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Responding to Climate Change

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In 1989, I wrote a book on climate change, *Living in the Greenhouse.* At the time the scientific community was still divided about climate change. It was clear that the planet was getting warmer and that other changes were happening, like rising sea levels and altered rainfall patterns. It was also clear that the massive increase in our use of the so-called "fossil fuels" — coal, oil and gas — was changing the amount of carbon dioxide in the air. While a distinguished Swedish scientist had shown in the late 19th century that this could affect the global climate, some cautious colleagues were reluctant to accept that human energy use was actually *causing* the changes that were being observed. As more research has been done, it has become clearer that changes to the global climate have not just followed the increasing human use of fossil fuels but are being caused by that process. While there was genuine uncertainty in the science, it was defensible for short-sighted politicians to do nothing about the problem. The science has now been refined to the point where there is no legitimate dispute about the human influence on climate. That doesn't mean that the debate is over. As I was finalising this contribution, our national daily newspaper was still printing columns suggesting that we should do nothing because the science is not yet rock-solid!

The politicians of the developed world accepted the scientific arguments ten years ago when they negotiated the Kyoto protocol to slow down release of greenhouse gases. Under that treaty, the developed nations that had contributed most of the extra carbon dioxide in the atmosphere agreed to stop increasing their energy use, stabilising their greenhouse pollution at about the 1995 level. Australia and the United States were the only advanced nations that had failed to ratify this agreement as I began writing; as I finished this essay, the incoming Rudd government formally agreed to ratify the Kyoto agreement, leaving the Bush regime in the United States totally isolated. The political issue is the search for equitable ways of moving beyond the Kyoto agreement, which sets targets for the industrialised world to stablise its greenhouse gas pollution by 2012.

Climate Change

The Earth as a whole has warmed about 0.7 °C in the last hundred years, with Australia warming slightly more than the global average. The Earth is now warmer than at any time since credible records began. As predicted by climate scientists, there have been other changes associated with the warming: shrinking of glaciers, thinning of polar ice, rising sea levels, changing rainfall patterns and more frequent extreme events such as droughts and severe storms. Climate change is already having serious economic effects: examples include reduced agricultural production, increased costs of severe events like fires and storms, as well as the need to consider radical water supply measures such as desalination plants. Of course, climate change doesn't just have short-term economic effects, but is affecting all natural systems. To grow, plants need carbon dioxide, warmth and water. We are changing all of those variables, so the ability of all plants to grow is being affected. Since we are increasing the amount of carbon dioxide in the atmosphere and increasing average temperatures, some plants are doing better. The changes to rainfall patterns are dramatically affecting the availability of water in many areas. Since different plant

species respond in different ways to the altered growing conditions, we are systematically changing the balance of plant species in mixed systems: the competition between crops and weeds on farms, the balance of trees and grasses in bushland. Altering the mix of plants affects the conditions for animals and insects, so the whole balance of nature is changing. The Millennium Assessment Report, released in 2005 by the United Nations, warned that species loss is accelerating as habitat loss, introduced species and chemical pollution are supplemented by climate change. The report warns that we could lose between 10% and 30% of all mammal, bird and amphibian species this century, depending on the scale of global warming. These are alarming consequences that demand an urgent and concerted response.

The world scientific body, which advises the United Nations and individual governments on these issues, is the Intergovernmental Panel on Climate Change, the IPCC. It does not make forecasts about the future, but it does produce projections. The distinction is that a projection is based on some assumptions. In the case of climate change, the big unknown is how much more greenhouse pollution we will pump into the atmosphere. So the IPCC has developed a range of projections, based on different future patterns of fuel use. Studies of air bubbles trapped in polar ice have been used to determine the history of the atmosphere. These show that the carbon dioxide level has varied naturally over the last 700,000 years between about 180 and 280 parts per million (ppm). The level in the air today is 380 ppm, and that concentration is increasing by about 3 ppm per year. Because the atmosphere's capacity to trap heat is now far outside the range of recent Earth history, there is genuine uncertainty about the future rate of warming for any given pattern of energy use. For the most optimistic future the IPCC considered, modelling leads to the conclusion that the average temperature will increase a further 1.3° this century; that projection combines a rapid reduction in fossil fuel use with the best interpretation of the uncertain science. Less optimistic views of the climate science lead to increase of 2°

or more, even with an aggressive reduction in release of carbon dioxide. A "business-as-usual" future, with fuel use continuing to increase as rapidly as it has in the last 50 years, leads to temperature increases of five degrees or more.

