
Final Report to
Garnaut Climate Change Review

**NEM Market Failures and Governance
Barriers for New Technologies**

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GLOSSARY

MRET	Mandatory Renewable Energy Target
NEM	National Electricity Market
TUOS	Transmission use of system
SWIS	South West Interconnected System
ETS	Emissions trading scheme
ACCC	Australian Competition and Consumer Commission
AER	Australian Energy Regulator
AEMC	Australian Energy Markets Commission
MCE	Ministerial Council on Energy
NEMMCO	National Electricity Market Management Company
NECA	National Electricity Code Administrator
VENCorp	Victorian Energy Networks Corporation
ESIPC	Electricity Supply Industry Planning Council
COAG	Council of Australian Governments
AEMO	Australia Energy Market Operator
GMO	Gas Market Operator
GMC	Gas Market Company
REMCo	Retail Energy Market Company
IMO	Independent Market Operator
NTP	National Transmission Planner
NTNDP	National Transmission Network Development Plan
ANTS	Annual National Transmission Statement
NER	National Electricity Rules

EXECUTIVE SUMMARY

The Garnaut Climate Change Review (herein denoted “The Garnaut Review”) is investigating a range of issues regarding Australia’s response to climate change arising from emissions of greenhouse gases. As part of its investigations, The Garnaut Review is examining the presence of market failures that may reduce the effectiveness of policy responses to reduce emissions. As electricity generation is a major source of emissions in Australia, a key area is whether there are any market failures impacting on electricity market operations. MMA has been asked to investigate potential market failures in the electricity market and to determine the materiality of these failures in terms of affecting greenhouse mitigation.

The focus is on the National Electricity Market, which covers the eastern and southern States of Australia. Similar issues may affect other markets in Western Australia and Northern Territory. The NEM is structured as follows:

- A wholesale market, which determines the dispatch of generating plant in each 5 minute trading interval across the states of South Australia, Tasmania, Victoria, NSW and Queensland. Dispatch of generating plant is based on ascending order of bids from least cost to highest cost until demand in each interval is met. The spot market price is essentially determined by the bid of the last plant dispatched to meet demand.
- A financial contract market, which supplies financial instruments to enable generators and retailers to hedge their market risks.
- A transmission system, which transmits electricity from generators to major distribution regions. Pricing in this is determined by regulation regime, which determines revenue caps for each transmission network service provider (so that pricing structures are such so that revenues do not exceed the caps). Investment in capacity is also determined by planning bodies, typically state based although a national planner is being established.
- A distribution system, which transmit electricity from the transmission system to customers. As with transmission, distribution is typically a natural monopoly and therefore prices are affected by a regulatory regime determining revenue caps. Service standards and investments are also determined through a regulatory regime.
- A contestable retail sector, where customers are able to chose their retailer. Retailers purchase electricity from the wholesale market and sell to end-use customers. Although largely contestable for most customers groups, price caps on retail prices do apply in some states for small customers.

Generation in the NEM is largely though coal-fired generation, which contributes over 80% of total generation. Gas-fired generation has increased in recent years due to technological developments, reform of the gas markets and favourable government policies. Renewable generation has stabilised as a proportion of total generation, again

through favourable Government policies such as the MRET scheme. Despite rising capital and fuel costs, coal is likely to remain the dominant form of generation in the NEM in the foreseeable future unless policies are put in place to favour low emission generation options (such as emissions trading).

In this report, a market failure is deemed to occur when a market fails to provide goods and services in an economically optimal manner. Market failure occurs when society's marginal costs do not equate to the marginal benefits to society for a particular good or service. As a result, market price signals do not reflect the full social costs of producing the good or service and so producers under or over produce the good from a societal perspective.

Even if an emission trading scheme is implemented a number of market failures exist under the current institutional and market arrangements that may impact on the effectiveness of emission trading. Table 1 contains a list of the potential market failures and the effect of these failures on low emission generators. Although a range of failures have been identified, there is no problem with the overall structure of the market or institutional arrangements. Rather the identified market failures require minor changes to rules and regulations.

In terms of the potential to have a material impact on emissions trading, the main market failures identified include:

- Benefits of distributed and embedded generators are not fully recognised under current market rules. The presence of retail price caps and the lack of interval metering means there is very little use of time differentiated retail prices. Further, the monopoly status of transmission and distribution service providers coupled with superior information on network costs, provides these entities with the ability to stymie investment in embedded generation, including cogeneration, distributed generation in remote regions and small scale roof-top generation from PV systems. Mandating feed-in-tariff or other pricing arrangements that recognise the benefits of these generation options is one solution. Nodal pricing may also provide better locational signals, but this is likely to be administratively complex.
- The presence of economies of scale in network combined with monopoly provision of network services means that investment in network capacity to allow low emission sources of generation to access the wholesale markets may be suboptimal. Under current arrangements, the first low emission generator in a region may have to pay for the cost of connecting and upgrading the transmission system. Subsequent low emission generators may free-ride on this investment and gain low cost access to transmission. Alternatively, the first generator may invest in capacity that is limited to its generation capacity. National transmission planning that recognises broad social and market benefits from transmission systems may overcome these market failures.
- Regulatory network pricing and investment regimes may favour transmission and distribution investment over embedded low emission generation investment. Recent

changes to the National Electricity Rules are unlikely to have fully ameliorated the bias towards network investments over embedded generation.

Table 1: Market failures impacting on adoption of low emission generation

Market Failure	Affect of Market Failure	Policy Option to Correct for Market Failure
Generator market power	Low prices to pre-empt entry	No action
Uncertainties in the market	Difficulty in obtaining appropriate financial contracts	No action
Neutrality of technology	Inconsistent technical requirements <ul style="list-style-type: none"> • Ancillary service • Control equipment 	Review of rules
Externalities	Benefits of embedded generation not fully recognised <ul style="list-style-type: none"> • Network benefits • Loss reduction 	Recognise externalities of embedded and distributed generation
Monopoly networks	High cost standby arrangements and connection agreements Non transparent network planning arrangements Asymmetric information	Independent network planning body to produce annual statements that provide transparent value propositions for network augmentation including non-network solutions.
Free rider	Suboptimal network investments. Access difficulties for embedded generation	Nodal pricing Feed-in-tariffs Financial transmission rights
Economies of sale in networks	Investment in suboptimal network capacity	Funding during initial period
Regulatory failures <ul style="list-style-type: none"> • Inappropriate incentives • TUoS arrangements • Demand side participation 	Network solutions preferred over potentially more efficient non-network solutions including embedded distributed generation and demand side alternatives.	Independent network planning body to produce annual statements that provide transparent value propositions for network augmentation including non-network solutions.

Further analysis is required to investigate the social benefits and costs of the market failures identified in this study and options to address them.

1 INTRODUCTION

1.1 The Garnaut Climate Change Review

The Garnaut Climate Change Review (herein denoted “The Garnaut Review”) is investigating a range of issues regarding Australia’s response to climate change arising from emissions of greenhouse gases. The Garnaut Review has been asked to report on:

- The likely effect of human induced climate change on Australia’s economy, environment, and water resources in the absence of effective national and international efforts to substantially cut greenhouse gas emissions;
- The possible ameliorating effects of international policy reform on climate change, and the costs and benefits of various international and Australian policy interventions on Australian economic activity;
- The role that Australia can play in the development and implementation of effective international policies on climate change; and
- In the light of 1 to 3, recommend medium to long-term policy options for Australia, and the time path for their implementation which, taking the costs and benefits of domestic and international policies on climate change into account, will produce the best possible outcomes for Australia.

The Garnaut Review has taken the strategy that an effective response to climate change would necessarily include a review of the potential market failures affecting the uptake and deployment of new technologies with lower emission intensities. Such market failures may reduce the effectiveness of broader policy measures directed at reducing emissions of greenhouse gases. The focus of the terms of reference is on market failures and barriers resulting from the current market design of Australia’s electricity markets, which may hinder the uptake of the new generation technologies that differ from the large scale but centrally located forms of fossil fuel technologies that dominate generation today.

1.2 The Australian Electricity Market

The National Electricity Market (NEM) covers the states of Queensland, New South Wales and the ACT, Victoria, South Australia and Tasmania. While the NEM provides the bulk of electricity supply in Australia, other significant electricity grids include the South West Interconnected System (SWIS) of Western Australia covering the area from Kalbarri in the North to Albany in the South and Kalgoorlie in the East and the Darwin-Katherine System in the Northern Territory. The focus of this study is the NEM.

