ENVIRONMENT BUSINESS AUSTRALIA

TARGETS FOR OUR FUTURE

20% greenhouse gas emissions cuts by 2020 and 60% by 2050

A preliminary outline of how this can be achieved

Contents

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Summary

Climate change an economic and security threat but a market opportunity
Climate change is not just an environmental challenge. It is becoming a defining fact of economic development[1] and, as emphasised by the Pentagon and the Lowy Institute, it is fast becoming a major international security issue.

Environment Business Australia (EBA) believes that the most important role Australia can play in coming years is to demonstrate that productivity and a prosperous economy can be achieved, and maintained, with energy efficiency, clean energy and significant cuts to greenhouse gas (GHG) emissions.

There are major business opportunities if Australia can position itself quickly enough in the 'carbon constrained marketplace'. Failure to act will see competitors seize the lion's share of technology, project, and financing opportunities, especially in the rapidly developing economies of China and India where so much needs to be done to abate greenhouse gas (GHG) emissions, while at the same time growing economies and pulling people out of poverty.

Immediate action needed
Climate change can no longer be considered a "long term" issue. The task ahead is not to avoid 5 degrees Celsius average increase in global temperature '*at some point in the future*'. What we have to do is rapidly put in place steps that avoid an average global temperature rise of 1.5 degrees C. If we do not achieve this then the speed and intensity of climate change may increase as 'positive feedback loops' kick in (such as faster melting of polar ice and glaciers). The implications are that a 2 degree C rise would then be brought forward - potentially by decades. At that point averting further rapid change would become increasingly difficult and it is foreseeable that 3 degrees, then 4, then 5 degrees C would follow rapidly.

Stop downplaying the risks
We must therefore stop downplaying the hazards of climate change and use all the tools at our disposal to avoid risk and seize opportunity. There is no longer any economic, security, competitive, or political advantage to be gained from continuing to deny the risks associated with climate change. The truth is that the world has accepted the need to respond to climate change and there is competitive advantage to be gained by acting decisively to develop a strong position in the emerging new order.

Converging threats of peak oil, water shortages and other issues
It is however, also important to acknowledge that the marketplace is about to face a convergence of issues, the like of which it has never encountered before - climate change, peak oil, energy security, peak soil[2], peak metals[3]

[1] World Resources Institute
[2] Depletion of soil carbon, minerals and nutrients combined with erosion, salinity, acidification all reducing soil's productive capacity

and water shortages, are each major issues in their own right, but the implications of the *combination* on global security, financial stability, ecosystem services, and human welfare are potentially catastrophic.

The challenges to an energy intensive country like Australia are likely to be particularly dire. If Australia is to emerge with its current lifestyle and prosperous economy intact, new policies, technologies (and their supporting infrastructure) and investment will be needed in rapid order. A clear signal needs to be given to the market that carbon is to be priced and that targets, timelines and milestones for GHG cuts will be bound by regulation.

Core recommendation - 60% cuts by 2050, 20% cuts by 2020 across the whole economy

EBA's core recommendation in this paper is that GHG emissions abatement must occur across the whole economy and that targets are needed for the long term - 60% by 2050, and also for the medium term - 20% by 2020.

EBA's original intent with this paper was to demonstrate how 20% cuts in GHG emissions by 2020 against a 1990 baseline could be achieved – and we believe this is still possible. However, having lost the past ten years to factional debate, institutional impetus has been lost. Therefore, as we believe it is of critical importance to set Australia on a speedy transitional trajectory to emissions reduction action, and in order to avoid further delays, we have focused this paper on 20% cuts by 2020 against *today's* emissions levels.

It is worth noting that Germany, also an energy intensive country, has stated its intent to reduce emissions by 40% by 2020 against a 1990 baseline.

Introduction

EBA recognises that, with the Australian economy still growing rapidly, and based on the IEA's forecast that additional energy will be required to service and sustain this growth, the figure of 20% GHG cuts by 2020, even against today's baseline, is in reality a 38% cut in emissions compared to a 'business as usual' trajectory.

These targets could be too low

There are many scientists who are already saying these targets are too low (as they are aimed at keeping atmospheric carbon below 550 parts per million (ppm)), and that we should be aiming to stabilise at a maximum of 450 ppm. As we are already at 430 ppm of CO2e (carbon dioxide and the other 5 key GHGs) the challenge is of course immense. This report therefore treats the 20% and 60% targets as interim guidelines which may well need to be strengthened.

National priority to embrace the new technology revolution

Clearly, we are talking about very substantial cuts in GHG emissions and this poses a massive challenge to the economy, especially as the policies and infrastructure to deliver on these cuts are not yet in place. However, we

[3] New Scientist Environment, 23 May, Earth's natural wealth: an audit

most strongly believe the target is achievable if it is made a national priority with bi-partisan political support to offset the 'first mover' investor risk.

The good news is that the clean energy market offers many new opportunities to Australia. The broader environment industry, or 'cleantech' sector, is ready, willing and able to help fast-track the next technological revolution which will benefit Australia's ongoing prosperity and allow us to assist developing countries grow their economies and pull their people out of poverty.

With a rapid introduction of new policies and systems the following approaches could deliver over 50% GHG emissions cuts by 2020

Energy efficiency	**20%**
Recycling	**10%**
Fuel switching	**10%**
Hot rock geothermal	**2%**
Solar thermal	**10%**
Photovoltaics	**2%**
Marine	**2%**
Wind	**5%**

Technology deployment requires extensive multidisciplinary support
Fortunately, it is possible to exceed the recommended 2020 target by a considerable margin and we have outlined some technology approaches below. Indeed the 2020 target could be reached with just the first three of our suggested practical steps - energy efficiency, waste reduction and recycling, and fuel switching. But, to deliver on the increasing demand for energy in Australia and globally, cleaner energy and renewable sources of energy need to be wedged into play as rapidly as possible.