There is increasing concern in the climate science community that even these sorts of projections may be understating the risks of climate change. The IPCC models basically assume smooth transitions between different stable states and exclude the possibility of sudden non-linear changes. We now know that natural systems can undergo non-linear changes to radically different states, as when a fishery collapses or the ocean forges a new channel through a sand island. There are several possible non-linear changes that could dramatically accelerate climate change. Warming is reducing the snow and ice cover, a process that increases the absorption of solar radiation because snow and ice are highly reflective; absorption of more solar radiation will increase the global temperature, so the snow and ice cover will reduce still further. In similar terms, the rate of release of methane from Arctic tundra is a function of temperature; warming will release more methane, increasing the capacity to trap heat which will warm the Arctic further, causing an increasing rate of release of methane which will further increase the capacity to trap heat. Global warming is making forests drier and more likely to burn, releasing carbon dioxide which makes the Earth warmer, making forests drier … For these sorts of reasons, many scientists think the recent IPCC report under-states the risk of a rapid rise in temperature with associated problems such as melting of land-based ice. The IPCC caution is understandable; while these risks are well known, there is no way of putting any sort of quantitative estimate on the probability of them happening. Knowing that these sorts of changes could occur should increase our caution about interfering in the global climate system and reinforce the urgency of developing a coherent response. A real worry is that rapid warming could destabilise the Greenland ice sheet, leading to a catastrophic sea level increase of about six metres.

So What Do We Do?

Just as other serious environmental problems have been tackled at the international level, a global response to climate change is needed. The science shows that the world must reduce greenhouse gas emissions to about 40% of present levels (or less) by 2050 (or sooner). In November 2007 the IPCC released its latest synthesis report, stating that the world as a whole must ensure that total emissions peak no later than 2015 and then reduce rapidly. The report went on to spell out what that means for the developed countries in general: reductions of 20% to 45% by 2020 as the first step toward massive cuts of 80% to 95% by 2050. While the IPCC did not specify which limits should apply to particular countries, we cannot escape the fact that Australia is now the largest per capita emitter, even worse than the United States because we use dirtier fuels to generate our electricity. So aiming for reductions at the greater end of the IPCC range is simply our obligation to the rest of the world. It will require action from all levels of government to encourage cleaner energy supply and much more efficient conversion of energy into the services we need. The obvious way to fund the transition is the systematic elimination of the huge current subsidies of fossil-fuel supply and use, releasing public funds for expansion of renewable energy supply technologies and improving efficiency of energy use. Various studies estimate the annual public subsidy of fossil-fuel supply and use in Australia as between five and eight billion dollars (without allowing for the costs of climate change).

To reduce the amount of carbon dioxide we put into the air, we must use cleaner fuels and use them more efficiently. Gas is far better than electricity. Most of our electric power comes from burning coal. Using coal-fired electricity to heat water or cook, rather than burning gas, puts about four times as much carbon dioxide into the air. Renewable energies, such as solar, wind power or biomass, release very little carbon dioxide, so they should be the preferred option. Many households and some businesses have now adopted green power schemes, by which a premium is paid to have electricity entirely from renewable sources. This is a

remarkably cost-effective way of achieving large reductions in emissions. I calculated that a typical Brisbane household using green power reduces their carbon emissions by about as much as giving up the family car, for a cost of about $3 per week. Such schemes should be promoted.

The data from the green power schemes put the economics of achieving emission reductions in perspective. To get all of my electricity from renewables adds about 20% to the power bill. A larger fraction of overall electricity from renewable sources is an option that should be considered. Extrapolating from the costs of existing green power schemes, a target of 20% extra renewable power would only add about 4% to a typical power bill. Since we have so far used the most economically attractive power schemes a more realistic figure would be two to three times that, or about 10%. This sort of increase is clearly considered politically acceptable, because it is the increase the Howard government chose to apply to most goods and services when it introduced a goods and services tax (GST). If we were to move toward cleaner but more expensive electricity, governments would probably find it politically expedient to continue to provide public subsidies to such energy-intensive activities as aluminium smelting which would not otherwise be economical. The imposition on most areas of business would not be significant; most businesses pay little attention to energy efficiency because energy is only a small fraction of a typical operating budget.