In the second half of the 1990s, reforms began in the Australian electricity industry that changed the way electricity was supplied. Prior to these reforms, electricity supply was provided largely by vertically integrated authorities. The reforms disaggregated these

authorities into separate generation, transmission, distribution and retail entities. The goal of the reform process was to increase competition, improve efficiency and provide greater choice for end-use electricity consumers. To facilitate these reforms, VicPool was established in Victoria and the State Electricity Market was set up in NSW (and ACT) to allow the wholesale trading of electricity within the states.

In the late 1990s, the two state based markets were amalgamated to form the NEM and expanded to cover South Australia and Queensland. Tasmania joined the NEM as a separate region in 2005. Currently Snowy exists as a distinct region that encompasses the Snowy Hydro generators. This region will be abolished on 1 July 2008.

The NEM was designed before climate change became a major issue for governments. While the NEM was ostensibly designed to be technology neutral, the structure and design of the NEM may result in suboptimal levels of investment in low emission generation technologies in the light of greater understanding of the cost of greenhouse gas emissions. While a credible and efficient emissions trading scheme (ETS) will encourage the development and investment in low emission technologies, the deployment may still be discouraged by any market failures in the NEM.

1.3 Study Objectives

McLennan Magasanik Associates (MMA) has been commissioned by the Garnaut Review to undertake a study of the NEM market failures.

The objectives of this project are to:

- Provide the Garnaut Review with an assessment of the barriers and obstacles being faced by new electricity generation technologies in the context of an ETS, and
- Provide the Garnaut Review with an analysis of these market failures and weaknesses, and an indication of potential reform solutions.

Although the focus of this report is on the NEM, market failure issues in other electricity markets in Australia, namely the SWIS and Darwin-Katherine System, are also highlighted.

2 STRUCTURE OF THE NEM

2.1 Governance

2.1.1 Privatisation and reforms

In Victoria and South Australia, the whole supply chain was progressively privatised during the late 1990s and 2000. While Queensland has privatised the retailers, in NSW and Queensland, the state governments retained public ownership of the existing assets. New competitors in the generation and retail spheres were allowed to compete with the existing entities in all the states. Regulators were set up in each of the states to promote competitive market conduct and to prevent the misuse of market power. With the formation of the NEM, regulatory authority over the industry has progressively shifted to the Australian Competition and Consumer Commission (ACCC) initially then to the newly formed Australian Energy Regulator (AER). A separate body, the Australian Energy Markets Commission (AEMC) was set up to oversee the rules that govern the industry. The Ministerial Council on Energy (MCE) was established under the Council of Australian Governments as the policy-maker and legislator for the industry.

The National Electricity Market Management Company (NEMMCO) was established in 1996 to operate the NEM. It was set up by the participating states and operates on non-profit basis, recovering the costs of operating the NEM and running the organisation by charging market participants fees. NEMMCO operates the NEM in accordance with a set of rules. When the NEM commenced, this set of rules was laid out in the National Electricity Code. In June 2005, the National Electricity Code was replaced by the National Electricity Law and Rules. NEMMCO's functions are prescribed in the National Electricity Law, and procedures and processes for market operations, power system security, network connection and access, and pricing for network services in the National Electricity Market are all prescribed in the National Electricity Rules.

The NSW government has announced its intention to privatise both its retailers and generators while retaining public ownership of the transmission and distribution networks. Queensland currently has both private and publicly owned generators.

2.1.2 Regulation

State based regulatory bodies were initially set up during the mid 1990s at the start of the industry reforms. These jurisdictional regulators were tasked with regulating the whole electricity supply chain. With the commencement of the NEM, the ACCC was made the regulator for transmission services as well as monitoring the market behaviour of generators. The National Electricity Code Administrator (NECA) was set up to maintain and monitor compliance with the National Electricity Code. State regulators retained regulatory authority over the distribution networks. Licensing of both generators and retailers remained with state regulators. In addition, Victoria set up the Victorian Energy

Networks Corporation (VENCorp) to operate both the gas market as well as to plan and operate the Victorian electricity transmission system which is separately owned by PowerNet (now SP Ausnet). At about the same time, the Electricity Supply Industry Planning Council (ESIPC) was established to plan and monitor the electricity supply industry in South Australia.

This separation of regulatory authority led to complaints that there were too many regulatory authorities and rules governing the operations of the electricity industry. To co-ordinate policy and to establish a national energy policy framework, the Ministerial Council on Energy (MCE) was established by the Council of Australian Governments (COAG) in 2001. The MCE is the national policy and governance body for the Australian energy market, including for electricity and gas. The objectives of the MCE are:

- To provide oversight and coordination of policy development to address the opportunities and challenges facing Australia's energy sector, and
- To provide leadership so that consideration of broader convergence issues and environmental impacts are effectively integrated into energy sector decision-making.

As a result, the AEMC and the AER were established as the statutory bodies for the oversight and regulation of the National Electricity Market replacing the ACCC and NECA. Eventually, it is expected that the AER will assume the electricity (and gas) regulation functions of the state jurisdictional regulators operating in the NEM.

The AEMC is responsible for rule making and market development. This rule-making role does not require the AEMC to initiate changes to the Rules other than where the change involves correcting minor errors or where the change is of a non-material nature. Rather, the role involves managing the rule change process, and consulting and deciding on rule changes proposed by others usually participants.

The AEMC also conducts reviews at the request of the Ministerial Council on Energy or at its own volition on the operation and effectiveness of the Rules or any matter relating to them.

The AER has responsibility for the enforcement of and monitoring compliance with the Rules, as well as responsibility for economic regulation of electricity transmission and distribution. The AER determines the revenue of the transmission and distribution networks based on the asset value of these networks and the cost of operating and maintaining the assets.

2.1.3 Australia Energy Market Operator

COAG has agreed to a proposal to establish the Australia Energy Market Operator (AEMO)¹, an industry funded body for both electricity and gas, to strengthen energy market governance. AEMO's functions² are envisaged to encompass:

¹ http://www.coag.gov.au/meetings/130407/docs/COAG_NRA_competition_reforms.rtf

- Responsibility for the day to day operation and administration of the power system and electricity wholesale spot market in the NEM (as currently performed by NEMMCO),
- The planned Gas Market Operator (GMO) expected to take over the gas market functions of VENCORP, the GMC and REMCO and to have responsibility for the operation of a bulletin board and short term trading market for gas, and
- The national transmission planning function.

With the establishment of the AEMO, a number of state based bodies will cease to exist. These include:

- all functions currently undertaken by
 - NEMMCO,
 - VENCORP (including its role as the Gas Retail Market Operator (GRMO) providing retail gas market services in Queensland),
 - Gas Market Company (GMC) (operator of the NSW & ACT Gas Retail Market), and
 - Retail Energy Market Company (REMCO) in South Australia.
- While the governments of WA and NT are still considering whether to be part of this process and no decision has been made in relation to the transfer of market operation functions of the Independent Market Operator (IMO) and REMCO in WA to AEMO, it is envisaged that this will eventually occur.
- Similarly, while no decision has been taken on incorporating of the functions of the ESIPC in South Australia, the role of ESPIC will also likely be absorbed into national transmission planner.

A criticism of the current transmission planning arrangements is that there is no strategic NEM wide transmission planning body. State based transmission authorities currently undertake transmission planning within their respective states with NEMMCO providing a co-ordinating role across state boundaries. The establishment of the National Transmission Planner (NTP)³, located in the AEMO, will enable the development of a strategic National Transmission Network Development Plan (NTNDP) to oversee the development of the power system, including the current and planned future capability of the national transmission network and development options. The objective of the NTP is to promote the development of a strategic and nationally co-ordinated transmission network having regard to the:

- Best practice in transmission planning,

² <http://www.nemmco.com.au/corpinfo/000-0269.pdf>

³ <http://www.aemc.gov.au/electricity.php?r=20070710.172341>

- Development in technology that affects transmission development,
- Competitiveness and feasibility of fuel sources for generation,
- Government policies, and
- Demand side, embedded generation and fuel substitution alternatives.

These new arrangements are expected to deliver a coordinated and efficient national transmission grid, meeting local and regional reliability and planning requirements, and be flexible enough to respond to generation and load changes. The NTNDP will replace the current Inter Regional Planning Committee and Annual National Transmission Statement (ANTS). The NTNDP is expected to contribute to improving the efficiency of the transmission network investment decisions by providing an integrated long term development plan.

