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

Dear Committee Secretary

House of Representatives Inquiry into Renewable Energy in Australia

The Energy Supply Association of Australia (esaa) welcomes the opportunity to comment on the House of Representatives Standing Committee on Industry and Resources Case Study into Renewable Energy in Australia.

esaa is the peak industry body for the stationary energy sector in Australia and represents the policy positions of the Chief Executives of 44 electricity and downstream natural gas businesses. These businesses own and operate some $110 billion in assets, employ over 40,000 people and contribute $14.5 billion dollars directly to the nation's Goss Domestic Product.

esaa's policies and positions are fuel and generation technology neutral as our members employ all current commercially available forms of electricity generation capacity in Australia including fossil fuel and renewable energy sources. Consequently, the Association strongly advocates that in a competitive market environment, investors should be able to select from the widest practical range of generation technologies and be informed by stable national policy settings.

Australia faces a significant challenge to reduce greenhouse gas emissions without compromising the reliable and competitively priced supply of energy that is essential to our economy and society. It is therefore critical that greenhouse gas emissions policies and measures focus explicitly on allowing the operation of the market to deliver emissions reductions in a least cost, efficient and effective manner. esaa considers that this can only be achieved through the introduction of a single national greenhouse policy, by the Commonwealth Government, that includes an emissions target to 2050, the implementation of an economy-wide emissions trading system and the inclusion of a funding scheme to support nascent technologies.

Electricity supply and demand

Australia has significant, diverse and high quality energy resources. With over 600 years supply of brown coal and 290 years supply of black coal, as well as large natural gas deposits, indigenous reserves of fossil fuels have intrinsically shaped the structure of Australia's electricity supply industry to date.

In order to more fully understand the impacts and implications of achieving greenhouse gas emission reductions in the stationary energy sector, the Association completed a three staged *Energy and Emissions Study*[1].

It is clear from the completion of the Second Stage of the Association's *Energy and Emissions Study: Emissions Targets and Least Cost Generation Options* that achieving greenhouse emissions reductions will be a difficult and costly task and that the extent of the impacts is contingent on two elements: the level of emissions abatement being sought and the availability of low-cost emissions abatement opportunities.

The Second Stage of the Study reveals that electricity demand is forecast to grow, even with increased energy efficiency, to approximately 360,000 GWh at 2030 reflecting an increase of approximately 65 per cent on 2006 levels. The analysis indicates that to meet load growth over this period, between $35 billion and $78 billion in capital expenditure will be required to build 30,000 MW of new generation facilities alone. The exact quantum of capital will depend entirely on the extent of any emission reductions to be attained and the availability of alternative generation technologies. The results indicated that potentially in excess of $100 billion will need to be spent to meet electricity load growth over the next two decades which would double the capital currently invested in electricity supply facilities. These are very large investment outlays.

We expect that renewable energy generation sources will be a part of Australia's future generation fleet. The extent of renewable energy penetration will very largely depend on its cost compared to other very low or zero emission generation technologies and the level of the emission constraint, presuming that Australia seeks to meet any greenhouse gas emission constraint in a least cost manner.

Most renewable and zero emission technologies are, or are likely to be, significantly more expensive than current emissive forms of generation. For example, the Association's *Energy and Emissions Study* reveals that the indicative long run marginal cost of solar photovoltaic generation capacity at 2030 is $145 per MWh, geothermal capacity is $43 per MWh, biomass $70 per MWh and wind capacity is $90 per MWh. In contrast, the long run marginal cost of emissive coal generation capacity at the same point in time is estimated to be $30 per MWh.

This situation is clearly reflected in the following figures from the Association's Stage 2 *Energy and Emissions Study*. A description of each of the technologies identified in these figures is provided at Attachment A.

