Carbon Tracker Initiative

The Climate Institute

Unburnable Carbon:
Australia's carbon bubble

About Carbon Tracker

Carbon Tracker is a non-profit organisation working to align the capital markets with the climate change policy agenda. We are applying our thinking on carbon budgets and stranded assets across geographies and assets classes to inform investor thinking and the regulation of capital markets. We are funded by a number of US and UK charitable foundations.

About The Climate Institute

The Climate Institute is an independent research organisation. Our vision is for a resilient Australia, prospering in a zero-carbon global economy, participating fully and fairly in international climate change solutions. We are funded primarily by private philanthropy and also through our Climate Partner network of companies who are working to promote the innovation and investment needed for Australia to be competitive in the emerging global low-carbon world.

Background to the research

Following the publication of our global analysis, we are undertaking more detailed research at a regional level, focusing on financial markets with significant exposure to fossil fuels extraction. This report has been produced with The Climate Institute to provide the local Australian policy context.

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Global exposure to Australian coal

Australia has developed into a major coal hub for the Pacific market and beyond. Yet, rising costs and the transition to a low-carbon economy could leave Australian coal operators and their investors with stranded assets. The significance of Australian coal for investors goes far beyond its own shores, with more Australian coal owned by companies listed on exchanges outside Australia than by those listed domestically. Markets in Japan and London have high exposure to Australian proven coal reserves. The decisions in overseas markets that will leave Australian assets stranded are beyond any Australian political control.

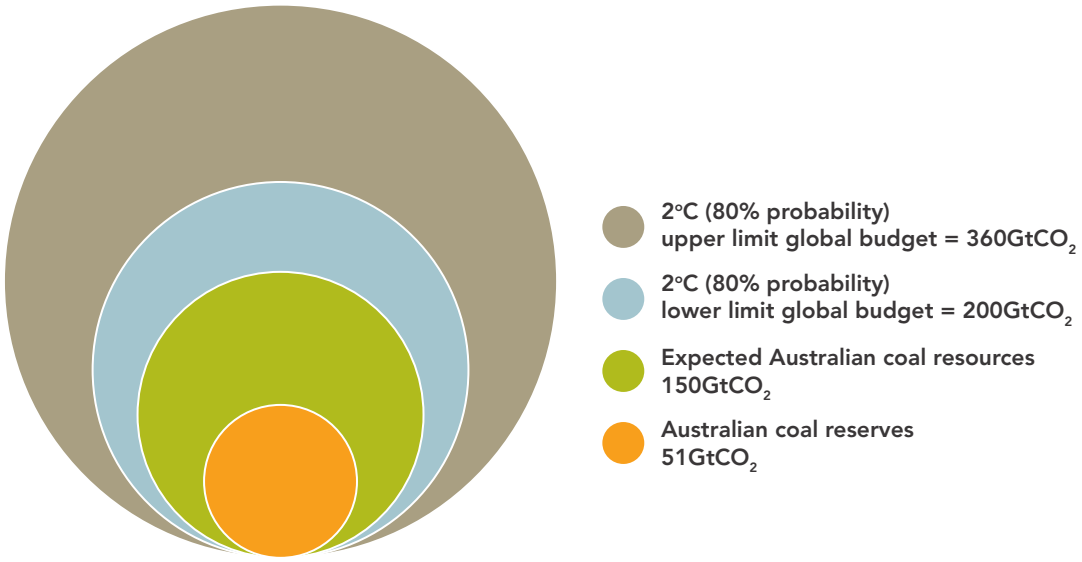
Capping the market for coal

Reviewing all the measures in the key export markets for Australian coal indicated that all are taking action to reduce emissions. These countries in fact rank fairly high up the scale of effort. Notably, China has recently announced its plan for energy consumption to peak at 4 billion tonnes coal equivalent within the current five year plan. The IEA projects China's coal consumption will peak within the next 10 years (assuming all policies currently announced are actually implemented). Beyond this, there is a global trend of a tightening regulatory framework for the coal sector, whether it be driven by concerns around cost, air quality, water availability, or climate change. This has resulted in heightened competition as coal producers are displaced from their traditional markets (eg the US). Technological advances and policy support measures are also seeing alternatives such as wind power become cheaper than coal generation, including in Australia itself now.

