Submission No: 139

Australian
Business Council
for Sustainable
Energy

Committee Secretary
Standing Committee on Industry and Resources
House of Representatives
PO Box 6021
Parliament House
CANBERRA ACT 2600

10 July 2007

Dear committee members,

Email: ir.reps@aph.gov.au

BCSE Submission to the Inquiry into the Development of the Non-Fossil Fuel Energy Industry in Australia: Case Study into Selected Renewable Energy Sectors

The Australian Business Council for Sustainable Energy (BCSE) welcomes the opportunity to provide comment to the House Standing Committee on Industry and Resources' Inquiry into the Development of the Non-Fossil Fuel Energy Industry in Australia: Case Study into Selected Renewable Energy Sectors.

The BCSE is an independent member-based industry association representing the broader sustainable energy industry in Australia. The BCSE has over 300 businesses and other organisations as members covering renewable, natural gas and distributed energy generation equipment suppliers and installers, energy retailers, and energy efficiency product and service providers. The common feature of our membership is their interest in meeting Australia's energy needs with lower greenhouse emissions.

Climate change is a critical global challenge. The Stern Review has said that the power sector around the world will have to be a least 60 per cent decarbonised by 2050 in order to stabilise at or below 550ppm CO2-e. Renewable energy will be absolutely essential to meeting this challenge in the most cost-effective way and to drive technological improvement and cost reductions of renewable energy requires deployment and associated market experience. We expect emissions trading in at least the first decade or two will not adequately facilitate this deployment and additional policies will be required.

The appendices included within this document are an integral part of this submission. We have also provided a series of attachments that are an integral part of, and should be read alongside, this submission.

If you have any questions or issues you would like to raise please do not hesitate to contact Tristan Edis via phone: 03 9349 3077 or e-mail: tristan@bcse.org.au.

Original signed by

Ric Brazzale
Executive Director

Executive summary

Climate change is a significant global challenge. The Stern Review has said that the power sector around the world will have to be a least 60 per cent decarbonised by 2050 in order to stabilise at or below 550 parts per million (ppm) of CO_2 equivalent (CO_2-e). That renewable energy will be absolutely essential to meet this target is recognised by the Federal Minister for the Environment and Water Resources Malcolm Turnbull, who said to Sky News:

"I mean, the thing that a lot of people overlook is that in order to get to the massive reductions in greenhouse gas emissions by mid century we are talking about having to have all of our electricity, or almost all of it and almost all of our transport energy, coming from zero emission sources

Renewable energy includes a diverse mix of technologies utilising a wide range of resources, of which Australia has a plentiful supply. These technologies, including hydro, wind, solar photovoltaic, solar thermal, geothermal, bio-energy and wave currently contribute around 8-10 per cent of Australia's electricity sent out to the grid[1]. Currently, Australia has 8381 MW of renewable energy capacity, with another almost 1200 MW either committed or under construction.

Our climate change response will require a significant up-scale in the market share of renewable energy. The current industry size is very modest in comparison to the renewable energy resource available in Australia. Together, and in combination with other energy technologies, these renewable resources can be reliably incorporated into the electricity grid – improving our energy security without the need for storage technologies.

Growing a world class renewable energy industry is a huge economic opportunity for Australia. While currently just a modest size compared with its potential, the industry provides significant employment (over 6,200 direct jobs) and generates significant investment. Globally the industry saw $38 billion in investment and a 22 GW increase in installed capacity during 2005.

While emissions trading will be the backbone to Australia's climate change response, in the near term we do not expect it will be sufficient to drive investment in renewable energy. However, a massive upscale in renewable energy will be necessary in the medium to long term. It is in the best interests of Australia to continue to support renewable energy deployment now, in order to ensure a strong local industry and a significant cost reduction in the technologies through learning-by-doing. In the long run this will mean cheaper renewable energy when it is most needed and will reduce the overall cost of emissions trading over the medium to long-term. This will require continued renewable energy deployment policies in the near term, but ultimately these should be withdrawn for technologies as they achieve scale and maturity and become competitive under a carbon price that reflects the social cost of greenhouse emissions.

Minister for the Environment and Water Resources Malcolm Turnbull has explained this principle in outlining the reasoning behind the government's expansion of the Photovoltaic Rebate Program:

"It is very expensive relatively to grid connected fossil fuel powered energy so it is an expensive way to buy greenhouse gas abatement, there's no question about that. The reason for the solar subsidy is to drive technology. What we're doing is fuelling demand so that there'll be more solar panels built, more installed, people will learn through experience. A lot of the cost of installing a solar panel is actually the truck roll and you know getting up on the roof and all of the techniques of doing it, not just building the panel, so the more demand there is the more costs come down and every country in the world – be it Australia, be it California, be it Germany or Japan – that subsidises solar panels does so for the purpose of driving it down the cost curve, because what we're all looking for is that time when photovoltaics are really competitive with grid connected energy because they are an enormous opportunity… the purpose of the photovoltaic rebate is to drive a developing technology."

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[1] While ABARE reports that renewable energy had a markets share of 7.4 per cent of Australia's electricity production in 2004-05, this data includes significant auxiliary electricity use (the electricity used internally by power stations). If auxiliary energy use is removed, the market share of renewable energy contribution to Australia's useful electricity supplied to the grid is greater than ABARE quoted figures.

Other jurisdictions participating in and planning emissions trading also have renewable energy deployment policies. In the United States, many of the states planning emissions trading, such as the North East states - planning the Regional Greenhouse Gas Initiative - and California, also have Renewable Portfolio Standards (market-based renewable energy target schemes). In Europe, the European Union has committed to a legally binding overall target of 20 per cent renewable energy share of gross inland energy consumption by 2020 (covers not only electricity, but also heat and transport), to be met concurrently with the operation of an emissions trading scheme. This is backed by member states having implemented renewable energy deployment schemes such as premium feed-in tariffs or market-based renewable energy targets.

There is a robust economic rationale to continue and indeed expand renewable energy deployment schemes in Australia in parallel with emissions trading. While these schemes could be improved and streamlined, abolishing these schemes without any viable replacement would threaten investor confidence in the energy sector, drive-up the cost of greenhouse reductions in the medium term and squander a substantial economic opportunity for Australia.

In summary:

- Responding to climate change requires a major shift in the emissions intensity of our electricity. Renewable energy is essential to this effort.
- Renewable energy is a market-ready technology that can meet a large share of Australia's electricity needs without the need for technological breakthroughs.
- Growing a world class renewable energy industry is a major economic opportunity for Australia.
- We can significantly increase the contribution of renewable energy to our electricity supply while maintaining highly reliable and secure electricity. Intermittency is not the constraint some have suggested.
- Emissions trading will form the backbone of Australia's response to climate change but alone it will be inadequate. To ensure the most cost effective greenhouse abatement we need additional policies.
- To drive technological development and reduce costs we need to deploy renewable energy at increasing scale *now*.
- To ensure the most cost-effective response to climate change renewable energy deployment support is needed.
- Most other jurisdictions participating in emissions trading internationally have recognised the need for complementary renewable energy deployment policies
- Federal and state renewable energy deployment schemes in Australia should be continued or expanded as complements to emissions trading

Responding to climate change requires a major shift in the emissions intensity of our electricity. Renewable energy is essential to this effort.
The existence of global warming has now been accepted. This year the Intergovernmental Panel on Climate Change, which brings together hundreds of the world's scientific experts in the study of climate, has released its Fourth Assessment Report. They have concluded that *"warming of the climate system is unequivocal"* and that *"the global increases in carbon dioxide concentration are due primarily to fossil fuel-use and land-use change, while those of methane and nitrous oxide are primary due to agriculture".*

Global warming is driven by human emissions of greenhouse gases and is an immediate problem which requires urgent attention. Just as electricity generation is the largest contributor to Australia's greenhouse gas emissions (35 per cent) so it will need to be the primary part of the solution to the problem. Emissions from electricity generation increased by 50 per cent between 1990 and 2005.