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[1] Stage 2 of the Energy and Emissions Study: *Emissions Targets and Least Cost Generation Options*, 2006: has been provided as an attachment to this submission. This document is also available electronically at: http://www.esaa.com.au/images/stories//energyandemissionsstudystage2.pdf

Figure 1: Indicative base load long-run marginal cost and emission intensities in 2030[2]

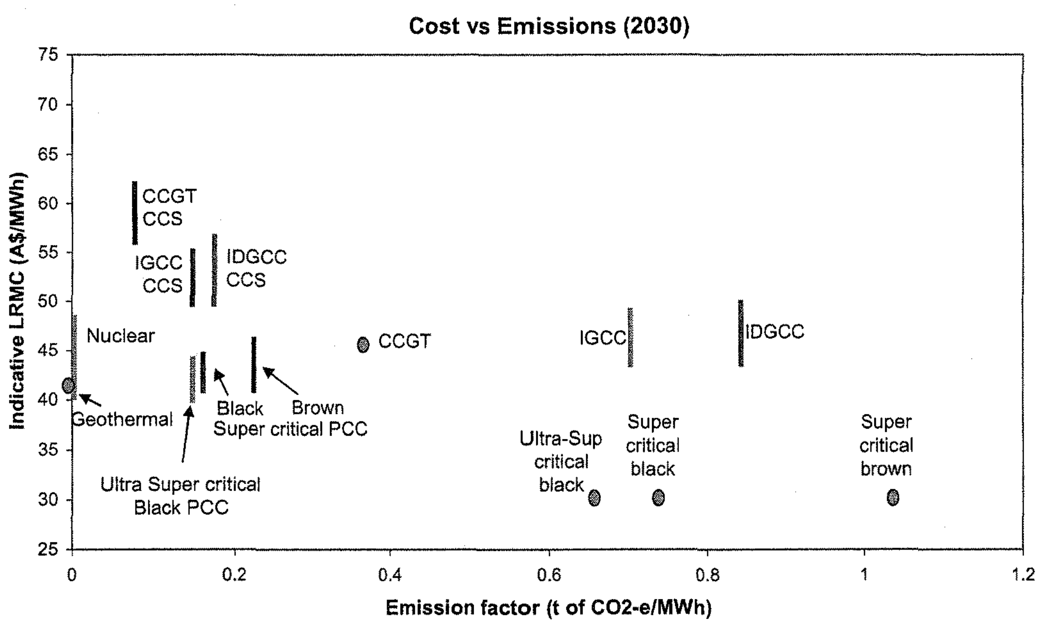
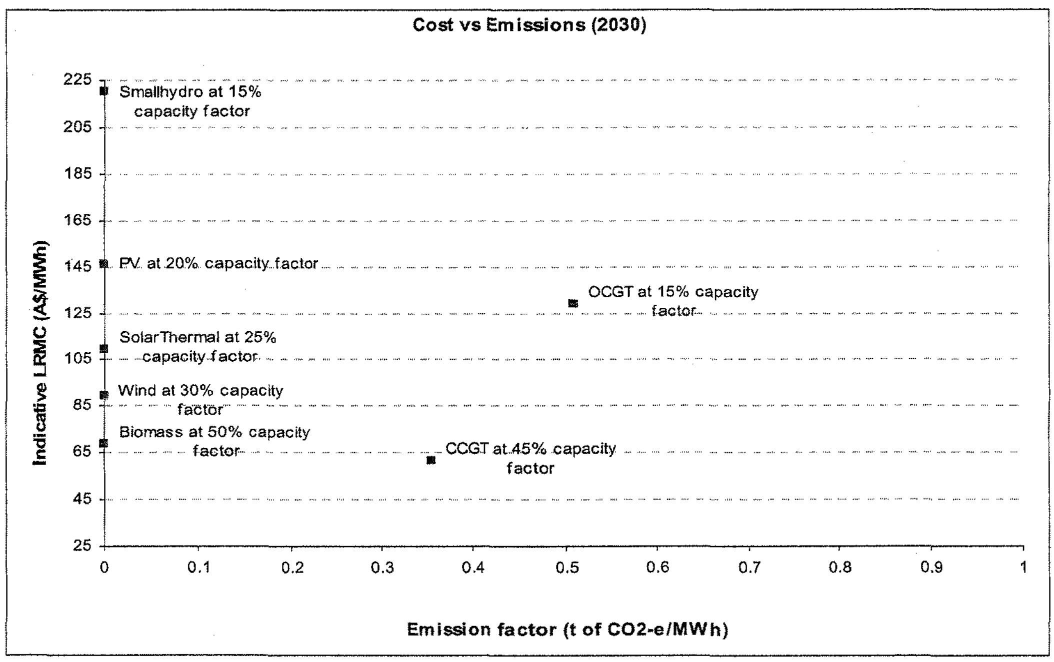


