

> Quarterly Infrastructure Research Report



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Infrastructure research report: An assessment of the impacts of Australia's Emissions Trading Scheme on Infrastructure

1. Introduction

The passage of legislation enabling a greenhouse gas pricing scheme in Australia [1] this month has prompted a consideration of the impact of carbon pricing on infrastructure.

It is proposed to introduce the scheme in two stages. In the first stage, a 'fixed carbon price', effectively a carbon tax, will be imposed on major emitters from 2012 onwards. This will subsequently be replaced by a cap and trade emissions trading scheme (ETS) from 2015. Given that the fixed carbon price arrangements are relatively short term, this paper will focus on the potential impacts of an ETS. Imports of carbon credits are permitted under the scheme and it is assumed that international carbon markets will play an important part in the ETS.

It is acknowledged [2] that the pricing of carbon would have a negative effect on economic growth, when compared to 'business as usual' (BAU), and there has been considerable debate as to how significant these effects will be. The Australian Treasury has undertaken extensive econometric modelling in an attempt to quantify these impacts. While confirming a negative economic impact, this modelling suggests there may be a significant advantage in moving to price carbon sooner rather than later, or an early-mover advantage. That is, the early introduction of such a scheme will allow Australian industries to adjust and commence restructuring ahead of any concerted international action on climate change [2].

The Australian Government's default policy on greenhouse gas emissions is to reduce emissions in 2020 to 5% below the year 2000 levels, via a suite of policies, including the ETS and a range of mandatory targets and sector-specific programs. This abatement target would be adjusted to bring it in line with any international agreement between now and 2020. Treasury modelling assumptions of concerted global action by 2010 and the continued development of the global carbon market by 2015 are by no means certain.

The Australian scheme is interesting compared to greenhouse gas emissions pricing arrangements proposed in other countries for a number of reasons:

- > It covers a large proportion of the economy, although some major sectors, such as agriculture, will still fall outside the initial ETS structure;
- > Transitional assistance to affected industries has been a particular focus;
- > It closely conforms with the protocols likely to govern international carbon markets; and
- > Treasury modelling [2] specifically includes estimates of the impact of the ETS on specific geographic regions and sectors of the economy, and is possibly more extensive than modelling undertaken elsewhere.

An ETS may impact infrastructure via a range of direct and indirect mechanisms. For example, some infrastructure operations, including electricity generation and gas transmission and distribution, are direct emitters of greenhouse gases and are likely to be required to purchase permits under the ETS. Indirect factors are also expected to be significant in these sectors as higher prices passed through to consumers are likely to dampen demand.

In operations closely correlated to gross domestic product (GDP) such as transport, fuel price increases may also be significant, dampening the demand for transport services, depending on the elasticity of fuel cost to demand. Additional indirect impacts may result from a reduction in GDP.

This paper briefly outlines the workings of the ETS. It proposes an additional more conservative scenario than modelled by the Treasury, before discussing the potential impacts on selected infrastructure sectors. Finally, we briefly compare the scheme with that proposed in the UK. A medium-term horizon to 2020 has been selected.

2. The Australian Emissions Trading Scheme

Under the proposed ETS scheme major polluters, defined as those emitters currently exceeding 25,000 tonnes of CO₂-e per annum, will be required to have accredited emission permits for each tonne of CO₂-e they emit. This will capture slightly more than half of Australia's emissions [2] and is expected to involve about 500 entities. They will have to achieve essentially all of the targeted emissions abatement from either direct operational savings or purchases of certificated savings from international carbon markets.

The price of permits will be set at the marginal cost of abatement. This means that, on average, actual abatement will be cheaper than purchasing permits. This provides an incentive for polluters to reduce their emissions so as to reduce their permit requirements. The number of Australian permits available will decrease each year forcing the permit holders to reduce emissions accordingly or purchase permits to cover their liability.

Using the assumption of a concerted global response to climate change as a base case, the Treasury has modelled several scenarios differentiated by the degree of abatement:

Scenario 1: Core policy scenario

In this scenario, the emission target for 2020 is 5% less than the 2000 emissions, or 527 million tonnes carbon dioxide equivalent (MT CO₂-e), including imported abatement. This represents an overall saving of 152 MT CO₂-e in 2020 against the BAU case. This objective is consistent with Australia's share of the global action required to stabilise carbon dioxide concentrations at around 550 parts per million (ppm) by 2050, compared with current levels of about 380 ppm. In 2020, it is estimated that about 270 MT CO₂-e of emission permits will be available [2].

Scenario 2: High price scenario

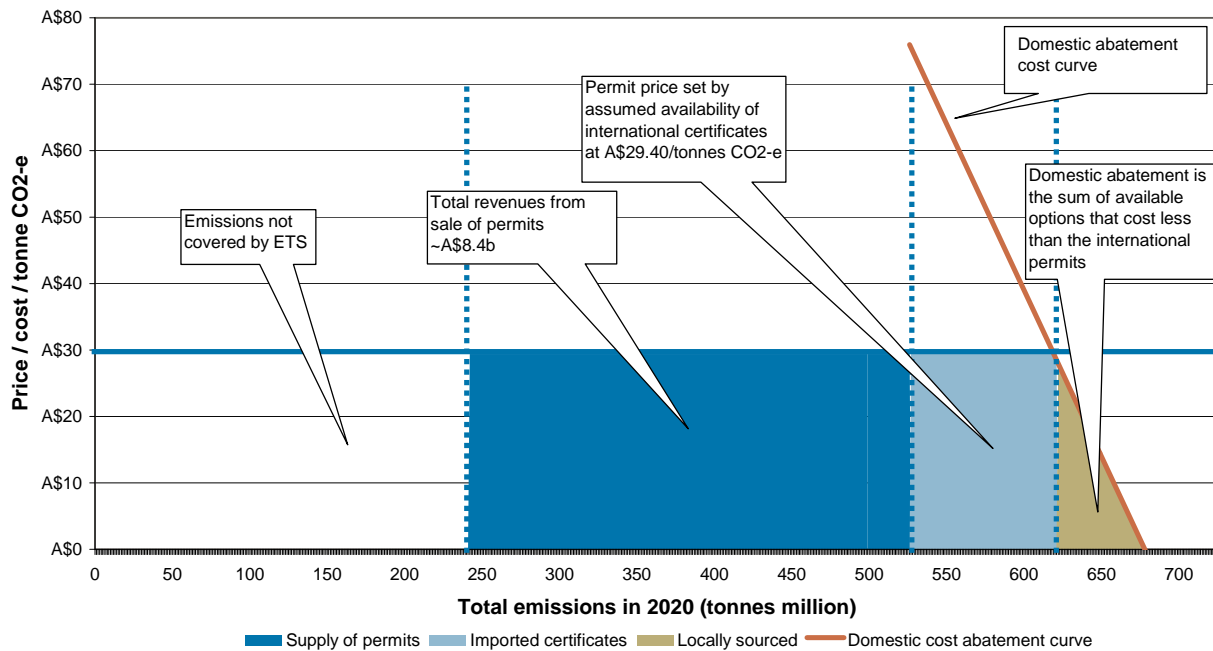
In this scenario, the emission target for 2020 is 25% less than the 2000 emissions including imported abatement, or 416 MT CO₂-e. This objective is consistent with global action required to stabilise carbon dioxide concentrations at around 450 ppm by 2050. The hope is that this more aggressive abatement target will limit global temperature rises to less than 2°C, the agreed international ambition level reflected in the United Nations Framework Convention on Climate Change Copenhagen Accord and Cancun Agreements. In 2020, it is estimated that about 211 MT CO₂-e of emission permits will be available [2]. The reduced quantity of permits reflects the more aggressive abatement trajectory of this scenario.

The forecast outcomes of these two scenarios by 2020 are provided in the following table:

Parameter	Core policy scenario	High price scenario
Global stabilisation target (ppm CO ₂ -e)	550	450
BAU emissions (MT CO ₂ -e)	679	664
2020 Emission target (MT CO ₂ -e)	527	431
2020 Imported abatement (MT CO ₂ -e)	94	118
Domestic abatement (MT CO ₂ -e)	58	130
Permit price (A\$ billion 2010)	29.40	62.00
BAU GDP (A\$ billion 2010)		1,726
Forecast GDP (A\$ billion 2010)	1,722	1711
GDP impact in 2020 (A\$ billion 2010)	5	14
GDP impact % in 2020	-0.33%	-0.86%

The workings of the scheme under the Core Policy assumptions are summarised in the following graph, using the Treasury results.

Emission permits supply and demand – core policy



The purchase price of the permits will be determined by the marginal cost of abatement at the target of 527 MT CO₂-e. The Australian Treasury estimates that under the Core Policy scenario this will be A\$29.40 per tonne equivalent carbon dioxide (CO₂-e). As indicated above, Treasury modelling suggests that this marginal cost will be set by the price of international permits.

If Australia had to rely on domestic abatement options only, costs would increase rapidly as shown by the orange line in the above graph, which has been back-calculated from the Treasury results. International carbon markets, therefore, will allow Australia to import certificated savings achieved elsewhere. Treasury modelling of concerted global action in response to climate change indicates that a deep pool of international abatement certificates will be available by 2020. At a certain point, these certificates will be cheaper than further abatement within the Australian economy. At this point, it will become cheaper to import foreign certificates.