The UK Government's Stern Review on the Economics of Climate Change recommended that in order to contain the risks of dangerous climate change to tolerable levels and avoid catastrophic events, we need to limit greenhouse gas concentrations to between 450 and 550 ppm CO_2-e.[2]

According to the Review, in order to do this:
"By 2050, global emissions would need to be around 25% below current levels. These cuts will have to be made in the context of a world economy in 2050 that may be 3-4 times larger than today – so emissions per unit of GDP would need to be just one quarter of current levels by 2050. The power sector around the world will have to be at least 60%, and perhaps as much as 75%, decarbonised by 2050 to stabilise at or below 550ppm CO2-e."

Environment Minister Malcolm Turnbull has recognised the necessity for renewables in this context:
"I mean, the thing that a lot of people overlook is that in order to get to the massive reductions in greenhouse gas emissions by mid century we are talking about having to have all of our electricity, or almost all of it and almost all of our transport energy, coming from zero emission sources."
(Sky News)

Renewable energy is a market-ready technology that can meet a large share of Australia's electricity needs without the need for technological breakthroughs.
Renewable energy encompasses a variety of sources utilising a diverse range of technologies. These technologies include bioenergy, solar photovoltaics, solar thermal (including solar water heating), hydro, wind, geothermal, wave and tidal technologies. Bioenergy, itself a diverse group, includes the energy from sugar cane residue (bagasse), sewage gas, landfill gas, agricultural and food wastes and wood waste. These resources are dispersed across a very large area of Australia. This diversity is a significant strength in offering multiple opportunities for technological improvement and security of supply. If one fuel-type or technology faces problems or constraints, other fuel-technology combinations can fill the gap. Geographic diversity also reduces risk and balances out the variances experienced in one geographic area, due to say local weather patterns.

The BCSE has prepared a series of papers on the different technologies which discuss the current costs and size of the local industry and market share, the available resource and specific barriers they face. These briefing papers (**Appendices 1 through to 4**) on solar photovoltaics, bioenergy, solar water heating and wind power accompanied by the PV Roadmap (**Attachment 1**) and an industry fact sheet on geothermal energy (**Appendix 5**) are supplied as attachments. *Australia's Renewable Energy Use, Technologies and Services,* which profiles the Australian industry, programs and initiatives, is also attached (**Attachment 2**).

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[2] Sir Nicholas Stern (2006) *Stern Review: The Economics of Climate Change*, available from www.sternreview.org.uk

Cumulative renewable energy capacity installed by 2004-05 provided 18,600 GWh of Australia's electricity and currently contribute around 8-10 per cent of Australia's electricity sent out to the grid. According to the BCSE's annual publication, the *Clean Energy Report 2007,* as of end 2006 Australia had 8381 MW of renewable energy capacity. Of this capacity 568 MW had been commissioned just in the past two years. Another almost 1200 MW of capacity was also committed or under construction as at the end of 2006. A copy of the *Clean Energy Report 2007* will be mailed to all members of the Committee and provides a comprehensive snapshot on the current state of the clean energy industry in Australia.

Appendix 6, *Australia's Clean Energy Resource Base,* prepared by the BCSE, summarises Australia's renewable energy (as well as gas) resources including their energy potential, costs and constraints. Current renewable energy capacity is a tiny fraction of what the industry could provide, given policies to drive demand. There is a large, high quality renewable resource base available in Australia. Twenty per cent of our electricity needs from renewable energy by 2020 is readily achievable and meeting half, or even more, of our needs by 2050 is also a realistic and desirable goal.

The industry has the ability to quickly respond to policy, progressing new projects and bring new electricity generation capacity to market. The response of Australia's renewable energy industry to the Federal Government's Mandatory Renewable Energy Target (MRET) scheme is an indicator of the ability of the industry to meet Australia's growing energy needs. MRET is fully subscribed, so there is enough plant either operational, committed or under construction to meet the 9,500 GWh demand for renewable energy certificates created by the scheme. This has occurred years ahead of the target date of 2010.

Renewable energy is now a major player in the power generation sector. Globally, existing worldwide capacity grew during 2005 by 22 GW to a total of 182 GW (this is in addition to the 748 GW of large conventional hydro capacity). In 2006, 15 GW of new wind capacity was installed globally, bringing the total existing wind capacity to 74 GW [3]. Cumulative global capacity is forecast to grow to 230 GW by 2020. The annual rate of installation of new capacity would by then be running at 34 GW [4]. In 2005, 1.2 GW of new solar photovoltaic (PV) capacity was installed globally, bringing the total existing solar PV capacity to 5.4 GW.[5] Solar PV cell/module annual production is forecast to grow to 10 GW by 2010 [6]. To put this in perspective Australia's entire total generating capacity is just over 50 GW.

The capacity of newly commissioned wind projects is particularly significant, overtaking nuclear new build prior to the year 2000. Since then wind capacity under construction has continued to climb, significantly outstripping nuclear capacity installed over the same period (see figure 1 below). According to the US Department of Energy, wind power was second only to gas in its share of new power generating capacity installed in the US in 2005 and 2006 and greater than coal and nuclear[7].

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[3] Global Wind Energy Council (2007) Press Release: *Global wind energy markets continue to boom – 2006 another record year*, 2 Feb 2007.
[4] Crispin Aubrey, Angelika Pullen, Arthouros Zervos, and Sven Teske (2006) *Global Wind Energy Outlook 2006.*
[5] REN21 (2006) *Renewables Global Status Report 2006 Update.* (Paris: REN21 Secretariat and Washington, DC:Worldwatch Institute).
[6] Michael Rogel, Paul Choi, Joel Conkling, Anthony Fotopoulos, Keith Peltzman and Scott Roberts (2006) *Solar Annual 2006*, Photon Consulting.
[7] US Department of Energy (2007) *Annual Report on US Wind Power Installation, Cost, and Performance Trends: 2006*, May 2007.

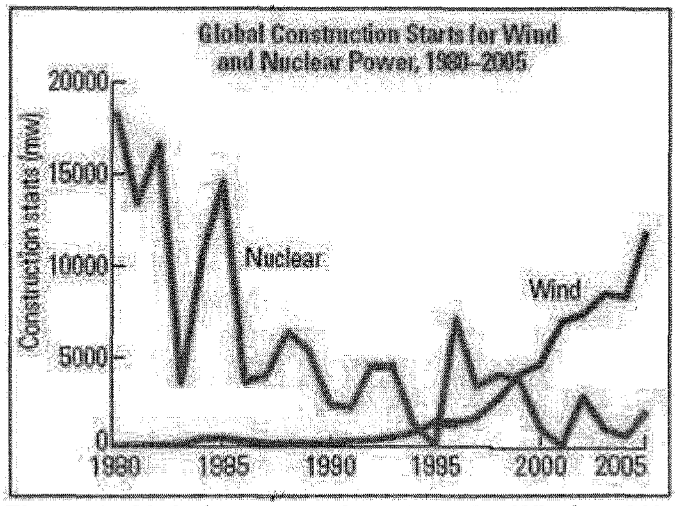

Figure 1: Global construction starts for Wind and Nuclear Power, 1980-2005[8]

Renewable energy is already a serious and significant source of power. Even without technological breakthroughs it can supply a very substantial proportion of Australia's needs. Thankfully further technological improvements can also be expected as the market and experience grows.