2.2 Networks

The NEM also includes the electrical networks, used for transmission of electricity from generators to the distribution network and then on through to the customers. Under the National Electricity Rules, the **transmission** system consists of network assets carrying electricity at 220kV and above, plus those assets operating between 66kV and 220kV if they operate in parallel to and provide support to the higher voltage transmission network, or are deemed by the AER to be part of the transmission network. Assets operating between 66kV and 220kV that do not operate in parallel to and provide support to the higher voltage transmission network may be deemed by the network operator to be part of the distribution system by agreement with the AER and the jurisdictional regulator. From the transmission network, **distribution** networks carry electricity to the end-users. These distribution networks consist of assets that distribute electricity at nominal voltages up to 66kV.

The revenue received by all transmission and distribution networks is regulated by the AER. Transmission networks are revenue capped where the annual revenue received is fixed regardless of the volume of electricity transmitted. Some distribution networks are also revenue capped on an annual basis while others are regulated based on an average price. Distribution networks capped on an average price have the ability to increase their revenue in any year by increasing the volume of electricity sold through their networks.

Interconnectors are high-voltage transmission lines that transport electricity between adjacent NEM regions. Electricity is imported into a region when demand is higher than can be met by local generators, or when the price of electricity in an adjoining region is low enough to displace the local supply.

An interconnector's ability to transfer electricity is limited by the physical transfer capacity of the interconnector. When the technical limit of an interconnector's capacity is reached, the interconnector is constrained. If prices are very low in one region and high in an adjacent region, electricity can be sent from the low price region to the high price region across an interconnector up to the constraint limit of the interconnector. When this

limit is reached, local generators will be dispatched to meet local demand based on dispatch of the lowest cost generation within the region.

An interconnector that has passed the regulatory test and has been deemed to add net market value to the NEM may be classified as a regulated interconnector. A regulated interconnector receives an annual revenue based on the value of the asset (return of and on investment) and the cost of operating the interconnector. This revenue is set by the AER regardless of actual usage. Regulated interconnectors operate between all adjacent regions of the NEM.

Unregulated (or market) interconnectors derive revenue by trading in the spot market. Unregulated interconnectors are not required to undergo regulatory test evaluation.

3 MARKET FAILURE

3.1 Defining Market Failure

Narrowly defined, market failure occurs when a market fails to provide goods and services in an economically optimal manner. From a Pigouvian perspective, market failure occurs when society's marginal costs do not equate to the marginal benefits to society for a particular good or service. As a result, market price signals do not reflect the full social costs of producing the good or service and so producers under or over produce the good from a societal perspective.

However, even if markets produce efficient outcomes from an allocative perspective, the outcomes may still be unsatisfactory from an ethical or distributional perspective. If the definition of market failure is to include equity as well as efficiency considerations, then any failure by markets to produce economically optimal or socially desirable (equitable) outcomes may be considered a market failure. The introduction of equity into economic analysis requires complex considerations, given range of plausible standards for evaluating equity. Accordingly, we will examine the forms of market failure accordingly to the narrowly defined terms of allocative efficiency.

In this context, just because the market does not deliver what certain segments of society considers should be delivered, or fails to provide a good or service because it is not profitable, does not mean that there is a market failure. There also could be perceptions of market failure hindering adoption of new technologies when in fact there is more of a case of imagination failures due to proponents of new technologies not taking full advantage of the current institutional or regulatory environment.

3.1.1 Barriers that represent market failures

Generally, markets work well for most goods and services, allocating resources in the most economically efficient manner to ensure that society obtains the greatest benefit from their use. However, there are a number of barriers that are consistent with the economic concept of market failure, circumstances where markets, left to themselves, do not deliver efficient outcomes. These contribute to some degree to reduced economic efficiency. In these circumstances, markets are considered to "fail" in their role of efficiently allocating resources. Government action that seeks to address the sources of market failure may enhance economic efficiency if the benefits of intervention exceed the costs. Dealing with market failure is an important rationale for government intervention and regulation.

The COAG meeting of 10 February 2006 agreed that "*effective regulation is essential to ensure markets operate efficiently and fairly, to protect consumers and the environment and to enforce*

*corporate governance standards. However, the benefits from each regulation must not be offset by unduly high compliance and implementation costs.*⁴

Areas where government intervention has been used to improve market performance or correct for market failure include:

- The ability of an economic agent to exercise some degree of market power.

In industries with a homogeneous product and economies of scale, a natural monopoly will often arise. Monopoly and non-competitive behaviour can lead to the over-charging and restriction of supply of goods and services relative to the social optimum. However, when economies of scale and scope are available, the most efficient outcome may be a monopolistic structure with one or a small number of firms. Utilities are often considered to be natural monopolies. In the case of the electricity industry, transmission and distribution networks provide essentially the same product, the transportation of electricity, and the cost of an additional customer is low while the marginal cost of selling one more MWh is usually not substantial relative to the average cost of providing the infrastructure required. Adding additional customers would increase the company's revenue and lower the average cost of servicing the customer base. So long as the average cost of serving customers is decreasing, the larger firm will more efficiently serve the entire customer base and any potential new entrant will inevitably face a higher cost to serve a smaller customer base. The monopoly service provider will have the ability to extract economic rent as potential competitors will be discouraged from entry.

Governments typically intervene in such markets where competition may be restricted through public ownership. In recent years, this field of government intervention has been the subject of significant reform with competition policy and regulation preferred over direct ownership.

- Imperfect or asymmetrical information

Markets cannot operate optimally where consumers or producers do not have adequate information to make informed decisions or to undertake transactions. However, information is also costly and for individual market participants, obtaining the required information is often prohibitive. Information asymmetry also impedes the optimal functioning of a market. In this case, greater information held by some side of a potential transaction can lead to differences in the assessment of potential benefits and thus lead to difficulties in striking an agreed price.

Governments intervene to overcome information failures to improve the functioning of the market. In the renewable energy sector, this may be a reason for the lower than optimal up-take of small scale distributed generation. The small customer is likely to find that the cost and effort required to acquire the information for the connection of roof top solar PV to the grid is too high. As a result they are not aware of the

⁴ Council of Australian Governments, Meeting Outcomes, 10 Feb 06, www.coag.gov.au/meetings/100206/index.htm

opportunities available. Regulation is often used in areas of high risk and where information is too technical to be widely understood. Information issues can also be addressed directly through provision of information and transparent processes.

- Externalities

Externalities refer to the costs and benefits that are not factored into consumption and production decisions. For example, pollution is commonly cited as a negative externality associated with energy consumption. To the extent that negative externalities are associated with energy consumption, economists would argue that the cost of energy is under-estimated in the market, and private decision-making will lead to excessive levels of consumption. In the case of electricity generation, the cost of pollution is not necessarily factored into the cost of fossil fuel fired generation⁵ leading to too low a cost from this source of generation to the disadvantage of renewable, non-pollution sources of generation.

Governments usually have environmental and health regulations to overcome such externalities. Market-based instruments such as levies and subsidies are also being used to try to internalise social costs into private decision-making.

- Public good

Public goods are an externality with two distinctive features. Firstly, one person's consumption does not reduce the amount available for someone else (non-rivalry) and secondly, no one can be prevented from sharing in the consumption of the good (non-excludability). Once created, the good can be used by others at little or no additional cost. The existence of public goods gives rise to the free rider problem – where an individual lacks the incentive to pay for a good if that payment has no effect on the quantity of the good that may be consumed. Since it is possible to free ride (non-excludable), it is difficult to raise revenue from the sale of a public good. As a result, public goods cannot be provided by private market participants and the responsibility thus rests with government. Roads, lighthouses and national defence have usually been used as examples of public goods where governments have provided the service funded by government taxes.

Unless a mechanism is available to ensure that everyone who benefits pays, individuals may have an incentive to attempt to avoid paying. With network business services, the first connection is often the most costly given the infrastructure needed to support this first customer. Customers who can simply free-ride on the infrastructure already in place will thus have an incentive not to be the first connection if they are to be charged the marginal cost of the service. Overcoming the free-rider problem is a rationale for government intervention in markets to enable the funding of such investments

⁵ In some states, regulation covering emission of prescribed pollutants do exist. However, not all pollutants are necessarily covered by these regulations

- Governance and regulatory framework

While not strictly a market failure, governance and regulatory arrangements can form barriers to entry by imposing requirements that may be a disincentive for more efficient solutions than traditional means to address the requirements of the market. The arrangements may also not fully recognise the benefits that non-traditional solutions bring to the market and so the arrangements under compensate these solutions.

3.1.2 Market barriers or impediments that are not market failures

Some market barriers that might slow the take up of low emission energy technologies or processes are not market failures. While they may be barriers to entry, they may represent rational or efficient economic behaviour. Impediments of this type include:

- Uncertainty about future energy prices and hence the potential returns from an investment in low emission energy generation, resulting in proponents applying a higher cost of capital and discount rate in evaluating proposed renewable energy projects.
- Constraints on the availability of capital to the extent that renewable energy investments are constrained by the scarcity of capital experienced in other areas of the economy.
- Inertia in the adoption of new technology that is widespread across all economic activities.