However, we cannot emphasise strongly enough that technology will not be deployed without major policy, finance and behavioural changes all being brought into play. Each new technology will require appropriate infrastructure, knowledge development and training. The framework for this needs to be planned and designed in the next twelve months to make sure that quantum leaps forward can be made from 2010 onwards. Later in the paper we spend time looking at the 'enabling framework' that is required.

Focus on current and near-horizon technologies first
Our recommendations below focus on existing or 'near horizon' technologies - energy efficiency, recycling, fuel-switching, solar thermal and hot rock geothermal, and our recommended approach is one of seizing the opportunity side of the challenge ahead.

We recognise the tremendous opportunity for longer term cuts from clean coal technologies, hydrogen energy delivery, and ways to use CO2 as a beneficial feedstock. These will be vital to securing 60% cuts by 2050. However, we have not looked to these to deliver the initial 20% cuts as they may not be able to be scaled up to make a meaningful impact in the timescales we are considering. We do emphasise the need for stepped up research and operational trialling of these longer timeframe technologies.

Environment Business Australia

EBA is a business think tank and advocacy group promoting commercial solutions to environmental challenges. We push for far-reaching policies to help shape the marketplace for clean and efficient technologies and smart systems and ideas. The environment industry/cleantech sector, which EBA represents is estimated to have a turnover of approximately $25 billion in Australia.

EBA's aim with this paper is to provide the first part of an indicative pathway to take us to a clean energy future. We have drawn from a variety of reports that deliver a similar message primarily the Princeton University 'Climate Stabilization Wedges' analysis by Pacala and Socolow; and the World Resources Institute publication 'Scaling up'. As these reports will be well known to the informed reader we have not reiterated their findings, rather we are reinforcing the theme with an approach that we believe will work well for Australia.

EBA is preparing a second report on the *'wedges, levers, and keystones'* that will be required to build a bridge between the energy supply we have now, and the one that is needed to deliver a safe, secure future.

Immediate steps needed by Government

The role of government is to set social and political boundaries. Government intervention is needed because the marketplace does not readily accommodate innovation when it is not receiving clear signals about negative externalities. Market failures exist and competitive neutrality is undermined when pollution and waste are permitted to be outsourced onto the environment. Such negative externalities effectively provide a subsidy that is not available to leaders who seek to abolish waste and pollution from their operations.

Policies need to be legal and enforceable, the scope of companies to adopt more costly options while their competitors are not obliged to do so is inevitably limited [4]. Voluntary measures are unlikely to be significant drivers of technology wedges in themselves because so many of the technologies, at least in their early stages, entail additional costs even though their take-up may reduce operating costs and reduce costs to the broader economy.

Intervention to capitalise on national interest opportunities

Our research has shown that no major electricity market, anywhere in the world, has developed without government intervention. The establishment of clean energy markets also requires government intervention until such time as:

- **The market properly costs and prices the entire supply chain**
- **Significant capital at national and global scale is mobilised**
- **The clean energy market is fully established.**

The immediate policy steps needed are outlined in the *Government Enabling Framework* section below.

[4] World Resources Institute

The immediate issue for governments is to decide on the suite of policy tools to be used. Emissions trading is a significant stride forward but complementary measures, in particular regulation, are needed as well (especially in the lead up to trading and in the early years). This is as much to protect and further incentivise early movers as it is to set the energy transition in motion.

Innovative policy settings that direct commodities and services to their highest value use, help facilitate and speed up the market's selection of, and investment in, large scale deployment of appropriate technologies that can be woven into the market while last century approaches are winnowed out. This will allow for a smoother 5, 10, 25 year transition to a clean energy future, helping to ensure that employment is maintained, giving companies time to diversify their holdings, and accelerating amortisation and retirement of polluting infrastructure.

US$20 trillion to be spent on energy over next 25 years
Targets need the support of regulation to be taken seriously by business and the community and to become reality. In the next 25 years the International Energy Agency (IEA) estimates that US$20 trillion will need to be invested in new energy and much of this in developing countries. It is imperative to the future of civilisation that this be low to zero emissions energy and clearly defined targets will help channel investment in this direction.

Globally investment is mobilising - but Australia is falling behind
Investment in industry in other countries is getting ahead of Australia, especially where groupings of local authorities or states (as in the USA for example), or where national governments (e.g. Britain, Japan, Germany) have put in place policy and regulatory frameworks designed to achieve climate change outcomes. Industry sectors are recognising that this is the biggest fundamental shift that has faced global economics, and they are re-positioning themselves to compete in the carbon constrained market.

Australian R&D, demonstration and operational trialing/refinement, commercialisation and deployment of technologies, and economy-wide systemic efficiencies, all require investment to be fast-tracked. It we do this we can build a smarter economy that is more resilient to environmental and external trade/security shocks at the same pace as other nations.

The solutions that business can provide right now

Australia - a demonstration site for technology, infrastructure, and economic reform
The technology approaches below, show how the cuts in GHG emissions we recommend can be achieved without negative economic impacts by using existing and near horizon technologies. The list is not exhaustive, nor is it intended to dictate which technologies should be selected, but it provides an indication of the extent to which Australia can become a showcase for solutions.