Growing a world class renewable energy industry is a major economic opportunity for Australia

Renewable energy is already delivering jobs and investment for Australia. While the Australian renewable energy industry is but a modest size compared to its potential, it is conservatively estimated that it provides direct employment for over 6,200 people. In general, renewable energy technologies provide significantly more jobs per unit of energy generated than for fossil-fuel alternatives.

Capital investment in wind, hydro and bioenergy generation projects alone has totalled $1.8 billion for projects commissioned since 1997 (the baseline year for the MRET scheme). This does not include the significant investment in solar photovoltaic and solar thermal over this period of time. Internationally, renewable energy is a booming industry, 2005 saw a record investment of US$38[9] billion into new renewable energy capacity globally, excluding large hydro capacity. This was up from US$30 billion in 2004. If large hydro capacity is included, this brings the years investment up to between US$53 - 58 billion. The leading countries (excluding large hydro) were Germany and China which each invested US$7 billion, followed by the United States, Spain, Japan and India. (If large hydro is included China's investment rises to US$17 billion.) The leading technologies sharing in this investment in 2005 were wind power, solar PV and solar hot water. The leading technologies with respect to capacity deployed during the year were large hydro, wind and solar water heating. This investment supports nearly one million direct jobs in ongoing employment in manufacturing, operations and maintenance (excluding jobs in large hydro generation). Jobs supported in allied industries are likely to be several times larger.[10] The *Renewables: Global Status Report* of the Renewable Energy Policy Network for the 21st Century (REN21) reports on the status of the industry globally – the market, growth areas and industry trends. Attached are the 2005 Report and the 2006 Update (**Attachments 3 and 4**).

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[8] Worldwatch Institute (2006) American Energy. *The Renewable Path to Energy Security* (Washington: Worldwatch Institute)

[9] REN21 (2006) *Renewables Global Status Report 2006 Update*. (Paris: REN21 Secretariat and Washington, DC:Worldwatch Institute). This includes approximately US$1 billion of investment into biofuels

[10] Derived from data reported in the *Renewables 2005: Global Status Report* and updated in the *Renewables: Global Status Report, 2006 Update,* excluding jobs from biofuels.

Australia has the opportunity to secure a larger share in this booming industry. If Australia were able to fully develop the bioenergy sector and deliver a fifth of its electricity from this source by 2030, the BCSE estimates this would lead to the creation of fifty thousand job years in construction and manufacturing and seven thousand ongoing jobs.[11] The BCSE estimates if all the wind projects in Australia that are actively under evaluation and planning were to progress, along with all projects currently operating and under construction, the industry would support 5,500 jobs in operations and maintenance and over 31,600 jobs in construction and manufacturing.[12] However, to exploit these opportunities there must be a domestic market for renewable technologies, to maintain and attract a local industry in design and manufacturing. If we don't do this, the industry will take its investment and the jobs this creates offshore.

We can significantly increase the contribution of renewable energy to our electricity supply while maintaining highly reliable and secure electricity. Intermittency is not the constraint some have suggested.

Those unfamiliar with these issues have raised doubts regarding the ability of renewable energy to deliver baseload electricity. However, whether a specific technology can deliver baseload or not, is not actually the correct question. The real requirement of our power sector is the provision of reliable, secure, low-emission, safe electricity when and where we need it. Rather than intermittency what really matters to the end-user and the network operator is whether energy can be provided reliably.

It is important to look at this issue of reliability and variation from a system perspective, rather than on a power station by power station basis. Renewable energy is a heterogeneous mix different technologies with complementary attributes. Together, and combined with other energy sources such as gas-fired generation, these technologies are capable of providing highly reliable zero-emissions energy to Australia's homes, businesses and industry. Renewable energy has already been very successfully incorporated into the national electricity grid as well as smaller regional grids such as the South West Interconnected System (SWIS) and this has been managed *without* the need for storage.

Appendix 7 *Renewable and Reliable* looks at some of the studies that have investigated penetration of renewable energy in the technology mix and discusses the evidence that renewable energy is ready to supply reliable power into the electricity grid at significantly greater levels that have currently been achieved.

South Australia is a case in point demonstrating the ability of the grid to accept a significant level of penetration from renewable energy technologies. Wind projects currently operating and under construction will by 2008 provide 16 per cent of South Australia's electricity needs. This has occurred with no increase in the required reserve capacity and ancillary services costs have declined. Along with landfill and sewage gas generation and solar photovoltaics this wind capacity brings South Australia very close to its 20 per cent target for renewable energy market share of the state's electricity demand. In their submission to the Electricity Supply Industry Planning Council (ESIPC) on the issue of high wind penetration in South Australia, the SA transmission network operator, ElectraNet, said that wind powered electricity generation was capable of meeting technical standards for connection to the grid required to assure power quality. The ElectraNet submission also said that the reserve margin in existence at the time should be adequate for the addition of wind generation without the need for additional reserve capacity. In particular, commenting on wind fluctuations, the submission says *"Statistical information from a single meteorological mast at one potential wind site indicates that the probability of the total loss of a large scale wind farm in a single 10 minutes period would be less than 0.01%. This is of the same*

[11] Business Council for Sustainable Energy (2007) *Bioenergy. Renewable Baseload Power.* (Brochure Attached)

[12] Business Council for Sustainable Energy (2007) *Wind, Serious power ready now.* (Brochure Attached)

order as the probability of a large single unit trip in a conventional power station." (See **Attachment 5** *Comments from ElectraNet*).

The rest of the National Electricity Market (NEM) has non-hydro renewables penetration of less than 2 per cent, and in the SWIS it is approximately 4 per cent. This demonstrates that there is significant room for growth before reaching the levels already being successfully managed in South Australia.

Emissions trading will form the backbone of Australia's response to climate change but alone it will be inadequate. To ensure the most cost effective greenhouse abatement we need additional policies.

The Stern Review clearly states the importance of technology policy as an essential complement to emissions trading:

> *"policy to reduce emissions should be based on three essential elements: carbon pricing, technology policy, and removal of barriers to behavioural change"*
>
> *"The urgency of the problem means that technology development may not be able to wait for robust global carbon pricing. Without appropriate incentives private firms and capital markets are less likely to invest in developing low-emission technologies."*
>
> The Stern Review

A national emissions trading scheme has been proposed for Australia. This addresses the first and probably most important item recommended by Stern, which is carbon pricing. Emissions trading should form the backbone of the federal government's response to reducing greenhouse gas emissions. In addition the Federal Government Task Group on Emissions Trading has recommended significant increases in funding for energy efficiency programs, which the BCSE sees as commendable. While energy efficiency will help to reduce the demand for electricity, stabilising greenhouse emissions at levels necessary to avoid dangerous climate change must also involve nearly a complete decarbonising of electricity over the longer-term. To prepare for this renewable deployment policies are essential, and should *not* be seen as an alternative that needs to be phased out, but rather as a complement that works with carbon pricing to deliver a sound long-term, affordable response to climate change.