4 MARKET FAILURE IN THE NEM

In general, electricity markets may be exposed to a number of potential market failures. In the NEM as well as in the SWIS, regulation is often used in an attempt to ameliorate the impact of market failure. Electricity markets are seen to exhibit characteristic that increase the likelihood of market failure. The product is considered an essential good with significant social and environmental externalities. The supply is generally concentrated in a small number of large providers using capital intensive and long lived assets. These characteristics are seen to limit the ability of competition to ensure that economically optimum results are achieved.

4.1.1 Generator market power

Volatile pool prices do not by itself indicate market failure. Pool prices are set by the unit with the highest bid required to meet demand⁶. Generators are allowed to rebid as they assess the level of demand and available supply taking into account plant failure. While generators may only be able to exercise its market power for short periods when supply conditions allow, this ability can cause extreme pool price volatility. This volatility is factored into contract prices in terms of higher risk premiums, and contributes to the difficulties that large users have in obtaining long-term energy contracts.

Some pool price volatility is however required as it provides signals for new investment. Without a separate mechanism to signal the need for capacity, the NEM requires this volatility to ensure that there is investment in sufficient capacity to meet demand. As the supply/demand balance tightens, generators can increasingly exercise market power in more bidding intervals, and thus raise the average price level and provide the signal required by new entrants.

Any exercise of generator market power has not prevented new entry and may in fact have encouraged new entry thereby bring prices back down. While it may be argued that generators may exercise market power to keep prices low to pre-empt entry, this is likely to be self defeating and low prices in the earlier days of the NEM reflected excess capacity rather than market power.

Generator market power is thus likely to be a concern only if it is sustained. That is, where a generator or a coalition of generators are able to continuously and sustainably raise prices above costs. In the absence of other barriers to new entry, the exercise of market power may be sustained.

⁶ In practice, system marginal price is set by a complex set of equations (the NEMDE Linear Program) based on constraints in the network and the losses within and between regions. The resulting price is usually not the bid price of highest despatched generator but rather the result of equations involving a number of generators, the loss factors and interconnector constraints.

4.1.2 Uncertainty in the market

Of greater concern for new generation is the lack of a long term contract market⁷. With the exception of generation as part of a vertically integrated business (AGL and Origin Energy), new entrants are generally unable to obtain contracts for their energy of sufficient length to underwrite their long lived investments. Contracts in the electricity market are mainly for one or two years with contracts for three years or more being difficult to obtain. Contracts for five or ten years are rare. This situation is largely the result of the uncertainty that exist in the market over future developments in the market and the structure of the industry.

4.1.3 Neutrality of technology

The NEM was established around existing generators and their capabilities. New entrants, however, were subject to certain technical requirements including those regarding control equipment and the ability to meet ancillary services which the older existing generators did not have to meet. This additional requirement means that the cost structure of new entrants are likely to be higher than that of existing generators placing them at a cost disadvantage.

The NEM is designed to be technology neutral. This means that renewable technology and embedded generation must be able to compete with more established fossil fuel fired generation technology in accessing the market without assistance. This places these technologies at a disadvantage given its higher cost structure. While often renewable generation technology has very low marginal costs (e.g. solar and wind generation technologies), the capital costs are significantly greater than conventional generation technologies. However, this fact should not be considered a market failure by itself, but a factor that makes some markets failures a material barrier to the development of the industry.

4.1.4 Embedded Generation

Low emission distributed micro-generation technology had been disadvantaged as prices paid for such generation did not take into account the value and benefits to the electricity network which arose from the adoption of such technologies embedded within the electricity grid. This situation is in the process of being rectified with both South Australia⁸ and Queensland⁹ introducing feed-in tariffs significantly in excess of the general use tariffs. Victoria has legislation that requires electricity retailers to establish feed-in tariffs for small scale renewable energy generation. The ACT is also considering the introduction of legislation to provide for feed in tariffs from renewable energy generation¹⁰. Embedded generators can also make a case to have some of the benefits of

⁷ W Parer, 2002, *Towards A Truly National And Efficient Energy Market*, Canberra

⁸ http://www.climatechange.sa.gov.au/news/news_5_2.htm

⁹ http://www.dme.qld.gov.au/Energy/solar_feed_in_tariff.cfm

¹⁰ ACT Government, *Feed-In Tariff Discussion Paper*, Dec 2007

deferred network upgrades passed on, as occurred with the Somerton Plant in Victoria, which received some payments for the benefits perceived from deferred system upgrades. Nothing in the rules prevents embedded generators being able to negotiate with network service providers to share some of the benefits from embedded generation¹¹, but there is often a perception that an asymmetry issue exists in that only the network service providers truly know the value of the network benefits and would have an incentive to under report these benefits.

Another benefit that embedded generators bring to the electricity market that should be available to proponents is the reduction in network losses. As electricity is transported through the wires in the transmission and distribution system, energy is lost in the form of heat. This loss is exponentially related to the load demand. By siting a generator near a load, the amount of energy required to be imported from the network is reduced. This reduces the losses incurred by the network for all other customers. While larger embedded generators are usually able to include this benefit in their negotiations for connection to the system, this benefit is not necessarily reflected in feed in tariffs that simply reflect general use tariffs and also if the feed in tariffs are paid on net exports only.

On 1 January 2008, certain changes to the National Electricity Rules (NER) were made to provide additional incentives for embedded generation and demand management by providing increased regulatory certainty so that efficient investments in these alternatives to network investment can be included within the regulatory framework. While there may be some indications that distributors are trialling direct load control and considering small scale generation, the outcome of the changes to the NER are still uncertain and it remains to be seen if the market barriers to embedded generators will be overcome by the changes.

4.1.5 Monopoly networks

Transmission and distribution network service providers are usually natural monopolies and in the absence of regulation will usually be able to limit services and raise prices. Customers seeking access to these network systems are also usually at a disadvantage due to the asymmetry of information. The problem of free riders may also be present when network investment is considered. With many small customers, each benefiting a little from a large transmission investment, there is the temptation to free-ride. While everyone would be better off sharing in the investment, the temptation to free ride and avoid paying for the expense may overcome any ability to form a consortium to negotiate a contract with the network service provider.

Network operators control access to information regarding their networks and have the ability and under the regulatory regimes often the incentive to impede access by embedded generators given that presence of such generators may reduce the need for

¹¹ Such arrangements may even benefit network service providers as the payments could be deemed to be outside the regulated revenue arrangements governing their revenue streams from regulated network services.

network augmentation. Network owners are also normally the planning authority. Incentives in the economic regulatory framework that apply to networks encourage network businesses to grow their assets while maintaining network reliability in order to increase revenue. Alternative solutions to maintain or improve network reliability do not have the same incentives. As a result, a conflict of interest arises when network service providers are expected to assist embedded generators in their connection to the network. The recent NER changes are unlikely to overcome this failure of asymmetry of information, although they explicitly mandate for the proper consideration of embedded generation.

Potential embedded generation including those proposing low emission generation technologies like co-generation and renewable technologies like wind farms and small scale solar generators often complain that the potential for embedded generation is impeded by a number of barriers including:

- Difficulties in accessing network operation information during negotiation on network connection agreements and costs. The embedded generation proponent does not have full information on their use of the network system, so may incur higher costs for connection to the transmission network.
- Lack of requirements for embedded generation to be explicitly considered where augmentation of networks is being considered. The regulations do require that network service operators consider alternatives to network upgrades as part of the approval process for these upgrades, but often the information is sought too late to allow the full development of alternative proposals.
- Network pricing structures that includes high stand-by charges with minimum chargeable demand that are only used when the embedded generator is not operating. This requirement penalise customers that self-generate, having to incur both the costs of generation as well as network demand charges that other generators do not incur.
- Low 'buy back' rates for electricity to be exported to the network that do not reflect a proper recognition of the network benefits that the generator brings to the network including the reduction in losses, network augmentation and potentially improved supply reliability. Recent regulatory changes and the implementation of interval metering and time of use tariffs may overcome part of this obstacle by encouraging fairer buy back rates.
- The existence of the retail arm of the network business creates potential conflict of interest in supporting embedded generation projects proposed by third parties. This issue has diminished over time as there is increasing separation of retail and network businesses (particularly for private retail entities and increasingly for publicly entities to the extent that only in NSW, Tasmania and Northern Territory do their exist combined retail/distribution entities)

4.1.6 Free riders

Incentives also exist for potential proponents of larger scale renewable energy generators to delay the development of their investment in the hope of free riding at least partially, on network extensions. NEM networks charge for connection on the basis of shallow connection costs¹². This involves the connection proponents paying for all connection assets up to the point of connection to existing assets. As potential renewable energy developments may be some distance from the existing network, the assets required for connection may amount to a substantial investment. Should the network be expanded due to general load requirements, or if another party has paid for the extension due to a requirement for connection, the next party to connect to the network is able to free ride on this extension and only needs to pay for any direct additional assets to be connected. Even if this connection requires an upgrade deeper down the network than the immediate connection, the principle of paying only shallow connection costs would allow the proposed connection to avoid payments for deeper costs.