- **Energy efficiency** - ***potential for a minimum 20% GHG cuts through improving the energy efficiency of the economy by a minimum 20% by***

2020. **This can be achieved through a 2% compound improvement per annum in systemic energy efficiency after a 3-year period to implement programs and get savings up to the 2% p.a. level. These savings can all be achieved through measures with a positive NPV for the economy, with consumers gaining direct savings. Europe has recently set a 20% energy efficiency by 2020 target.**

- **Waste reduction and recycling** - ***potential of 10% GHG cuts by 2020***. **This requires 70%+ diversion from landfill and recycling of the materials, embodied energy, greenhouse gases (specifically methane), and soil carbon in the waste stream - the high levels of nutrients and carbon in the food chain should be recycled and diverted from deep ocean outfalls and landfills. A side benefit is production of natural fertiliser to help farmers boost soil carbon and food productivity levels, while giving them support in the carbon trading market.**

- **Fuel switching** - **potential for gas (including coal seam methane) to replace coal-fired electricity generation[5]. Cogeneration needs to be increased, currently only 5% of total energy (about 2700 MWe installed capacity) is cogenerated. This is extremely low compared to other developed countries. There is the opportunity to increase this to 7-8% in the next decade. Gas fired cogeneration plants are typically about 75%+ thermally efficient compared to coal-fired plants which only deliver about 25-30% of energy used to the end user. At the domestic level, switching electric hot water systems to gas-fired or solar with gas-boosting water heating would significantly cut household emissions. With 50% less emissions than coal-fired electricity plants we give fuel-switching a *conservative estimate of 10% reduction in GHG emissions in Australia by 2020***

- **Renewable energy** - **achieving diversification of energy sources, with a greater percentage of renewable energy included in the mix, is currently stalled due to the lack of a carbon price signal and insufficient policy support for deployment. It is anticipated that early baseload (2010-2012) supply from hot dry rock geothermal and solar thermal energy in particular, could be ramped up extensively and be cost effective with the right policy settings. It is worth noting that Germany recently stated their intent to achieve 45% of energy delivery via renewable energy sources by 2030. The UK's Centre for Alternative Technology has released a report saying that Britain could be carbon neutral by 2020 using existing technologies:**

    - **Hot rock geothermal** - **With early action, 25% of new generation capacity could be met with this technology by 2030, this would equate to 10% of Australia's total generation capacity. Two companies are confident of being able to supply 500 MWe installed capacity by 2015 (with potential for initial generation being as early as 2010) and this could be significantly accelerated from 2015, reaching 2000 MWe by 2020 and 4500 MWe by 2030. Australia benefits from the best known resource**

[5] APPEA statement says gas industry believes it could reach 70% of Australia's electricity production by 2015

for deep hot rock geothermal energy and has a global leadership position. *Conservative estimate of 2% GHG reductions in Australia by 2020 increasing significantly thereafter as new plants come on line.*

- **Solar thermal** - (with chemical energy storage and/or combined with geothermal or clean coal). A 138 km by 138 km site with 20% land coverage by solar collectors working at 20% overall efficiency, would theoretically have the capacity to provide all of Australia's primary energy. At least 25% of new generation capacity could easily be provided by solar thermal energy by 2020. In an important breakthrough Australia has developed a cutting edge chemical process energy storage technology.

  These generation and storage technologies now need to be moved to full scale operational deployment and refinement. Solar thermal technology has the potential to provide 300 MWe installed capacity of electricity by 2012. As examples of other countries seizing a competitive edge over the world's sunniest continent - Spain has recently opened a 10 MWe solar thermal power plant and intends to roll out a further 100 plants; there is consideration of major solar parks in the Sahara to provide EU electricity requirements; the US State of Nevada recently completed a 64 MWe plant that was built in under 15 months. Australia has the technical capacity, the available land and the available financing to develop plants of similar (and increasing) capacity at the same speed, in other words, five plants could be operating by 2012. A potential additional benefit of solar thermal energy is the capacity to value-add to Australia's coal exports. This would include the gasification of coal and export of liquid methanol and could deliver 30% extra energy to the end consumer while more than doubling exports, even while the world moves to a carbon constrained marketplace. *Conservative estimate of 10% GHG reductions in Australia by 2020.*

- **Solar photovoltaic** - Investment to regain Australia's competitive advantage is considered worthwhile as there is potential for household and commercial buildings to become close to energy self-sufficient. That would lead to a lowering of demand side electricity requirements. The current constraints on solar photovoltaic deployment centre on the rate that factories can be built to manufacture solar panels. *Conservative estimate of 1-2% (above energy efficiency/solar hot water) GHG reductions in Australia by 2020.*

- **Marine** - potential for 2,000 MWe installed capacity by 2020 reducing annual GHG emissions by approximately 1,000,000 tonnes of CO2 and 30,000 tonnes of SO2. This represents some 1400+ wave energy modules which have the specific additional benefit of being able to produce desalinated seawater with near zero GHG emissions. The desalination component is of considerable importance when considering the number of

countries likely to face water security issues. The Oceanlinx[6] technology, as demonstrated at their Port Kembla site, has been named one of the world's top ten technologies by the International Academy of Science[7]. Oceanlinx is also one of four marine energy technologies selected by the UK for demonstration at the Wave Hub[8]. *Conservative estimate of 2-5% GHG reductions in Australia by 2020*

- **Wind** - is the lowest cost zero emissions technology currently available at scale, providing electricity at 7 cents per kilowatt hour in Australia. Wind has the potential to supply 15% of the world's global electricity demand by 2030 (1.12 million MWe installed) and to reduce global greenhouse gas emissions by 1.66 billion tonnes (3 times Australia's current emissions level). Wind energy is currently growing at 30% per annum. *Conservative estimate of 5% GHG reductions in Australia by 2020.*

Commercially ready and internationally competitive

The GHG emissions reductions noted above are provided in consultation with industry experts who have commercial cutting-edge approaches and technologies[9].