Treasury modelling forecasts that this will occur after 58 MT CO₂-e of savings are made domestically in 2020, when the marginal cost of further domestic abatement reaches A\$29.40 per tonne CO₂-e [2]. Thereafter, imported certificates will be cheaper and account for the next 94 MT CO₂-e of the required abatement.

As can be seen in the above graph, the implied value of permits issued will be A\$8.6 billion. Actual government revenues will be less than this depending on the number of free permits issued. Even assuming 50% of permits are free issues, revenues of A\$4.3 billion from permit sales will considerably exceed the direct cost of amelioration.

The 'gross cost' of the scheme to the polluters, then becomes the sum of:

- > The cost of domestic savings, the beige triangle area in the above graph, approximately A\$1.1 billion;
- > The cost of purchasing importing certificates, approximately A\$2.6 billion; and
- > The cost of purchasing permits, between say A\$4.3 billion to A\$8.6 billion, depending on the number of free permits allocated to entities.

This represents a gross cost of between A\$7.9 billion and A\$12.2 billion in the year 2020, which will be paid by the polluters.

It is proposed to use the permit revenues to:

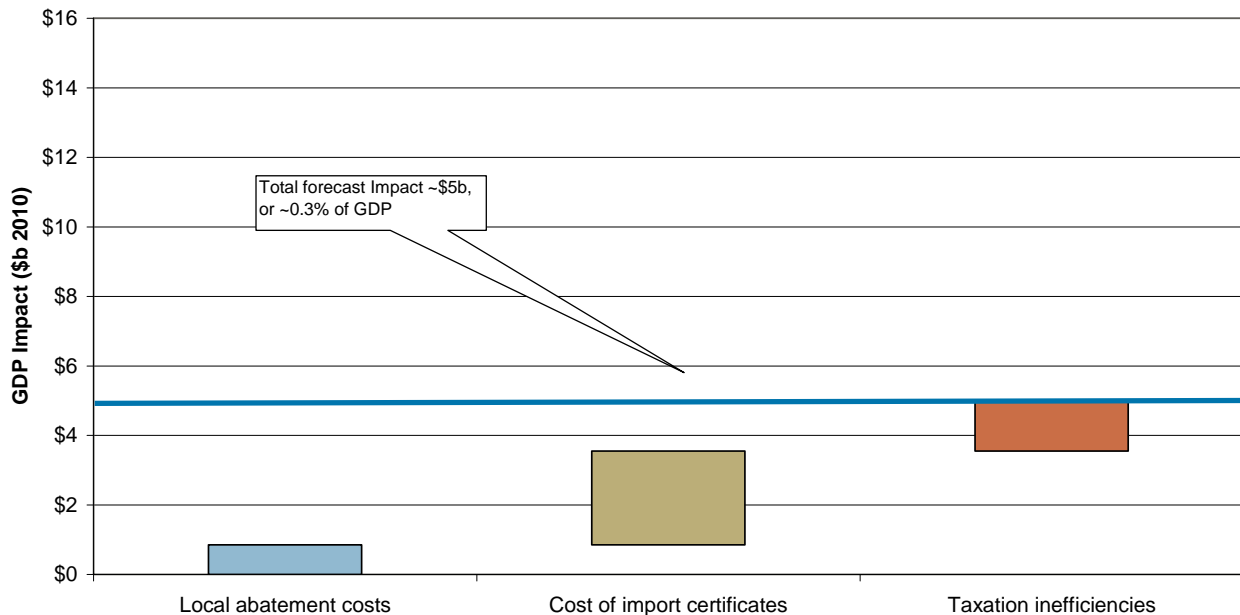
- > Provide compensation and assistance to industries to facilitate restructuring to a lower emission intensity;
- > Provide compensation to consumers for price increases resulting from the ETS;

- > Provide direct assistance to specific emission-intensive industries, especially those exposed to trade with countries without an ETS, and;
- > To fund specific abatement research.

Given that the permit revenues will largely be recycled within the economy, the overall cost to the economy is less than the gross cost to polluters. The economic cost is equal to the sum of the resource costs, i.e. the cost of abatement plus any losses associated with inefficiencies in the recycling of permit revenues.

This is shown in the following graph based on Treasury estimates that the total cost to the economy in 2020 will be approximately A\$5 billion, or approximately 0.3% of forecast GDP in 2020.

ETS impacts on GDP in 2020 – core policy scenario



Similar calculations for the High Price scenario suggest:

- > Maximum permit revenues of approximately A\$13.7 billion;
- > Direct abatement costs of approximately A\$11.4 billion; and
- > A GDP impact of A\$14 billion, or circa 0.9% of GDP in 2020.

Scenario 3: Worst Case scenario

Despite the extensive nature of the Treasury modelling, the results are highly reliant on the input assumptions, especially regarding the availability and cost of tradable international carbon credits. These, in turn, are reliant on the scope and depth of international carbon markets. Treasury modelling assumes a concerted global response by 2015, which would logically imply the development of suitably deep markets.

The 2010 United Nations Climate Change Conference held in Cancún, Mexico considered protocols to succeed the Kyoto Protocol after 2012. The conference agreed to target a temperature rise limit of 2°C, which is consistent with stabilising greenhouse gases at around 450 ppm by 2050, which in turn is consistent with a 20% abatement of Australian emissions by 2020, i.e. the Treasury's High Price scenario.

This raises the question why the Australian Treasury modelled a case of only a 5% abatement target by 2020 in the context of concerted global action as its Core Policy scenario when a 5% reduction is effectively its default policy in the *absence* of concerted global action. In the absence of such action, there is no guarantee that deep international markets will be established. Indeed a continuation of the current economic crisis in developed nations could see the collapse of existing carbon markets.

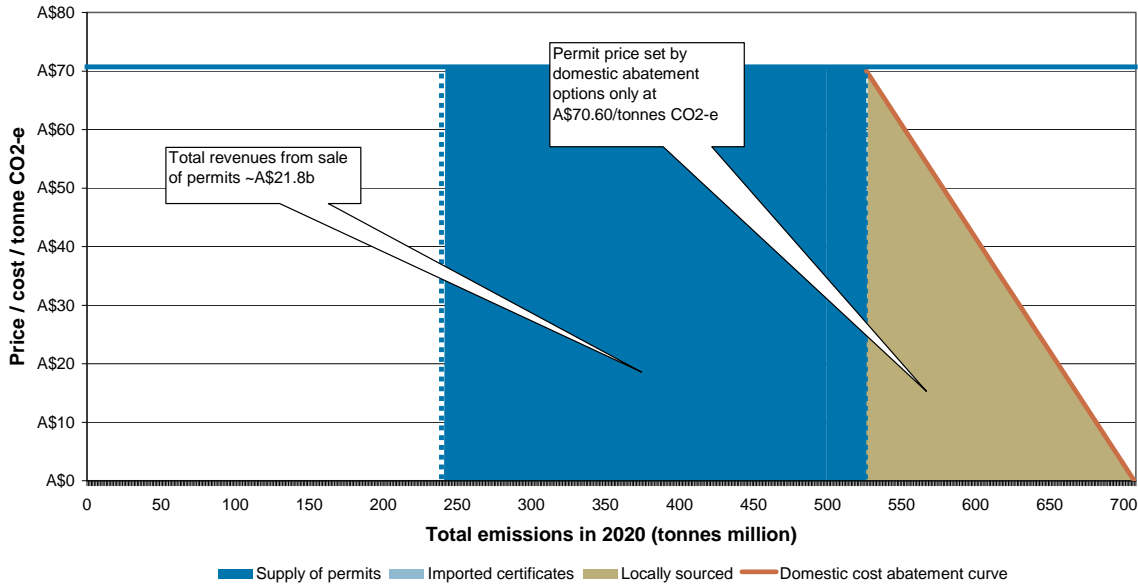
We suggest an additional worst case scenario which considers the collapse of international carbon markets. We have attempted to estimate the overall impacts by extrapolating the existing Treasury modelling [3]. The assumptions are:

- > The BAU 2020 emissions would increase to about 710 MT CO₂-e by 2015, in the absence of concerted global action [3];

- > To achieve a 5% reduction relative to 2000, the overall required saving would be about 180 MT CO₂-e [3] rather than 152 MT CO₂-e under the Core Policy scenario;
- > In the absence of international carbon trading, the whole 180 MT CO₂-e of required abatement would need to be sourced domestically, compared to only 58 MT CO₂-e under the Core Policy scenario;
- > Back calculation [3] from existing Treasury modelling suggests that the marginal domestic abatement cost, at this level of abatement in 2020, will be approximately A\$70 per tonne CO₂-e; and
- > There are no free issues of permits.

This situation is summarised in the following graph.