Many overseas countries have invested heavily in new forms of renewable energy; for example, about a quarter of the installed capacity of the state of California is now made up of various forms of renewable electricity supply. As I was finalising this contribution, the New Zealand government announced that it will not permit any new fossil fuel power stations. Renewables now provide a third of Sweden's energy, half of Norway's and three quarters of Iceland's. The small country of Iceland is a model of what can be achieved. Already getting all its electricity from renewables, hydro and geothermal, it decided in 1999 to convert its transport system to run on hydrogen, produced by using its

clean electricity to extract the gas from sea-water. Iceland has plentiful renewable energy, a solid scientific base and is an island state so it can make independent decisions about its transport system. Of course, we have all those advantages, so we could follow suit if we had Iceland's fourth advantage: visionary leaders who are looking ahead. More generally, most European countries now have serious targets like getting an extra 10% of their electricity from renewables by 2010. We should also adopt serious targets for the share of electricity from renewable sources, such as 10% more by 2010, 25% by 2020 and 50% by 2030.

That would not involve massive price increases. As far back as 1992, the Department of Resources and Energy estimated that we could get 30% of our electricity from renewables at no significant extra cost. The technology has improved dramatically since then, despite meagre funding compared with the resources poured into other options like "clean coal" and nuclear energy. A recent report by the Australian Conservation Foundation and other environmental NGOs, *Bright Future*, showed that we could still get 25% of our power from a mix of renewables by 2020, despite 15 years of inaction since the 1992 report. Barry Naughten, formerly a senior economist with the Australian Bureau of Agricultural and Resource Economics (ABARE), summarised the global view as follows:

> … a major model-based analysis by the International Energy Agency in June 2006 analysed cost-effectiveness of technologies that could together reduce emissions at 2050 by 60%. Not all these scenarios included expanded nuclear. Indeed, the IEA noted that many of its member-states opposed such expansion. But even in a scenario where such expansion was assumed, nuclear was found to account for only 6% of the total emission abatement compared with 44% from improved end-use energy efficiency, with the remaining 50% from a variety of other technologies.

Energy choices are clearly influenced at the margin by price. Domestic electricity users receive no price information at the point of use, which means most have very little idea of the best ways to save energy. It is likely that significant reductions could be

achieved by providing price information. The taxing of energy should also be considered. As the ESD Working Group on Energy Use said in 1991, there is no rational basis for a system that taxes petroleum fuels but does not tax gas, coal or electricity. Given the huge difference in greenhouse impact if, for example, a domestic or commercial user chooses gas rather than coal-fired electricity for cooking or heating, a government trying seriously to meet an emissions target would be seeking to influence those choices. Many countries now have carbon or energy taxes to influence consumer choice. Those options should at least be evaluated. As with any other tax change, including the introduction of the GST, there would be winners and losers, so careful consideration should be given to equity issues.

Efficiency

Shifting to renewable energy is important, but the more urgent and more cost-effective part of the solution involves turning energy more efficiently into the services we want. Nobody actually wants *energy*; we want hot showers and cold drinks, the ability to cook our food, wash our clothes and move around. Most of the technology we use is very wasteful. The European Union now has a target of cutting energy use by a quarter by 2020, and some countries like the Netherlands have more ambitious aims. Efficiency improvements should be a universal goal. Energy efficiency provides economic benefits because saving energy is much cheaper than buying it. The book *The Natural Advantage of Nations* gives a number of case studies. In ten years the chemical firm DuPont cut its energy use by 7% and its greenhouse pollution by over 70% while increasing production almost 30%. It saved more than $2 billion in the process. Five other major firms, including IBM, Alcan, Bayer and British Telecom, have reduced their greenhouse gas emissions by 60% since the early 1990s — and saved another $2 billion. In 2001, BP announced that it had already met its 2010 target of cutting greenhouse gases to 10% below its 1990 level. It reduced its energy bills by $650 million over the decade. General Electric has set a goal of improving

energy efficiency by 30% by 2012. At the household level, if your fridge or washing machine is more efficient, that is real money in your pocket as well as a win for the environment.

Transport

Australia's approach to transport in recent years has been dominated by road building, with about $4 billion of public funds being spent on all forms of public transport while more than $40 billion has gone on roads. Other approaches are possible. The Queensland government's Integrated Regional Travel Plan (IRTP) found that "a 100% increase [in public transport use by 2011] within the city boundaries would be achievable with the right mix of policies and investment to improve public transport and discourage private vehicle use". This should be seen in the context of the overall philosophy of the IRTP, which is that 'tough measures to restrain the use of the private car' are not politically feasible. On health grounds, we should be encouraging more people to cycle in our cities. In many European cities between 20 and 40% of all urban trips are made by bicycle, despite a generally less favourable climate. These levels are usually achieved where the infrastructure makes cycling much safer by separating cyclists from heavier vehicles. It would be realistic for Australian cities to aim at a target of 10%. There is now a National Cycling Strategy. It spells out excellent principles to encourage cycling, but little has been done to implement it.

