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Research Partner

Infrastructure Partnerships Australia

Submission to Carbon Pollution Reduction Scheme – Green Paper

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ABOUT THIS PAPER

This paper comprises analysis and recommendations by Infrastructure Partnerships Australia (IPA) in response to the Australian Government's Carbon Pollution Reduction Scheme, Green Paper, together with a report prepared for IPA by KPMG which has shaped IPA's thinking. The KPMG research includes detailed discussion of the nature and gaps in key infrastructure in energy, freight and passenger networks which may inhibit achievement of the Government's goals in introducing a CPRS and RET and an approach to addressing the identified gaps or shortfalls in key infrastructure to ensure achievement of the Government's goals in developing the CPRS.

Generally, economic modelling of the impact of emissions is concerned with quantifying the impact on the costs and prices of emitting industries rather than examining the effect that measures to reduce GHG emissions have on the provision of infrastructure and how such measures may alter demand for infrastructure. It is hoped this paper provides a new viewpoint on the discussion of the CPRS.

IPA is supportive of the Government's goals in developing the CPRS but sees infrastructure investment in key sectors as a critical first step in avoiding unwarranted economic shocks and making the CPRS effective.

IPA acknowledges and thanks Bilfinger Berger Australia for its support for this research as our Research Partner.

INTRODUCTION

Infrastructure Partnerships Australia (IPA) is the nation's peak infrastructure body. Our mission is to advocate the best solutions to Australia's infrastructure challenges, equipping the nation with the assets and services we need to secure enduring and strong economic growth and, importantly, to meet national social objectives.

Infrastructure is about more than balance sheets and building sites. Infrastructure is the key to how we do business, how we meet the needs of a prosperous economy and growing population, and how we sustain a cohesive and inclusive society.

Infrastructure Partnerships Australia seeks to ensure governments have the maximum choice of options to procure key infrastructure. We believe that the use of public or private finance should be assessed on a case-by-case basis. IPA also recognises the enhanced innovation and cost discipline that private sector project management and finance can deliver, especially with large and complex projects.

Our Membership is comprised of the most senior industry leaders across the spectrum of the infrastructure sector, including financiers, constructors, operators and advisors. Importantly, a significant portion of our Membership is comprised of government agencies.

Infrastructure Partnerships Australia draws together the public and private sectors in a genuine partnership to debate the policies and priority projects that will build Australia for the challenges ahead.

Accordingly, IPA welcomes the opportunity to submit to the Australian Government's Carbon Pollution Reduction Scheme (CPRS) Green Paper to reduce carbon pollution by placing a cap on the amount of carbon pollution industry can emit under the CPRS.

RECOMMENDATIONS

IPA welcomes the introduction of a CPRS into the Australian economy. The need to reduce greenhouse gas emissions is urgent and the introduction of a scheme that drives Australia to a lower emissions target is needed. However, while the Federal Government's scheme is welcome and important, it is clear Australia cannot go to a carbon reduced economy overnight. Key to any success will be the development of new and renewed infrastructure assets in energy, freight and passenger networks to provide a foundation to achieve the national goal of giving full effect to the CPRS.

The CPRS is a major component in the Government's strategy to address the challenge of climate change. How it is implemented and its practical outworkings are of both international and national significance. One matter of vital importance to the success of any strategy designed to lower carbon emissions and particularly to the CPRS, which has received little prominence in discussion to date is the role to be played by infrastructure in the energy and transport sectors.

IPA is convinced that the CPRS has a greatly reduced chance of meeting its targets unless adequate and appropriate infrastructure is in place to support the move to a lower carbon emission economy. The CPRS is designed to fundamentally alter the way industries operate, and to have far reaching and long lasting effects on the level of emissions in the atmosphere. This cannot be done without infrastructure in place to support these new methods of doing business.

Australia is starting from a position of historical underinvestment in the infrastructure needed to support the demands of a growing population and economy. IPA contends that the Government needs to look at a broad package of methods to remove barriers to investment in infrastructure which have contributed to current underinvestment. These include, but are not limited to, revising regulatory and taxation frameworks to encourage infrastructure investment, planning considerations and positively developing markets to enable private finance to fully contribute to infrastructure development.

Once the need to lower carbon emissions is taken into account, the gap between where we are and where we need to be is clearly going to be much greater, and require a significant and sustained period of investment in infrastructure. IPA estimates the investment required to bridge that gap is in the region of $120 billion across energy, freight and passenger transport infrastructure.

IPA submits that, factoring in the long lead times and significant future investment required in Australia’s energy, freight and passenger transport networks, in order to meet the Government’s goals for the CPRS, the CPRS needs to have a shallow trajectory over the early years, a phase-in period of 20 years and an investment of more than $120 billion in new infrastructure. After an initial period of shallow trajectory, the rate of change could be ramped up from the mid-term, with five-year reviews to confirm that the interim trajectory is taking new technology and domestic and international investment bottlenecks into account.

Our argument is that the trajectory needs to be shallow initially to enable a catch up in infrastructure investment, without which the targets set within the CPRS will not be achievable. The Government needs to consider the long lead times associated with infrastructure when setting any review periods. The current preferred option of five years would not appear to adequately take infrastructure investment time horizons into account.

IPA is strongly of the belief that the Government should consider using a significant proportion of the revenue raised by the auction of carbon permits to fund the necessary infrastructure projects, particularly those in freight and passenger transport infrastructure where Government sponsorship rather than market forces are the normal delivery model in Australia. This means that the revenue raised from putting a cost on carbon emissions will contribute directly to the achievement of the targets to reduce emissions, as well as contributing to the economic well-being of the country (based on strong the correlation of investment in infrastructure and economic.

KPMG

Infrastructure Partnerships Australia

Impact of Infrastructure gaps on the objectives of the Carbon Pollution Reduction Scheme

Final Report

September 2008

This report contains 36 pages

IPA report_Final_150908.doc

Contents

1 Executive Summary

The Commonwealth Government's Green Paper on the Carbon Pollution Reduction Scheme (CPRS) has stimulated debate on the long term effects of both climate change and the policies which might be put in place to combat carbon pollution.

The CPRS is envisaged as a major driver towards a low carbon economy. However, in moving towards this low carbon economy more detailed consideration and action needs to be centred around the impact of the scheme on infrastructure gaps in the energy and transport sectors.

1.1 Infrastructure development

Australia enters the CPRS with a historic underinvestment in infrastructure.

Disregarding the need to move to a lower carbon emission economy, estimates of the investment needed to bring the infrastructure in line with predicted demand increases the range from $25 billion (CEDA, 2005) to $770 billion (Citigroup, 2008).

Within the energy sector, the CPRS will require a move away from the more carbon polluting sources of electricity to "greener" options.

Where public transport is concerned, the major cities in Australia are running at close to capacity and the anticipated growth in population means that significant increases in capacity will be needed. If the CPRS is successful in changing patterns of behaviour, additional growth in public transport capacity is essential.

Similar infrastructure challenges exist if freight transport is to move in significant volumes from higher emission road transport to lower emission rail transport.

A strong correlation has been identified between investment in infrastructure and economic growth. The Garnaut report *Trajectories and Targets* (September 2008) shows that the CPRS and subsequent reductions in emissions will have a comparatively minor effect on the Gross National Product (GNP). However, this will only be the case if it is based on significant, timely investment in infrastructure in the areas of energy and transport.

1.2 The proposed CPRS

Reference to investment in infrastructure is noticeable by its absence in the reports surrounding the proposed CPRS. However, there are several areas where infrastructure needs to be specifically considered.

1.2.1 Trajectory

The way the scheme is introduced, and the targets and the cap on carbon emissions that are set have an effect on the rate at which the economy will have to respond. The more ambitious the carbon cap and trajectory, the steeper the required rate of change will be.

In light of the significant and far reaching investment in infrastructure that is required in Australia, it would appear that a shallow trajectory, at least in the early stages of the scheme, will be necessary. This will allow for the long lead times needed for infrastructure projects to be planned and implemented. Further, it seems unlikely that without new infrastructure to support a low carbon economy the targets would be achievable.

1.2.2 Review periods

The preferred period to review targets and carbon caps is currently stated as a rolling five-year period.

This period is likely to be inadequate to allow adequate infrastructure planning and implementation, which is usually undertaken over a much longer period.

1.2.3 Carbon permit trading

The CPRS proposes that firms will trade their carbon permits in a marketplace, enabling auctions of excess permits to be held. This is seen as a way to maximise the incentive to actually reduce emissions rather than just pass on cost increases. The auctions are expected to generate considerable amounts of capital, which the Government has pledged will all go towards alleviating the effect of putting a cost on carbon pollution on the most vulnerable households and (to a limited extent) affected industries.

Given the necessity of the infrastructure to achieving the carbon reduction targets, and the positive effect on the economy as a whole of making investments in infrastructure, it would seem reasonable to allocate some proportion of the revenue raised to these important projects.

1.3 Low carbon economy infrastructure

The gap which has been identified between the infrastructure in place and the infrastructure needed has always been calculated on assumptions based on an economy where carbon emissions does not carry a price.