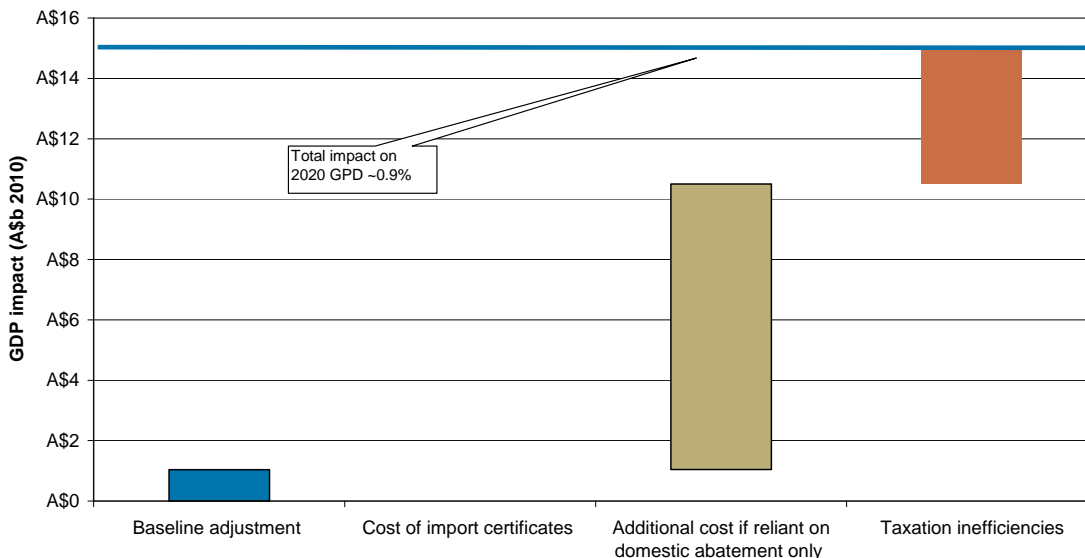
Emission permits supply and demand – domestic abatement only



The gross value of permits under the scheme would be A\$21.8 billion of revenue equivalent to the value of about 310 MT CO₂-e of permits.

The impact on GDP is summarised in the following graph.

ETS impacts on GDP in 2020 – worst case scenario



Specifically, these impacts are:

- > An additional direct cost of approximately A\$1 billion due to the higher BAU baseline resulting from the failure of concerted international action;
- > Further direct domestic abatement costs of approximately A\$9.5 billion; and
- > Losses due to redistribution inefficiencies of approximately A\$4.5 billion.

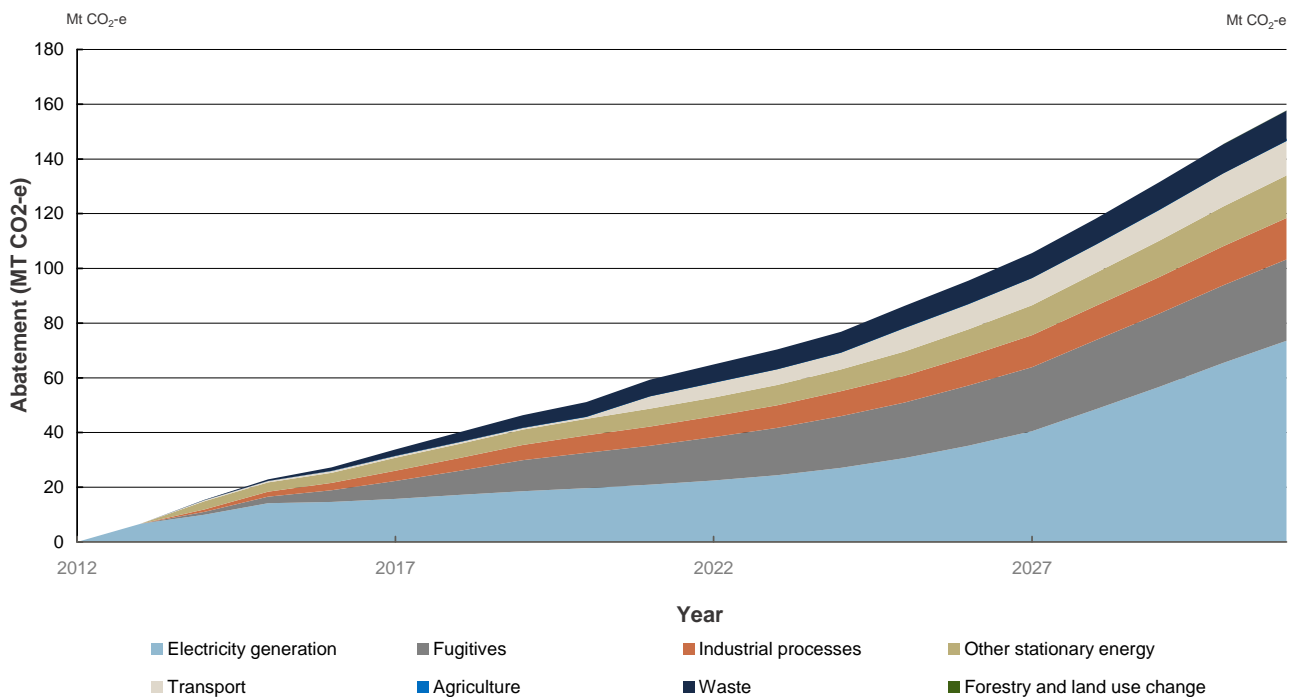
This would represent a cost to the economy of approximately A\$15 billion, or approximately 0.9% of forecast BAU GDP in 2020, which is very similar to the forecast cost in the Treasury's High Price scenario. Economically, therefore, the cost to Australia in 2020 is essentially the same whether there is concerted international action on climate change or if there is a total failure of international negotiations.

An important difference between the scenarios is the potential revenue stream available to the government from the sale of permits. In the Worst Case scenario forecast government revenues are up to 50% higher than in the Core Policy scenario, depending on the level of free permit allocation, primarily due to the higher marginal cost of abatement. If combined with the increased expenditure by industry on domestic abatement, some of the additional revenues could be used to drive more rapid industry restructuring.

3. How the ETS will impact Infrastructure

The anticipated sector domestic abatement achieved under the Core Policy scenario is shown in the following graph:

Forecast reduction in sector emissions



Source: The Australian Treasury, 2011

The main impact of the ETS will be on the electricity generation sector. This sector is expected to achieve the largest level of domestic abatement with 20 MT CO₂-e of savings expected by 2020 under the Core Policy scenario. This will arise primarily through a combination of an increased penetration by non-hydro renewables at the expense of brown coal, and demand side management initiatives aimed at both improving energy efficiency and reducing waste.

The modelling also suggests that improved control of fugitive emissions will figure prominently in the response of industries to the ETS. This is estimated to account for approximately 15 MT CO₂-e of domestic abatement under the Core Policy scenario in 2020. Fugitives refer to the escape of hydrocarbon gases from fossil fuel extraction and its subsequent transmission, distribution and usage. These gases, while small in quantity, have a high greenhouse impact.

While most fugitive emissions arise from extraction activities, e.g. methane escaping from coal mining, gas transmission and distribution activities can also be responsible for significant releases.

A survey of the companies reporting to the Australian Department of Climate Change and Energy Efficiency reveals that natural gas pipeline and gas distribution operations often exceed the 25,000 tonnes CO₂-e per year limit [4]. Hence, we can expect that most of these operations will be required to purchase permits under the ETS. Many of these systems fall under existing economic regulations and in the first instance we expect permit costs to be largely passed through to customers. However, we anticipate that industry regulators may further tighten the existing caps on allowable fugitive emission levels. This may lead to a requirement for additional capital expenditure by these operators.

Industry responses in industrial processes and stationary energy systems combined are expected to result in about the same degree of abatement as improvements in the control of fugitive emissions.

Surprisingly, transport is expected to play only a small role in domestic abatement resulting from the ETS in 2020. In part, this is due to the fact that fuel price rises resulting from a deterioration of the supply /demand position are likely to exceed any carbon pricing signal from the ETS. That is, a reduction in transport emissions is built into the BAU scenario.

An ETS promotes structural change in an economy by pricing in the external cost of carbon emissions into production. As noted previously, these costs may be direct inputs into production costs but indirect costs may also be significant. Treasury modelling [2] reveals the following estimated impact of the ETS on various outputs in a number of infrastructure sectors. We have taken output as a proxy for value. There is no specific modelling available for our Worst Case scenario. Note, the increase in non hydro renewables, in the Core Policy scenario, will largely be driven by existing mandatory renewable energy targets, not solely the ETS.

Treasury modelled sector outputs

	Change from BAU		Growth from 2010	
	Core Policy scenario	High Price scenario	Core Policy scenario	High Price scenario
Electricity: coal-fired	-9.6%	-41.2%	-9.0%	-41.0%
Electricity: gas-fired	0.8%	68.2%	26.0%	112.0%
Electricity: hydro	-1.5%	-2.7%	-1.0%	-2.0%
Electricity: other renewables	20.4%	37.0%	521.0%	600.0%
Electricity supply	-3.3%	-7.6%	12.0%	7.0%
Gas supply	-1.2%	1.5%	27.0%	31.0%
Water supply	-0.3%	-1.0%	20.0%	19.0%
Road transport: passenger	-0.1%	-0.9%	23.0%	21.0%
Road transport: freight	-0.2%	-0.5%	38.0%	38.0%
Rail transport: passenger	0.2%	0.4%	10.0%	11.0%
Rail transport: freight	-0.1%	0.1%	61.0%	61.0%
Water transport	-0.1%	0.1%	31.0%	32.0%
Air transport	-0.2%	-0.2%	9.0%	10.0%
Communication	-0.3%	-0.9%	56.0%	55.0%

By far the largest impact forecast will be the restructuring of the electricity generation sector. The combination of existing mandatory targets and the ETS means that the big mover under both scenarios is renewables other than hydro which is expected to grow by over 500% by 2020, albeit from a relatively low base.