Figure 2: Indicative intermediate and peaking long-run marginal cost and emission intensities in 2030



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[2] All black coal, gas, biomass and geothermal figures are for NSW in 2030. All brown coal figures for VIC in 2030. 85% capacity factor is assumed for all base load technologies.

Although the figures are illustrative, they provide a concise demonstration of the cost implications of deploying low and zero emission technologies. In a competitive market least cost forms of generation will rationally be chosen; the use of higher cost but lower emissions generation options is dependent on policy measures that reward the uptake of these technologies. esaa contends that the most effective means by which to reward market participants is through a national, economy-wide emissions trading scheme.

esaa greenhouse policy

esaa has, since 2004, called for a single, national greenhouse gas emission policy that applies to the entire economy and includes an emission reduction target for 2050. Such a target should be established being cognisant that: the economic impact is manageable; the rate of change can be managed; and a predictable investment climate will result. esaa contends for reasons of national consistency and international engagement that such an integrated policy and target can only be practically established by the Commonwealth Government.

Further, esaa has concluded that a greenhouse gas emissions price signal is required for all greenhouse gas emitting entities to promote investor confidence, deliver greenhouse gas abatement and reward the uptake of new lower emission technologies. esaa considers that the least-cost approach to pricing greenhouse gas emissions is to implement an emissions trading scheme – with 11 associated design features (provided at Attachment A) . This should be coupled with a funding scheme to ensure that new low emission technologies have sufficient financial capital to become commercial and to lower the long run cost of emissions abatement.

Policy rationale

The Association's policy approach is built around two key principles. Achieving investor confidence on the longer term policy settings for greenhouse gas emissions reductions and securing the required emissions reductions at least cost.

Emissions trading can secure emissions reductions at least cost as it provides complying parties with the freedom to choose between alternative abatement options including, but not limited to, investment in infrastructure (e.g. carbon capture and storage and lower emission and renewable energy generation capacity) as well as soil and forestry sequestration and energy efficiency improvements. Accordingly, the extent to which any abatement opportunity is taken up is dependent on the costs of alternative options.

However, many of the very low and zero emission technologies that will be required to achieve increasingly large reductions in greenhouse gas emissions are either in the very early stages of development or require substantial further improvement to reduce their costs and to prove their capability at scale. The Association therefore contends that there must also be a funding scheme to ensure that new low emission technologies have sufficient financial capital to complete the research, development and demonstration phase and to then become commercial so that the long run cost of emissions abatement is minimised. Such a funding scheme must be technology neutral and provided on a competitive basis in order to ensure that funding does not lock in any particular technology but is available to a range of technologies.

Such a funding scheme will improve the opportunity for immature and comparatively more expensive low emission technologies to overcome what the Electric Power Research Institute refers to as the 'mountain of death'. This term describes the difficult and costly process of bringing a new technology into the marketplace where the high cost of first-of-a-kind plants can often stall a new technology in the demonstration stage[3].

Alternative policy approaches are not efficient

In contrast to the Association's least cost, efficient, policy approach to achieve greenhouse gas emissions reductions there are a number of alternative policy approaches that are sometimes promoted to reduce emissions, including the use of measures to directly regulate market outcomes.