The Stern Review estimated the social cost of carbon at $US85 per tonne $CO_{2\text{-}e}$. Emissions pricing is absolutely fundamental to overcoming this market failure by internalising this social cost. However there are political practicalities that will limit the degree to which governments can correct this externality in the short-term. It is apparent from the Report of the Prime Ministerial Task Group on Emission Trading that in the short term the sort of target envisaged for an Australian emissions trading scheme will not provide a particularly stringent or challenging emissions target consistent with the social cost of carbon. The report talks of a gradual movement away from 'business-as-usual', with a likely scenario that emissions will continue to rise for a period, *"although at a significantly slower pace"* to allow firms time to adjust and to *"ensure that short-term economic costs are kept modest"*.

There are a range of renewable energy technologies that are already being deployed at large scale that would be cost competitive *at carbon prices half that of the social cost of carbon*. However it is highly improbable an emissions trading scheme either implemented along the lines of the Task Group scenario discussed above or the states and territories' National Emissions Trading Taskforce proposal, will involve permit prices reaching close to this level over the next decade.

It is unlikely that a low stimulus provided by an emissions trading scheme will drive any deployment of renewable energy in the near term. Initially future gas generation deployment will be the predominant technology to enable us to meet our emissions targets. But ultimately, to contain the risk of dangerous climate change, the target will have to increase in stringency, making zero-emissions technologies necessary.

There is a sound rationale for a gradual increase in the stringency of emissions trading. However in the time until emissions permits reach the full social cost of carbon, fossil-fuel plant will continue to partially externalise their greenhouse pollution costs.

The European Commission articulates this issue in explaining their rationale for a legally binding 20 per cent of renewable energy target by 2020 for EU energy consumption.

> *Energy market price signals remain distorted in favour of non-renewable energy sources...Although external costs are partially internalised through the EU's Emissions Trading System, fiscal instruments or support frameworks for renewable energy sources, current market prices are still far from reflecting true cost.*
>
> Communication from the Commission to the Council and the European Parliament: Renewable Energy Roadmap. Renewable energies in the 21st century: building a more sustainable future.

Furthermore, there are market imperfections in relation to technological development related to the appropriability of gains from innovation and learning. Leaving these market imperfections untouched will increase the long-term economic cost of emissions trading and potentially hold back political acceptance of necessary emission reductions.

The Stern Review notes that,
"Innovation produces benefits above and beyond those enjoyed by the individual firm ('knowledge spillovers'); this means that it will be undersupplied. Information is a public good. Once new information has been created, it is virtually costless to pass on. This means that an individual company may be unable to capture the full economic benefit of its investment in innovation. These knowledge externalities (or spillovers) from technological development will tend to limit innovation."

Environmental economists Jaffe, Newell, and Stavins observe that,
"Market failures associated with environmental pollution interact with market failures associated with the innovation and diffusion of new technologies. These combined market failures provide a strong rationale for a portfolio of public policies that foster emissions reduction as well as the development and adoption of environmentally beneficial technology."[13]

The dual purpose of providing further policy support for renewables *now* - *before* they are essential to meet our emissions targets is to:

- maximize the cost-effectiveness of emissions trading
- ensure the economic benefits of a thriving local industry

As explained above, if there is no additional deployment support for renewable energy in the near term, investment in these technologies will be limited and renewable energy skills, knowledge and capabilities will atrophy and certainly will not improve. Ultimately, however, Australia will require these skills and capabilities to meet more challenging emissions targets. Australia has a choice:

- We can develop and improve the industry's capabilities and cost structure incrementally now through sub-markets for renewable energy; or
- We can face higher costs later when this industry is required at very large scale but is relatively immature because of a lack of prior learning opportunities.

[13] Adam Jaffe, Richard Newell, and Robert Stavins (2003) *A Tale of Two Market Failures Technology and Environmental Policy,* Resources for the Future Discussion Paper, October 2004. Available from www.rff.org

Sub-markets for renewable energy enable the industry to gain experience essential to learning and improvement at relatively contained costs. This is preferable to sole reliance on a carbon price to drive deployment which could mean very high prices are imposed upon the whole electricity market before we start to gain experience and learning for renewable energy.

We explain below in more detail why this is the case.

To drive technological development and reduce costs we need to deploy renewable energy at increasing scale *now*

In an interview with the ABC TV *Four Corners* program[14], Minister Turnbull explained the rationale behind the Federal Government's solar photovoltaic rebate and outlined the important role for deployment policies to support cost reductions through learning by doing:

> *It is very expensive relatively to grid connected fossil fuel powered energy so it is an expensive way to buy greenhouse gas abatement, there's no question about that. The reason for the solar subsidy is to drive technology. What we're doing is fuelling demand so that there'll be more solar panels built, more installed, people will learn through experience. A lot of the cost of installing a solar panel is actually the truck roll and you know getting up on the roof and all of the techniques of doing it, not just building the panel, so the more demand there is the more costs come down and every country in the world – be it Australia, be it California, be it Germany or Japan – that subsidises solar panels does so for the purpose of driving it down the cost curve, because what we're all looking for is that time when photovoltaics are really competitive with grid connected energy because they are an enormous opportunity… the purpose of the photovoltaic rebate is to drive a developing technology.*
>
> Minister for the Environment and Water Resources, the Hon Malcolm Turnbull MP

He goes on to explain why this early improvement is essential for the longer-term abatement task:

> *…photovoltaics have the advantage of being able to generate electricity, which of course can be used for any purpose so that is really a focus on developing the technology we need. See you have to remember that by mid-century the whole world, not just Australia, the whole world is going to have to generate all or almost all of its energy electricity and all or almost all of its transport power from zero emission sources. If we can't do that we will not be able to meet the massive reductions in greenhouse gases the world needs. So technological development is a vital part of the greenhouse response and that's why we're subsidising photovoltaics.*
>
> Minister for the Environment and Water Resources, The Hon Malcolm Turnbull MP

If we are to successfully address the problem of dangerous climate change, it is important that development of renewable technologies is accelerated to bring down their costs, improve their performance and reliability, and to learn about how to best integrate these technologies within a wider technological and social system.

While research and development are important aspects in achieving these improvements, typically energy generation technologies do not emerge out of a lab ready to go and commercially competitive. Developers and the customers who use the technologies still need to gain field experience with them and the larger the volumes of product deployed the more they learn and consequently the better they get at using and producing the product.

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[14] Australian Broadcasting Corporation (2007) *Interview – Malcolm Turnbull MP*, Available from ABC website: http://www.abc.net.au/4corners/content/2007/s1961210.htm

In energy generation technologies, learning by doing, the concept pioneered by economics Nobel Laureate Kenneth Arrow, plays an incredibly important role in achieving improvements in cost and performance. In his seminal paper, Arrow[15] shows that if the productivity of capital is an increasing function of the level of cumulative investment because of learning, then individual firms will under invest in capital because they do not internalize the larger social gains from learning. From the cost perspective, the theory of learning by doing suggests that technology costs will fall as experience with a technology grows. The International Energy Agency (IEA) has examined this issue of learning by doing and experience curves and their implications for climate change policy in two publications, *Experience Curves for Energy Technology Policy* and *Creating Markets for Energy Technologies.* They note that there are two effects that come about from government energy technology deployment programs. The immediate physical effect, which may be reduced energy use for the same service or reduced greenhouse emissions which are the primary rationale for government intervention. But they note, *"in many instances that view is too narrow; it neglects the importance of the link between deployment programmes and private sector decisions to invest in the market learning process."*[16] This learning effect is the second outcome from government deployment programs.