Speed is of the essence if technology solutions are to have optimal impact on limiting the damage of GHGs. Neither Australia, nor any other country, can afford to wait for some "preferred" technology to emerge so that our energy status quo can continue. There is a long lead-time required for planning and designing the integration of new technology approaches for energy plant. This combined with the lengthy amortisation periods for the considerable investments required, means that industry is dependent on government putting the right policy settings in place to accelerate clean energy technology deployment into a market of sufficient scale.

Some of the technology solutions we are suggesting will be early movers in a developing market, others will take time to reach their longer-term potential. We recognise that, as a market with relatively small scope and scale, Australia is unlikely to be a commercial home to all of them. However, our proximity to, and our excellent relationship with energy-hungry countries in the region puts us in an excellent position. It allows us to develop a variety of energy, and energy-services exports, and to provide practical aid by transferring clean technology to where it is most needed.

Energy Security and energy imports/exports

In addition to providing electricity, both solar thermal and HFR geothermal have potential to add value to coal resources through the production of liquid methanol. This is an important consideration for Australia where, for the first time, our imports of liquid fuel are costing us more than we are gaining in revenue from the export of coal. Methanol could also be bulk shipped to our

[6] Formerly named Energetech
[7] This award covers all forms of technology, it is not limited to energy supply
[8] British Government is positioning the South West of England as a world leader in the development of wave energy technology
[9] Energetics; ANU solar thermal and energy storage team; Geodynamics; Victorian Coal Resources; Pacific Hydro; Oceanlinx; Global Renewables

export markets providing energy at lower GHG emissions than current coal burning technology.

Other emissions reductions processes
In addition to the renewable energy and efficiency measures listed above, the following are also credited with significant CO2 abatement or mitigation potential:

- **Biofuels/biomass - especially sources which do not compete with the food chain, or require cutting of tropical rainforests for land space, or speed up depletion of soil carbon, minerals and nutrients. In commercial stage development is research into force-feeding CO2 to algae which acts as a carbon 'sink' that can then be transformed to fertiliser, animal fodder, or biofuels for ground and air transportation, and potentially for hydrogen production. This bio-mimicry approach makes good use of CO2 and this is likely to have greater community appeal than geological sequestration. Biofuels are already coming into the market in many countries.**

- **Cleaner coal - including cleaner burning coal technologies; more efficient plant; coal to liquid fuels; carbon capture and geological storage (CCS) of CO2 (although this has yet to be proven viable at the scale required or a cost that is competitive with renewably energy). The main concerns with CCS are the time lag before it could deliver any major reduction in GHG emissions[10]; its still unknown costs; and risks regarding community acceptance of long-term safety. Biomimicry uses for CO2 are therefore worth extensive investigation and trialling as is enhanced coal seam methane capture.**

- **Hydrogen energy delivery system - fuelled by renewables/clean coal//sustainable biomass and working in tandem with fuel cells. This is seen as having good potential for both stationary energy and transport fuels, but again, proponents suggest it will be at least ten years before large scale market penetration will occur.**

- **Nuclear energy - Australia's role in planning and creating a global nuclear fuel leasing program with supply of uranium and thorium. This would include the constant monitoring at all stages of overseas refinement and use; take-back of spent nuclear fuel rods for safe geological storage gives Australia a value-adding role in security and financial terms. Community acceptance appears to be the main issue, although cost and length of commissioning time are additional hurdles.**

- **Offsets - reforestation/sustainable forestry/deforestation and land-clearing avoided/return of soil carbon to productive use are tangible ways for Australia to use vast tracts of land. Australia has already begun to assist developing countries realise the value in maintaining tropical rainforests. Australia could capitalise further on domestic offsets by increasing the amount of land to remain uncleared and providing benefits to farmers to achieve this. Audited offsets will provide an important part of the marketplace. Australia's landmass is**

[10] FutureGen plant will not be fully tested until 2017 and unlikely to be commercially ready until 2022

ideal to host/co-host various renewable energy and industrial processes; provide forestry and native vegetation carbon sinks; and provide carbon sinks through the return of soil carbon to the land from putrescible municipal waste and sewage.

Initial cost versus investment and return

The cost of reducing GHG emissions and making the transition to a clean energy future must be balanced against the daunting risks that climate change poses to our economy, security, environment, health, food supply, and quality of life. Many of these risks are not reversable. While it could be argued that artificially deflated prices for energy have helped to make many economies vibrant, the collateral damage to the global commons is now recognised as a cost too high. This is particularly true as there a now smarter and more efficient approaches available.

Energy efficiency - investment and return

Unlike existing alternative supply side options, many energy efficiency options pay off immediately. Investments to capture savings will provide a net positive present worth to the community - they are genuinely and immediately 'no-regrets'.

Government intervention is critical if Australia is to harvest this potential. Certainly, there is a long way to go to reach the statement in the 2003 Energy White Paper, "Energy efficiency is, and will remain, a central element of a cost-effective greenhouse abatement strategy, delivering about 40 per cent of expected energy sector abatement in 2010."