The Association cautions against the use of such policy approaches as they inevitably require governments to select technology 'winners' or abatement techniques and are not aimed at securing least cost outcomes. Mandatory renewable energy targets that have no relationship to a market determined cost of greenhouse gas emissions generally fall in to this category. Such an approach can reduce economic efficiency by diverting capital away from more productive investment options which means that ultimately, the overall cost of reducing emissions is likely to be much greater.

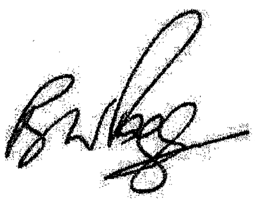
Conclusion

Achieving greenhouse gas emissions reductions, in an environment where energy demand is forecast to grow, is a complex challenge. It is a challenge that will require investment in new technologies, energy efficiency and the revamping of existing infrastructure.

Investment in renewable energy generation capacity is likely to contribute to the task of meeting future demand growth and achieving emissions reductions. However, the cost differentials that exist between these forms of generation capacity will need to be addressed. The most efficient, least cost, means by which to achieve this outcome is to introduce a national, economy-wide emissions trading scheme together with a funding scheme to support nascent technologies.

The Association would be pleased to provide further assistance to the Secretariat if required.

Yours sincerely



Brad Page
Chief Executive Officer

[3] Moore, Taylor "Coal-based Generation at the Crossroads" EPRI Journal, Summer 2005, pg 11.

Attachment A: Description of generation technologies

Fossil fuel technologies

Combined Cycle Gas Turbine (CCGT)

The integrated combustion of gas and steam turbines is called a combined cycle gas turbine (CCGT). CCGT plants achieve high thermal efficiencies by utilising most of the waste heat from the gas turbine exhaust. While used mainly to supply intermediate or peak load in Australia, they are increasingly becoming an economic option for base load generation where natural gas prices are competitive.

Supercritical (SC) and ultra-supercritical (USC) pulverised fuel (coal)

Conventional (sub critical) pulverised fuel (PF) power generation is the main generation technology used in Australia. It involves burning finely milled coal in air in a boiler to generate steam to drive turbo-alternators. Over the last 60 years significant improvements have lead to supercritical (SC) and ultra supercritical (USC) technology being developed. SC and USC plants are characterised by progressively higher boiler steam pressures and temperatures, whereby thermal efficiencies can be increased. Dry-cooling techniques are increasingly used in conditions where a lack of adequate water resources is a problem. The water savings associated with dry cooling need to be balanced with the efficiency losses that generally result.

Integrated Gasification Combined Cycle (IGCC) – black coal

Internationally, IGCC is a technically proven and near-commercial technology. In the IGCC process, coal is converted into a synthetic gas (syngas), which is cooled and cleaned to remove particulates and sulphur compounds, passed through a shift reactor (to separate CO2) and then burned in a CCGT unit. The main components are thus a coal gasification facility, an air separation unit (oxygen instead of air is typically used in the gasification process), a gas cleaning facility, CO2 shift reactor and a CCGT power plant. As concentrated CO2 is one of the by-products of the gasification process this technology is highly suited to carbon capture and storage (CCS). IGCC systems using air instead of oxygen in the gasification process have also been developed. These avoid the upfront capital and energy cost of the air separation unit, but are not as ideally suited to CO2 capture.

Integrated Drying and Gasification Combined Cycle (IDGCC) - brown coal

Research has been underway for some time to develop IGCC technology to utilise brown coal, which requires a technology to be developed to dry the coal before or as part of the gasification process. So-called Integrated Drying Gasification Combined Cycle is one such process that has been developed in Victoria.

Zero emissions technologies incorporating Carbon Capture and Storage (CCS)

CCS technologies could be combined with any of the generation options outlined above and can in principle be retrofitted to existing plants. While many of the techniques and technologies are well-established in other industrial applications, their adaptation to power generation systems is currently at the experimental or demonstration stage. The type of fuel and generation technology that is used will determine the type of capture technology that is most suitable. The three main approaches that could be used to capture carbon dioxide are:

- Post combustion capture (PCC) or flue gas capture: after combusting either pulverised coal or natural gas, carbon dioxide can be separated and captured from the flue gas using contact with chemical solvents, physical absorption, cryogenic separation or membrane separation.