Base load gas-fired generation is also expected to grow strongly under the High Price scenario. In this case, there are no mandatory targets and this change would be due entirely to the pricing signals generated by the ETS. It is expected that this would also be true under the Worst Case scenario where the domestic abatement target is even greater. This would also require significant additional investment in gas and electricity transmission infrastructure.

Electricity supply, or consumption, is forecast to decline in both scenarios, in response to higher prices. This should not be confused with electricity transmission infrastructure which will actually increase significantly as discussed below.

The impact on other infrastructure sectors appears to be relatively minor in comparison. This is confirmed by our own modelling of the impact of the ETS on Melbourne Airport [5]. This indicates a relatively modest reduction of domestic demand which is essentially offset, in a value sense, by management's ability to defer commensurate capital expenditure.

4. Investment opportunities

The ETS may catalyse entirely new classes of infrastructure. Some of these longer-term opportunities could include:

- > *Carbon sequestration.* Suitable sites for sequestration may be remote from the most economical fossil fuel sources. This creates opportunities to develop both sequestration sites and networks of connecting carbon dioxide pipelines.
- > *Demand-side management* in electricity networks could encourage the installation of large-scale energy storage devices. Commercially, such a storage facility could be stapled with renewable generation to provide an effective zero-emission schedulable electricity source. This would significantly increase the unit value and potential penetration of renewable energy.

This list of opportunities is by no means exhaustive but is intended to highlight that periods of change create opportunities. However, these opportunities are more likely to be apparent after 2020.

Looking out to 2020, the main opportunities for ETS-induced infrastructure investment will result from the required restructuring in the electricity generation sector.

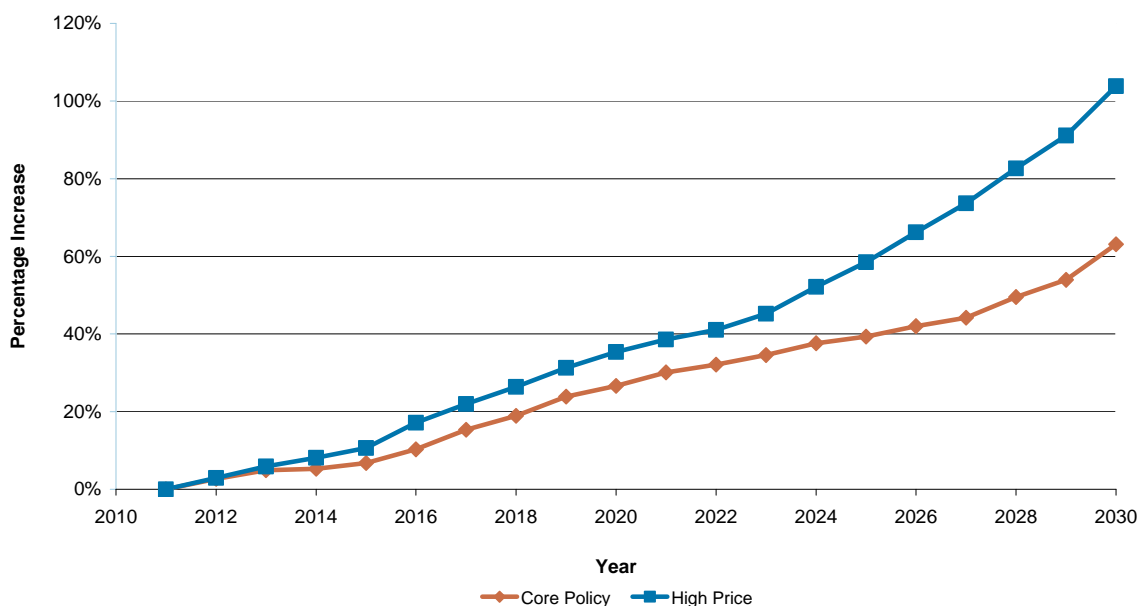
Direct investment in a merchant base load generating plant appears to be very risky given the high sensitivity of the generation mix to the domestic abatement target revealed in the Treasury modelling.

Transmission investment is a different issue. The forecast growth in renewable energy output indicated by Treasury modelling must be matched by an equivalent investment in transmission systems. In many cases, the best renewable energies resources are in remote locations and are not convenient to current transmission networks.

The increase in renewables also hides an implicit requirement to increase gas-fired peaking plant capacity to account for periods when renewable generation is not available. Such a peaking plant may be a better investment than a base load plant given that it would be underwritten by the increased penetration of renewables. This plant would require its own gas supply infrastructure and electricity transmission infrastructure.

The flowing graph illustrates the potential increase in electricity transmission requirements by 2020 that would be an indirect consequence of the introduction of the restructuring of the electricity generation sector [6]. The Worst Case scenario should result in even higher transmission investment given its greater domestic abatement requirement.

Additional transmission capacity required



Source: AMP Capital Investors, 2011

Given that the current written-down value of Australia's energy networks is well in excess of A\$65 billion [7], the potential investment required is significant.

5. Comparison with the UK ETS

The UK, along with most of the European Union, already participates in an ETS scheme, which was introduced in 2005 to assist the European industry in adjusting to a carbon-constrained future. Industry coverage of this scheme is currently limited, but it is proposed to expand its scope to cover approximately 40% of emissions in the UK case. Since its inception, carbon prices have generally been less than the €30 per tonne CO₂-e [8] needed to catalyse wide-spread structural change of industry. This has been put down to:

- > Overly modest savings targets;
- > Too many free permits issued;
- > The impact of parallel direct action policies, particularly on energy efficiency; and
- > Demand contraction due to the poor economic outlook for the region [8].

The UK forms an interesting comparison to Australia, in that:

- > The UK has been a leader in a push for more ambitious domestic targets than other European countries;
- > Its economy is about twice as big, but it currently emits a similar tonnage of green house gases (approximately 600 MT CO₂-e per annum [8]);
- > Its proposed abatement target for 2020 is similar to Australia's High Price scenario in absolute terms (140 to 180 MT CO₂-e [8] from current levels); and
- > The forecast impact on UK GDP, by 2020, is about -1% [8]. Given that the UK economy is twice as big as Australia's, this suggests that the unit cost of abatement is about twice as high as Treasury's modelling of the High Price scenario.

However, perhaps the greatest contrast is in the minimal role that certified imported certificates play in the UK planning. In essence, the policy objective in the UK is to achieve a level of carbon pricing that will drive rapid and major structural change in the industrial sector. In the medium term to 2020, low-priced imported certificates from outside Europe would dampen the pricing signal and therefore lower the rate of transformation. Hence, these imports are to be limited to less than 20 MT CO₂ –e per annum [8].

A sector-by-sector comparison is difficult due to the differences in sector definitions between the countries. However, our best estimate is provided in the following table [9].

2020 Changes in Emissions from current levels (MT CO₂-e) by sector.

	Core Policy scenario	High Price scenario	UK Targets
Energy electricity	-12	-58.5	-50
Stationary	27	22	-13 to -22
Transport	11	9	-25
Fugitives	13	11	0
Agriculture	-4	-10	-15
Industrial processes	0	-4	-4 to -6
Waste	-6	-8	-5
Domestic increase/decrease	29	-38.5	-120 to -132
Imports	-94	-118	-20
Net abatement	-65	-156.5	-140 to -152

The UK policy of limiting imports means that most UK abatement will be driven by domestic reform and, consequently, the impact on industry sectors will be much greater than forecast for the equivalent sector in Australia. Briefly:

- > The UK generation sector will deliver about the same saving as the Treasury's High Price scenario, albeit from a substantially lower initial level of carbon intensity. This means greater restructuring, including greater renewables penetration, and significantly higher costs than for Australia.
- > Stationary energy (heating) has a net difference of about 40 MT CO₂-e. The UK savings are largely the result of the introduction of mandatory efficiency targets, i.e. they will not result directly from an UK ETS. However, this suggests that a similar approach could produce dividends in Australia.
- > The UK transport sector produces about 35 MT Co₂-e of abatement relative to Australia. Again this is largely a consequence of mandatory fuel efficiency targets which will drive a much earlier adoption of hybrid and electric vehicles in the UK than Australia [8].
- > To achieve roughly the same level of abatement as the UK, under the High Price scenario, Australia is looking to import six times as many certificates as the UK.

As our discussion regarding the three Australian scenarios demonstrates, import levels are the key lever in driving industry restructuring. Additionally, the UK program further emphasises the potential of mandated targets to drive reform in sectors which are not included in the ETS or in which the forecast carbon pricing signal is too small to drive rapid change.