There are several international studies (e.g. Vattenfall 2006, McKinsey 2007) demonstrating the large untapped potential of energy efficiency savings which are cost effective even with a zero carbon price. These demonstrate that 35-45% of a 60% emissions reduction target can be met by cost effective energy efficiency measures with a low carbon price. However, even these analyses may underestimate energy efficiency savings because they only look at technology savings and not savings through improved system design. Additional savings opportunities will arise with increased energy and carbon prices and developing technology.

The National Framework on Energy Efficiency (NFEE) says that accessing the benefits of energy efficiency would require an investment over 12 years of approximately $12.4 billion (NPV terms) generating lifecycle energy savings of approximately $26.9 billion (NPV terms). These NFEE figures represent a 9% efficiency improvement achieving a 26% internal rate of return on investment. To achieve the full 20% savings believed possible, the incentives would need to be doubled with an investment of one billion dollars per annum supported by enhanced regulation. Outcome focused incentive and regulatory programs will be critical to achieving the 20% energy efficiency savings.

NFEE modelling (conservative scenario) suggests that by year 12 the economic benefits for Australia would be:

- **Real GDP would be $1.8 billion higher (+0.2%).**
- **Employment would increase by around 9000 (+0.1%).**

- **A 9% reduction in stationary final energy consumption (-213 PJ).**
- **A 9% reduction in greenhouse emissions from the stationary energy sector (-32MT).**

Recycling materials, embodied energy, methane and soil carbon - the investment and the return

Australia's waste sector GHG emissions appear relatively low at 3% (compared with stationary energy or transportation) but there are multiple benefits in reducing GHGs as air pollution and groundwater contamination can be simultaneously reduced. If Australia were to direct 70% of municipal solid waste to plants that could recycle the materials, embodied energy, methane and soil carbon, then GHG emissions could be reduced by 18 million tonnes per annum. A natural, carbon rich soil fertiliser would be an additional benefit, helping farmers to avoid the need for GHG intensive chemical fertilisers. This technology and infrastructure is particularly needed in rapidly developing economies like China and India.

A $200 million government fund to cover the 'funding gap' at the State level between landfill prices and advanced waste treatment processing fees, would provide sufficient incentive for private sector debt and equity to invest in. This would result in the commissioning of 5-10 plants (10 if State Governments provide matching funds) to initiate the national roll-out. Achieving the 10% per annum reduction in GHG emissions mentioned earlier, could be achieved at a one-off Federal Government investment of approximately $2 per tonne of annual carbon credits, when the fertiliser product is adopted in the market, and when the model is also applied to commercial and sewage waste.

Hot rock geothermal - the investment and the return

The energy delivery and GHG emissions reduction benefits of Australia's hot rock geothermal are substantial. Industry projections show a geothermal station producing 40 MWe of power could be up and running by 2010, expanding to 500 MWe by 2015. By 2030 there could be 4,500 MWe of geothermal energy entering the national grid, accounting for 25% of new energy generation and saving the equivalent of 5 million cars worth of GHG emissions (30 million tonnes CO2). The Centre for International Economics (CIE) estimates that HFR geothermal could inject more than $10 billion into the national economy by 2030 with additional benefits of enabling mining in the Moomba to Adelaide corridor estimated to be around $4.3 billion

Modelled costs for generating large amounts of baseload electricity, with a price on carbon dioxide emissions at an estimated $30 per tonne, are $45 per MWh for HFR geothermal which is significantly lower than nuclear and gas ($65 per MWh) and coal ($67 per MWh)[11].

A recent McLellan Magasanik Associates report[12] suggests geothermal is the most cost effective source of energy in spite of the distance from end users.

Solar thermal power - the investment and the return

[11] Based on data from the UMPNER and Geodynamics
[12] 29 March 2007; comparing clean coal, gas, renewables, nuclear, energy efficiency

The anticipated construction and development cost of early solar thermal power plants is around $1 million for a unit of installed capacity capable of generating 1 gigawatt hour per annum of electricity. This translates to a generating cost of approximately 10 cents per KWh, comparable to large wind plants.

An additional benefit of solar thermal is the flexibility to combine solar collector technology with high temperature thermo-chemical energy storage. This combination means that multi megawatt baseload energy or on-demand peak electricity generation can be selected. Solar thermal energy can also boost a variety of industrial and agricultural technologies including desalination, sewerage treatment, chemical extraction, town heating, horticulture (e.g. fuel from biomass) and aquaculture.

Globally, the value of the concentrated solar power market is expected to reach $28 billion by 2020. The European Solar Thermal Industry Association (ESTIA) estimates that the "OECD Pacific/Australia" market in 2025 will have more than 2000 MW of solar thermal power projects, estimated to be worth US$700 million.[13]

Wave power with desalinated water - the investment and the return
Australia could have sufficient wave power plants in place by 2020 to generate 2,000 MW from multiple ocean energy devices. Alternatively these same plants could produce 125 billion litres of desalinated water or a combination supply of electricity and drinking water. For a wave energy plant generating 200 MWe, electricity is expected to be supplied at under 5 cents per KWh.

Even electricity from early one-off devices is expected to be supplied at under 10 cents per KWh. Desalination costs are expected to be under $1 per 1000 litres of water. Compared to the real cost of coal fired electricity 100 years ago (approximately $2 per KWh in today's dollar terms), wave energy is further down its cost curve[14].

Globally, the value of the wave energy market is expected to reach $7 billion p.a. by 2020 and the UK government estimates there will be $1 trillion of capital expenditure on wave energy technology by 2025.