Cars take twice as much energy per passenger-kilometre as the average for buses, four times the energy of tram or light rail systems, seven times the energy of electric trains and fifty times the energy of bicycles. That suggests that the order of preference for urban transport should be the exact opposite of that advanced by recent public policy. We regard bicycles as transport for young people until they can graduate to something more dangerous, we have allowed tram and train systems to become steadily less attractive, and have made only token investments in buses while squandering huge sums on infrastructure to encourage use of cars and freight trucks. We should set targets for the

share of urban trips to be made by more efficient modes, with specific policies to achieve those targets.

This raises the important issue of the link between infrastructure provision and the pattern of transport. Providing new infrastructure generates its own demand, while removal results in demand reduction. This conclusion applies to all forms of transport: cars, freight vehicles, bus and train travel, cycling and walking. In each case, the provision of better infrastructure generates increased demand, while the removal of existing infrastructure [or failure to provide desired extensions] constrains demand. Current thinking no longer sees travel demand as an independent variable for which supply must be provided, but a variable which is directly and measurably influenced by the available supply capacity. The provision of any increased capacity, whether in the form of extra buses, light rail vehicles, cycleways or road space for cars and trucks, is effectively a policy decision to stimulate increased use of that particular travel mode.

As an extension of that argument, the goal of the "low-transport city" is now foreseeable. National capital cities like Vienna and smaller cities like York have effectively banned cars from their Central Business Districts except for emergency vehicles and early morning deliveries, while other cities have sought to constrain car use by such strategies as road pricing, congestion charges or increased parking fees. Singapore and London have both found that quite modest charges on vehicles entering the CBD at peak hours have reduced vehicle numbers significantly. London's congestion charge is also raising funds to improve public transport. Given the community benefit from increased use of public transport, it would be a sensible public policy initiative to make it free. This would be socially progressive whereas the growing emphasis on the private car is clearly regressive.

Since individuals naturally prefer to make their own decisions about transport, it has been argued that the best way to stimulate more responsible behaviour is through the provision of information about the alternatives and their consequences.

Transport SA operated a pilot scheme which reduced vehicle-kilometres travelled by car about 20% in typical households, showing that small investments in information infrastructure may produce very large savings in spending on transport infrastructure. Traditional thinking has made it more difficult to get small funds for information systems than to obtain much larger amounts for capital investment in the transport network. There is a clear case for adopting a broader approach to thinking about infrastructure costs and benefits. Building on the successful Transport SA pilot scheme, a significant fraction of the resources now spent on urban roads should be allocated to information systems that would help travellers to make better-informed decisions.

Emission reduction will be achieved by some recent transport initiatives, such as the Brisbane busway system, the rail links to Sydney and Brisbane airports, light rail and O-bahn tracks, but these are dwarfed by the massive investment around the country in new urban arterial roads and wider inter-urban roads. The 2007 election involved a bidding war between the major parties, each promising to spend billions on new roads. These proposals might have been designed to encourage increased use of road transport and increased emissions. If we are serious about our Kyoto target, we must invest in the infrastructure that will make transport of people and freight more efficient and less polluting. Transport infrastructure proposals need to be evaluated in the light of the effect they will have on demand and hence on greenhouse gas emissions, with a higher priority being given to infrastructure that will reduce emissions.

The most rapidly growing area of emissions is due to road freight. While the scale of the present subsidy to road freight is well known, governments have been unwilling to address the issue, despite such costs to the community as greatly increased emissions, increased congestion, and greater numbers of deaths and injuries. As with other subsidised economic activities, the withdrawal of subsidies probably needs to be phased in over a period of some years to prevent dislocation and allow an orderly pattern of investment. Unlike some other subsidised operators,

road hauliers do not sell their product on the world market, so the readjustments will be almost entirely internal to Australia.

The Australian vehicle fleet is, by international standards, old and inefficient. The balance of purchasing choices is heavily influenced by the fact that the majority of new cars are bought as part of corporate or government fleets, and research shows that fuel efficiency is not a major consideration in those purchasing choices. Many countries now set fuel efficiency targets for all new vehicles or mandatory minimum average standards for vehicle fleets. Setting average standards allows fleet operators flexibility to use different vehicles for different tasks or different groups of employees, while providing a requirement to meet a minimum overall performance standard. Minimum fuel efficiency standards for new vehicles should be introduced, with a period of five years' grace to allow re-tooling and sale of old stock. Minimum average fuel efficiency standards for all vehicle fleets should be introduced without delay.