The introduction of the CPRS will put an increasing price on carbon emissions, and so patterns of consumption, energy generation, methods of travel and freight can be expected to change. This means that infrastructure requirements will also change. Investment will need to be re-aligned to support lower emission strategies. For instance, funding for freight enabling projects will need to be channelled towards rail freight infrastructure, even in the event that the overall level of investment is not capable of increasing. An additional practical challenge will be that the rest of the world will be embarking on the same course, leading to skills and materials shortages, which in turn will push up the price.

The current level of underinvestment in economic infrastructure has been the result of decades of underinvestment in both public and private sectors, as well as some regulatory, fiscal and market obstacles to such investment. In order to achieve the CPRS objectives the Government will need to ensure that these obstacles are addressed, and focus public spending on those areas where there is a market failure in supplying the infrastructure (mainly the transport sector).

2 Introduction

2.1 Background

KPMG have been engaged by Infrastructure Partnerships Australia (IPA) to identify gaps in Australia's infrastructure that will impact on, or hinder, the ability of the Carbon Pollution Reduction Scheme (CPRS) to meet its objectives.

In completing this engagement KPMG were to focus on four key elements, including:

- The nature and gaps in key infrastructure in energy, freight and passenger networks which should be addressed to ensure achievement of the Government's goals in developing the CPRS, as described in the Commonwealth Government's Green Paper;
- The quantum, type and timing of investment needed to overcome these gaps;
- The extent to which the identified gaps or shortfalls in key infrastructure may inhibit achievement of the Government's goals in introducing a CPRS and Renewable Energy Targets (RET); and
- Recent / current priorities and how they relate to the gaps identified.

2.2 Scope of engagement

The scope of work for this engagement involved a number of key stages, including:

- Data collection and collation from various sources;
- The hosting of a workshop with IPA and other stakeholders from private sector and government organisations involved in the infrastructure sector to discuss how development of new and renewed infrastructure assets in energy, freight and passenger networks might impact the success of the CPRS and the policy implications this raises for the Commonwealth Government in finalising the framework for the practical application of the CPRS in terms of carbon price, use of revenues from permit auctions, emissions trajectory and proposed phase in of the scheme;
- Analysis of the secondary data and workshop outcomes to establish a position on closing the infrastructure gap and provide adequate and appropriate infrastructure in the future to facilitate the goals of the Commonwealth Government in introducing the CPRS; and
- Reporting the outcomes of the above stages in a succinct final report.

2.3 Warranty and disclaimer

Inherent Limitations

This report has been prepared as outlined in Section 2.2 of this report. The procedures outlined in Section 2.2 constitute neither an audit nor a comprehensive review of operations.

The findings in this report are based on a qualitative study and the reported results reflect a perception of Infrastructure Partnerships Australia representatives but only to the extent of the sample surveyed.

No warranty of completeness, accuracy or reliability is given in relation to the statements and representations made by, and the information and documentation provided by, Infrastructure Partnerships Australia and its management / personnel and government stakeholders consulted as part of the process.

KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report. KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form. The findings in this report have been formed on the above basis.

Third Party Reliance

This report is solely for the purpose set out in Section 2.1 of this report and for Infrastructure Partnerships Australia's information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

This report has been prepared at the request of Infrastructure Partnerships Australia in accordance with the terms of KPMG's contract dated 6 August 2008. Other than our responsibility to Infrastructure Partnerships Australia, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

3 Infrastructure development in Australia

3.1 Introduction

The purpose of this chapter is to discuss the infrastructure task previously identified facing Australia. Over the last few years various economic commentators have concluded that there is a need for significant investment in Australia's economic infrastructure which has resulted from sustained growth of the Australian economy, coupled with underinvestment by Government and the private sector.

The size of the economic infrastructure gap[1] is considerable. Estimates of the cost of closing this gap vary, from $25 billion (CEDA, 2005), to $320 billion (ABN Amro, 2008), and up to $770 billion over the next ten years (Citigroup, June 2008). Of these estimates, around $12 billion relate to energy infrastructure and $90 billion relate to transport infrastructure to start to address Australia's existing economic infrastructure needs[2]. However, it is important to note that these estimates are based on how Australia has historically met its infrastructure requirements where externalities, such as carbon emissions, have not been considered as part of the investment decision making process.

The remainder of this chapter discusses the size, scale and likely timing of the infrastructure required to close the gap to meet identified demand for our energy and transport sectors in Australia. We confirm however that this analysis is based on publicly available information, and that first principles analysis has been not completed for this assessment.

3.2 Australia's energy infrastructure needs

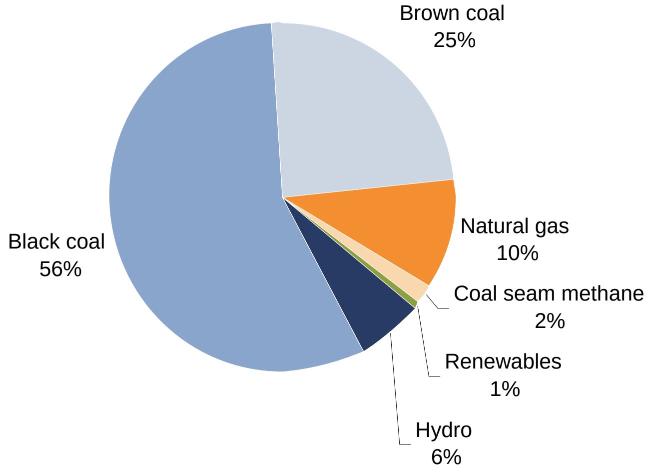
This section considers recent and current levels of demand for electricity (as measured by consumption), and projections for the expected levels of demand in 2010 and 2020.

Some of the material in this section (and the next) is drawn from an ACIL Tasman report on the impact of an emissions trading scheme (ETS) on the energy supply industry that was commissioned by the Electricity Supply Association of Australia (ACIL Tasman 2008).

[1] Defined as being those projects that appear to have longer term commitment from Government, energy infrastructure identified by NEMMCO as necessary to meet capacity requirements, and projects that have been deemed to be 'critical' by Infrastructure Partnerships Australia.
[2] These costs represent the sum of estimates already identified, while it is recognised some projects considered necessary to resolve the infrastructure gap have no cost estimates at present, and therefore are not included in these costs.

The following diagram demonstrates the predominance of black and brown coal in current electricity generation infrastructure in Australia (accounting for 81 percent of total generation capacity and a greater percentage by energy generated).

Figure 3.1 Energy generation capacity by fuel type



The Statement of Opportunities (SOO), published annually by NEMMCO (the operator of the National Electricity Market[3] (NEM)), provides information to existing and potential NEM participants in assessing future need for electricity supply capacity; demand-side management potential; and transmission network augmentation. NEMMCO has estimated in the 2007 SOO that 1,185 MW in additional generation capacity will be required by 2010/11 with 7,000 MW (approximate) of generation capacity required by 2016/17. The following table supports the need for the nominated capacity augmentations as demand for electricity is anticipated to increase by more than 27% between 2006 and 2020.

[3] The National Electricity Market (NEM) is a wholesale market for electricity supply in the east coast of Australia covering the ACT, Queensland, NSW, Victoria, Tasmania and South Australia. The NEM delivers electricity to market customers on an interconnected power system that stretches more than 4,000 km from Port Douglas in Queensland to Port Lincoln in South Australia, and includes a sea-bed cable between Victoria and Tasmania.

Table 3.1 Electricity demand in Australia

Year	Electricity Consumption (observed and forecast)	Percentage change
1989-90	155,019 GWh [a]	-
2006-07	226,544 GWh [b]	+ 46%
2010	235,855 GWh [c]	+ 4%
2020	288,870 GWh [c]	+ 22%

[a] ABARE www.abareconomics.com/interactive/energyUPDATE08/excel/Table_I_08.xls [b] ESAA (2008) [c] ACIL Tasman (2008) — table 20, business as usual (BAU) estimates. BAU estimates are based upon the official forecasts of regional summer and winter peak demands to 2017 that were published by NEMMCO in its 2007 Statement of Opportunities. These have been projected forward to 2020 using the average annual growth rates for energy consumption between 2008 and 2017.

Over 130 proposed new generation and expansion projects have been identified across Australia to address increasing electricity demand. Of this, almost 7,000 MW of new capacity is under construction, commissioned or completed with natural gas fuelling around 65 per cent.

Table 3.2 Proposed new generators and expansion projects

Primary fuel type	Proposed projects	Proposed Capacity (MW)	Under construction, Commissioned or Completed (MW)
Biomass	2	60	60
Black coal	12	4,554	958
Brown coal	3	480	400
Coal	4	2,440	-
Coal seam gas	4	1,000	-
Coal seam methane	1	30	-
Geothermal	1	30	-
Natural gas	44	11,918	4,461
Oil products	3	366	-
Solar	6	205	40
Waste heat	1	200	-
Water	1	140	140
Wind	56	6,162	783
Total	**138**	**27,586**	**6,842**

Source: ESAA, 2008

Projections for the composition of the electricity generation sector, by fuel type, over the period through to 2020, have been made for the emission levels of the sector at that point in time. Further, it is noted that these projections on the composition of the electricity generation sector reflect the Government's '20 per cent by 2020' renewable energy target (RET).