4.1.7 Economies of scale

Networks are usually characterised by large economies of scale. This presents another problem for the development of wind, solar and geothermal generators which rely on remote resources. During the initial phases of development, the installed capacity is likely to be small relative to the potential resource. Unless the developer owns the full resource, the transmission network will only be expanded with sufficient capacity to enable it to meet the needs of the immediate development rather than the potential capacity of the resource. The initial developer will have no incentive to fund the installation of network capacity greater than its needs. This is likely to be sub-optimal from society's perspective as savings from economies of scale will be lost.

Currently, arrangements in the industry do not provide any mechanism for additional network capacity to be funded based on a longer term societal perspective. Additional network capacity can only be funded by the broader customer load if it can be shown that the project meets the regulatory test (that is, it is the best alternative). However, building capacity beyond the needs of the proposed generation capacity will most likely have a negative net present value (that is, from the regulatory test perspective, it is better not to install the additional network capacity since there is no generation capacity proposed that will utilise the network capacity). As a result, the network will only have sufficient capacity to carry the energy produced by the initial generation project. When the next generation project to develop the resource is proposed, the transmission network will then have to be augmented with additional cost exceeding the incremental cost if the additional capacity had been built into the network initially.

¹² Shallow connection costs includes the costs of connection assets upto the point of connection with the existing network infrastructure. Deep connection costs include the cost of augmenting the existing network infrastructure beyond the point of connection.

4.2 Regulatory Framework

4.2.1 Incentives

The incentives provided in the regulatory framework encourage network owners to grow their assets. The prices that networks are allowed to charge are directly related to the value of the asset base. That is, the higher the asset value, the higher the average prices may be. New entrants offering solutions that replace network assets are thus often faced with unsympathetic network operators. This includes solutions that lower peak demand or provide distributed generation. Often these solutions may be more economic and environmentally friendly but encounter significant connection barriers. How the recent changes to the NER impact on these incentives are unclear as although they provide directions to explicitly consider the benefits of embedded generation, they have not yet been tested to see if they work in practise to encourage such generation..

4.2.2 Avoided TUOS

While not strictly a market failure, the regulatory framework does provide some barriers to the ability of new entrants to fully capture the benefits they bring to the power system. While the regulatory rules require that networks pass on the benefits of avoided transmission use of system (TUOS) charges to larger embedded generators, no such requirement applies to compensating smaller distributed generators for the avoided TUOS. There is thus an uneven regulatory treatment between two parts of a similar source of generation based on size.

In addition, the regulatory framework provides for any avoided TUOS to be recovered by TNSPs as they are revenue controlled. TUOS charges are not actually avoided. Avoiding the TUOS charges by one transmission customer simply raises the level of TUOS charges for all other transmission customers. Any reduction in TUOS revenue in one year is made up by higher charges in the following year due to the correction mechanism in the revenue control arrangements applicable to transmission businesses. Due to the locational nature of transmission pricing, the avoided TUOS charges from one customer are also likely to result in higher TUOS charges for other customers of the same distributor. Thus the same distributor that pays the avoided TUOS charges for one customer is likely to pay higher TUOS charges in subsequent years for its other loads.

4.2.3 Demand side participation

While originally designed to be a two sided market, the NEM has developed mainly as a supply side market with little or no participation from the demand side¹³. There are no direct pricing signals designed to draw a stronger demand side response and the low energy prices that exist do not provide a strong incentive for demand reduction. The NEM rules do not allow demand side response to directly participate in the wholesale

¹³ Some large energy intensive industrial customers such as the aluminium and zinc smelters do interrupt their loads for a limited time during extremely high price periods.

market although an aggregator can draw together the dispersed demand response resources¹⁴. However, even where such resources are available, the despatch of a demand side response leads to a reduction in pool prices as demand is withdrawn¹⁵. This mutes the price signal seen by the demand side participant.

The absence of a capacity market in the NEM also does nothing to encourage the demand side to develop an ability to provide reserve capacity during peak periods.

Under current regulatory arrangements, distribution network businesses derive revenue from energy throughput. The fixed component of a network tariffs are typically paid on the peak demand by the customer. Thus, demand side response, by reducing demand, reduces the potential revenue received by distribution businesses. As a result, distribution businesses have an incentive to discourage demand side participation. This in itself is not a market failure, except where the network service provide is able to use their superior information and/or price averaging under regulated tariffs to stymie demand side responses¹⁶.

The reliability safety net provisions of the National Electricity Rules require NEMMCO to ensure that the reliability of supply meets the certain specified reliability standards. When these standards are in danger of being breached, NEMMCO goes to the market to secure additional supplies. These supplies have in part been met by demand side participation with NEMMCO contracting with the demand side for load shedding to occur during times of supply stress. However, these contracts are usually for a short term, usually during the summer months when demand is high and only usually for one year. These short contracts do not give demand side participants sufficient certainty to invest in changes to their production processes. As a result, participation is limited.

Some recent changes to the NER were aimed at counteracting the incentives for networks to undervalue or minimise expenditure on demand side response. These changes required network service providers to consider efficient demand side resources in meeting the expected demand for services. To provide an incentive for network service providers, various states have different schemes including:

- Allowing the recovery of foregone revenue from the implementation of demand side participation.
- Direct funding of demand management schemes.

¹⁴ The NEM rules do allow for dispatchable loads as long as they meet some strict criteria.

¹⁵ This is seen as a market failure in that the entity withdrawing demand does not reap the benefit that other customers receive from the lower prices induced.

¹⁶ Some utilities in Australia are starting to trial time of use tariffs for customers with interval meters, in which network costs are fully variable by time of day, with the variable cost reflecting the long run marginal cost of replacing network assets.

The success of these changes is uncertain. Overall, whilst overcoming market failures that stymie demand side responses in the NEM (and other electricity markets) may be important in itself, it is not likely to be an important component in a strategy to assist an emission trading scheme to reduce emissions. This is because demand side response policies affect the absolute peak demand, which is a small component of overall energy consumption¹⁷. If the rule changes do encourage the uptake of small scale embedded generation (as a demand side response), then they may make an important contribution to the success of emission abatement policies.

¹⁷ As an example, the peak 1000 MW of demand in Victoria occurs for less than 100 hours of the year, or less than 1% of the dispatch periods in the NEM.

5 IMPACT OF MARKET FAILURE ON LOW EMISSION ENERGY TECHNOLOGY NEW ENTRANTS

5.1 Wind Energy

With the introduction of the Mandatory Renewable Energy Target (MRET) Scheme, wind generation rapidly increased. This has created some difficulties for the operation of the power system. Wind generation cannot be easily controlled and nor can it be dispatched by NEMMCO to meet the demand of the load in the manner or to the same extent that coal, gas or hydro-electric generation can be dispatched. The output from wind farms is dependent on locational wind characteristics, which can vary unpredictably from one dispatch interval to the next. As output from wind farms cannot easily be predicted in advance, this may require system operators to put on more plant in advance to account for this unpredictability. To minimise the cost of this unpredictability, NEMMCO has developed the "semi-dispatch" process to allow for more control over wind generation. The AEMC has published a determination approving the proposed process.

The Federal Government is implementing a wind forecasting regime and wind forecasting techniques are improving, along with the technology to control dispatch by wind farms, so the unpredictability of wind output is less likely to be a material issue in the future.¹⁸

Wind farms are frequently located in relatively remote sites, where the electricity distribution or transmission network either did not exist or was not designed to handle the quantity of energy and power output from the wind farms. As a result, the networks were required to be either extended or substantially strengthened. The current regulatory regime requires those seeking connection to pay for the cost up to the point of connection. For remotely located wind farms (as well as other remote generation including solar and geothermal generators) the additional cost of connection often proves to be insurmountable. The regulatory arrangements do not provide a mechanism for the sharing of such costs in anticipation of other remote generators or the spreading of these substantial connection costs to the general load. Remote generators are faced with either paying for the connection themselves or attempting to build a consortium of other potential generators in the area to fund the connection assets.