6. Discussion and conclusions

Ultimately, the impact of the ETS on Australia's economy will be driven by market considerations. Treasury modelling of this market assumes the availability of low-cost, readily-available import certificates, which in turn produce relatively low forecasts of economic cost. The Australian Treasury does not present any analysis of the sensitivity of economic cost to international certificate price under either of the scenarios analysed.

The Core Policy scenario, as presented by the Treasury, has the virtue of low apparent economic cost, but as discussed above does not appear to be consistent with current government policy.

In effect, the High Price scenario seems to a better reflection of current government policy and our potential international obligations. In this scenario, the expected economic cost is a reduction of GDP by 0.86% in 2020, about three times the forecast impact under the Core Policy scenario.

The Worst Case scenario asks what happens if international negotiations fail. Interestingly, the estimated economic cost is much the same as the High Price scenario, despite the significant difference in emissions abatement (180 versus 270 MT CO₂-e, respectively, on an equivalent BAU basis). This illustrates both the efficiency benefits that concerted global action and deep international carbon markets would bring in reducing emissions in the short to medium term. In

particular, the comparison with the UK illustrates the greater relative importance of international permit markets to smaller economies.

However, if concerted global action does not occur, the cost of current government policy does not seem excessive in achieving a significant restructuring of domestic industry. A reduced dependence on imports would drive an even more rapid restructuring of the electricity generation sector, probably towards more gas-fired generation to fill the base load requirement. Further penetration of large-scale renewables generation may be limited if the technology to schedule production is not available. Rooftop renewable schemes coupled with smart distribution networks may be a viable small-scale option within this timeframe.

Australia's reliance on imports may be justifiable in the relatively short term out to 2020, but the Treasury's modelling scenarios continue this reliance out to 2050 with up to 50% of Australia's abatement under the Core Policy scenario being sourced from imports. Our view is that, while imports are an important transitional measure, a continued long-term reliance on imports seems inherently risky.

The high price the UK appears willing to pay to achieve similar absolute levels of abatement, in the absence of significant imports, probably reflects the relative importance of the manufacturing sector in the two economies. In addition to driving rapid industrial reform, the UK policy will largely future-proof the UK economy against the risk of the supply of low cost international certificates drying up as countries such as China and India grow and participate fully in internationally-linked emissions trading schemes.

The other main risk to the government's policy is that progress towards concerted global action may be derailed as a consequence of the current economic turmoil. This will test the resolve of governments. The United Nations Climate Change Conference in Durban in December 2011 will be interesting, and in the absence of a resolution of the economic situation, the achievement of concerted global action by 2015 appears to be optimistic.

In its absence, Australia could reduce the economic cost of the ETS via a number of avenues:

- > It could set up regional or bilateral agreements with other countries for the purchase of certificates. While it is unlikely that such schemes could fully compensate for a failure to develop a deep global market and the supply of low-cost certificates is likely to be limited, even a small reduction in the marginal cost of abatement could be significant. For example, if 25 million tonnes of certificates were available, the marginal abatement cost would drop to approximately A\$60 per tonne CO₂-e. Direct abatement costs would reduce by close to A\$1 billion, permit revenues by about A\$3 billion and GDP impacts by A\$1.5 billion.
- > Given that it would no longer have international obligations in the absence of a global agreement, Australia could permit the use of low-cost domestic carbon abatement options which do not meet current international standards for sustainability. These include significant opportunities associated with agricultural and forestry management reforms.

However, a high reliance on domestic abatement carries with it the potential for a high volatility in marginal abatement costs and permit revenues, given the relatively shallow pool of domestic abatement opportunities. Expanding the scheme to include industries such as agriculture may assist in reducing volatility, but an option may be to retain the tax structure rather than transitioning to a trading scheme. Although the level of abatement is indeterminate under a carbon tax regime, retail pricing volatility should be minimised. It should also provide a higher degree of security for abatement investment decisions.

From an infrastructure perspective, the ETS should drive major investment in the electricity transmissions sector under all scenarios. We feel that the consultant's reports on the electricity sector, commissioned by Treasury, pay too little attention to the issue of integrating the forecast growth in renewables into the existing transmission and distribution systems. In particular, we expect a significant requirement for local transmission system amplification and for additional gas-fired peaking generating capacity with associated gas transmission requirements.

Electricity transmission assets are currently largely owned by state governments who, coincidentally, are under increased pressure to fund new social infrastructure. This fortunate coincidence suggests that governments may favourably consider privatisation proposals for these assets.

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Infrastructure update

How to read this section

In this section, we have summarised recent infrastructure activity by region and sector. We have principally considered developed economies and major emerging economies.

The four regions included are:

- > Europe;
- > North America, focusing on the US and Canada;
- > Northern Asia, focusing on China and India; and
- > Australasia, focusing on Australia and New Zealand.

The sectors are summarised in the following table.

Sector	Description
Power	New generation assets, except renewable energy.
Transmission & Distribution	Energy distribution, mainly electricity and natural gas.
Transport	All transport infrastructure, including air and sea ports, railway and road developments.
Water & Sewage	Assets associated with management of the water cycle, including collection, distribution, treatment and disposal. Irrigation projects are also included.
Telecommunications	Communications assets.
Social Infrastructure	Includes health, education and justice assets.
Energy Storage	Principally energy storage projects, including liquid hydrocarbons, natural gas and carbon sequestration. Additionally, pipelines built for carbon sequestration will be included in this sector.
Renewables	Renewable energy generation projects of all types.

To assist in analysing this information further, details of funding has been broken down as follows.

- > **Investment** – This refers to situations where a traditional funding model is used for both new stand-alone developments and the development of an existing asset base. The latter represents 'business as usual' activities in either replacing or growing existing infrastructure assets. In general, infrastructure operators have demonstrated that they can fund the equity requirements of all but the largest of expansion projects from cash flows.
- > **Public private partnerships (PPP)** – This covers all types of private sector provision of infrastructure including build, own, operate and transfer (BOOT) schemes and concessions as well as design, build and finance. From this edition on, projects involving privatised utilities, such as UK water companies, will be classified as public private partnerships (PPPs) as these represent expenditure which does not appear on the government's balance sheets.
- > **Merger and acquisition (M&A) activity** – While this does not represent bricks and mortar construction activity, it is a useful indicator of the appeal of the sector to investors overall.
- > **Private equity (PE)** – Private investment in infrastructure assets.

This summary was developed from publically available sources and while due care has been exercised in its preparation, AMP Capital offers no warranties as to its completeness or accuracy.

European infrastructure

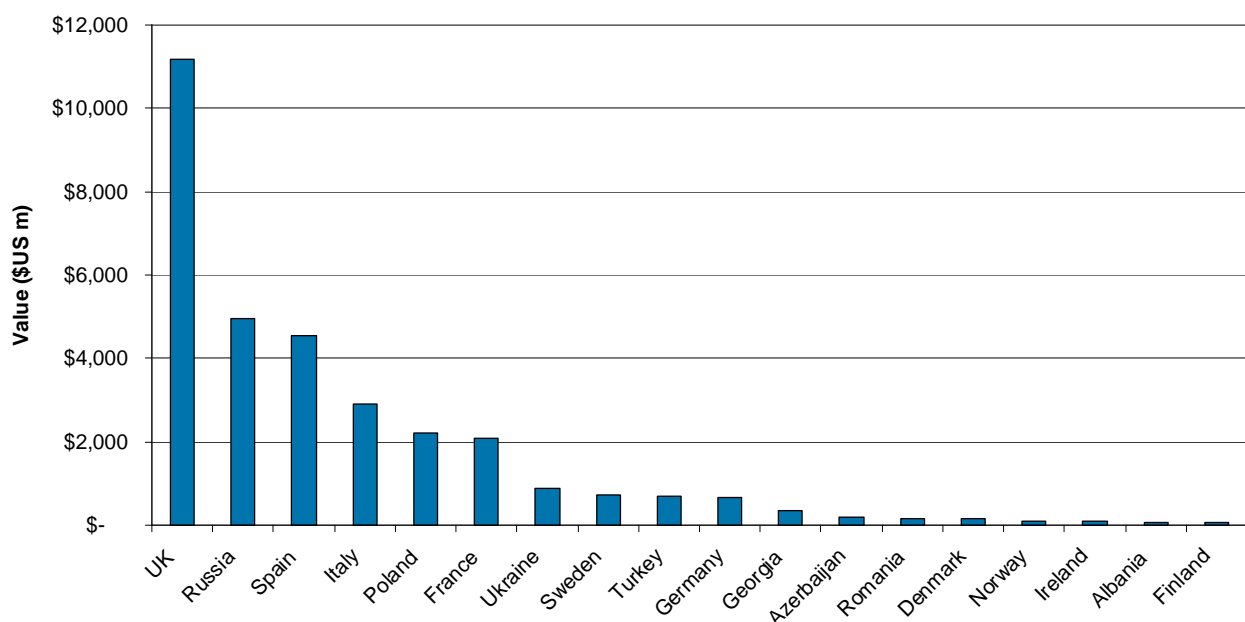
The general economic gloom continues and while Europe collectively tightens its multiple belts, identified project value sagged to only US\$32 billion of committed new construction in the period. Hope was offered in the shape of some mega project announcements. However, it remains uncertain as to whether these will eventuate in the announced time frames. The projects are summarised below.