Table 3.3 Expected composition of the electricity generation sector, by fuel type, over the period to 2020 (percentage contribution)

Fuel	2005	2010	2020
Black coal	55	53	46
Brown coal	22	21	18
Gas	13	15	15
Renewable	9	10	20

Source: DCC (20008b), page 20.

The following two tables provide a simplified assessment[4] comparing the construction cost of the additional capacity required by 2010/11 and 2016/17 under a baseline scenario which assumes the additional capacity constructed reflects the current composition of generation by fuel types.

Table 3.4 Potential construction cost for additional 1,185 MW by 2010/11

Fuel type	Composition	Capex ($M per MW)	Capex ($M)
Scenario – Baseline			
Black coal	55%	1.70	1,108
Brown coal	22%	1.90	495
Gas (CCGT)	13%	1.05	162
Renewables	9%	2.50	267
			2,032

Table 3.5 Potential construction cost for additional 7,000 MW by 2016/17

Fuel type	Composition	Capex ($M per MW)	Capex ($M)
Scenario – Baseline			
Black coal	55%	1.70	6,545
Brown coal	22%	1.90	2,926
Gas	13%	1.05	956
Renewables	9%	2.50	1,575
			12,002

The above analysis shows that the cost of providing additional generation infrastructure that is already required to close of the gap from a demand perspective is in order of $12 billion ($2008) by 2016/17.

3.3 Australia's transport infrastructure needs

The current stock of public transport infrastructure, and proposals in relation to these, varies between each jurisdiction in Australia. What is common to each of these jurisdictions though is underinvestment over an extended period, ongoing population growth and — partially as a result of urban planning frameworks such as Melbourne 2030 and Sydney 2030 — a move towards increased population density in major metropolitan centres. Equity considerations will

[4] Capex estimates represent construction and physical plant costs and excludes any fuel delivery or energy output infrastructure (i.e. transmission and distribution assets).

also come into play with regard to filling gaps which currently exist in various metropolitan public transport systems as a result of urban sprawl in the last 20 years.

3.3.1 Passenger transport projects

The following passenger transport projects have been identified to help address our current and future passenger transport needs.

Table 3.6 Proposed passenger transport projects

Project	Estimated cost ($M)
NSW - Inner Sydney Light Rail system	$2,007
NSW - North West Metro (2010-2017)	$12,500
NSW - South West Rail Link (2009-2012)	$1,400
NSW - New rolling stock in Sydney	$2,360
NSW - Sydney infrastructure projects	$1,574
Qld – Brisbane Light Rail	$250
Qld - Coomera to Park Road Rail Project (2008-2025)	$400
Qld - Elanora to Coolangatta rail line (2015-2025)	$600
Qld – Gold Coast Light Rail	$566
Qld - Gowrie to Grandchester Rail Line (2015-2020)	$1,300
Qld - Petrie to Redcliffe Busway (2010-2020)	$300
Qld - Redlands Bus Priority connection (2015-2025)	$200
SA – Expansion of Adelaide Light Rail	$162
Vic - Domain to Caulfield Rail tunnel (2015-2019)	$2,500
Vic - Footscray to Domain Rail tunnel (2011-2016)	$4,500
Vic - Tarneit Link (rail link between Werribee and Sunshine) (2015-2019)	$1,500
Vic – Triplication of Dandenong Rail Line	$1,000

Source: IPA (2008), IPA (2007), Citigroup (2008), AusCID (2005). Note: AusCID estimates have been escalated by 12% per annum to reflect the surge in construction costs in recent years.

The above table outlines at least $33 billion in passenger transport projects required over the next 10 to 20 years.

3.3.2 Freight transport projects

An estimated $13 billion in rail freight projects have been identified to increase system capacity to support modal switching between road and rail, as outlined in the table below.

Table 3.7 Proposed rail freight projects

Project	Estimated cost* ($M)
National - Bridge strengthening	$228
National - Major Periodic Maintenance and Minor capital works	$622
National - Melbourne-Brisbane inland rail link	$3,553
National – Melbourne-Sydney rail link	$2,566
National - North-South strategy	$1,000
National - Sydney-Brisbane rail link	$2,171
NSW - Hunter Valley rail links	$708
NSW - Hunter Valley strategy	$369
NSW – Liverpool Range Tunnel	$465
NSW - Rail access to Port Kembla	$790
NSW - Southern Sydney Freight Line	$245
NSW – Sydney Ports Intermodal Facility	NA
SA - Rail access to Port Adelaide	$126
Vic - Melbourne Albury Wodonga	$71
Vic - Melbourne Mildura track upgrade	$31
Vic - Rail access to Port of Melbourne	$173
Vic - Rail access to Portland	$47
Vic - Tottenham yard bi-directional standard gauge	$6
WA - Rail access to Fremantle	$79

Source: IPA (2008), AusCID (2005), ARTC 2008. Note: AusCID estimates have been escalated by 12% per annum to reflect the surge in construction costs in recent years.

3.3.3 Road projects

In addition to supporting a modal switch from road to rail, over $43 billion in road projects will be required to assist with congestion and improve the efficiency of road travel to reduce emissions.

Table 3.8 Proposed road projects

Project	Estimated cost ($M)
Hume and Pacific Hwy Upgrades	$1,200
NSW - F3-M2/M7 Connections	$3,000
NSW – F6 Fwy Expansion (without or with tunnel)	$1,160 – 2,200
NSW - M4 East & M4 Botany Tunnel	$7,000
NSW - New England Hwy – F3 to Branxton (2009-2012)	$765
Qld - Brisbane Airport Tunnel (2009-2013)	$2,000
Qld - Brisbane Northern Link (2009-2013)	$2,400
Qld - Bruce Hwy Cooroy / Gympie Upgrade (2009-2014)	$1,000
Qld - Centenary Hwy Upgrade (2009-2025)	$1,000
Qld - Creekside Blvd-Sunshine Motorway (2010-2015)	$1,000
Qld - Logan Motorway Upgrade (2015-2025)	$300
Qld – South East Qld Road Upgrades (Ipswich and Gateway Motorways, Gateway Bridge Crossing)	$1,900
Qld - Sunshine Motorway Service Roads (2010-2015)	$200
Qld - Toowoomba Bypass (2010-2015)	$900
Qld - Yandina-Coolum Rd & Eumundi-Noosa Rd Upgrades (2010-2015)	$400
Vic - Eastern Fwy to Citylink and Port (2014-2019)	$5,500
Vic – East-West Growth Corridor Integration (road component)	$9,000
Vic - Inner West to Port Link (2012-2016)	$2,000
Vic – Truck Action Plan (2010-2012)	$500
Vic - Western Extension (2022-2025)	$1,500

Source: IPA (2007), Citigroup (2008)

3.4 Economic and social benefits of infrastructure development

As highlighted by the previous sections, there is increasing recognition that Australia's existing economic infrastructure is inadequate to meet the nation's short and long-term needs.

It is critical that Australia has timely provision of efficient and productive infrastructure to support production capability, continuing economic growth and national competitiveness. As the Productivity Commission highlighted in its 2004 review of National Competition Policy, economic infrastructure is "*highly capital intensive, requiring major investment expenditure on long-lived assets. Poor investment decisions or under-investment could constrain Australia's growth and living standards for many years*".

CEDA (2005) identified research showing a strong positive correlation between investment in infrastructure and economic growth, where 1 percent increase in infrastructure spending showing an increase in economic output by between 0.17 and 0.39 percent.[5]

[5] As infrastructure represents 12% of GDP, a 1% increase in its expenditure creates positive economic benefits as the associated economic output of that spend is greater than the input values (ie: it has a positive multiplier effect) .

The Property Council of Australia (2006) released modelling by the Centre for International Economics to illustrate the contribution to economic prosperity that a portfolio-level investment in ten critical infrastructure projects in NSW could generate for the state over the next 30 years. The modelling found that an investment of $18.5 billion in NSW's top ten unfunded projects could deliver significant economic expansion and raise prosperity including:

- a permanent increase in real Gross State Product (GSP) by around 3 per cent, equivalent to around $8.8 billion in every year;
- an increase in employment by around 1.6 per cent, roughly adding of 50,300 jobs to NSW's workforce;
- substantial gain in NSW's competitiveness, with an increase in export volumes of around 9 per cent; and
- benefits to each of the 12 statistical divisions in NSW from the improvements in infrastructure services, even though not every region would directly gain additional infrastructure.

Analysis performed by Econtech (2004) assessed the economic impact of overcoming infrastructure under-investment, by comparing two scenarios – 'baseline' (i.e. do nothing) and 'reform', whereby the problem of under investment in each sector is overcome.

The Econtech modelling results showed that under the 'reform scenario', the proposed investment would boost the productive capacity of five affected industries and increase GDP by 0.8 percent. Further, in the long run, lower industry costs in the freight, road, gas, water and electricity sectors would be passed on to consumers, resulting in benefits to the broader economy through lower CPI and higher living standards.

This chapter has highlighted the fact that Australia requires substantial and varied infrastructure to be provided over the short, medium and long term in order for demand to be met and our economic and social prosperity to be continued. Further, modelling analysis has confirmed that rather than considering such spending to be a burden, it positively contributes to the economic wellbeing of society.