This arrangement leads to the potential free rider issue discussed in Section 4.1.6. The first party that connects to the network is faced with all the cost of extending the existing network while the second and subsequent parties are able to connect to the expanded network at a substantially reduced cost.

¹⁸ The key issue here in any case is whether wind generation is treated more harshly than other forms of generation. All forms of generation have some element of unpredictability so the question is whether the rules apply in an equal way across all forms of generation. Also note that the rebidding rules do allow generators to shift quantity bands across the price band range offered by the generator. This should give all generators some flexibility in responding to the unpredictability of their generation.

An additional market failure that applies to remote wind generators is the existence of significant economies of scales in network services. Current arrangements in the industry do not provide any mechanism for the exploitation of socially optimal economies of scale in providing transmission network capacity ahead of generation capacity. Additional network capacity can only be funded by the broader customer load if it can be shown that the project meets the regulatory test, that is it the best alternative to meet either reliability requirements or provides net market benefits. Otherwise, the project proponent will be required to fund the project themselves. Building network capacity beyond the needs of the proposed generation capacity will most likely have a negative net present value so from the regulatory market test perspective, it is better not to install the additional network capacity since the additional capacity will not be needed. Funding for the network capacity will thus depend on the project proponent who will have no incentive to fund a larger capacity than the generator's requirements. As a result, the network will only have sufficient capacity to carry the energy produced by the initial generation project. When the next generation project to develop the resource is proposed, the transmission network will then have to be augmented with additional cost exceeding the incremental cost if the additional capacity had been built into the network initially.

This type of network externality creates a conundrum for policy makers. On the one hand, the existence of economies of scale with network extensions particularly to new regions for generation leads to the idea of providing assistance for optimal network sizing. But on the other hand such assistance could bias against other wind generation (or other renewable generation) options that are located within the existing network structure.

These market failures only apply to the case of expanding network capacity within a region of the NEM. Where network capacity across two regions needs to be expanded to allow wind generation to access the broader market¹⁹, there are rules that allow for a proper assessment of the expansion. Under the rules, the expansion can proceed if it can be demonstrated that the expansion provides net benefits to the market. The only issue here is the definition on net benefits may be restricted and may not include environmental benefits to society such as reduced emissions of greenhouse gases.

5.2 Solar Energy

While large scale solar energy (solar thermal and concentrated PV) generation also faces the connection cost issue faced by wind generation, small embedded solar PV system face a different set of issues. There are potentially two externalities associated with small scale PV²⁰ generation:

1. Unpriced high value of contributions to the grid during peak prices,

¹⁹ An example could be the expansion of the interconnect capacity between South Australia and Victoria to allow for greater development of wind generation in South Australia. Currently, the development of wind generation in South Australia could be limited by the small size of the South Australian market and the limited capacity to transport excess wind generation across to the rest of the NEM.

²⁰ Or any other form of distributed small scale generation.

2. Unpriced network benefits.

The major issue currently facing solar energy is on a smaller scale. While large scale solar PV is still uncompetitive with alternative technologies whether renewable or otherwise, solar PV micro-generation may be competitive if the full cost of externalities is taken into account in the design of tariffs for electricity exported back into the electricity grid. However, in most states in Australia, solar PV is disadvantaged through market failure which fails to take into account the value and benefits to the electricity network which arise from the adoption of renewable energy technologies embedded within the electricity network and the environmental benefits through reduced carbon emissions and other pollutants.

Peak solar output of PV systems corresponds closely with times of peak demand, typically during summer afternoons with high air conditioner use. On the other hand during off peak hours usually at night, solar PV output is zero. At peak times, the pool price frequently rises well above average pool prices, often reaching hundreds, or thousands of dollars per MWh. Extra generation of electricity by small scale distributed solar PV systems at these times of peak demand reduces system demand and lowers the peak wholesale price of electricity. Distributed solar PV thus contributes most when wholesale prices are highest. However, owners of solar PV panels are unable to capture this benefit of reducing system demand during high price periods if the PV system simply reduces the energy consumed by the house on which the PV system is installed. Buy back tariffs metered on a net basis (i.e. only on the amount exported to the grid) do little to encourage new investments in small PV systems. Even if the electricity generated is exported into the grid, if the buy back tariff is simply the equivalent of the general use tariff, the benefits of generating during times of peak system demand is not reflected as average retail prices on which general use tariffs are based are not an accurate reflection of cost of the value of PV to the market during these peak periods. More innovative tariffs are not offered for several reasons including lack of adoption of interval metering (not necessarily a market failure) and the imposition of retail price caps for some customer classes²¹.

However, it should be noted that the market rules do not prevent a household (or any other customer) from installing interval meters and arranging an innovative tariff arrangement with their retailer. This could include installing a separate meter for all generation output. This would in effect mean that gross metering would take place. However there would be an additional cost incurred for the additional meter and account. Whether this is a viable arrangement is dependent on the generation quantities and the set up cost.

Solar PV also has benefits for the network which often the tariffs fail to reflect. The retail prices charged for electricity which includes network charges (distribution and

²¹ As noted previously, some retailers are now trialling time of day tariffs that more accurately reflect the value of the energy displaced by small scale distributed generators. This should become more widespread as interval meters are rolled out.

transmission) faced by small customers are a highly averaged price. It does not incorporate any locational and time-of-use price signals to indicate to the customer the real network cost of their load. During times of peak system demand, the marginal cost to the network is much higher than the averaged network charges faced by customers as the cost of network augmentation to manage system load is driven by the extent of peak demand. Buy back tariffs that are the equivalent of general use tariffs thus do not accurately reflect the value that distributed solar PV systems bring to the network. Solar PV generation which provides embedded energy during high demand periods is potentially under-compensated for its network benefits as well as for its generation.

Beside network benefits, micro solar PV also leads to reduced network losses. As losses incurred in the transmission and distribution of electricity is exponentially related to the power demand, reducing the demand for imported power would lead to reduced losses that are greater than the average losses. Setting buy back tariffs the equivalent of general use tariffs do not reflect this benefit as general use tariffs include a provision for the average losses incurred. In cases where higher feed in tariffs are available, this benefit may be taken into account during periods where energy is exported to the grid. This benefit is most pronounced during peak periods when system losses are greatest. However, given that most feed in tariffs only apply to net exports, the benefit of lower losses is not captured during periods when the capacity of the solar PV is meeting only the resident load as is most likely during the summer peak periods.

These market failures may have led to inefficient investment decisions - overinvestment in networks and underinvestment in distributed energy solutions. However, in the case of PV generation, while the market failures are real, the high cost of PV generation means that their contribution to reducing emissions is likely to be limited in the short to medium term. Thus, overcoming this market failure is only likely to be material in the longer term.

5.3 Cogeneration

Cogeneration is the use of a heat engine or a power station to simultaneously generate both electricity and useful heat. While conventional power plants release the heat created from the generation of electricity into the environment, cogeneration captures the heat for industrial heating purposes. While conventional generators have an efficiency of less than 40%, by capturing and re-using the heat generated, cogeneration plants can achieve efficiencies in excess of 80%. As a result less fuel needs to be consumed to produce the same amount of useful energy and lower carbon emissions are produced for a given economic benefit. Because of the need for continuous generation of industrial heat, cogeneration also usually supplies base load power compared to other types of renewable or low emission generation technologies which cannot be depended upon to provide base load service.

5.3.1 Information asymmetry when negotiating connection agreements

In Australia, cogeneration is usually fired by natural gas which has lower emissions than other base load plant fired by coal. While the market failures faced by cogeneration are not as significant as other sources of low emission technologies, there are some issues that if addressed could lead to greater investments in cogeneration technology.

The major difficulty faced by proponents of cogeneration projects is usually in the area of information asymmetry when negotiating connection agreements with the network. Often co-generators are embedded in distribution networks within industrial estates where the heat can be used for industrial processes. As a result, a connection agreement needs to be negotiated with the distribution network service provider to export excess electricity not required for internal consumption and to provide for back up supply in the event the co-generator is unable to generate for either maintenance purposes or because of an unplanned outage. As discussed in Section 4.1.5, negotiations with a monopoly network is difficult given the information asymmetry as well as the incentive structure of the regulatory regime that applies to distribution network service providers. Often proponents of cogeneration projects have difficulty getting full recognition for the benefits they provide in avoiding or delaying network infrastructure costs that would flow to all customers. Usually only the network service provider is able to quantify the benefits that would flow from delaying network augmentation as a result of having a co-generator embedded in its distribution network. However the incentive faced by the network is to expand its system. As a result of this conflict, the network service provider is usually reluctant to provide much encouragement to the cogeneration proposal by allowing the full benefits of any network savings to be captured by the co-generator.