This principle of learning by doing certainly applies to many renewable energy technologies as outlined by Karen Palmer and Dallas Burtraw of Resources for the Future,
"Most renewable technologies are relatively immature... and thus the potential for learning with greater market penetration is relatively high. Empirical studies of learning curves for energy technologies suggest that there is a large variation in the rate of learning across different energy technologies with more mature technologies having substantially lower learning rates than newer technologies. The inappropriability of the gains from learning means that there may be a market failure at work that justifies policies to promote renewables, in addition to the usual environmental justification."[17]

The IEA provides a model for the learning system[18] (Figure 2) which illustrates how R&D, learning and volume of production are integrally linked in a virtuous cycle. According to the IEA, government support encourages corporations to try out new technologies in genuine market settings. This stimulates industry R&D and production, which ultimately stimulates the learning process and the cycle reinforces itself, resulting in further cost reductions and improved technology.

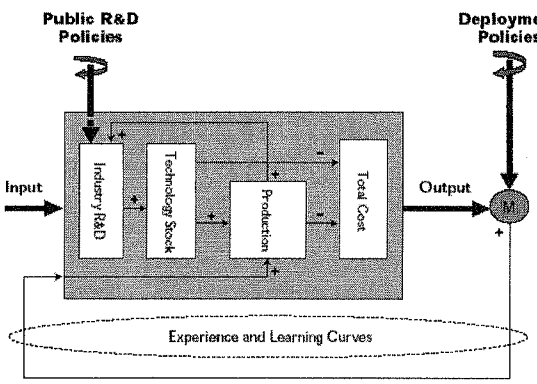

Figure 2. Influences on the learning system from public policies

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[15] Kenneth Arrow (1962) The Economic Implications of Learning-by-Doing. *Review of Economic Studies* 29: 155–73

[16] Mel Kliman (2003) *Creating Markets for Energy Technologies*, International Energy Agency. Available from http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1100

[17] Karen Palmer and Dallas Burtraw (2004) *Electricity, renewables, and climate change: searching for a cost-effective policy*, Resources for the Future, www.rff.org

[18] Mel Kliman (2003) *Creating Markets for Energy Technologies*, International Energy Agency. Available from http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1100

Source: *International Energy Agency*

Through this process the learning effect manifests itself in succeeding generations of the technology, with associated reductions in product prices, better technical performance and improved or innovative methods of marketing and application. The technology may become attractive to additional suppliers, and products produced with it will account for larger and larger segments of the market, thereby increasing the physical effects of deployment.

The IEA points out the implications of this principle for government policy,
"it is important to emphasise that while public sector R&D is important, it cannot directly bring about the cost reductions that will make the new technology competitive in the marketplace. The outstanding feature of this internal learning process is that there is no virtuous cycle and no substantial cost reductions without market interactions. Thus to provide a payoff, the results of public R&D have to enter into the internal industry R&D process. This constitutes a powerful argument in favour of government support for technology deployment – if government is supporting research, it should also be supporting deployment."[19]

The Stern Review provides further acknowledgement of this issue noting that,
"For energy technologies, R&D is only the beginning of the story. There is continual feedback between learning from experience in the market, and further R&D activity. There is a dependence on tacit knowledge and a series of incremental innovations in which spillovers play an important role and reduce the potential benefits of intellectual property rights."

There is a role for government in supporting technologies movement along the innovation chain, as illustrated below in Figure 3.

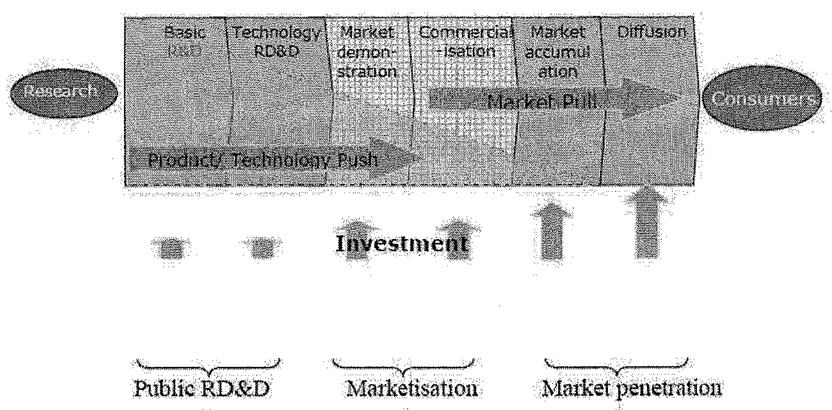

Figure 3. Steps in the innovation chain[20]

Professor Michael Grubb explains this figure:
"The classical policies at the ends of the innovation chain do not address the core technology 'valley of death' problems in the central stages. Public R&D cannot drive commercial uptake, market pull forces are weak because product differentiation is not a key market driver, and the promise of emission controls does not form a credible, long-term basis of sufficient security against which most firms could take substantial risks in the face of sceptical shareholders. In addition to the technical and financial risks, the political risk of such markets - real or perceived – further

[19] James McVeigh, Dallas Burtraw, Joel Darmstadter, and Karen Palmer (1999) *Winner, Loser, or Innocent Victim? Has Renewable Energy Performed As Expected?* Resources for the Future Discussion Paper 99-28, June 1999.
[20] Michael Grubb (2004) 'Technology Innovation and Climate Change Policy: an overview of issues and options', Submitted (in review) *Keio Journal of Economics*

undermines those who might wish to try. Neither public R&D nor prime reliance on carbon pricing / cap-and-trade will achieve the far reaching, long-term innovations required to address climate change."

While the Renewable Energy Development Initiative (REDI) and the Low Emissions Technology Demonstration Fund (LETDF) are worthwhile programs to support renewable energy to the point of demonstration, they are fairly small programs and they stop short of bridging the 'technology valley of death'.

Unfortunately, even after promising renewable technologies are demonstrated, it is highly unlikely their costs will be low enough to be competitive with higher emission technologies such as combined cycle natural gas or more conventional coal technologies under foreseeable, politically palatable carbon prices. As mentioned above it may be some time until the carbon price steadily increases to make these technologies financially viable solely under emissions trading. Without further deployment, renewables costs would stay high due to an absence of opportunities for learning and economies of scale. Learnings made through demonstration and commercialisation would not be capitalised upon and may even atrophy, and the opportunities for new industries will be lost to overseas competitors. When it is eventually deemed necessary to accelerate emission reductions the whole economy will endure higher costs than necessary from less mature renewable technologies setting the clearing price across the entire electricity market. This would be the case until its costs decline through experience.

What is required are sub-markets that enable renewable technologies to be deployed and develop experience in-use that is essential for learning-derived cost reductions as illustrated in Figure 4, which is taken from the Stern Review.