4 The proposed Carbon Pollution Reduction Scheme

4.1 Background

The Commonwealth Government's response to addressing the challenge of climate change has taken the form of a range of measures including the ratification of the Kyoto Protocol, the development of greenhouse gas (GHG) reporting requirements and an expanded renewable energy target.

As part of the further development of the Government's policy response, the Commonwealth Government in July 2008 released its Green Paper outlining its policy in relation to the design of a national emissions trading scheme – now known as the Carbon Pollution Reduction Scheme (CPRS). The Green Paper set out to explain what such a scheme might look like and how it might work. The Green Paper described this scheme as being the "primary means by which the government will seek to fulfil its international obligations".

Under its present timetable, the Government proposes to make final decisions on the design of the CPRS over the next few months. A White Paper outlining these decisions is expected to be released in December 2008 with accompanying draft legislation due in early 2009.

The Government is aiming for the relevant legislation to pass through Parliament by mid 2009 ahead of the 2010 introduction of the scheme.

The emission of GHG was once of nil cost to both producers and consumers of the products or services that created them (although not to others). The purpose of CPRS is to redirect these costs to the emitters (directly) and consumers (indirectly). In other words it will seek to internalise these external costs. The expectation is that the introduction of a price of carbon will change behaviours and transform the economy. By imposing the costs of GHG on emitters it will encourage them to make more rational choices and in turn more efficient allocations of resources into the production of goods and services that reflect the full cost of their production and consumption.

The introduction of such a scheme, however, has some difficulties in its implementation. Past experience with similar schemes in Europe have shown that if the scheme is not designed, implemented and administered effectively there may be negligible or even adverse effects on emission levels.

4.2 Green Paper summary

As is outlined in the Government's Green Paper on the CPRS (July 2008), the underlying objective of the scheme is to facilitate Australia's transition to a low carbon economy in the decades to come by enabling the market to establish a price for carbon which will in turn:

- create an incentive for producers of emissions, direct or indirect, to reduce the level of emissions associated with their activities;
- create an incentive for consumers to reduce their consumption of goods and services that embody discernible amounts of emissions; and

- improve the economics of alternative low emission technologies and/or non-carbon fuels.

Significantly, the rate at which Australia transitions to a low carbon economy will be guided by the level of the initial cap on total emissions, the trajectory for reductions in this cap and the limits on the transfer of emissions permits into and out of Australia.

The proposed CPRS will take the form of a 'cap and trade' scheme and create a market for carbon. The cap, which is set by the Commonwealth Government will eventually be in line with the international target for emissions; although initially there will be some differences as the scheme does not fully capture the whole economy.

Under the scheme only firms emitting over 25,000 tonnes of carbon equivalent a year will be required to acquire carbon pollution permits, which will effectively limit direct scheme participants to around 1,000 businesses. At the end of every year, liable firms would have to surrender carbon permits equivalent to the volume of the GHG they emitted over the year. The total number of permits issued by the Government each year would be limited to a total carbon 'cap' for the Australian economy. For example, if the overall emissions 'cap' is limited to, say, 100 million tonnes of GHG in a particular year, 100 million permits would be issued for that year. No absolute limits or caps are imposed on individual companies or sectors of industry so long as they surrender sufficient permits to cover their emissions.

It is envisaged that the size of the cap over time would become progressively smaller. This is described as the 'carbon trajectory'. Getting this trajectory right has been identified as a critical success factor for the scheme as emitters will need a reasonable adjustment period to alter their behaviour. The preferred system within the Green Paper is that the Government would set the cap levels on a rolling five-year basis, with a 10-year gateway beyond the five years that provides an operating band from which to base future trajectory expectations.

The intention is that a period of five years would balance the need to give market certainty against the desirability of flexibility for policy makers in the light of changing scientific knowledge about climate change, technology and international targets. Currently Kyoto targets are only known up until 2012.

Five years is a very short timescale for the development of infrastructure planning which usually is undertaken over a far longer time span. For example, the timeframe from approval to commissioning a major rail project could be in excess of 10 years.

To make the scheme more flexible, companies will also be able to trade permits on a secondary market (although the Green Paper is silent on the detail in relation to a secondary market). As permits become scarcer *and* more expensive, GHG emitters will experience increasingly stronger incentives to reduce their emissions, both to cut the costs of production and to profit from the sale of excess permits. Producers unable to reduce emissions will have to factor the cost of buying permits into their output prices, quite possibly driving down demand as customers look for cheaper and cleaner substitutes. A perceived disadvantage of this scheme is that it ultimately relies on indirect pressure via price and the market on the actual consumption of carbon intensive products.

In summary, the cap and trade design allows the Government to set the volume of emissions allowed within the economy (the cap) and relies on the market to determine the price of permits as they are traded or as action is taken to reduce emissions where this provides a cheaper alternative.

4.3 Scheme design

In order to oversee the application of this policy an independent statutory body will be established which will issue emissions monitoring reports and will enforce the surrender of the correct number of permits each year. Companies that have emissions in excess of 125,000 tonnes will have to have their figures audited.

Several critical features of the CPRS are yet to be determined.

The most important of these is the national 'emissions reduction trajectory'. The Government has stated that it will establish this by indicating medium term emission targets for a rolling five year period, which in turn will determine the number of pollution permits issued. The actual price of these permits will be largely determined by the emissions trajectory as it will determine the overall supply of permits available to the market.

The Government has proposed that pollution permits are auctioned on a quarterly basis, but that some free permits would be provided for Emissions-Intensive Trade-Exposed (EITE) industries. In addition, the Government has proposed to give direct assistance to certain coal fired electricity generators and other Strongly Affected Industries (SAIs) that would otherwise suffer severe financial consequences from the introduction of the CPRS.

As noted, the CPRS will only apply to entities emitting more than the equivalent of 25,000 tonnes of carbon dioxide a year which should amount to no more than about 1,000 companies. Given that there are over seven million registered businesses in Australia, the number directly affected by emissions trading is quite small. Of course, that 1,000 includes many of our largest and most economically important enterprises, and ones that provide inputs to virtually every other business.

Other critical issues concern the use of domestic and international emission offsets, the complementarity of the CPRS with existing state-based emission-reduction and trading programs, the structure of secondary market trading in permits, emissions measurement and verification, and the prevention of anti-competitive behaviours.

While the Government promises to compensate the most vulnerable businesses and households for these higher costs (using the proceeds of emission permit sales), it remains unclear exactly who will be eligible for this help. What is known at this point is that all revenue raised by the CPRS will be used to assist households and businesses to adjust to the scheme, and that up to 30 percent of permits will be allocated to emissions-intensive trade-exposed activities (including agriculture).

The CPRS is likely to have significant long-term effects and will reshape the structure of the Australian economy.

4.4 Economic modelling

In the past various groups of economists have undertaken modelling designed to estimate the impact of measures intended to reduce GHG emissions. This research has tended to concentrate on the economic impact on the two main emitting sectors of the economy: electricity generation and transport. While the CPRS will only directly impact a relatively small number of Australian enterprises, it will have significant overall (indirect) consequences for the majority of Australian businesses.

Generally, economic modelling of the impact of emissions is concerned with quantifying the impact on the costs and prices of emitting industries rather than examining the effect that measures to reduce GHG emissions have on the provision of infrastructure and how such measures may alter demand for infrastructure.

The Garnaut supplementary draft report, *Targets and Trajectories,* for instance, which was issued on the 5 September 2008, discusses a number of scenarios around climate change, the world response to the challenges inherent within climate change, and Australia's contribution to carbon reduction target setting. Australia is seen by this draft report as uniquely placed to influence the outcome of international negotiations, due to its geographical situation, relationships with China and the Asian economy, and a history of influencing international negotiations.

The report contains the results of some of the "most complex long-term modelling of the Australian economy ever undertaken". The scenarios used are that no mitigating action is taken (a disastrous scenario for all concerned) and the two front runner alternatives involving global co-operation, the so-called "550" and "450". (the "550" scenario is that the world stabilises the concentration of carbon gases in the atmosphere at 550 parts per million; and at 450 parts per million after an initial overshoot for the "450" scenario.).

It is recognised in the report that the different trajectories have to operate in a market that is predefined, and that this will have more of an effect on the economy of different countries than the trajectories themselves. That said, the effect on the GNP in Australia over the first 50 years of carbon trading is a small decrease (less than 1 percent), turning into a positive effect after 2063. The report specifically states that the effects of new carbon emission lowering technological change have been assumed.

Of the two scenarios considered, the 550 gave a slower start to developed nations, and so it follows economically a less painful period of adjustment, whereas the 450 is a more ambitious target, requiring earlier and more far reaching behaviour changes, although this option delivers much improved outcomes for the environment and global warming. It may be beyond the political will of all the countries involved to achieve this target.

The 550 option would seem to be the preferred way forward, although it is acknowledged that Australia may have to start its own programme of carbon reduction in the absence of global commitment and agreement to any targets. Certain industries, referred to as trade exposed, emissions intensive industries would be eligible, under the CPRS to receive compensatory payments from the government. These would not be to ease the general pain of moving towards a reduced carbon emissions economy per se, but to specifically compensate industries for the additional cost of competing in a world trade where other countries have not imposed comparable costs on carbon emissions to those imposed by the CPRS. The effect on these industries, and the challenge to the government of retaining an even playing field for them with the rest of the world whilst at the same time achieving carbon pollution reduction targets, is a main theme of the report, but not the effect of the underlying problems with the national infrastructure in energy and transport during the transition period.