Recent changes to the NER allows the AER to reject network augmentation expenditure proposed by network service providers if it can be show that expenditure on distributed generation would be more efficient. While this may give some encouragement to cogeneration proponents, it does not ensure that the issue of information asymmetry is addressed and it assumes that the regulator is able to obtain the necessary information to make a decision that there are distributed generation alternatives to network augmentation in an augmentation proposal. The effectiveness of this provision is still untested and how it will work in practice is unknown.

5.3.2 Avoided TUOS charges

While distribution network service providers are required to compensate co-generators (and other embedded generators) for the avoided TUOS charges due to the lower requirement for importing energy from the transmission system, these TUOS charges are not actually avoided. Transmission businesses are revenue controlled. Avoiding some TUOS charges by one distribution business simply raises the level of TUOS charges for all transmission customers. Any reduction in TUOS revenue in one year is made up by higher charges in the following year due to the “unders and overs” correction mechanism in the revenue control arrangements applicable to transmission businesses. Due to the

locational nature of transmission pricing, the avoided TUOS charges from one customer are also likely to result in higher TUOS charges for other customers of the same distributor. Thus the same distributor that pays the avoided TUOS charges for one customer is likely to pay higher TUOS charges in subsequent years for its other loads. As a result, the distributor incurs the TUOS charges twice:

- Once by the payment of avoided TUOS charges to the embedded generator and
- Second time by increase TUOS charges due to the transmission revenue control adjustments to the regional TUOS price.

As a result of this arrangement, distributors attempt to avoid making avoided TUOS payments to embedded generators. The current arrangements for making avoided TUOS payments appear to introduce a regulatory distortion to the market.

Overall, the potential contribution from cogeneration to reducing emissions could be large. Overcoming market failures associated with the adoption of cogeneration is likely to have a major impact on efforts to reduce emissions of greenhouse gases.

5.4 Demand Side Response

Embedded and other small scale distributed generation are usually part of demand side load reduction. While it encompasses technologies like solar PV and small wind turbines, other small scale distributed generation technologies include the use of natural gas-fired microturbines or reciprocating engines to generate electricity especially during hours of peak demand or network stress. Distributed generation systems are small-scale power generation technologies (usually between 1 kW and 10MW) with the larger ones tending to be co-generators providing space heating for building. Many of the issues discussed in Section 5.2 on buy back tariffs for solar PV are also applicable to other small scale distributed generation and shall not be repeated in this section.

5.4.1 Network impacts

Demand side response provides a number of benefits in meeting the supply needs of the electrical power system. These arise from the deferment of local transmission and distribution reinforcement related to meeting extreme peak demands. This benefit would grow over time as new network developments are progressively deferred and replaced by suitable distributed generation and other demand side resources.

Proponents face difficulties in negotiating appropriate terms and conditions that recognise the benefits of their projects in avoiding or deferring future network investments. While in principle, small and medium scale embedded generation projects should receive compensation to encourage their development and economically defer investment in the network, the “perverse” incentive offered by the regulatory environment discourages demand side response and rewards investment in network infrastructure. Recent changes to the NER to provide some certainty to distributors that efficient investment on demand management can be included in the regulatory determination of revenue may go some

way in assisting proponents capture some of these benefits. This benefit of demand side response has increased in recent years due to the rapid growth in take up of technology including the increasing use of air conditioning, the wide spread use of computers and other new appliances that places pressures on the electricity supplies and accentuated the peaks of electricity demand.

Another benefit that distributed generation brings to the network is the reduction of losses. However, while losses are incurred in the networks, the cost of losses is not borne by network operators. Cost of losses is the responsibility of electricity retailers who on charge customers. Owners of distributed generators thus have difficulty in getting recognition for the reduction in losses their assets bring to the system.

The rules require that avoided TUOS payments be made by the networks only to larger embedded generators. There is no requirement to similarly compensate the smaller distributed generation. This creates an uneven regulatory treatment between two parts of a similar source of generating capacity based on size.

5.4.2 Wholesale market impacts

In the NEM, the supply side sets prices. NEM rules also do not allow small scale distributed generation and demand side response to directly participate in the wholesale market. While an aggregator can draw together the dispersed demand response resources, the despatch of a demand side response leads to a reduction in pool prices as demand is withdrawn. This is likely to undervalue the resource and discourage increased participation. Should the despatch of demand withdrawal be treated the same way as the despatch of supply, during periods of high pool prices, the demand side may be in a position to set the system marginal price and thus bid in their resource at a price commensurate with the valuation of their worth. The current arrangements potentially leads to the situation where after the despatch of the demand response, pool prices fall below the level at which the resource was despatched. This arrangement leads to the muting of the pool price signals that would elicit increased participation from this resource.

The NEM also does not have a capacity market where resources are paid for the level of reserve capacity provided. This means that the reserve capacity provided by demand response is not recognised for the reliability support it provides. As a result, current NEM reliability standard supports the installation of surplus generating capacity with virtually no economic demand side response leading to excessive development of peaking plant. This may be inefficient as the costs incurred in installing surplus capacity is likely to be substantially in excess of any demand withdrawal to meet the infrequent extreme peak demands or coincident outages of large power generation units at times of high demand.

In the Western Australia Wholesale Electricity Market, a payment is made for the provision of reserve capacity. A mechanism thus exists for the reserve capacity provided by demand response to be compensated for the service it provides.

6 ADDRESSING MARKET FAILURES IN THE NEM

The Stern Review estimated that *“the power sector will need to be at least 60% decarbonised by 2050 to keep on track for greenhouse gas stabilisation trajectories at or below 550ppm CO₂e.”*²² While emissions trading will be the major policy instrument in response to climate change, rectifying other market failures that impede the entry of renewable and low emissions generation into the NEM would enable this target to be met at a lower cost.

A number of market failures identified is expected to be addressed by the setting up of the emission trading scheme currently under development. When emissions trading commences, it is expected that the market failures due to the cost of environmental externalities will be addressed as these costs will then be internalised. Renewable energy generators that emit no carbon emissions as well as low emission generators will be able to capture the benefits of their low emission generation output through higher pool prices.

Some of the barriers relating to networks may also be addressed with the setting up of the National Transmission Planner within the AEMO.

Even with the implementation of emissions trading however, other market failures are likely to persist in the NEM which would continue to present barriers to entry for renewable and low emission generators. Various options can be considered to overcome these market failures. These can be categorised as:

- Network infrastructure related policies affecting distribution and transmission (and interconnector) assets.
- Energy market related policies.

6.1 Network infrastructure related policies

6.1.1 Feed-in tariffs (Distribution)

As discussed in sections 4.1.3 and Section 5.2, small scale renewable and low emission distributed generation technology had been disadvantaged as prices paid for such generation did not take into account for the value and benefits to the electricity network which arose from the adoption of such technologies embedded within the electricity grid. At present, while South Australia, Victoria and Queensland have implemented or will soon implement feed-in tariffs that are greater than normal tariffs, the level of feed-in tariffs offered in other States are left to the retailers to determine. The feed-in tariffs available in other States are typically set at levels similar to the general use tariffs which do not reflect the benefits of distributed generation. Consideration should thus be given to require feed-in tariffs in all Australian states to set feed-in tariffs at a premium to general use tariffs to reflect the network benefits.

²² Stern, N H, 2007, *The Economics of Climate Change*, The Stern Review, pg 352

Even in states which offer a premium for feed in tariffs, the quantity exported to the grid is based on net exports rather than gross generation. This means that only excess energy exported to the grid is able to earn a return. For small systems installed by families that are home during the daytime, it is likely that no net exports are possible. However benefits to the grid still exist as in the absence of this source of electricity, extra demand will be placed on the grid. Feed-in tariffs with a premium on general use tariff based on gross generation will provide the incentive to install micro generation facilities. The difficulty is that while it is the electricity retailers that offer feed-in tariffs, the benefits are captured by networks. As a result, it will probably require distribution networks to contribute funds which they can recoup through the distribution pricing process. This will encourage the take up of small scale distributed generation technology.

This option implies that the feed in tariff should be set at a level equal to value of the additional benefits brought on. There is a question over whether the current rates for PV generation enshrined in state based feed in tariff schemes are equivalent to the value to society of the distributed PV generation. In principle, the feed-in-tariff should be set at a rate equivalent to the value from avoiding purchasing energy in peak pricing periods and avoided network costs.