- > In what would be one of the largest PPPs ever, the UK is seeking private investors to fund its £33 billion (US\$50 billion) high-speed rail project (HS2) which will connect London to Birmingham, Leeds and Manchester.
- > Russia plans to build a \$US22.3 billion liquefied natural gas (LNG) processing plant and associated pipeline infrastructure. Work is expected to be completed by the fourth quarter of 2015. This project reflects Russia's stated policy to become a force in LNG exports to complement its strong position in natural gas supply to eastern and Western Europe.
- > Russia is planning to build a high-speed train line connecting Moscow and St Petersburg, reducing the travel time to 2.5 hours. The new train line is expected to be built by the 2018 FIFA Football World Cup and is expected to cost 500bn (US\$18.2 billion) to R700bn (US\$25.5 billion). Russia is planning to fund 70% of the project and the remaining 30% will be funded by private investors.

The long anticipated move towards increased privatisation seems to have begun with Spain announcing the selection the Royal Bank of Scotland (RBS) to coordinate the privatisation of Madrid's Barajas and Barcelona's El Prat airports, together with the government's 49% stake in operator Aena Aeropuertos. The move is the latest step in shedding state-owned assets and reducing spending to narrow the nation's large budget gap.

Elsewhere, Sweden's 100% government owned utility, Vatenfall, will sell off its Finnish energy interests.

Infrastructure Spending By Country - Europe April to June 2011



The UK continues to lead with a broad range of projects and strong activity in the PPP area.

Russia also announced some larger energy projects in Siberia in collaboration China's Yangtze Power.

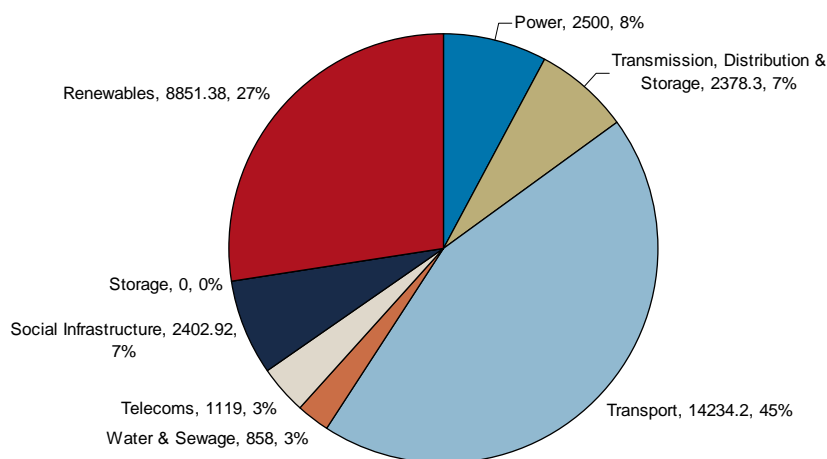
Spain gets an honourable mention with the tendering of US\$ 3.4 billion of work on the Madrid-Galicia high-speed rail line.

Despite the economic gloom, M&A recovered to US\$15.7 billion (in addition to project specific spending), with Vodafone selling its 44% stake in the French mobile phone operator SFR to Vivendi for €7.95 billion (£7 billion or US\$11,210 million). The deal gives Vivendi, who are France's biggest mobile phone operator, full control of SFR. Vodafone has recently sold stakes in Chinese and Japanese mobile operators. It will return £4 billion to its shareholders by buying back shares.

European infrastructure investment by sector – April to June 2011

Infrastructure Spending by Sector - Europe

April to June 2011



The Transport sector continued to be the largest sector during the quarter, accounting for more than 40% of total spending. The large amount of renewable projects illustrates Europe's continued commitment to reducing greenhouse emissions.

The major projects are summarised by sub sector in the table below.

Railways

Description	Amount (billions)
Spain has tendered €2.3 billion of work on the Madrid-Galicia high-speed rail line. The tenders are Spain's biggest contracts to date in the high-speed rail sector.	US\$3.4
A consortium comprised of Astaldi, Ansaldo and Impregilo has been selected to construct Line 4 of the Milan metro. Milan has chosen a consortium including construction firms Impregilo and Astaldi, as well as rail technology company Ansaldo STS as preferred bidder for a 30-year concession to construct and operate a new metro line. The project involves the construction of a 15-kilometre metro line connecting Linate Airport to San Cristoforo rail station, according to Ansaldo. The total investment cost of the project is about €1.7 billion, according to a statement from Impregilo. The Milan City Council and the Italian government will finance two thirds of the project costs.	US\$2.4
Network Rail has unveiled plans to transform London Bridge station over five years. The development will cost £800 million and add a new concourse and create two new entrances on Tooley Street and St Thomas Street. Combined with changes and improvements to the rail infrastructure around the station, the investment in the area will mark the final phase of the Thameslink program to deliver longer trains and more frequent services to more destinations.	US\$1.3

Roads

Description	Amount (billions)
The European Investment Bank (EIB) has provided a loan worth €800 million to support the construction of motorways linking Poland with its neighbouring countries. The loan will finance the construction of a 36km stretch of A1 Motorway, linking the Baltic Sea to Austria crossing Poland, the Czech Republic and Slovakia. The amount will also be used to link a 135km stretch of the A4, which crosses southern Poland from Germany to the Ukraine and 5km of S19 to access Rzeszow. The A1 and A4 Motorways are part of the Priority Trans European Network (TENT) Corridors representing crucial axes utilised for transport of some 80% of passengers and goods in the European Union.	US\$ 1.5

Power

Description	Amount (billions)
As part of the Yangtze Power and Russia's EuroSibEnergco collaboration, a 1,200MW gas fired plant in Lenskaya will be developed.	US\$1.2
ScottishPower has announced that it is planning to construct a combined cycle gas fired power plant located at former Terra Nitrogen/Growthow site in Severnside, South Gloucestershire, UK. The US\$1 billion project, christened the Avon Power Station, involves construction of combined cycle gas fired power plant with a capacity between 900MW to 1,200MW.	US\$1.0

Renewables

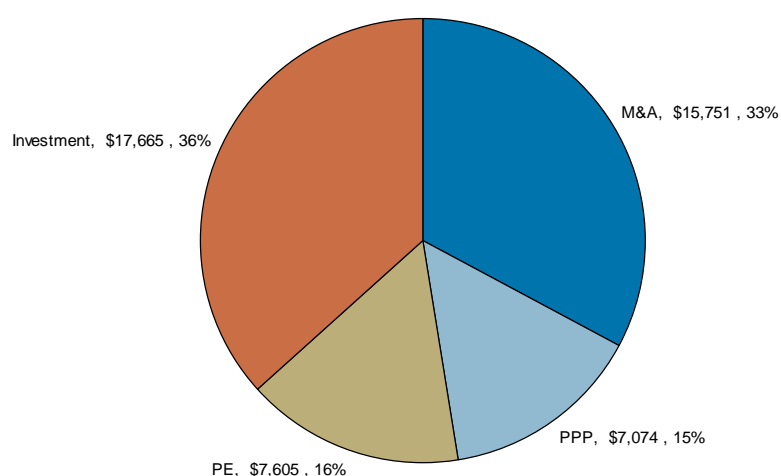
A significant number of renewables plants were announced dominated by Russia's collaboration with Yangtze Power to exploit Siberia's rivers. As part of the deal, two hydro facilities will be constructed;

- > a hydro-plant with the capacity of 600 to 1,500MW in Lenskaya, and;
- > the Trans-Sibirskaya hydropower plant with an installed capacity of 400 to 900MW.

The total investment will exceed US\$3.0 billion. Other renewable projects, while numerous, were of relatively small scale.

European infrastructure investments by type – April to June 2011

Infrastructure Spending by Type - Europe
April to June 2011



PPP activity has softened since the previous quarter, while PE investment remained strong in the power, renewable and telecommunications sectors.

North American infrastructure

PPPs are becoming more acceptable as shown by the following projects:

- > A US\$6.8 billion transportation budget signed into law by Gov. John Kasich, which allows Ohio to pursue solicited and unsolicited PPPs for various types of projects, including highways, airports, ports and rail.
- > Virginia's Commonwealth Transportation Board has adopted a new transportation program that includes US\$1.4 billion for PPPs over the next six years.
- > The Ministry of Infrastructure in Ontario, Canada, has released a 10-year infrastructure plan that includes C\$35 billion (€24.9 billion; US\$35.4 billion) in investment over the next three years, with PPPs expected to play a prominent role.