The Garnaut draft report accepts the view that climate change, and measures to combat climate change will have a significant impact on infrastructure spending. The report envisages that in the absence of measures to combat climate change there will be a need to significantly increase capital expenditure on infrastructure.

In Garnaut there are some indirect references to the effect of climate change on capital expenditure in infrastructure. Basically the more severe the level of climate change, the greater the expenditure on infrastructure will need to be. The difficulty is that Garnaut never identifies capital investment in infrastructure specifically as a driver within any of the models.

Garnaut makes reference to allowing within the model for technological advances which it is assumed will come on-line during the first 50 years of carbon trading. It is conceivable that these may make existing infrastructure obsolete, and require even higher levels of new investment.

Prior economic modelling on the impact of emissions trading schemes treat the impact on infrastructure in a similar fashion. In doing so they make implicit assumptions that the necessary infrastructure spending will occur without explicitly stating what that implications will be for infrastructure expenditure.

The work conducted by the Allen Consulting Group (2006), for instance, envisages that if measures to reduce GHG emissions are implemented then Australia's growth over the period to 2050 will decline from an average of 2.2 per cent per annum to 2.1 percent. The work also stated that a trajectory that delays emissions reductions will have a more adverse impact than one that starts earlier.

Work by the Econtech Group has further concluded that measures introduced to reduce GHG emissions will have significant impacts on particular industries, specifically transport and energy generation (Econtech, 2001, 2004). The Econtech study found the emissions trading scheme will raise the price of transport services but not uniformly across all modes. Instead it will have a greater impact on air and road transport, which are relatively fuel intensive, than rail and water transport. Because of the change in relative transport prices, the pattern of transport demand and use will change (Econtech 2001).

Capital expenditure on additional infrastructure will need to take place to accommodate the switch in transport use. Because, however, past investments in long life road and airport infrastructure are sunk, this will not mean that these assets can be easily switched to other uses. Instead there will need to be additional investments made in the relatively less emissions intensive (and therefore less costly) modes of transport.

This would mean that those industries that are most transport intensive in production (and energy intensive) would be most affected by the measures. Although no specific attempt was made to explicitly estimate what this would mean for infrastructure and capital expenditure in the transport and energy sectors, it is quite clear from the studies that the composition of capital expenditure on infrastructure spending would be affected.

Other studies, such as the work by ACIL Tasman (2008) on the impact of an ETS on the energy supply industry, envisage that such schemes would lead to not only higher prices of electricity but also the need for considerable capital expenditure on natural gas and renewable generation capacity. Capital costs of around $30 billion are estimated to be required in the period to 2020 to produce reduced emissions by the energy supply industry of between 10% and 20%.

It is clear from previous economic modelling work that the introduction of the CPRS will change the relative prices of different transport modes and energy sources which in turn will increase capital expenditure requirements in order to accommodate switches in transport use and energy generation.

4.5 Conclusion

It is clear from the current under investment in infrastructure that there are significant underlying obstacles to efficient investment, which will need to be addressed as a matter of urgency if the infrastructure (or lack of it) is not to act as a negative force against moving towards a low carbon emission economy. It is also reasonable to assume that the amount of investment needed to both facilitate the reduction of carbon emissions, and maintain a healthy GNP is considerable.

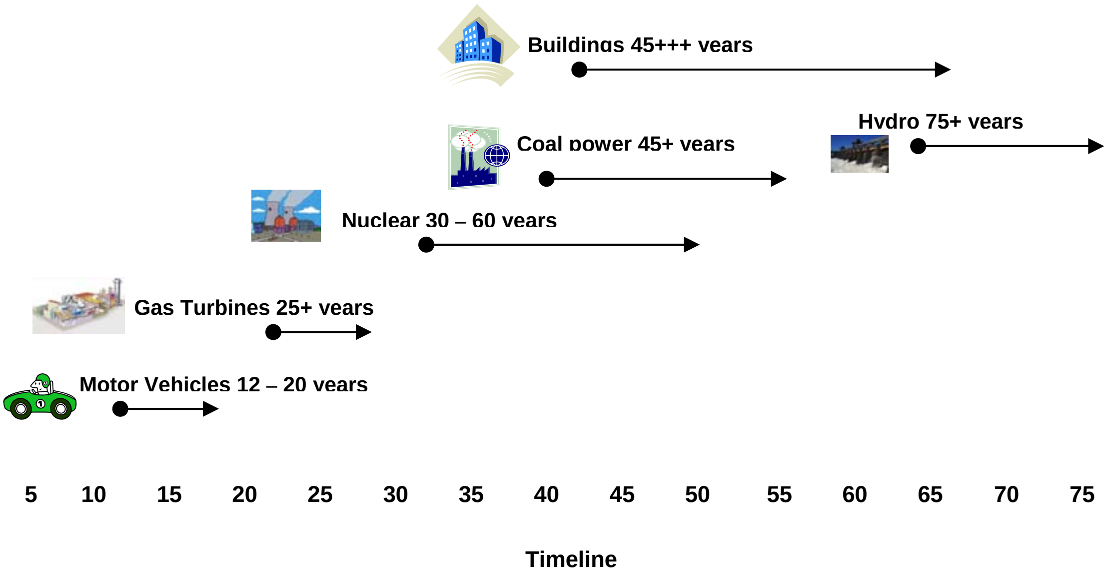
The following chapter considers this issue in detail.

5 Infrastructure development in Australia as a low carbon economy

5.1 Introduction

Ensuring continued economic and social growth while at the same time addressing climate change is a key challenge not only facing Australia, but the world at large. It is considered by many that the solutions lie in creating conditions that incentivise individuals, businesses and organisations to develop new technologies that allow a wholesale shift towards affordable, lower carbon outcomes. However, this shift is predicated on intensifying investment into the development and operation of lower carbon technologies, as well as adapting lifestyles and behaviours to embrace these technologies within society, including the provision of infrastructure that enables these low carbon outcomes to occur.[6]

Figure 5.1 Rate of technological change compared to the lifetime of relevant capital stock and equipment



Source: World Business Council for Sustainable Development

As depicted in the above diagram, infrastructure is long-lived. The implications of this basic understanding of infrastructure is that unless lower carbon emission infrastructure is encouraged, then the consequences of carbon- and energy-intensive investment decisions made today commit those emissions for decades. Even some transport solutions, which are 'consumed' over shorter time frames from an operational life perspective, if purchased today will be contributing to the emissions profile of Australia beyond 2020. However at present, most low- and zero-GHG energy technologies will not be cost competitive at scale without some combination of investment support mechanisms, technological advances or regulatory improvements.

[6] World Business Council for Sustainable Development, *Investing in a Low-Carbon Energy Future in the Developing World*, 2007, pp.2

It is these two countervailing points that necessitate Governments come together to consider the policy frameworks and investment required and act with a degree of urgency, as delaying the implementation of frameworks that facilitate infrastructure investments that support low- and zero-GHG outcomes could result in societies committing to an increasing rather than decreasing emissions profile.

The remainder of this chapter discusses the need to consider the implications of both the continued requirements for investing in infrastructure to ensure the economic and social progress of Australia, while at the same time ensuring the objective of a low carbon future driven by the CPRS is achieved. We identify the broad cost differential of switching from infrastructure projects which generate carbon outcomes for Australia at historic rates to solutions that produce substantially lower GHG emissions. Finally, we consider the necessary preconditions and associated implications for low carbon enabling infrastructure to be developed.

5.2 Defining a low-carbon society

In considering how infrastructure should be developed to facilitate a low carbon outcome for society, it is firstly important to understand what constitutes a low carbon economy and what strategies and actions could be adopted by current societies to move towards it.

The Japan-UK Low carbon economy project (the Project) defined a low carbon economy as one which should:

- Take actions that are compatible with the principles of sustainable development, ensuring that the development needs of all groups in society are met;
- Make an equitable contribution toward the global effort to stabilise the atmospheric concentration of CO2 and other greenhouse gases at a level that will avoid dangerous climate change, through deep cuts to global emissions;
- Demonstrate a high level of energy efficiency and use low-carbon energy sources and production technologies; and
- Adopt patterns of consumption and behaviour that are consistent with low levels of greenhouse gas emissions.[7]

The Project also noted that the implications of the above definition were different for countries at different stages of development. For developed countries like Australia, achieving a low-carbon society would involve making deep cuts in CO2 emissions by the middle of the 21st century through the development and application of low-carbon technologies and changes to lifestyles and institutions.[8]

[7] Skea, J. and Nishioka, S., *Policies and practices for a low-carbon society,* Climate Policy 8 (2008), p.6.
[8] Ibid, p.7

5.3 Moving towards a low-carbon society

While low-carbon societies are a long term goal, there are practical steps that can be taken today to place Australia on the right trajectory. In their seminal article, *Stablization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*[9], Pacala and Socolow identify a portfolio of technologies that currently exist which would allow the world's energy needs to be met over the next 50 years while at the same time limiting atmospheric CO2 to a trajectory that avoids a doubling of the pre-industrial concentration. The following table identifies 15 different options, which when considered in combination, were anticipated by Pacala and Socolow to reduce 7GtC per annum over the next 50 years. Within this table we have also identified whether the option relates to an energy, transport or freight infrastructure solution.