Further, even if feed in tariffs were to be applied, their impact on the emission reduction task may be minimal²³.

6.1.2 Network information asymmetry (Transmission and Distribution)

6.1.2.1 Independent National Transmission Planner (Transmission and Distribution)

Information asymmetry disadvantages renewable and low emission generators seeking connection that are near the load centre. Network operators control access to information regarding their networks and have the ability and incentive to impede access as discussed in section 4.1.5. The proposal to set up a national transmission planner with access to information for all transmission planning decisions may assist such generator seeking access to the transmission network. However, this is unlikely to ensure that generators seeking access to the distribution network have the ability to overcome the information asymmetry in the distribution network. To overcome this problem, it may be necessary to require all distribution businesses in the NEM to actively seek opportunities for embedded generation. All required augmentations of the distribution network should then be specified with embedded generation considered as an alternative to network augmentation. Where embedded generation is shown to be a more efficient alternative to network augmentation, network support payments reflecting the benefits should be made to the embedded generator. There may be some indications that this may be achieved to

²³ There are currently around 8.5 million dwellings in Australia. Assuming that half will be able to install PV systems (being separate dwelling with north facing roof space of adequate area to accommodate a PV system), that implies around 6,000 MW potential capacity of roof top PV. At a 17% capacity factor, this implies around 9,000 GWh of energy from this source or around 3% of current total energy consumption.

some extent by the recent changes in the NER which encourages distributors to actively consider alternatives to network augmentation.

6.1.2.2 Nodal Pricing (Transmission and Distribution)

The current arrangements for making avoided TUOS payments to embedded generators also appear to be introducing a distortion to the market. Rather than making avoided TUOS payments, it may be preferable to require network operators (transmission and distribution) to explicitly consider the benefits that embedded generation bring to the network in terms of network support and deferment of augmentation. Connection agreements could then be structured so that these benefits are passed on to the embedded generator.

The introduction of nodal pricing may address this failure. The establishment of nodal pricing will reveal the nodes that will benefit by the connection of a generator. Generators that connect to such nodes will be able to obtain higher prices for their energy compared to generators connected to unconstrained nodes. Distributed and embedded generators will benefit from the transparency of nodal pricing and networks will not be able to exploit their control over network information. However, nodal pricing will increase the administrative and compliance costs associated with running a wholesale electricity market. Nodal pricing may also increase the level of abuse of market power by allowing regional suppliers to deliberately constrain local networks to get higher nodal prices.

6.1.3 Stand by charges (Distribution)

Stand by charges are a major cost component to cogeneration proponents and often proves to be a major discouragement to self generators. While it is acknowledged that some level of stand by charges is required to compensate the network for the network capacity allocated to the cogeneration customer, current level of charges based on the maximum level of demand is unlikely to accurately reflect the use of the network by the customer. Based on an N-1 redundancy level, the self generating customers is only likely to use the full capacity that the stand by charges embody if there is a double contingency (that is, when its own generators are not operating as well as a failure by one network component). This is in excess of other customers' level of quality of supply as they use the network capacity based on a single contingency (that is, when one component of the network fails). The rules should be examined to reduce to burden that stand by charges impose on self generating customers. Using a probabilistic method for determining stand-by charges as occurs in Victoria may be one option.

6.1.4 Network free rider and economies of scale (Transmission and Distribution)

The main issue in addressing free riders and economies of scale is to establish a funding mechanism so that the first mover does not pay for all the network assets required to bring its generation to the market while later movers pay a significantly lower cost. It may be possible to establish rules so that the later movers make a contribution to the fund established when the first connection is made to compensate the first mover.

To ensure that network economies of scale are exploited, the fund will need to be sufficiently large to compensate for the losses that will be incurred during the initial phases of operation before the full capacity of the network is utilised. The establishment of a sufficiently independent National Transmission Planner may be able to address this issue. Where it can be shown that proposed network expansion is sub-optimal due to the existence of economies of scale, the National Transmission Planner should be able to operate a fund with either all customers or government contributing during the initial phases so that networks do not suffer losses. Sufficient capacity can then be built to exploit some economies of scale. However, this entails the National Transmission Planner absorbing some risk that the required investment in additional generation does not materialise. This risk can be minimised by incorporating sensitivity analysis in the benefits cost test that would underpin any support (much as is required for approval of regulated upgrades of interregional transmission capacity).

As an independent transmission planner, the NTP will be responsible for developing the NTNDP. It is expected that the NTNDP will take a long term perspective to the development of the power system including the capacity of the transmission network. The NTNDP will be required to have an economic focus by including more forward looking scenarios with investment strategies which are economically efficient, rather than simply being technically feasible as is currently considered in the ANTS. To be able to add value to the transmission planning process, the NTNDP will need to provide information to the market to guide long term network investment decisions and provide signals for efficient generation investment. To do this, it will need to be able to quantify the benefits that alternative solutions including embedded generation will bring to different parts of the transmission system. This can be achieved by the NTNDP specifying a mathematical function that defines the net market value, or the optimal timing for the construction of a new transmission asset including embedded generation and demand side management. The mathematical function can be defined in terms of load, generation, or any of a number of different factors, and would be constructed from technical and economic analysis to show when the construction of a new asset – or upgrade – could be expected to be economically efficient, or otherwise meet the objectives of the Regulatory Test. Its parameters would represent the sensitivity of value or optimal timing to variations in the forecast supply/demand conditions. The provision of such a function will assist in making the market for transmission services more transparent and to facilitate the examination of non-transmission options by parties other than TNSPs.

6.2 Energy market related policies

6.2.1 NEM requirements

Most of the energy market failures are likely to be addressed by the establishment of an appropriately designed emission trading scheme. As discussed in Section 4.1.3, while the NEM was designed to be technology neutral, existing generators had the advantage of not being required to meet all NEM requirements that all new entrants had to meet. This would place new entrants at a cost disadvantage relative to the existing generators. To

ensure that new generators compete on the same level as existing generators, including those that had been established prior to the setting up of the NEM, the electricity rules could be examined to ensure that newer generators are not subject to requirements that older generators are not required to comply with. The NEM has been in operations for a sufficiently long period of time for any “grandfathered” arrangements to be re-examined and removed should they prove to provide an advantage to the older and more polluting generators at the expense of newer lower emission generators.

6.2.2 Demand side response

Greater demand side response has both energy and network benefits. These are discussed in Section 5.4. While originally designed to be a two sided market, the NEM has developed largely as a supply side market with little or no participation from the demand side. The regulatory arrangements currently in place do not encourage the development of greater demand response. A major failing of the current arrangement for demand side response is the short term nature of NEMMCO’s Reliability Safety Net contracts which does not allow potential participants sufficient time to recover the cost of changing their production processes to participate in providing demand side capacity. Longer term contracts (perhaps 3 to 5 years) may be necessary to provide the necessary certainty to make a serious commitment to providing a sustained demand side response.

6.3 Summary of Options to Address Market Failures

A summary of the potential market failures that impact on the adoption of low emission generation is contained in Table 6-1. As far as assisting the emissions abatement task, the material (in terms of having the potential to significantly reduce emissions) market failures in the long term appear to be the issues related to network externalities related to embedded or distributed generators, network free rider issues and scale economies. Overcoming other market failures, whilst potentially providing net benefits to the community, may only lead to small reductions in emissions.

Table 6-1: Market failures impacting on adoption of low emission generation

Market Failure	Affect of Market Failure	Policy Option to Correct for Market Failure
Generator market power	Low prices to pre-empt entry	No action
Uncertainties in the market	Difficulty in obtaining appropriate financial contracts	No action
Neutrality of technology	Inconsistent technical requirements <ul style="list-style-type: none"> • Ancillary service • Control equipment 	Review of rules
Externalities	Benefits of embedded generation not fully recognised <ul style="list-style-type: none"> • Network benefits • Loss reduction 	Recognise externalities of embedded and distributed generation
Monopoly networks	High cost standby arrangements and connection agreements Non transparent network planning arrangements Asymmetric information	Independent network planning body to produce annual statements that provide transparent value propositions for network augmentation including non-network solutions.
Free rider	Suboptimal network investments. Access difficulties for embedded generation	Nodal pricing Feed-in-tariffs Financial transmission rights
Economies of sale in networks	Investment in suboptimal network capacity	Funding during initial period
Regulatory failures <ul style="list-style-type: none"> • Inappropriate incentives • TUoS arrangements • Demand side participation 	Network solutions preferred over potentially more efficient non-network solutions including embedded distributed generation and demand side alternatives.	Independent network planning body to produce annual statements that provide transparent value propositions for network augmentation including non-network solutions.