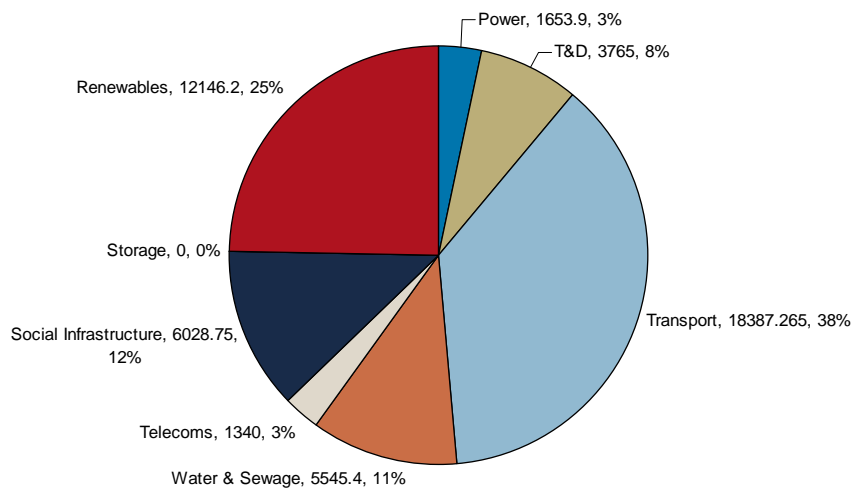
The bad news is that:

- > more evidence is emerging regarding the run down state of much of the US's infrastructure with the New York Department of Environmental Protection estimating that repairs to the 45-mile Rondout-West Branch tunnel, which supplied about half New York's water supply, US, will cost US\$2 billion. Two sets of cracks in the water tunnel are causing leakage of 36 million gallons of water per day.

New project announcements continued at similarly depressed levels as the previous quarters of US\$47.9 billion. The major sectors were transport, particularly roads projects, which were boosted by a number of states announcing construction projects for the financial year 2012, and renewables. Renewable developments hit their highest levels since the beginning of these surveys and featured a number of innovative projects including solar concentrating and the US's first off shore wind farm.

North American infrastructure investments by sector – April to June 2011

Infrastructure Spending - North America April to June 2011



The most significant projects, by sub sector, are summarised in the tables following.

Roads

Description	Amount (billions)
Washington and Oregon have agreed on a replacement for the Interstate 5 bridge across the Columbia River.	US\$3.2 - 3.6

Other road projects were numerous but relatively small.

Rail

Description	Amount (billions)
Amtrak, the US National Railroad Passenger Corporation, is planning to invest US\$1.5 billion in infrastructure improvement projects.	US\$1.5
Oregon's public transportation authority TriMet will develop the Orange Line mass transit system between Milwaukie and Portland, US.	US\$1.5

Power

Activity in the traditional generating sector remained continued on a medium scale gas fired plant.

Renewables

Despite the low amount of development proposals for new wind projects reported last quarter, renewable were certainly a performer, with the big news being the US Department of Energy (DOE) loaning US\$2.1 billion to support Units 1 and 2 of the Blythe Solar Power Project in California, sponsored by Solar Trust of America.

The concentrating solar thermal power plant, located next to the City of Blythe in Riverside County, California, comprises two units with a combined generating capacity of 484MW, an eight-mile transmission line and associated infrastructure. The power generated from the project will be sold to Southern California Edison and will deliver power to the California Independent System Operator (CAISO) power grid.

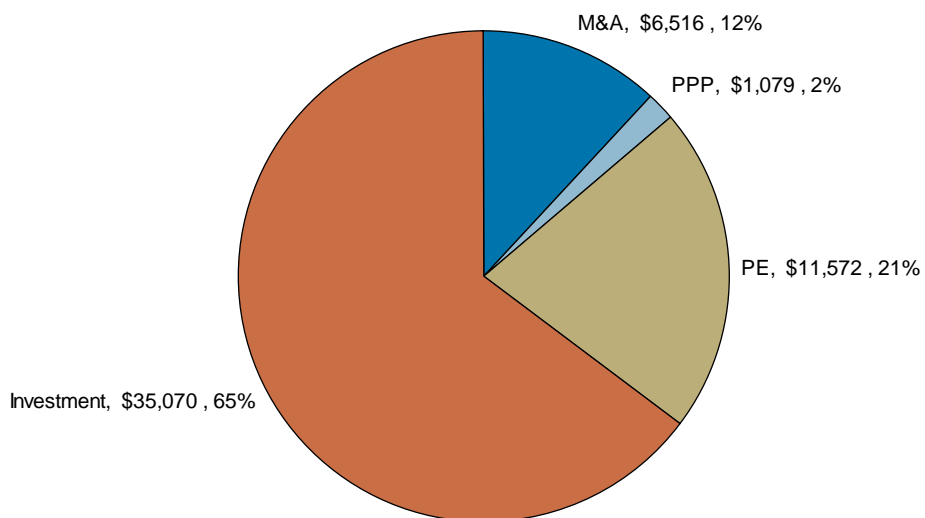
In other significant news, the first US offshore wind farm has been approved. The Cape Wind energy project will be located as planned in Nantucket Sound. The project will include 130 wind turbine generators, procured from Siemens, each with a maximum blade height of 120 m, to be arranged in a grid pattern several miles off shore.

Social Infrastructure

Social Infrastructure spending was down on the previous period to US\$6.5 billion, largely as a result of fewer large hospital projects. The main announcement was that London, Ontario-based St Joseph's Health Care has commenced work on a new building for specialised mental health care located adjacent to Parkwood Hospital in Canada. Construction of the new facility is expected to be completed in December 2014 at an estimated cost of US\$1.5 billion.

North American infrastructure investments by type – April to June 2011

Infrastructure by Type - North America



PE investments were again strong in the US health care and renewables sectors. Despite renewed state government interest in PPP delivery, only a few projects were booked during the period.

In contrast to the first quarter, M&A activity was weak, with only one significant deal identified. Williams Cos. took over energy distributor Southern Union Co. in a deal worth roughly US\$4.86 billion, funded in cash.

North Asia infrastructure

China's 12th Five Year Plan (FYP) was ratified in March, for the period 2011 to 2015. This includes targets for infrastructure investment by sector. The theme of the plan was 'inclusive growth', which means ensuring that the benefits of economic growth are more equitably spread. Some important initiatives include:

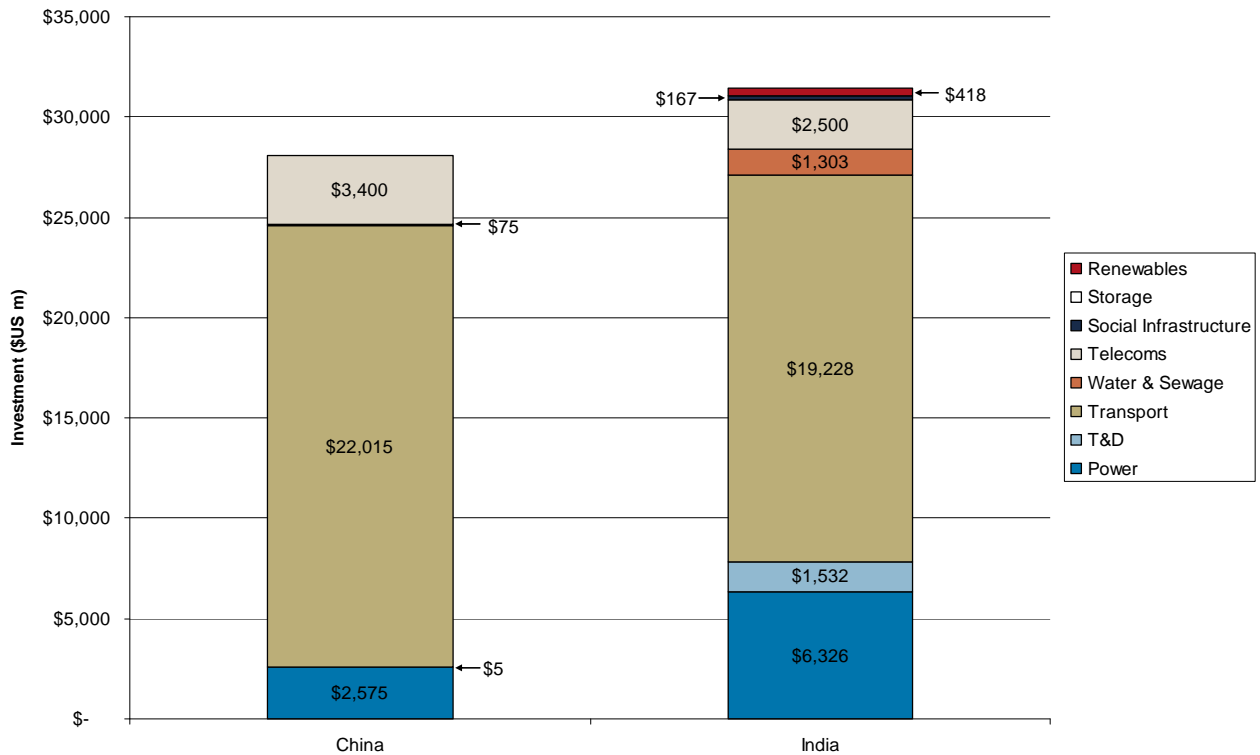
- > a notional GDP growth rate target of 7%;
- > promoting consumption over investments and exports;
- > closing the income gap through minimum wage rises;
- > increased social safety nets; and,
- > a range of energy efficiency targets.

Sectors that will receive a major boost from the 12th FYP are Health Care, Energy and Technology.

New projects indentified in the review period were somewhat lower than the previous period, with totals of US\$51.0 billion and US\$21.6 billion for China and India respectively. The transport sector was again the biggest winner.