Table 5.1 Strategies identified as being currently available that could reduce the carbon emission rate in 2054 by 1 GtC/year

Option	Infrastructure or industry response sector
1. Efficient vehicles (and their use)	Motor vehicle production, Road infrastructure
2. Reduced use of vehicles	Public transport infrastructure
3. Efficient buildings	Construction
4. Efficient baseload coal plants	Energy infrastructure
5. Gas baseload power for coal baseload power	Energy infrastructure
6. Capture CO2 at baseload plant	Energy infrastructure
7. Capture CO2 at H2 plant	Energy infrastructure
8. Capture CO2 at coal-to-synfuels plant	Energy infrastructure
9. Nuclear power for coal power	Energy infrastructure
10. Wind power for coal power	Energy infrastructure
11. PV power for coal power	Energy infrastructure
12. Wind H2 in fuel-cell car for gasoline in hybrid car	Motor vehicle production, petroleum sector
13. Biomass fuel for fossil fuel	Petroleum sector
14. Reduced deforestation, plus reforestation, afforestation, and new plantations	Agriculture
15. Conservative tillage	Agriculture
Source: Pacala, S. and Socolow, R., 2004	

The above table shows that of the 15 identified options to assist in moving towards a low carbon economy, 8 relate to energy infrastructure assets and 4 relate to transport infrastructure, production and/or fuels. Such an option package recognises the relative importance of the power generation[10] and transport[11] sectors to the production of CO2 emissions.

[9] Pacala, S. and Socolow, R., *Stablization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, Science, Vol 305, 2004, p968-972
[10] Power generation represents an estimated 40% of total world CO2 emissions in 2004 (Source: Centre for American Progress)

5.4 Transitioning energy infrastructure in Australia to a CPRS low carbon economy

The starting point for considering whether or not gaps are likely to arise in electricity sector infrastructure under the CPRS is an analysis of the projections for electricity demand in the period through to 2020. These projections are then compared with projections for emissions of CO_2-e from the electricity sector under some business-as-usual scenarios and in response to two different 2020 emission targets.

This analysis is focussed on generation infrastructure, and highlights the pressure which is likely to arise for new infrastructure in this area as a result of ongoing growth in the demand for electricity, the Renewable Energy Target (RET) and other complementary schemes such as the National Energy Efficiency Target (NEET) and the Victorian Energy Efficiency Target (VEET), and the retirement of existing high emission generation facilities which predominate in the National Electricity Market (NEM). The discussion here also references a number of important practical issues that will influence the capacity of the generation sector to adapt to a low emission future under the CPRS, such as technological constraints.

The ACIL Tasman report also included forecasts for electricity demand under two emission reduction scenarios — a 10 per cent reduction on emission levels in 2000 by 2020, and a 20 per cent reduction on emission levels in 2000 by 2020. These forecasts are presented in the table below, along with the ‘business as usual’ (BAU) forecast cited above.

Table 5.2 ACIL Tasman's demand forecasts under two emission reduction scenarios

Year	Forecast electricity demand		
	BAU	10% scenario	20% scenario
2010	235,855 GWh	235,855 GWh	235,855 GWh
2015	262,080 GWh	241,378 GWh	237,371 GWh
2020	288,870 GWh	254,205 GWh	248,429 GWh

The expected effect of an ETS (which is analogous to the CPRS), as indicated by the forecasts above, is to reduce the level of demand for electricity in 2020, although these reductions are not strictly linear with respect to the two emission reduction targets modelled.

The table below presents information on recent, and current, levels of emissions from the electricity sector, and projections for these in 2020 under a number of different scenarios.

[11] Transport represents an estimated 20% of total world CO2 emissions in 2004 (Source: Centre for American Progress)

Table 5.3 Emission levels of the electricity sector

Year	Emissions level (observed and forecast)
1990	129 Mt [a]
2000	175 Mt [a]
2005	194 Mt [a]
2008-2012 (Kyoto period average)	204 Mt [a] (with measures estimate)
2020	278 Mt [a] (BAU) 200 Mt [a] (with measures estimate)
	223 Mt [b] (BAU — no RET) 149 Mt [b] — 10% reduction on 2000 levels 132 Mt [b] — 20% reduction on 2000 levels

[a] DCC (2008b) pages 2 and 8. The 'with measures' scenario incorporates the (expected) impact of all greenhouse gas abatement measures, with the exception of emissions trading, and the BAU scenario excludes all greenhouse gas abatement measures. Pages 11-15 of the DCC document detail all of these measures. [b] ACIL Tasman (2008). For the 10% and 20% scenarios, these figures indicate the expected level of emissions from the generation sector if the emissions cap in 2020 requires 10 and 20 per cent reductions respectively in total emission on 2000 levels by 2020.

The numbers in the table above indicate that:

- Emissions from the electricity generation sector grew 10 per cent in the period between 2000 and 2005;
- Under a BAU scenario, with demand growth being provided for, emissions from the electricity generation sector will be considerably higher in 2020 than what they were in 2000. The Department of Climate Change's (DCC) estimate (278 Mt) is 58 per cent higher than the sector's level of emissions in 2000, and ACIL Tasman's estimate (223 Mt) is 27 per cent higher than the sector's level of emissions in 2000;
- 'Measures' to abate greenhouse gases (not including emissions trading) such as energy efficiency programs and industry partnerships to reduce emissions (i.e. Greenhouse Challenge) will reduce emissions in 2020 relative to a BAU scenario, but — even with 20 per cent of energy coming from renewable sources in 2020 — emission levels from the electricity generation sector will remain higher than what they were in 2000; and
- A national target for a 10 per cent reduction in emissions by 2020 (on 2000 levels) requires an estimated 14.8 per cent decline in the electricity generation sector's level of emissions relative to what they were in 2000.

It is essential that Australia's portfolio of generation capacity shifts towards greater use of low carbon emission technologies, which could include:

- Clean coal technology – Coal gasification or more efficient direct combustion;
- Natural Gas – Combined Cycle Gas Turbines;
- Carbon Capture and Storage – capturing CO2 from power plant to be stored;

- Renewables – Geothermal, Wind, Solar and Hydro; and
- Nuclear – Generation III and IV fast breeder reactors.

However, there are a number of practical issues facing each (major) source of generation capacity in Australia ahead of the introduction of a CPRS.

These issues, identified in the table below, have the capacity to influence — usually negatively — investment decisions in the electricity generation sector. In considering these issues, it is important to be mindful of the estimates presented above on the future demand for electricity in Australia and the expected composition of the generation sector in 2020.

Table 5.4 Practical issues for investments in the different sources of electricity generation capacity

Coal	Gas	Renewables
• Uncertainty about emission caps • Uncertainty about the future of current generation assets • Low emission technologies still being developed • CCS technologies still being developed – would also need transportation infrastructure • Inter-connector capacity issues • Economic case for investment is changing with time • Regulatory environment reduces investment incentives	• Uncertainty around the extent and location of gas reserves • Transmission infrastructure • Upstream fuel supply is currently a highly concentrated sector • Economic case for investment is changing with time • If Australia's gas price moves towards international parity, the attractiveness of a switch from coal to gas is reduced	• Several 'competing' sources – wind, solar and geothermal • Solar and geothermal are yet to be commercialised (large scale) • Many geographic areas suitable for renewables are not connected to or located near the grid • Economic case for investment is changing with time

In addition to the points above, there are also concerns about the availability of capital, skilled resources and the components needed for the construction of electricity generation facilities.

For example, there is currently strong demand globally for generation equipment from the leading equipment manufacturers and suppliers (including from Alstom, GE and Siemens) creating longer lead times for developers before they can physically obtain equipment. Bearing in mind these long lead times and competition within the market for this technology, this scarcity has a direct impact on the market price for equipment and significant flow on effects in terms of the cost of new infrastructure across the traditional, nuclear and renewable markets.

These lead times vary between different technologies, with around 2 – 3 years lead time for wind, 2 – 5 years for gas and 10 -15 years for nuclear generation from the time of deciding to build to commissioning.

These factors are acting to limit the rate at which the sector can transition towards a lower emissions future. This issue is particularly significant.

The ACIL Tasman (2008) study referred to earlier include a number of estimates — given certain assumptions[12] — about the levels of investment in generation sector capacity that will be needed to meet increasing demand and possible emission reduction targets set under the CPRS. The key findings and estimates emerging from the ACIL Tasman study include:

- in the NEM, BAU requires the installation of around 9,100 MW in new generation capacity between 2011 and 2020;
- to achieve a 10 per cent reduction in emissions by 2020, 6,700 MW of existing generation capacity will need to be retired and approximately 15,000 MW of new generation capacity will have to be commissioned (almost all entirely in the NEM); and
- in terms of investment spends, the BAU scenario requires $13 billion in investment by 2020, whilst the 10 per cent scenario requires $33 billion in investment by 2020 — $23.3 billion of this latter figure is attributable to the renewable generation target.