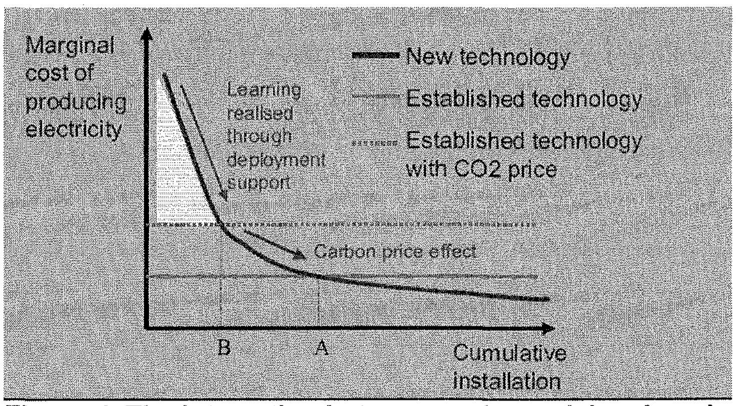

Figure 4. The interaction between carbon pricing, learning and deployment support[21]

These sub-markets enable renewable technologies to be financially viable but the extra cost of the technologies do not drive-up the market clearing price for the entire electricity market. For example, at present in Australia renewable energy power generation projects are generally only attractive at prices of around $65 per MWh or more. Emissions trading, which would affect the entire electricity market would mean an overall cost of $65 for every MWh of electricity would be necessary before one would start to see deployment of renewable energy (in the National Electricity Market the wholesale price of electricity has historically been around $30-$45/MWh). However a sub-market, such as represented by MRET, can drive this deployment through creating a sub-market dedicated to a particular set of technologies. This only increases costs within the subsection of the market allocated to that technology, rather than across the entire electricity market. For example the establishment of wind farms in Victoria are expected to require a price of around $70 to $80 per MWh to be viable. The Victorian Renewable Energy Target (VRET) will deliver this viability yet only lead to an overall increase in electricity costs across the entire market of around $1.82 per MWh.

[21] Sir Nicholas Stern (2006) *Stern Review: The Economics of Climate Change*, available from www.sternreview.org.uk

The use of these sub-markets will serve the purpose of reducing the technology costs and therefore reducing the cost of the entire abatement task. Ultimately we will have to pay for these technologies, far better to do it through a sub-market rather than have its costs set the price for the entire electricity market, when they are still immature.

Ultimately the aim is to continually drive the development of the next key technology required to meet an increasingly stringent emissions abatement task. What this may mean in reality is that renewable energy deployment marketplace may progressively exclude technologies as they achieve a level of technological maturity that implies limited opportunities for further cost reductions.

Renewable technologies have a strong track record of cost reductions over time. A 1999 study by McVeigh, Burtraw, Darmstadter, and Palmer[22] evaluated the performance of renewable technologies for electricity generation measured against stated projections that helped shape public policy goals over the last three decades. The renewable energy technologies investigated were biomass, geothermal, solar photovoltaics, solar thermal, and wind. They reviewed 25 studies conducted over the last three decades that contained projections of the costs and market penetration of some or all of these technologies. They found that with respect to cost:

- *Renewable technologies have succeeded in meeting expectations with respect to cost. For every technology analyzed, successive generations of projections of cost have either agreed with previous projections or have declined relative to them.*
- *In virtually every case, the path of actual cost has equaled or been below the projections for that period in time. The only exception appears in the case of capital costs for photovoltaics, where expectations from the 1970s and 1980s underestimated actual realized costs in the 1980s and 1990s.*

The European Commission (EC), in their recent *Communication from the Commission to the Council and the European Parliament* on the Renewable Energy Roadmap **(Attachment 6)**, reports a 50 per cent cost reduction for wind energy per kWh over the last 15 years while solar photovoltaic systems are more than 60 per cent cheaper today than they were in 1990. The Communication provides a brief overview on the current contribution made by renewable energy in the European Union (EU). It looks at the EU's target of 20 per cent renewable energy share of gross inland consumption by 2020, how this could be achieved and what the impact of achieving the target would be.

Modelling undertaken for the Commission in the development of their 20 per cent by 2020 target for renewable energy predicts how this concept of learning by doing impacts on costs going forward: *"These cost estimates take into account the fact that the unit costs of renewable energy, like other innovative technologies, tend to fall over time as practitioners gain experience. If the volume of use of a particular technology grows more rapidly, experience will be gained more rapidly and costs will fall more rapidly."* The modelling predicts that under a scenario of meeting this target with *"similar efforts across each sector and across technologies"*, there will be continuing cost reductions for all renewable technologies except hydropower out to 2020. In particular, solar PV is likely to fall by 50 per cent between 2005 and 2020, and the costs of wind energy are expected to continue to fall by more than 20 per cent. See the below Figure 5 which is extracted from the attached *Commission Staff Working Document* **(Attachment 7)** accompanying the *'Communication'* document, which depicts these estimated rates of unit cost reduction for each of the different renewable generation technologies between 2005 to 2020.

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[22] James McVeigh, Dallas Burtraw, Joel Darmstadter, and Karen Palmer (1999) *Winner, Loser, or Innocent Victim? Has Renewable Energy Performed As Expected?* Resources for the Future Discussion Paper 99-28, June 1999.

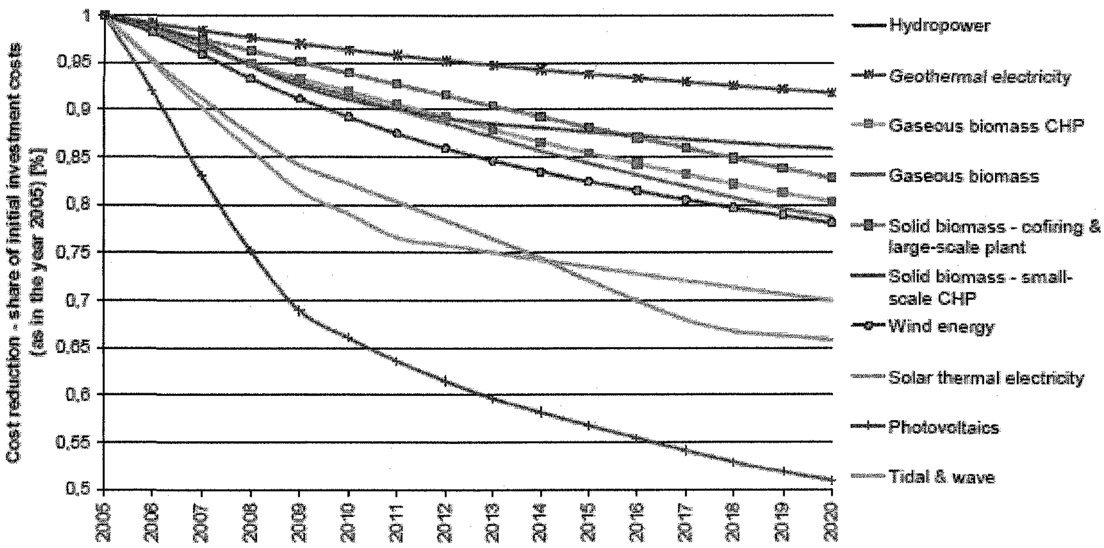

Figure 5. Estimated rate of unit cost reduction for renewable electricity generation technologies *Source: European Commission*

To ensure the most cost-effective response to climate change renewable energy deployment support is needed

Policies supporting renewable energy deployment will actually drive down the overall cost of meeting a given emissions reduction target in the medium to long term.

Modelling undertaken for the Climate Institute by energy market consultants McLennan Magasanik & Associates focussed on one of the key questions considered by the Prime Ministers Emissions Trading Task Group, *"What other policies would most effectively complement a possible future emissions trading system?"* It looks at a number of different scenarios, which would take Australia to emissions reduction of 80 per cent (compared with 1990 levels) by 2050. The scenarios compared include: emissions trading in isolation; emissions trading with a moderate energy efficiency target (to bring Australia in line with the OECD average); and emissions trading with a market-based clean energy target similar to MRET, in addition to an energy efficiency target.