Wind power - the investment and the return
The Federal Government's report on the nuclear industry[15] includes statistics on the energy payback time for electricity; wind is six months, five years for nuclear, seven for solar photovoltaic and higher for gas and coal due to the energy used up in the mining resource extraction process.

Wind energy provides the lowest energy intensity and arguably therefore, the fastest payback time in terms of energy used and energy produced out of all electricity technologies in Australia. The only technology in the world with a faster energy payback time than wind is run of river hydro which is only mainly used in regions of high rainfall such as New Zealand and Chile.

[13] European Solar Thermal Industry Association (ESTIA): Exploiting the heat from the sun to combat climate change - Concentrated solar thermal power now. (2005).
[14] Source, Oceanlinx
[15] UMPNER report prepared by Dr Ziggy Szwitkowski

Electricity produced from wind energy in Australia is currently supplied at approximately 7 cents per kWh. The long-range average cost of generating electricity from wind is expected to drop steadily from above $65/MWh to approximately $50/MWh in 2025.[16] Wind has been operationally refined over recent years bringing it down its cost curve further than other renewables which have yet to be as extensively deployed.

A Government enabling framework

The private sector's technological innovation can provide many of the solutions to environmental challenges, but it cannot operate successfully in isolation. Government policy intervention is critical to provide 'friendly markets'[17] for the next generation of business. In reality this is no more than putting in place an enabling framework[18] that allows the market to establish pricing which fosters a true competition process.

Government should:

- **Start by setting enforceable caps on emissions with mandatory GHG abatement targets of 20% by 2020 and 60% by 2050. There should be no cap on the price of carbon as the market should be given free rein to discover this price.**
- **Speed up introduction of emissions trading, introduce interim carbon pricing steps; for investors and project developers four or five years is too long to wait for a carbon price signal to take effect, confidence in the market needs to be re-established.**
- **All high emitters – sectors and companies to be included in emissions trading (including stationary energy, industry, agriculture, built environment, waste). No exemptions and no quarantining. Any compensation that the government may deem necessary for trade exposed sectors should follow their full engagement in emissions trading and could be funded from auction of emissions permits for capital grants, accelerated depreciation, or R&D.**
- **Full cost pricing/internalisation of externalities to avoid free-riders distorting the market. Uphold competitive neutrality so that businesses which lead on emissions/pollution/waste reduction are no longer undermined by competitors who currently achieve an unfair competitive pricing advantage by outsourcing their waste and pollution onto the environment.**
- **Creation of a 'climate bond' for individual as well as institutional/superannuation fund investors; in addition, use revenue from penalties and sale of permits to fund R&D, plant retirement/accelerated depreciation, technology replacement, capital grants, technology deployment .**
- **Energy efficiency *performance* measures to be made mandatory within 12 months.**

[16] Renewable Energy Generators Australia: Renewable energy – A contribution to Australia's environmental and economic sustainability (2006).
[17] Friendly markets concept proposed by the World Business Council for Sustainable Development (WBCSD)
[18] The 'enabling framework' concept was coined by Environment Business Australia to explain why governments need to use their powerful tools and levers as innovatively as the private sector uses technology and finance. www.environmentbusiness.com.au/policy

- **An increase to the Mandated Renewable Energy Target (MRET) to 10% by 2010, 15% by 2015 and 20% by 2020. The current retirement of MRET has done a great deal of harm to investor and project development confidence in the Australian market. MRET was recognised as a world leading renewable energy deployment initiative and was so successful in attracting investment that its initial target was achieved ahead of due date.**
- **Combine the best elements of VRET, NRET and QLET and to roll out an expanded MRET.**
- **Development of mandatory targets as complementary measures to fast-track the deployment of technology 'wedges'[19] and to reduce waste.**
- **Remove subsidies and preferential contracts that create perverse outcomes. To avoid economic or employment upheaval the subsidies could be re-allocated to foster socially and environmentally desirable outcomes.**
- **Product stewardship regulation across a broad range of products and commodities.**
- **Rapid introduction of standards for energy efficient appliances, goods and services.**
- **Speed up Australian introduction of benchmark OHS& E standards to bring Australia into line with world's best practice.**
- **Facilitating investment, especially from overseas major institutional investors keen to invest in the cleantech space such as CalPERS.**
- **Fiscal incentives and penalties – for example applying funds raised from the emissions trading scheme to accelerated depreciation and replacement of technology; re-investment tax concessions.**
- **Using government's own procurement and investment to drive desired outcomes and create new markets.**
- **Full cost recovery pricing as a sound basis for competitive neutrality.**
- **Trade negotiations at WTO, multi-lateral and bi-lateral level including environmental standards.**
- **Education.**

Regulation is key to success

This is not a proposal for *more* regulation. It is a strong recommendation that a key priority of the Federal Government should be to focus regulation on desired outcomes, and then to streamline and harmonise regulation across all three levels of government and across all departmental jurisdictions. At present regulation in Australia is fragmented, frequently contradictory, and centred around outdated prescriptive processes or technologies. Current regulation does not provide sufficient clarity to company boards of directors or to investors. It provides neither sufficient incentive to leaders, nor adequate penalty to laggards.

Regulation is required to uphold mandated standards of performance in energy efficiency, to drive low/zero emissions energy delivery, and to fast-track waste and pollution eradication. The mandated targets suggested above can 'sit' beneath an overarching emissions trading framework.