Blowing the carbon budget

Carbon Tracker continues to consider fossil fuels in the context of a carbon budget. Given the high level of fossil fuel exports from Australia, and the absence of a domestic carbon budget, it is more relevant to consider the global picture. In 2012, the International Energy Agency (IEA) acknowledged that, in the absence of carbon capture and storage (CCS) technology, more than two thirds of coal, oil and gas reserves cannot be burnt before 2050 if we are to have a 50% chance of limiting global warming to 2°C. These are not great odds of landing the plane safely.

Australian coal against global coal budgets



This fits with the most recent Unburnable Carbon 2013 report produced with the Grantham Research Institute on Climate Change and the Environment at London School of Economics and Political Science which confirms a global carbon budget between 500GtCO$_2$ and 900GtCO$_2$. This range is created by different assumptions made about the level of aerosols in the atmosphere, which have a net-cooling effect, and the level of reductions of non-CO$_2$ greenhouse gases, which have higher global warming potential. These budgets accommodate oil and gas emissions as well as coal. If coal globally is allocated 40% of these budgets, coal's current share of global fuel combustion emissions, then this gives a carbon budget of 200 – 360GtCO$_2$.

Australian coal reserves owned by listed companies are equivalent to 51GtCO$_2$, which would be 15-25% of the global coal carbon budget to 2050. Applying the conservative estimate that only 50% of Australia's listed coal resources are exploited, equates to 42-75% of the global coal carbon budget over the same period. Australia currently produces only 11% of the world's annual coal output; its resources represent a far larger proportion of the global carbon budget. This means the exports cannot maintain their current level within carbon constraints unless Australian coal dominates the market.

High probability of stranded assets

These numbers bring a stark new reality – all stakeholders need to start thinking about which of those assets are more likely to get burnt within the next few decades. This has led to a new debate about the potential for stranded assets. From a climate change point of view it makes sense to switch to less carbon intensive options, which results in a hierarchy of renewables over gas and over coal. Within the coal sector it is clear that if demand is reduced and prices fall then the most expensive sources of coal will suffer first. Given Australia's current position as a high-cost producer, this should be of concern to the sector and those who invest in it. Some companies have already scaled back plans for expansion. Although, gas and coal companies are investigating the potential for carbon capture and storage to mitigate emissions from combustion, it is not yet clear that this is within a timeframe and costbase which gives investors any certainty.

Revenues at risk

As margins are squeezed over the next few years, this could impact revenues which are the basis for calculating discounted cashflows used in valuation models. Analysts have calculated that up to 44% of coal revenues could be at risk if the IEA's 450ppm pathway – the 2°C scenario - is followed. This raises questions about the assumptions underlying the valuation models used by these analysts. This is not just about whether there is a carbon price. There are far wider implications of achieving emissions targets. The fundamentals of the demand for and price of fossil fuels are also likely to be impacted in a low-carbon future.

This has much greater implications for pure coal companies than it does for the big diversified mining multinationals. BHP Billiton and Rio Tinto – the world's largest listed diversified mining companies - can redirect capital into other commodities, and whilst a declining coal revenue stream would be noticeable, it can be planned for and the companies can adapt and emerge stronger. Coal-based businesses need to consider what is a sensible course of action that does not leave them and their shareholders exposed to stranded assets.

Wasted capital expenditure?

