earthquakes.

Hydro-Electric

Advantages

- Hydro electricity is a renewable energy source that does not produce any greenhouse gases.
- Operation and maintenance costs for hydro-electricity plants are considerably lower than for thermal electricity generating plants. There are few unscheduled breakdowns are few because their mechanical design is relatively simple, and no excess heat is generated during operations.
- Hydro-electricity generating plants have a long life.
- When a hydro-electricity water storage dam is built, the water in the dam can be used as a source of drinking water and for recreational purposes such as boating and fishing.
- To meet any changes in demand for electricity, hydro-electricity generators can be stopped and started in minutes. A fossil-fuel station can take up to eight hours to shut down, and a nuclear station can take up to several days.
- Although dams prevent the natural flushing out of a river during a flood, they also control flooding downstream in times of high rainfall and snowmelt.

Disadvantages

- Usually a large area of land has to be flooded to ensure a continuous flow of water to the turbine. In some cases, when a dam is built, large populations have to be relocated. In China the Three Gorges Dam Project on the Yangtze River will displace more than 1,000,000 people. It the largest hydro dam built.
- Dams affect river ecosystems. Rivers usually experience seasonal flooding that flush out river backwaters and deposit silt on river banks. Dams prevent those seasonal floods and allow silt and vegetation to clog up river backwaters. These cause changes to the environments of many plants and animals and may cause a reduction in their populations.
- Hydro-electricity dams are costly to build.
- An adequate supply of water from rain or snow is required for the hydro-electricity generation plants to continue operation. If a drought occurs power production can be severely affected. Countries that produce hydro-electricity need alternative electricity supplies for such events.

Tidal

Advantages

- Tidal electricity generation does not produce greenhouse gases.
- Electricity produced in this way could replace electricity that is generated from fossil fuels. This would contribute to the reduction of CO_2 being released into the atmosphere.
- Operation and maintenance costs for tidal generation plants are low.

Disadvantages

- The development of electricity generation plants using the energy of tides involves high initial building costs.
- The plants change existing environmental systems by controlling tidal waters in coastal inlets. The process of trapping water in inlets for extended periods of time interferes with fish spawning and breeding cycles in that area.
- Fish could be injured attempting to pass through water turbines to reach spawning grounds.
- Tidal dams could contribute to environmental harm by trapping pollutants that have been released into the rivers upstream from the dam.
- For tidal electricity generation to be viable tidal variations greater than 15 meters are required. These large variations occur in a limited number of countries in the world.

Biomass

Advantages

- Biomass is a renewable resource.
- Biomass can be converted into several forms of energy; for example, wood can be processed and turned into gas. Landfill can produce methane, and sugar cane and other plant products can be used to make ethanol, a liquid fuel.
- Biomass gets its energy from the sun through photosynthesis.

Disadvantages

- Biomass energy comes mainly from plants and requires harvesting.
- Plants grown to provide biomass require land. This land could be used to produce food.
- Biomass crops, if grown too quickly, will use many of the nutrients in the soil reducing its fertility.
- Burning plants release large volumes of carbon dioxide. Carbon dioxide contributes to the greenhouse effect.

Wave

Advantages

- Wave electricity generation is a source of clean, renewable energy and does not produce any greenhouse gases.

Disadvantages

- The unpredictable nature of the sea remains a problem with wave electricity generation.
- Facilities need to be built to withstand the effects of waves under exceptional circumstances; such waves can exert forces 10 times stronger than normal waves.
- Electricity generating facilities using waves may cause changes to shore lines and local ecosystems.
- The electricity produced by an open water column will vary because the energy from waves will vary from time to time.

Geothermal

Advantages

- The energy provided through geothermal activity has no direct cost once it is contained and directed to an electricity generation plant.
- Geothermal plants can operate 24 hours-a-day, since they do not rely on the weather or the sun.
- Geothermal plants can be built at the energy source.
- Geothermal plants can be built quickly compared to fossil fuel generation plants.

Disadvantages

- The plant and equipment, such as pipes, require high maintenance, and the hot ground water contains dissolved materials. When the water cools some of these materials deposit on the pipes as solids causing blockages.
- Because the water is acidic the pipes corrode.
- Gases, such as carbon dioxide and hydrogen sulphide, are dissolved in the underground, hot water. When this water is released on the earth's surface, and the pressure on this water is reduced, the dissolved gases escape into the air (like when you open a bottle of a warm, fizzy drink). Carbon dioxide is a greenhouse gas and hydrogen sulphide is poisonous.
- Taking water from underground can cause the surface land to cave in or subside. Pumping water back into the ground can reduce this risk.
- Taking geothermal energy from rocks too quickly might cool them down. The temperature of the rocks must be monitored to ensure the usage does not exceed the reheating capacity of the area.

Solar

Advantages

- Solar thermal plants and photovoltaic cells do not produce greenhouse gases. Photovoltaic cell technology contains few moving parts and requires little maintenance.
- Photovoltaic cells can be placed on rooftops for domestic and certain commercial/industrial applications, which leaves land (such as backyards) free to be used for other purposes.
- Photovoltaic cells are ideal for electrical generation in remote locations.
- Australia has a lot of sun!

Disadvantages

- The generation of electricity from photovoltaic cells and solar thermal plants is costly compared to the generation of electricity from fossil fuel. These costs are expected to fall as sales and production increase.
- The generation of electricity from solar energy is unreliable. The sun's light may reach the panels intermittently, and other factors, such as the sun's position relative to the solar panel and atmospheric conditions (such as clouds), may have an effect on solar energy generation.
- Some solar-generated electricity has to be stored to have a continuous supply, for example at night. Storing the electricity in batteries, or using it to pump water to a storage dam from which it can later be released through a hydro-electricity generation facility can do this.
- Electricity generation from photovoltaic and solar thermal systems require vast amounts of land.