[19] Princeton University study of technology wedges to provide energy while reducing GHG emissions

Supply chains in developed countries like Australia should maintain standards in developing countries

Targets are needed not only to improve performance in Australia but also to address the consequences of Australia demanding goods at rock-bottom prices from the developing world. As China and India are pressured to accept binding targets in phase two of the Kyoto Protocol, the countries (and their consumers) applying this pressure are forgetting their complicity in the levels of pollution and GHG emissions in developing nations.

Consumer market supply chains in Australia, and the USA in particular, are leading the demand for "cheap" products. These are cheap goods made with cheap labour and cheap energy. "Cheap" invariably means poor safety, social and environmental standards as the revenue is not sufficient to cover investment in clean and efficient manufacturing processes.

High standards in the international operations of leading resources and mineral processing companies are maintained in developing countries in relation to child labour, occupational health, safety and environment (OHS&E) standards. The same obligations should be placed on the manufacture/wholesale/retail/investment/project development supply and logistics chain. Australia should encourage all developed-economy trading nations to require equivalent OHS&E standards from their companies operating overseas countries for:

- **All imported resources or manufactured goods**
- **All industrial and manufacturing processes financed, or project developed in developing countries**

In other words the market should demand the same standards in India, China or other developing countries, as we require of first-world suppliers and this includes levels of embodied GHG emissions.

Benefit/cost analysis

Australia's abundance of resources and skills

Australia's abundance of natural resources and environmental 'gifts' can deliver strong economic benefits[20] especially if the country achieves earlier rather than later transition to a clean energy future. This is an important consideration as, unlike previous technology driven transformations (such as IT and automated high volume manufacturing), Australia is uniquely advantaged to outperform in this one due to our abundance of natural resources, access to renewable energy, and our world leading resources/infrastructure development skills and corporate expertise.

Cost of 'clean' is low, the cost of damage is high

The cost of achieving a clean energy and a climate-safe transformation on a global scale has been put at 1% of GDP by the Stern Report. We recognise it may well be slightly higher in Australia due to our energy intensive economy.

[20] positive GDP results as opposed to increasing GDP by inflicting negatives impacts which have to be overcome (e.g. car crashes are perversely 'good' for GDP)

On the other hand, the costs of inaction would be far higher in Australia as the country is highly vulnerable to the impacts of climate change.

Australia's market vulnerability to climate change

Australia would also be highly vulnerable to other countries shifting production of goods and services from coal to other energy sources if we are not able to clean up and value-add to our coal and metals resources. Australia already exports alumina to Iceland for processing using clean geothermal energy, and the international market demand for light metals (because of their end use efficiency) may soon be accompanied by demand for supply chain carbon intensity verification. It would be logical to assume that Australia could smelt alumina domestically using geothermal energy thereby fulfilling market demand for lightweight metals with a low carbon footprint.

Failure to take advantage of transition to a low-emissions energy future could be devastating to the Australian economy for the following key reasons:

- **The country will not be prepared for changes in resources and energy demand - we may lose our energy advantage, and will be vulnerable to international instabilities over oil supplies.**
- **Our exports are vulnerable to changes/restrictions in market demand (for example, overseas importers stapling carbon miles to Australian wine).**
- **Skilled and experienced personnel may seek jobs overseas.**

Already, a clear negative outcome has been the unexpected loss of productivity under recent weather conditions (probably climate change induced and certainly worsened by climate change) due to our historic failure to invest in water and energy efficient systems.

Ten times richer in 2100 or 2102

A number of economists, including Stanford's Professor Stephen Schneider, have argued that if the cost of action to reduce GHG emissions is spread out over the appropriate timeframe, the community does not suffer economic hardship from the marginal slowing of the projected growth in global GDP "whether we became ten times richer in 2100 versus 2102 would hardly be noticeable." Professor Schneider likens the investment necessary to tackle climate change to a "politically acceptable insurance policy against the spectre of potentially 'dangerous' climate changes". Most risk averse people would select this insurance.[21]

Give up a cup of coffee a week for climate action

This point has been reinforced by the AGL/Frontier Economics/WWF report[22] which says "A prosperous society is dependent upon a relatively stable climate". They put the cost of reducing GHG emissions by 40% by 2030 at between $5.19 billion NPV and $24.16 NPV (depending on the pathway chosen and whether or not large-scale measures to use energy more efficiently are put in place). This represents a cost of between 43 cents and

[21] C.Azar, S.H. Schneider / Ecological Economics 42 (2002) 73-80
[22] Options for moving towards a lower emission future; May 2007

$2 dollars a week per person each year to 2030. In other words the cost is equivalent to everyone foregoing one cup of coffee a week over 20 years. Costs always seem high when billion dollar figures are mentioned, but it behoves government to explain that this cost is spread over a 20 year time frame and it is probably the cheapest insurance policy available on the market today.

Clean energy is cost competitive

Recent work by Ziggy Switkowski, Allens Consulting, McLellan Magasanik, Vattenfall[23], McKinsey and others reveal that in the very near term gas, solar thermal, and hot rock geothermal can be considered cost competitive with clean coal (with carbon capture and storage) and wind is already close to competitive with traditional coal.[24]

New technologies come down a cost curve but pollution goes up

The cost of initial demonstration and first major operational plants is always higher than the direct cost of maintaining existing plant. Imagine the cost of installing coal-fired electricity across the country today if it did not already exist. But, as clean energy and renewable energy sources enter the market and come down their cost curve, the cost impacts of pollution and climate change will be rising. The economy wide cost savings of renewables/clean energy/energy efficiency become considerably more important as more energy is required globally. It is reasonable to expect a crossing point once these externality costs are no longer hidden from the public and the market, and as the community increasingly demands that the collateral damage of waste, pollution and GHG emissions be eliminated.