Within the ACIL Tasman report, the assumption that replacement generators would commence operations relatively smoothly and there would be no disturbances to supply was also noted. This however is unlikely to be the case in practice, as the modelling does not capture the 'significant difficulties that would be encountered in terminating production from major assets well before the end of their technical life' (ACIL Tasman 2008, page 3). This is one of the numerous practical issues facing the electricity sector as it approaches a period of transitioning to a lower emissions future.

Modelling by McLennan Magasanik Associates (MMA) is also consistent with the work done by ACIL Tasman. The cost associated with replacing existing coal generation plants in the NEM with Combined Cycle Gas Turbines (CCGTs) is in the order of $30 billion. Currently the level of installed coal-fired generation capacity in the NEM is 28,000 MW (or approximately 60 per cent of total capacity) — this is equivalent to over 70 typical 400 MW Combined Cycle Gas Turbines (CCGT) of which there are less than a handful in operation in the NEM at the moment.

While ACIL Tasman and MMA have indicated the marginal cost of moving away from traditional higher emission generation technologies to lower emission ones could be in the order of $30 billion, KPMG considers these estimates are likely to materially underestimate the true infrastructure cost to society once electricity transmission and distribution infrastructure, gas pipeline supply assets and source fuel development costs are included.

[12] Assumptions employed by ACIL Tasman in producing these results were (a) carbon capture and storage are still in a demonstration phase in 2020, as is integrated gasification and combined cycle generation (b) the costs of a number of renewable technologies have come down, especially photovoltaics, and geothermal generation based on hot dry rocks is proven and commercial, with take-up slowed by the rate at which new plant and interconnection into the market can be built (c) nuclear generation was not included as a generation option (d) the electricity generation sector will need to meet at least its proportional share of any economy wide emissions reduction target (e) the price of permits in 2020 (in 2008 $) was $45/tonne CO_2-e in the 10% reduction scenario and $55/tonne CO_2-e in the 20% reduction scenario.

5.5 Transitioning transport infrastructure in Australia to a CPRS low carbon economy

The main sources of emissions in the transport sector come from passenger cars and road freight. There are also emissions in this sector from rail and shipping transport but these are considerably lower than those associated with the road based forms of transport. In 2006 the transport sector contributed 13.7 per cent (or 79.1 Mt CO2-e) of Australia's net emissions — road transport accounted for 87 per cent of these (or 68.9 Mt CO2-e).

The analysis in this section highlights the opportunity for reducing emissions in the transport sector by actively supporting modal shift with the freight task (road to rail) and increasing the utilisation of public transport systems.

These opportunities are, generally speaking, relatively well known, being the subject of numerous inquiries and various policy statements (for example, Victoria's *Meeting our Transport Challenges'* policy statement). In order to realise these opportunities though, it is expected that high levels of investment in transport infrastructure will be required in the years to come.

In addition to new infrastructure to support modal shifting in the freight sector and greater capacity in public transport systems, it is expected that investments will also be needed to road networks in the years ahead. Unlike the electricity sector, the relationship between these investments and emission reductions is not so direct in the transport sector. While reductions can be achieved through the substitution of high emission transport modes for low emission transport modes in some parts of the transport sector, road based transport mediums (particularly cars and trucks) seem likely to remain the dominant feature of the transport system for many years to come. The potential benefits of investments in road-based transport modes for emission levels arise from a more efficient usage of the transport system, including the reduction of congestion levels.

The conclusions emerging from this section are based upon the observation that emissions in the transport sector are dominated by the two distinct users of the road network — passenger vehicles and commercial, or freight, vehicles. In order to facilitate reductions in the emission levels associated with these users, related infrastructure — either existing or new — needs to be leveraged in an effective manner, mindful of other relevant policy frameworks.

In relation to passenger vehicles, investments in the capacity of public transport infrastructure offer the greatest potential for reducing emission levels. Key policy frameworks relevant to these investments are those around urban planning.

In relation to commercial vehicles, facilitating an increase in modal switching between road and rail appears to offer the greatest potential for reducing emission levels, especially on high volume, high distance, high frequency freight routes. Key policy frameworks that are relevant to this outcome include current fuel subsidisation schemes and the current road pricing framework.

The table below details the emission levels associated with the key sub-sectors of the transport sector in 1990 and 2005, and forecasts for their expected emission levels in 2020.

Table 5.5 Emissions in the transport sector (Mt CO2-e)

	1990	2005	Kyoto period Average (2008-12)	2020
Passenger cars	35.2	44.0	45.7	49.3
Motorcycles	0.2	0.2	0.2	0.3
Buses	1.2	1.3	1.4	1.6
Light Commercial Vehicles	7.5	11.1	12.8	17.9
Rigid trucks	4.1	5.6	6.2	6.9
Articulated trucks	6.1	8.8	10.2	12.8
Aviation	2.9	5.1	6.5	8.7
Rail	1.7	2.1	2.6	3.3
Shipping	3.0	2.4	2.5	2.8
Total	**62.1**	**80.8**	**88.1**	**103.7**

Source: DCC (2008c) http://www.climatechange.gov.au/projections/pubs/transport2007.pdf (page 11)

The table below presents details on observed emission levels, and forecast for these, for the freight transport sector in particular — these figures are essentially a summation of those outlined above for the various means of freight transport.

Table 5.6 Contribution of Freight Transport to Australia's emission levels

Year	Freight sector emissions (observed and forecast)	Percentage change (period on period)
1990	22.5 Mt	-
2006	30.1 Mt	+ 33.7%
2020	44.6 Mt	+ 48.1%

Source: Total Environment Centre (2008), page 6.

In summary, various reports indicate:

- Emissions from the transport sector as a whole are expected to increase by 28 per cent between 2005 and 2020;
- The most significant increase in emissions within the transport sector between 2006 and 2020 is associated with the freight sector — emissions here are expected to increase by 48 per cent between 2006 and 2020;
- Emissions from passenger vehicles are expected to increase by 12 per cent between 2005 and 2020 — this is less than the expected 23 per cent in the level of car ownership in Australia over the same time; and
- Emissions from the rail and aviation sectors are expected to increase by a high level proportionality in the period to 2020, but these increases are coming from a very low base.

Unlike the electricity sector, there are neither publicly available, comprehensive assessments of potential infrastructure gaps in the transport sector nor a clear market framework in which availability, service levels and costs are clearly discernible which may hinder the ability of the CPRS to achieve its objectives. As noted, the relationship between these investments and emission reductions is not as clear for the transport sector as it is for the electricity sector. Nonetheless, there is a high level of recognition around the key options that exist for reducing emissions from the transport sector.

To create a low-carbon transportation sector three significant changes need to be adopted at the same time within society, including the:

- Significant increase in the fuel economy of the vehicles people drive, and improvements in the road infrastructure that allows more efficient driving;

- Development of low carbon, alternative fuels, and their associated refuelling infrastructure; and

- Improvement of public transportation infrastructure and development planning to reduce the number of private trips taken in society.

Investing in a more diverse and inter-modal transportation network is a long term strategy for meeting climate challenges, but importantly is a necessary component of any integrated approach to reducing Australia's carbon outputs. To achieve this, the Government should facilitate more investment in public transport, either the construction of new systems and services or through the expansion of existing ones, including the development of high-speed rail connections between major population centres.

As is illustrated by the table below, there is significant variation in the average carbon intensity of different modes for passenger transport.

Table 5.7 Average carbon intensity of different passenger transport modes

Transport mode	gram CO_2-e per passenger/ km
Passenger airlines	228.3
Passenger cars	110.4
Passenger rail – diesel	74.4
Buses	66.4
Passenger rail – electric	53.5

Source: Rail Safety and Standards Board U.K

Investments in public transport infrastructure will help provide choice to individuals within society about how to move from one destination to another, particularly once the carbon component of petrol is reflected in the price paid by consumers at the petrol pump.

Investment in public transport infrastructure needs to be considered in light of system capacity and projected population growth.

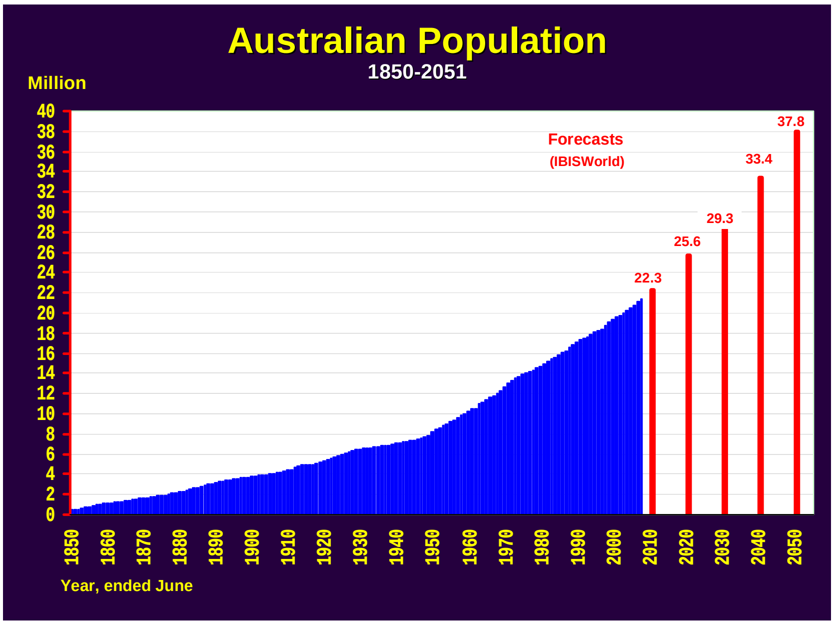
The rise in petrol prices over the past 18 months has accelerated already growing public transport patronage across Australia, including:

- 50 per cent growth in South East Queensland from 1998/1999 to 2005/06;
- 23 per cent increase in Melbourne rail patronage over the last two years; and
- 41 per cent growth in Perth in the last year following the opening of the new Mandurah rail line.