Resource costs - which include fuel, capital and operating costs - are a broad measure of the economic efficiency of the different policies that are modelled. The modelling shows that by adding a clean energy target (CET) into the policy mix (requiring all new load to be met by low emissions technology), reduces costs out to 2050 to $14.3 billion, compared to $15.9 billion without this deployment policy (Figure 6). So while energy efficiency provides a considerable cost saving to reduce emissions, the policy-mix can be made even more cost effective by ensuring the earlier deployment of clean energy technologies and hence capitalising on the market experience (or learning) gained through this. These results are explained in **Attachment 8**.

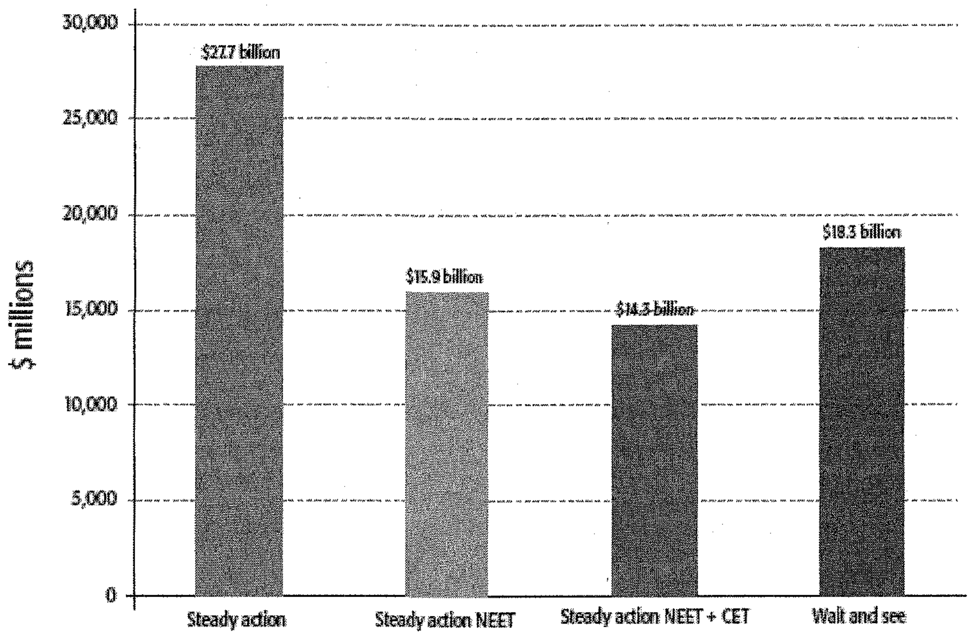

Figure 6. Resource costs to 2050
Source: *Making the Switch*, The Climate Institute, 2007

Most other jurisdictions participating in emissions trading internationally have recognised the need for complementary renewable energy deployment policies
Of course Australia can not drive this technological learning process alone, and it wouldn't be doing so. Just about every other jurisdiction that has or is contemplating the implementation of emissions trading has a renewables deployment scheme in place, using either a market based target measure or premium feed-in tariffs. Australia can choose to free-ride but this is a rather myopic and morally questionable perspective to take. It will mean we will miss out on the economic opportunities and upside presented by the energy transformation that is necessary. It also means that we will not be pulling our weight so to speak in delivering the new technologies vital to addressing the long-term challenge that climate change presents.

Internationally, the list of jurisdictions that have legislated policies specifically supporting the deployment of renewable energy is extensive. There is a broad array of policy approaches that have been taken by jurisdictions to date in providing deployment support for low emission technologies. These include government tenders, tax credits, rebates funded through general tax revenue or levies, feed-in tariffs, and market-based target schemes.

In our view, based on the experience of our members, the most successful policies and most conducive to long-term investments essential to achieving learning improvements have been feed-in tariffs and market-based target schemes similar to MRET (referred to as Renewable Portfolio Standards in the US).

Tax credits as implemented by the US Federal Government are a good example of how not to do it. Their on again, off again nature is not conducive to investor confidence. They are not fitting with the kind of major, long-term investments required to develop the sophisticated, knowledge intensive and capital intensive power generation technologies.

Budgetary schemes with 3-5 year lives that must pass the gauntlet of the Expenditure Review Committee every year are also completely mis-matched to the nature of the technology development and industry development task and opportunity we face.

Tender schemes have the habit of adopting complex selection criteria that are open to political influence and wide ranging interpretations. They rely on subjective judgements requiring leaps of exceptional foresight (often decades into the future), by selection panels and government officials who often lack substantive experience in the field. The tender processes seem to inevitably develop into highly drawn-out, administratively costly, highly uncertain, subjective guessing games. An *example of this was the Federal Government's Greenhouse Gas Abatement Program which was* drawn out from a 3 year process into a 6 year process. Of the $400m it was allocated, it could only spend $100m. Such schemes require selection panels to make judgments about firms' and technologies' prospects and potential that are far better tested in an open marketplace - where success is determined by what you deliver, not what others think you can deliver. Tender schemes typically represent the very essence of a picking winners scheme with all its faults. MRET for good reason took a very different market-based approach and illustrates how picking winners can be fraught with problems as outlined in ***Box 1 – MRET as a lesson in the vagaries of trying to pick winners.***

Box 1 - MRET as a lesson in the vagaries of trying to pick winners
Some sectional interest groups have criticised the Federal Government's Mandatory Renewable Energy Target as a "picking winners" scheme designed primarily to benefit wind. This proposition could not be any further from the truth, and in fact the scheme is an extraordinary illustration of how experts can fail to foresee in advance what technologies are the most viable. MRET is actually the antithesis of a "picking winners" scheme. It is open to a very broad range of fuel types and technologies (more than 22 technology-resource combinations) with one criteria for success – market competition. Those that can deliver renewable electricity the cheapest and the quickest are those that win.

Before the scheme was instituted the Australian Greenhouse Office commissioned Redding Energy Management, who were highly qualified experts, to assess for each technology, the potential for Australian industry to expand existing (or develop new) renewable energy capacity to meet the renewable energy target. The report concluded that Bagasse (sugar cane residue) would dominate the scheme gaining between 50-70 per cent share of the target. Other biomass fuels under one least-cost scenario were also expected to gain around 10 per cent as was solar hot water, while wind was expected to achieve between as little as 0.35 per cent and up to 5 per cent share.

What actually occurred was very, very different. Every year the BCSE prepares an assessment of renewable energy project development and Renewable Energy Certificate creation (known as the *Carbon Markets Report*). What we found in last year's report, based on the latest data of actual project commitments and generation was that wind will take the greatest share of the scheme, (but not anywhere close to all of it as some people would have you believe), bagasse and other biomass will not reach anywhere near the projections, and hydro and solar hot water are noticeably more successful than projected.