A Comprehensive Strategy

Hugh Saddler, Mark Diesendorf and Richard Denniss have developed a detailed energy scenario for Australia in *A Clean Energy Future for Australia*, showing that we could dramatically reduce our greenhouse pollution without recourse to nuclear power. It is worth noting that a strategy of this sort would be much better for employment and the economy generally than the present approach. A 2003 Commonwealth report, *National Framework for Energy Efficiency*, estimated that domestic, industrial and commercial energy use could be cut 30% using measures that would repay the initial investment in less than four years. That approach would create more than 10,000 jobs in activities such as retro-fitting buildings, installing solar hot water systems and replacing inefficient equipment, mostly in regional Australia. Efficiency measures and a real commitment to renewable energy would employ about as many people as the entire workforce of the coal industry.

When John Howard was Prime Minister, he told the Australian Parliament "a 50% cut in Australian emissions by

2050 would lead to a 10% fall in GDP, a 20% fall in real wages", attributing those figures to ABARE. That government agency has been justifiably criticised for overstating the cost of reducing emissions, but Mr Howard's claims distorted its findings by omitting a crucial phrase: "compared with business as usual". In fact, ABARE did not say the economy would shrink and real wages would fall if we cut our emissions; their report projected a 246% increase in GDP by 2050, not a 10% fall, and an 81% increase in real wages! Embellishing even more, Mr Howard went on to claim that there would be "a staggering 600% rise in electricity and gas prices", when ABARE's estimate was 80%, slightly less than the projected growth in real wages. ABARE's modelling confirmed the common-sense view that meeting ambitious reduction targets will involve no real economic pain. We would only sacrifice a small fraction of the anticipated increase in our wealth for the sake of keeping the planet habitable.

So we should set a long-term target to cut our greenhouse pollution by 2050 and take it seriously. Our past approach was a source of shame to thinking Australians; at Kyoto we demanded the world's most generous target and then made no serious effort to cut our emissions. Few countries have so recklessly increased their release of greenhouse gases. In his recent book, *Greenhouse Solutions with Sustainable Energy*, Dr Mark Diesendorf writes:

> Fortunately, we already have sustainable energy technologies that are capable of achieving deep cuts in Australia's greenhouse gas emissions of 50 to 60% by 2040–60. For stationary energy [uses other than transport], these technologies are the myriad of products and measures comprising efficient energy use, together with solar hot water, bio-energy from crop residues, wind power and, as a transitional fuel, gas (both natural gas and coal seam methane). More expensive renewable energy technologies, such as bio-energy from dedicated crops, solar heat at 100–300 °C and solar electricity, could be further developed to achieve total emission reductions of 80% or more in the second half of the 21st century. If climate change continues to accelerate, these technologies could be implemented earlier.

Diesendorf shows in his book that a mix of technologies (wind power, bio-electricity and combined-cycle gas power) could replace a 1000 MW coal-fired power station and reduce carbon emissions by nearly 5 million tonnes a year. It is possible to replace a coal-fired power station entirely by a renewable supply like wind power, but the capacity has to be scaled up to give the equivalent average output over a year. Diesendorf estimates that 2700 MW of wind turbines has the same average power output as a 1000 MW coal-fired power station, allowing the power station to be retired, as has been done in Denmark. Even with this extra capacity, wind power is still cost-effective. In the United Kingdom a 2005 study found the average cost per kilowatt-hour of electricity from wind turbines to be 8 Australian cents, compared with about 15 cents for nuclear power.

In *A Clean Energy Future for Australia,* demand management measures such as solar hot water and improved efficiency are used to reduce electricity demand in 2040 to 14% below the 2001 value. This is a crucial point. Studies that presume continuing growth in energy use tend to reach the conclusion that new renewable capacity cannot be built fast enough. In the medium-efficiency scenario, carbon emissions from electricity are cut by 78% with a supply mix of gas (30%), bio-energy from crop residues (28%), wind (20%), coal (9%), hydro (7%) and solar for afternoon peak demand (5%). This example shows it is entirely realistic to meet Australia's future energy needs with a mix of clean supply options.

Conclusion

A concerted response to climate change is our moral responsibility to future generations. There is no excuse for inaction, as the problem is really urgent. Fortunately, it is entirely possible to meet our material aspirations using clean energy supply technologies with efficient conversion into the services we need. That must be our national goal.

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