- *Oxygen separation: carbon dioxide concentrations in the flue gas can be increased* significantly by increasing the level of oxygen and reducing the nitrogen content in the combustion air (as in the oxy-firing process described above).

- *Hydrogen (or syngas) approach:* A pre-combustion capture approach suited to the IGCC process described above. The fuel is first reacted with oxygen, air, or in some cases, steam to produce a gas consisting mainly of carbon monoxide and hydrogen. The carbon monoxide is then reacted with steam in a catalytic shift converter to produce carbon dioxide and more hydrogen. The carbon dioxide is then separated from the hydrogen, typically using chemical absorption methods.

Carbon dioxide can then be transported using high pressure pipelines – a technique that has already been proven for use in enhanced oil recovery (EOR) projects since the 1980s (although on a much smaller scale than what would be required for transporting power generation emissions). It could also be transported in tankers similar to those used to transport LPG. Transportation costs will vary greatly depending on volume, distance, geography and method.

Captured carbon dioxide has the potential to be stored in a variety of geological or ocean sites including active and depleted oil and gas reserves, deep and unminable coal seams and saline aquifers.

<u>Renewables</u>

Hydro

From an elevated barrier, water can be diverted through a tunnel or tube into a turbine coupled to a generator that converts the kinetic energy of the falling water into electricity.

Biomass

Biomass generators produce electricity from organic matter such as energy crops, plant derivatives (bagasse), industrial and animal waste (landfill, faeces, carcasses). There are various technologies with quite different features (fuel availability, costs etc) including:

- Direct combustion: the most widely-used technology (for example burning wood waste in a boiler to produce steam).

- Co-firing of coal (PF) with biomass: the combustion of biomass in an existing coal-fired power plant furnace. Typically the biomass (eg. wood chip) is added to the feed coal making up 5% of the total fuel combusted to produce steam.

- Liquid fuels: methanol, ethanol and bio-fuel can be produced from biomass. These can be used for both electricity generation and for transport energy uses.

- Gasification: a process of decomposition of organic matter at elevated temperatures (called pyrolysis) to produce a combustible gas. The resulting gas is a more versatile fuel than the original biomass and can be used in more efficient combined cycle power generation systems.

- Anaerobic digestion: a biological process whereby organic wastes are converted to biogas usually comprised of a mixture of methane and carbon dioxide. The biogas can then be used as a fuel source for generation. The process is based on the breakdown of the organic molecules by naturally occurring bacteria (for example as in landfill gas).

Wind power

Wind turbines use the kinetic energy of the wind to spin the rotor blades of a turbine, driving a generator that produces electricity. Wind farms increasingly consist of a large number of individual turbines (the largest in Australia has 55).

Wind farms can be located either onshore or offshore but costs have so far prohibited offshore wind farm development in Australia. The availability of sites with an ideal wind regime is a naturally limiting factor since the economics of a wind farm are heavily impacted by wind speed. Problems with intermittency may be increasingly addressed through emerging technological solutions (electricity storage) and advanced forecasting techniques.

Solar photovoltaic (PV)

PV technology transforms the energy of solar photons into direct electric current (DC) using semiconductor materials and then into alternating current (AC) using an inverter. The basic unit is a solar or PV cell. When photons enter the cell, electrons in the semiconductor material are freed, generating electric current. PV technology has a wide range of applications; those directly associated with electricity production include:

- Stand alone off-grid systems: most likely in developing countries or remote rural areas. Such systems can be cost effective in isolated areas compared with the cost of delivering electricity from the grid.

- Grid-connected systems: these can be attached to buildings or other infrastructure and can be used to sell electricity into the grid when not needed.

- Utility-scale (or concentrated) PV systems: power plants made up of many PV arrays installed together (capacity of up to several MW). These are likely to achieve sent out costs lower than the other applications.