Table 1. ***Generation by fuel under MRET – Original projections versus latest data***

Fuel Type	Redding (GWh per annum)	Latest data (GWh per annum) (Carbon Markets Report)
Sugar Cogen	4864	1080
Wind	402	3470
Landfill gas	836	600
Hydro	834	1940
SWH	1150	1623
Other Biomass	1500	439
Other	117	158
TOTAL	**9703**	**9310**

The two most successful policy mechanisms internationally have been Renewable Portfolio Standards (RPS's) and feed-in tariffs. In general, feed-in tariffs have been preferred by European countries with RPS's preferred by the US states, although the US was the first jurisdiction to implement a feed-in tariff. Both of these policy approaches have shown themselves to be successful and have grown significant local industries in various regions. It is important to note that many of the countries who support renewable energy deployment do so in addition to involvement in emissions trading. In Europe, the European Union has committed to a legally binding overall target of 20 per cent renewable energy share of gross inland energy consumption by 2020 (covers not only electricity, but also heat and transport), to be met concurrently with the operation of an emissions trading scheme.

Renewable Portfolio Standards are essentially targets for an increased market share (percentage or actual amount) of electricity generation. Local examples of the RPSs are the Federal Government's Mandatory Renewable Energy Target (MRET) scheme and the renewable energy target schemes of Victoria, NSW and Queensland[23]. The Pew Centre on Global Climate Change reported in June 2006 that of the total 65 US states, territories and districts, more than one third (22 states and one district) have implemented an RPS. As a policy measure, the RPS enjoys bipartisan support. Among the 22 RPS schemes established to date, sixteen were enacted with a Republican governor, five with a Democrat, and one with an Independent. Outside the US, jurisdictions in Japan, India, Canada, Poland and Sweden also utilise the RPS. Over time these RPS announcements have tended to become more ambitious, with two recent programs announced in California and New York aiming for targets of 33 per cent by 2020 and 25 per cent by 2013 respectively. The US and Japan were both in the top five countries in 2005 for investment into renewable energy. On the rationale for legislating an RPS, the Pew Centre reports that: *"Environmental factors, such as reduction of conventional pollutants or greenhouse gas emissions, are often seen as secondary drivers in many states. RPSs are already boosting renewable energy supplies in a cost-effective manner, and appear to hold considerable potential for more dramatic gains. They are driving the expansion of important homegrown industries."*

Furthermore, states with policies supporting deployment of renewable energy often have a multi-pronged policy approach. The North-east US states are developing an emissions trading scheme - the Regional Greenhouse Gas Initiative (RGGI). Every state involved in the RGGI, except for New Hampshire, also has an RPS.

[23] It is still not clear whether the Western Australian 15% target is genuine or just aspirational with no meaningful mechanism to drive achievement of the target. The SA's government's 20% Target relies on free riding on Federal Government and NSW State Government schemes.

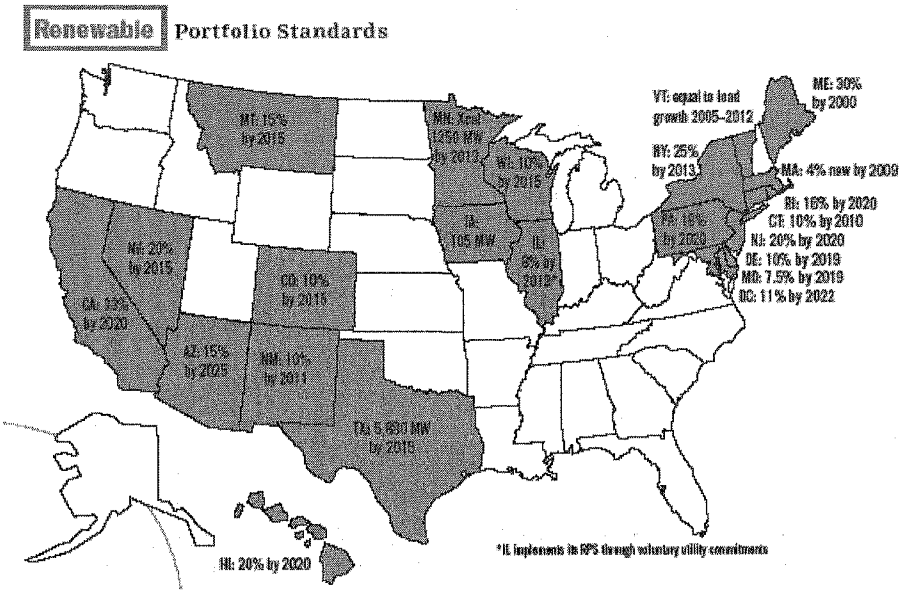

Figure 7. Renewable Portfolio Standards in the US[24]

Feed-in tariffs are an alternative approach whereby legislated buy-back rates are set by the government for generation produced by each technology. These buy-back rates generally decline each year consistent with learning curve theory, forcing producers to achieve cost-reductions if their technology is to continue to be viable. In contrast to Renewable Portfolio Standards the price for the power is set, and this determines deployment, rather than determining the target market share which then sets the price.This model has a number of advantages over market measure targets, in particular reducing risk and uncertainty and more readily providing support to a broader range of technologies. However, it is sometimes criticized for lack of cross-technology competition.

The US was the first country to implement a feed-in tariff, but it has been Europe where the policy has taken off and seen feed-in tariffs become the most popular policy mechanism globally to drive renewable energy deployment. Feed-in tariffs are utilised in 18 EU member countries, as well as numerous other countries including Brazil, India, Israel, Korea, Nicaragua, Norway, Sri Lanka, Switzerland, and Turkey. Germany and Spain, which each have feed-in policies, were in the top five countries for investment in renewable energy in 2005. As with jurisdictions utilising RPSs, many of these countries are utilising a policy mix to support deployment of renewables - with feed-in tariffs as well as taking part in the EU Emissions Trading Scheme.

The attached *Renewables Global Status Report: 2006 Update* and the *2005 Global Status Report* from REN21 provide more information on the global industry and policies.

Federal and state renewable energy deployment schemes in Australia should be continued or expanded as complements to emissions trading

MRET has been a very successful scheme, however as previously mentioned it is now, for all intents and purposes, fully-subscribed and will not drive any further deployment of renewable energy.

Continuing deployment of renewables is a key criterion for minimising the cost of meeting emissions targets. However, now that MRET is fully subscribed, there is a need for it to be expanded or for an alternative broad-based deployment measure to be implemented. While the solar power rebate

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[24] Barry Rabe (2006) *Race to the Top: The expanding role of US State Renewable Portfolio Standards.* Pew Center on Global Climate Change.

programs are important deployment programs these are specific to just photovoltaics and are of no assistance to other technologies.

Now Victoria, NSW and Queensland are implementing their own market-based renewable energy target schemes, closely modelled on MRET. Also Western Australia has announced a target, however it is unclear whether this will be supported by a certificate based scheme or remain a largely empty, aspirational gesture.

Renewable energy target schemes such as MRET, VRET and the NSW Renewable Energy Target all need to continue in parallel with emissions trading or ideally be consolidated into a significantly enlarged national scheme. As detailed in the preceding pages these zero-emission sub-market schemes have a sound economic rationale related to technology development (these schemes should be seen as part of a broader international effort) and industry development. Also abolition of these schemes would be a significant sovereign risk issue with several hundred million dollars of sunk investment associated with these schemes.

If there is concern that these market-based measures provide insufficient support for a broader suite of less mature technologies, then the schemes should be expanded and amended, not scrapped. The UK, for example, is considering altering the structure of their Renewables Obligation to encourage a broader suite of technologies. Any scheme needs to balance achieving the benefits from competition between technologies with the need to bring on new technologies whose promise may be great but which are immature and expensive. This is a fine balance that is unlikely to ever be perfectly resolved.