For all these companies, how the capital is spent within the company becomes of most interest. The capital expenditure (CAPEX) plans of extractives companies will determine where new production will come from in 5-10 years' time, and potentially for decades beyond, assuming there is still a market for fossil fuel commodities. This means that the policy context of 2020 and beyond is suddenly relevant to the strategy of the sector. And there is much uncertainty around what this may look like. At present we do not believe the market is pricing this uncertainty in.

Looking at coal resources which are earmarked for development into proven reserves demonstrates the growing interest in Australian coal. Companies listed in India, China, the US, Brazil, Thailand and Korea have low proven reserves but high levels of resources to develop. Investors around the world need to look at their exposure to high-cost coal assets. Already, there is increasing focus on investors, particularly asset owners, to review how their funds are used for any new capital commitments in this area, such as capital raisings.

Dash for gas

In terms of other fossil fuels, Australia is a net oil importer so would benefit from developing alternatives to the internal combustion engine. Offshore gas deposits have been exploited using liquefied natural gas (LNG) transportation to international markets. This may provide some opportunities where coal is replaced with gas. Whilst gas could be considered an intermediate step from coal to low-carbon energy sources, a consensus has yet to be achieved on the extent of methane emissions during the extraction of unconventional gases, such as coal seam gas and shale gas. Therefore, it is important to understand the likely greenhouse gas (GHG) contribution of this emerging fuel in the future.

Redefining risk

This report is a clear wake-up call for investors that they need to find new ways of analysing the ongoing viability of the companies they hold stock in. We would recommend a particular focus on the CAPEX strategies of companies who are continuing to pour capital into carbon intensive fuels which are facing an uncertain future. Coal resources in Australia owned by listed companies would triple the current scale of reserves if only 50% of them get developed. Mining companies spent AU$5.71billion of capital in 2012, whilst oil and gas units spent AU$14.1billion seeking more hydrocarbons.

Considering a range of scenarios can enable investors to understand how exposed their portfolios are. This can only bring more informed decision-making, improving on single point analysis which assumes the future will repeat the past.

Impaired assets

This also raises questions about whether company disclosure on these issues is adequate. On the quantitative side, more data on the carbon dioxide (CO_2) potential of reserves would enable investors to understand how exposed their portfolio is. On the qualitative side, narrative reporting is an opportunity for companies to explain their strategy and factors which may affect future performance.

In addition, more explicit guidance to explain the compatibility of the business model with a low-carbon future would be valuable. The accountancy world is also developing integrated reporting and this will likely focus more attention on areas such as IAS36 - Impairment of Assets. Pressure from auditors or regulators may arrive to revise some of the optimistic assumptions used in applying this accounting standard.

Foreword – Local Government Super

Some investors have been working on addressing the threats of climate change for more than a decade. The main driver for this has been the acceptance of the science of human-induced climate change. The logical next step is to think about the future: what are the ramifications for our environment, communities, economies and investments from the scientific projections of a changing climate?

Long-term asset owners and investors, such as superannuation funds, are bound to act as fiduciaries and make investment decision in their members' 'best interest'. These are terms with vague, largely-untested legislative definitions that are entrenched in past and current industry practice. This tends to foster a conservative, business-as-usual mindset and does not often take into account looming systemic risks. However the investment risks (and opportunities) from climate change are complex, covering broad factors such as physical impacts; carbon policy and legislation; anticipating winners and losers in the transition to a lower carbon economy. This complexity is exacerbated as climate risks are considered forward-looking and 'long-term' (though as there has been little concerted action to reduce carbon emissions over the last decades, it can be argued that the long term risks are already here and will manifest). So investors need to evolve their investment models to address climate change risks.

Carbon Tracker's first global 'Unburnable Carbon' report, released in 2011, was an important step in building better investment models. It examined a particularly investment-relevant carbon risk not previously analysed – the financial risks and the extent for potential asset price 'bubbles' emanating from investing in fossil fuel companies whose financial value may never be fully realised as global carbon policies are set to limit the world to 2°C of warming. This is the scientific-consensus level of warming that avoids 'dangerous' levels of climate change and its associated potentially devastating investment consequences.