Infrastructure Investment by Sector - North Asia

April to June 2011



Power

No major projects were identified in China and India is playing 'catch up' as demand continues to outstrip supply.

Description	Amount (billions)
SCCL, a government coal mining company jointly owned by the government of Andhra Pradesh and government of India, has secured funding from Power Finance Corporation for the proposed 2 x 600MW power project in Andhra Pradesh. Coal for the project will be extracted from the abandoned underground mines at Ramakrishnapuram.	US\$1.35
JK Organisation plans to build a 1,360MW power plant in Madhya Pradesh	US\$1.5
Larsen and Toubro (L&T) has received engineering, procurement and construction contract worth INR350 billion for the construction of a 1,080MW gas-based power plant in Tamil Nadu, India.	US\$1.7

Roads

In China, the major road projects were announced in the June quarter following the release of the government's 12th 5 Year Plan.

In India, road projects continued largely reliant on PPP funding arrangements.

Description	Amount (billions)
Key highway projects are planned in the states of Gujarat and Rajasthan. Each expressway will measure some 250km in all. The work is expected to cost up to US\$2.89 billion.	US\$2.90
National Highways Authority of India has unveiled its plan to invest INR100 billion (US\$2.24 billion) for the construction of a four-lane highway in the Indian state of Jammu and Kashmir.	US\$2.2

Airports

Estimated expenditure on China's regional airport development project continued, but the big news is the plan to develop a new airport for Beijing.

China's second capital airport will be completed in October 2017. Chinese authorities will give the approval for the set-up of the project, located in Daxing District, Beijing. The second capital airport is designed to have nine runways, including eight for civil use and one for military purpose. It will help ease the huge stress on Beijing Capital International Airport, the first capital airport.

Rail

No new high-speed rail links were announced in China during this period, although significant developments of conventional rail and metro lines continued in India.

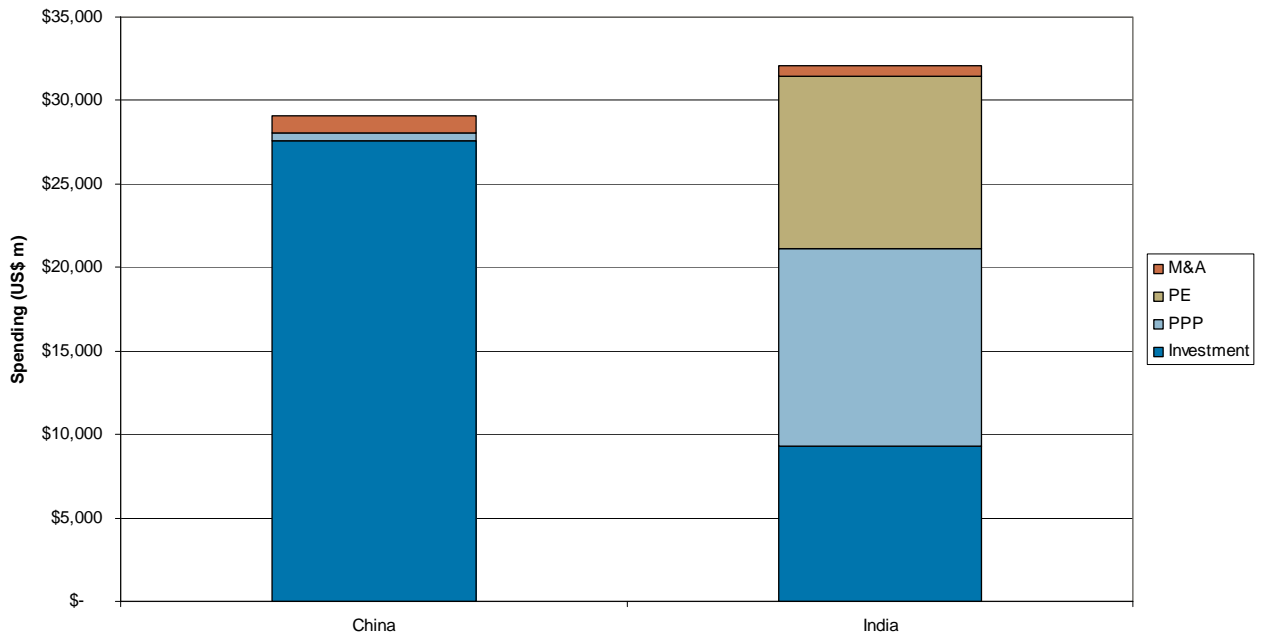
Description	Amount (billions)
Indian Rail is planning to raise Rs100 billion (US\$2.2bn) in tax-free bonds by September to expand the country's rail network. Indian Rail intends to raise Rs205 billion (US\$4.4bn) this year, to fund infrastructure development projects, including a record US\$750 million from overseas, as the ministry improves facilities to lure traffic from roads.	US\$4.4
Hyderabad Metro Rail Authority in the state of Andhra Pradesh has awarded a concession contract worth Rs140bn (US\$2.8bn) project to L&T Hyderabad Metro Rail, a subsidiary and special purpose vehicle of L&T Infrastructure Development Projects.	US\$2.8

North Asian infrastructure investments by type – January to March 2011

In India, the PPP spending remained strong on the back of road and rail concessions, while PE investment in the energy sector continued.

Infrastructure Spending by Type - North Asia

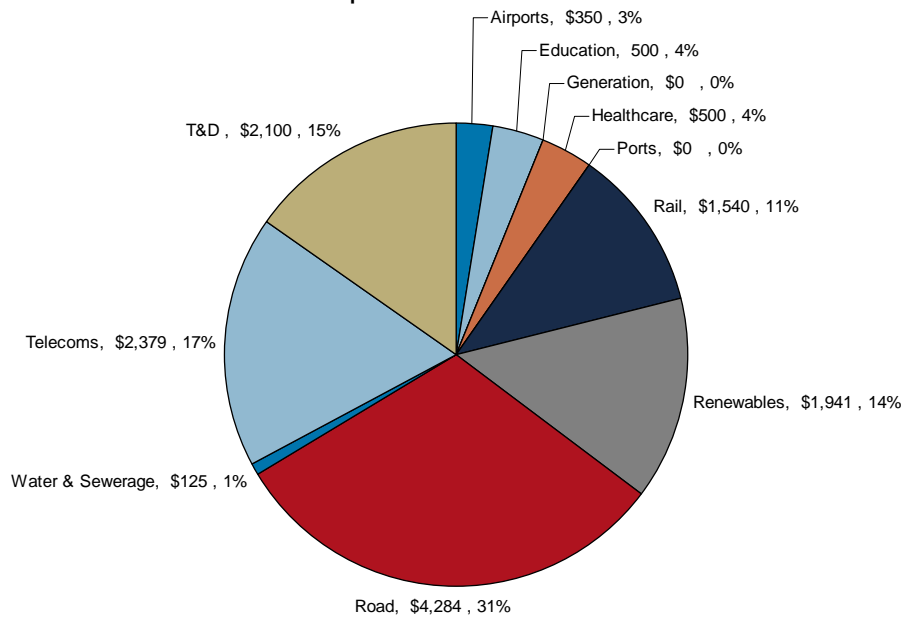
April to June 2011



M&A activity remained muted, with spending of only US\$1.6 billion.

Australasian Infrastructure

Infrastructure Spending by Sub Sector - Australasia April to June 2011



Expenditure continued at a high level with transport contributing 44% of the total. Telecoms, including the NBN roll out, Transmission and Distribution and Renewables sectors all represented roughly 15% each of the total invested.

Major projects include:

- > The Australian Government has selected BP's solar unit, Fotowatio Renewable Ventures, and Pacific Hydro for the construction of a 150 MW plant worth A\$923 million (US\$977.19 million) near Moree in NSW under its solar demonstration scheme. The Moore project involves 650,000 solar panels over an area of 1,100 ha and transmission line that will link the plant to the electricity grid.
- > Areva and its partners have been selected to construct the 250MW Solar Dawn, a solar thermal gas hybrid power plant near Chinchilla in the north-eastern state of Queensland under the Federal governments Solar Demonstration program.
- > Australia's NBN Co. has granted A\$1.1 billion contract to Silcar Communications to start rolling out fibre optic cable for the government's national broadband network.
- > Additionally, Ericsson has been selected to roll out a TD-LTE network to rural households under a A\$1 billion contract from Australia's NBN Co.
- > The federal government of Australia will provide A\$585.4 million to carry out a number of road projects in South Australia, which include A\$430 million for constructing the South Road Superway, A\$80 million for Dukes Highway including A\$4.7 million to eliminate another 25 dangerous black spots on local roads and A\$84.1 million to assist councils upgrade their local roads.

Australasian infrastructure investments by type – April to June 2011

PPP and PE activity was muted during the quarter but M&A activity rebounded on the back of the sale of the Abbot Point Port by Indian group Mundra Port and Special Economic Zone, a subsidiary of the Adani Group in an all cash deal worth A\$1.8 billion.

The company emerged as the successful bidder for the 99-year lease of Abbot Point X 50 Coal Terminal, following the international competitive bidding by the state of Queensland in Australia.

Infrastructure Spending by Type - Australasia April to June 2011