The rapid growth in public transport patronage has lead to overcrowding of trains, trams and buses, with many transport systems now operating close to capacity.

In addition to the current capacity constraints, future investments in public transport infrastructure needs to be considered in light of projected population growth. Long range forecasting completed recently for IPA (IBIS World 2008) predicts strong population growth to 37.8 million by 2051, significantly higher than the ABS current estimate of 33.4 million.

Figure 5.2 Population projection to 2051



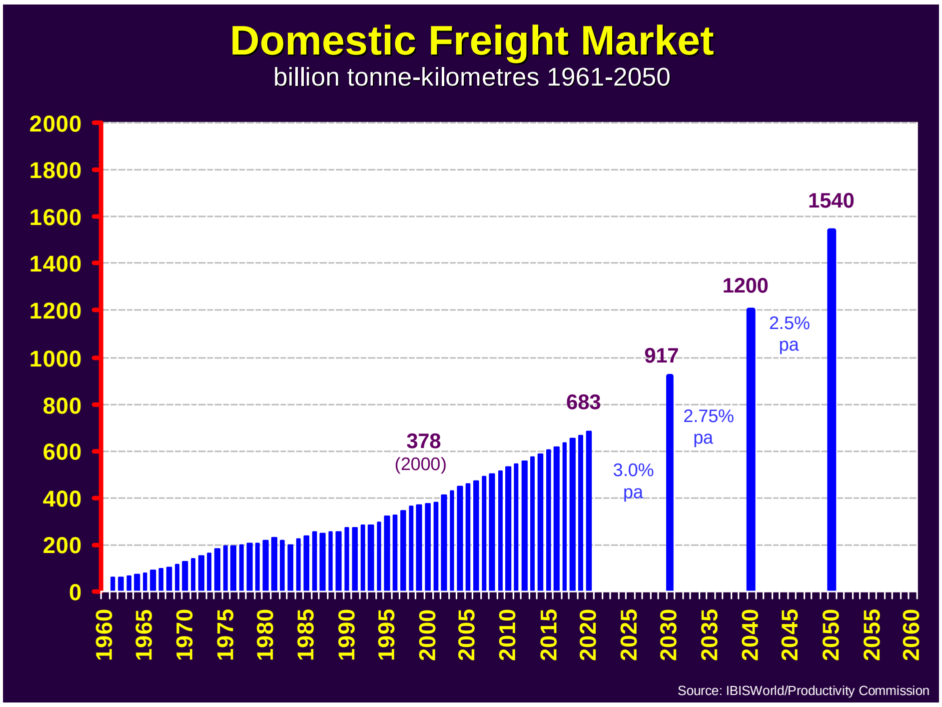
Source: IBIS World (2008)

As discussed in Chapter 3 of this report, the infrastructure gap associated with public transport infrastructure has been conservatively estimated at about $33 billion, while the gap for roads infrastructure predominately utilised for passenger cars has been again conservatively estimated at $19 billion. Based on achieving the objectives of CPRS, the relative funding differential between low emission public transport infrastructure and higher emission private transport infrastructure appears appropriate.

In the area of freight transport, facilitating an increase in modal switching between road and rail appears to offer the greatest potential for reducing emission levels, especially on high volume, high distance, high frequency freight routes. Improvements in fuel efficient vehicles and the overall efficiency of the road network have the potential to complement modal switching in bringing about a reduction in the level of emissions associated with the freight sector.

Again, this needs to be considered in light of the anticipated growth in domestic freight. The domestic freight task in Australia has been forecast by IBIS World (2008) to treble from an estimated 502 billion tonne-kilometres in 2008 to 1540 tonne kilometres in 2050, as shown below.

Figure 5.3 Projected domestic freight market



Source: IBIS World (2008)

As indicated by the table below, there is a significant level of variation between various freight transport modes in terms of their carbon intensity per tonne of freight transported.

Table 5.8 Average carbon intensity of different freight transport modes

Transport mode	gram CO_2-e per tonne / km
Air	1,422
Road transport	
• Light Commercial Vehicles	1,294
• Rigid trucks	183
• Articulated trucks	60
Rail	
• Government	20
• Private	5.4
Coastal shipping	13

Source: Total Environment Centre (2008)

To support an increase in modal switching between road and rail it is expected that greater infrastructure investment will be needed in relation to:

- Establishing, and enhancing intermodal rail terminals;
- Addressing track capacity and bottleneck issues within capital cities, especially where freight trains are using the same railway lines as urban passenger rail services; and
- Improving the quality of rail tracks, and their alignment with each other, along the eastern seaboard.

However, based on the gap analysis for transport infrastructure previously identified in Chapter 3, about $24 billion of road freight transport enabling projects have been proposed, while about $13 billion of rail freight transport enabling projects have been proposed. Given the substantial differences in emissions generated between the two freight movement sectors, it appears the relative infrastructure funding is misaligned in context of enabling the CPRS objectives to be achieved. Rather, a greater proportion of rail freight infrastructure should be prioritised and proposed to assist in achieving a low carbon economy in the future.

6 Conclusion

The introduction of the CPRS will have far reaching implications for Australia, not only through the day-to-day activities of people in society, but also for the providers of economic infrastructure more specifically.

It is understood that Australia, independent of the CPRS, has a gap in the provision of economic infrastructure, with estimates ranging up to $770 billion for the cost of providing these assets. In particular, the gap in energy and transport economic infrastructure has been estimated at around $12 billion and $90 billion respectively, assuming projects are supplied using a business-as-usual approach in terms of energy intensity. However, if these gaps in economic infrastructure is addressed in a manner that seeks to facilitate the objectives of the CPRS, and therefore assist in shifting Australia to a lower carbon economy, then the cost of closing the infrastructure gap increases substantially and could be more than $120 billion.

This cost increase and shift in focus towards lower emission infrastructure solutions, including renewable energy generation, public transport and rail freight, has important implications for the CPRS.

One of the critical elements of the CPRS will be the national emissions reduction trajectory that is employed. It is vitally important that the Government has regard to a number of factors in determining this trajectory, one of which is the rate of change possible in the infrastructure sector due to its long life characteristics, including the long lead times required to plan, develop and commission these assets. However, given the analysis in this paper specifically around the energy sector (which is the single largest carbon emitter in Australia), these lead times are likely to be even longer if new, low emission technologies are sought to be employed over traditional technologies.

The current and short term forecast gap in base load power generation cannot be effectively filled by renewable energy. The CPRS could, in the short term, further widen this gap as the uncertainty surrounding target levels could act as a disincentive to investment in traditional base load power. The natural lag between current technology use and the uptake and development of new technology is likely to put further upward pressure on power prices during this period of under investment in base load power. However, in the absence of long term certainty around the trajectories and targets contained in the CPRS, the investments required to close the identified infrastructure gap is unlikely to occur.

The CPRS has regard (ultimately) to the environmental challenge. The Commonwealth Government needs to deal with the structural adjustment issues that will arise in the individual sectors. The Commonwealth Government therefore needs to think about the necessary assistance to ensure that the structural adjustment occurs smoothly. The Commonwealth Government will need to allocate an efficient level of permit revenues to the infrastructure challenge to ensure that productivity/output levels are not compromised.

To facilitate an orderly transition to a greener economy, the CPRS must allow for and facilitate the required investment in key sectors of the economy including critical infrastructure. Recognising the long lead times and significant investments required in energy, freight and passenger transport networks, a way to achieve this may be to set a mild trajectory over the early years, to ensure that sufficient capital is available to fund investment in critical infrastructure.

Government should also urgently review any regulatory impediments that may inhibit investment in critical infrastructure.

Finally, it is KPMG's view that the change necessary for the energy sector will be facilitated through market mechanisms, much in the same way those mechanisms have developed in the NEM. This change should occur so long as the financial capacity of market participants is not materially adversely affected through the introduction of the scheme, and that the remaining generators in Government ownership behave in a fully commercial manner and signal to the market that they are going to do so.

However, investment in economic infrastructure in the transport sector is likely to require Government intervention, through both direct investment and policy decisions, as the market mechanisms associated with infrastructure for this sector are relatively weak. Further, the lack of harmonisation across jurisdictions, both legislatively and motivationally, further inhibits the objectives of the CPRS to be achieved from a transport infrastructure perspective.

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