Higher capex – lower opex

Policy intervention should be ahead of this demand in order to support the benefits and reduce the potential negative economic impacts of retirement/replacement of outdated technologies and plants. The capital costs of making energy services delivery smarter and more efficient should be seen as an investment in lowering operating costs. Like any other major investment in plant, amortisation over time should feature in investment decisions, allowing current spend to be made without the constraint of governments wanting to appear 'debt free'. The national energy strategy should therefore include future generations paying their share of energy delivered and damage avoided.

New energy generation may require additional investment if extensive tracts of land are required, or where generation is sited away from capital cities requiring lengthy grid transmission. However, co-location options[25] can cut costs, and high voltage DC transmission lines can transmit power over long distances with minimal loss.[26]

Early climate action is good for Australia

[23] http://www.vattenfall.com/climatemap
[24] For example, see Fig. 4.7 levelised cost ranges for various technologies, UMPNER Report
[25] For example, co-locating solar thermal, HFR geothermal and algae biofuel production
[26] High voltage DC transmission lines are used in the Basslink Interconnector between Tasmania and the mainland.

Early action will bring economic benefits by helping Australia to:

- **Make domestic and export markets work more efficiently**
- **Build social as well as economic, trade and environmental benefits**
- **Help provide energy security/independence**

Main impediments to action

For decades Australia, and other Western countries, have benefited from artificially deflated prices for energy and water - we have become used to this low pricing and we have become complacent about the implications[27]. The lack of full cost recovery pricing has lead to negative externalities[28] for example the collateral damage of coal fired electricity (pollution, greenhouse gas emissions, land sterilisation) is not included in the costs through the supply chain and to the end consumer. This has created a fundamental lack of competitive neutrality for the new, and cleaner, energy sources trying to access the market.

Renewable energy *appears* more expensive because it carries early R&D, demonstration, commercialisation and high market penetration costs in its pricing, at present the market is not yet sufficiently up to speed with the difference between negative and positive externalities and is not deciphering the available signals and is continuing to favour the entrenched energy providers. This means that greenhouse gas emissions continue to rise. Once emissions are priced, they become an additional cost of production either directly or through higher prices for emissions intensive goods and services used in production.[29] This will provide a much needed incentive to reduce emissions or to substitute low emission sources of energy.

Clearly, while the significant potential for the GHG reduction approaches above may seem straightforward on paper, this potential will not be achieved until a level playing field is created for new market entrants. Economies of scale favour new technologies being brought down their cost curve - allowing the economy to tap into their full potential.

Conclusion

International responsibility to lead where we are able

As a country endowed with an abundance of renewable and other energy sources, Australia has an international leadership responsibility to champion technology development. Firstly to develop next era clean energy supply, and secondly, to help other countries by speeding up technology transfer and by helping to build up expertise capacity. The third benefit is that this approach can increase our energy security and help other countries do likewise.

Clear trends of climate change impacts emerging

There are many scientific, economic and security reports now in the public domain[30] and their findings reinforce our recommendations that we must act

[27] ExternE study EU and USA collaborative report
[28] Significant collateral damage to the global and Australian commons; for example impacts on soil productivity, lower rainfall leading to drought, and damage to iconic assets such as the Great Barrier Reef
[29] Switkowski UMPNER Report
[30] Pentagon, Lowy Institute, Hadley Centre, Tyndall Centre, Pew Centre, IPCC, NASA, Stern Review inter alia

speedily and forcefully to cut greenhouse gas emissions (GHG). By doing this we will combat the three main trends that concern scientists, investors, politicians, business leaders and the community. These trends are the continuing increase in GHG emissions, increasing global warming, and rising sea levels. The foreseeable impacts of these trends include population dislocation and migration, food production shortfalls because of flooded agricultural land and desertification, and the spread of diseases.

These points were reinforced in May this year by NASA scientist, Dr James Hansen, who suggests the planet is dangerously near a major climate change tipping point. This would mean that regardless of the ability of human beings to adapt, the eco-system services that we rely on could foreseeably collapse.

Therefore, while Australia has just 0.3% of the world's population, and our GHG emissions represent 1.3% of the global total, we have a responsibility to act. We are in a strong position to tackle the treat of climate change with national and international short and long-term benefits due to our:

- **Ability to develop and deploy technology solutions to overcome this heavy carbon footprint**
- **Geographic position**
- **Resources and endowments**
- **Financial capital**
- **Intelligence**
- **Skilled and multi-national workforce.**

Exporting energy efficiency/clean energy products and services into Asia presents one of the best commercial opportunities for wealth generation ever presented to the nation. Enhancing Australia's wealth and balance of payments is just one of the benefits. We also have a vested self-interest in providing clean energy and clean technologies to developing countries so they can pull their people out of poverty. Reducing tension and reducing greenhouse gas emissions in the region will accrue tremendous benefits for Australia.

The necessary first step is for governments to enable transition with a national emissions trading scheme which includes clearly articulated GHG emissions reduction targets that put a firm cap on emissions (not on the price of carbon). That needs to be combined with timetables, milestones and innovative complementary policy measures headed by regulatory reform that is outcome focused. This will allow the market to discover the real cost of carbon, in turn facilitating investment into the new 'cleantech' economic wave.

Australia has always benefited from previous technology waves and will benefit most from the 'cleantech' wave by being an early commercialiser of innovation.

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5 September 2007

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