Solar thermal (ST)

Solar Thermal, also called Concentrating Solar Power, includes three main types of systems - parabolic trough, parabolic dish and power tower (not the same as the so-called 'solar tower' proposal in outback NSW). All of these technologies rely on a process whereby a concentrator captures and concentrates direct solar radiation, which is then delivered to the receiver. The receiver absorbs the concentrated sunlight, transferring its heat energy to a conventional power conversion system such as a steam turbine.

Geothermal

Geothermal energy is derived from heat originating within the earth. Processes using the natural steam generated by geothermal energy have been commercially applied in other parts of the world since the 1950s to generate electricity. A relatively new and unproven application of this concept known as 'hot dry rock' is currently being examined in a number of locations in Australia, including the Cooper Basin (South Australia). Heat producing granites, located 3km or more below the Earth's surface, are trapped by overlying rocks which act as an insulating blanket. The heat is extracted from these granites by circulating water through them in an engineered, artificial reservoir or underground heat exchanger and is converted into electricity in a turbine.

Nuclear Fission

Nuclear power plants generate electricity by first splitting the nuclei of uranium or another element (a process called fission). The uranium is bombarded with neutrons, causing the atoms to split, which releases additional neutrons and large amounts of energy in the form of heat. The heat is then used to generate steam, which in turn powers a generator. This process releases no greenhouse emissions since there is no combustion of carbon. However, conventional nuclear reactors using a 'once-through' fuel cycle produce large amounts of radioactive waste that must be stored safely for hundreds of years. More advanced reactors which reprocess waste in a 'closed' fuel cycle produce less waste but at a higher cost and security risk (reprocessing can be used to enrich plutonium for the purpose of developing nuclear weapons).

Nuclear Fusion

When two hydrogen nuclei collide at high speed, they may fuse together into a heavier nucleus, releasing energy. Similar fusion reactions generate the enormous energy produced by the sun and other stars. While the ultimate goal of nuclear fusion research is to develop fusion power plants to generate electricity, research on fusion is still at an early stage. The main advantages of nuclear fusion are: there would be an enormous fuel supply – one of the two main fuels, deuterium, can be extracted inexpensively from seawater; and there would be minimal long lived radioactive products compared with nuclear fission and hence a more sustainable and safer energy source for electricity generation.

Attachment B: esaa Emissions Trading Scheme Design Features

esaa contends that an efficient, effective and equitable emissions trading regime should have all of the following design features (these features should be considered collectively rather than individually):

- A firm, long-term greenhouse gas abatement target for the whole economy needs to be established to promote confidence in the scheme among participants and encourage investment.
- All significant greenhouse gas emitting sectors, sources and sinks should face the cost of releasing greenhouse gas emissions into the atmosphere including the stationary energy sector, industry, transport and agriculture.
- Under an economy wide emissions target each sector's contribution to greenhouse gas abatement should be set at a level proportionate to each sector's share of emissions.
- The emissions trading scheme should be national, if not international, and would not operate effectively without the involvement of all States and Territories.
- Provided Australia is not disadvantaged by its participation, an Australian emissions trading scheme should be linked (in some form) to international schemes that have sufficient coverage to facilitate access to lower cost abatement opportunities.
- To manage transitional costs, a relatively low domestic penalty should apply until a binding international agreement on greenhouse gas abatement targets is present.
- Greenhouse gas emitting entities that are adversely impacted by the application of an emissions trading system must be fully compensated for any economic loss of value from both existing assets and new assets that have passed the financial commitment stage prior to scheme announcement. Voluntary, early (prior to scheme announcement) action to reduce emissions should also be recognised.
- Economic loss of value must also be recognised and compensated when there is major policy or scheme design change, including the impact of any future transitions to international schemes or agreements.
- Any revenues generated by governments under the scheme, for example from permit auctioning and penalty payments, should be invested in emission abatement activities including research, development and deployment of low emission technologies.
- An emissions trading scheme should not contain a 'make good' provision in addition to financial penalties.
- To the extent that new low-cost abatement opportunities arise (either domestically or internationally) these should be incorporated into the scheme.