The second global Carbon Tracker report 'Unburnable Carbon 2013' as well as this first analysis of the fossil reserves of Australian coal companies further develops this analysis.

There is little doubt in the logic behind the concept of 'unburnable carbon' and that it constitutes a significant investment risk across all asset classes.

The analysis in this report provides one scenario of the large exposure that asset owners could face in a resource-intensive economy such as Australia to a re-valuation of fossil fuel reserves due to enforcement of carbon policy. This results in a 'carbon bubble' which must eventually burst and erode shareholder value. It is similar in concept to other bubbles created and endured by the finance industry - from tulips in 17th century Holland to more recent bubbles of the internet and US housing market.

While fund managers may be more nimble and confident that they can trade out at the earliest sign of realisation of the carbon bubble (time will tell as investment models are yet to factor it in systematically), superannuation funds can be likened to super tankers: long-term and universal asset owners managing very large sums of money on behalf of members - it is not easy to brake or change direction.

But there are many things that asset owners can do in regards unburnable carbon and climate change risks. We can insist upon better risk modelling and scenario analysis from our advisers and managers; we can better quantify carbon risks in our portfolio; we can look to develop low-carbon investment strategies that may act as a hedge to reduce these investment risks; and we can advocate greater certainty and co-ordination on global carbon emissions reduction policy as well as on accounting standards and fiduciary responsibility.

Unburnable carbon and climate change risks for investors are inevitable and increasing in magnitude, even if timing is uncertain. This report demonstrates once again the investment logic of acting sooner rather than later in order to reduce these risks.

Peter Lambert
Chief Executive Officer
Local Government Super

1. Introduction

Carbon Tracker published its groundbreaking 'Unburnable Carbon' report in July 2011.[1] The report compared, for the first time, global fossil fuel reserves, especially those owned by listed companies, with global carbon budgets. This made it clear that if the world is to have an 80% chance of achieving the 2°C climate change objective, it cannot afford to burn, unmitigated, all the existing coal, oil and gas reserves. For an 80% chance of achieving this, only one fifth of these reserves can be used up to 2050. This has significant consequences for the companies that hold these reserves, their investors and, should these reserves be written down, for the way in which regulators monitor and manage risk, particularly for those with responsibility for maintaining financial stability.

The IEA added weight to this carbon budget approach, by adopting the technique for their 2012 World Energy Outlook report. They found that the global stock of fossil fuel reserves is equivalent to 2,860 Gigatonnes of carbon dioxide ($GtCO_2$), of which, one third can be commercialised before 2050 to stand a 50% chance of limiting the global average temperature increase to 2°C, in the absence of carbon capture and storage[2]. Recently, Carbon Tracker released 'Unburnable Carbon 2013', a report which supported earlier analyses by finding that 60-80% of the fossil fuel reserves of listed firms are unburnable, and introduced financial data to provide a wider perspective of the carbon bubble risk. It found that US$674 billion of capital is being spent each year on finding and developed more reserves that are largely unburnable.

Aligning the financial system with the low-carbon future to which the world has committed will be essential to tackling climate change. Redirecting capital towards alternative, clean sources of energy will be a necessary part of this transition. Carbon Tracker focuses on fossil fuel reserves as a forward-looking material indicator of an extractive company's value, which enables us to link our work with financial analysis and inform discussions on future energy and investment scenarios.

Our analysis prompted questions from investors about how this scenario might play out – which reserves would be left in the ground as unburnable carbon? The work has also been picked up by analysts who see the trend for increasing constraints on the use of carbon- and water-intensive fuels. They have considered the implications for valuation of mining companies if future coal revenues are impacted by declining coal prices and demand.

In the US, there are already examples of stranded assets caused by unburnable carbon. As a result of low gas prices and new mercury emissions standards, parts of the US coal sector have become uncompetitive. US coal miners saw share prices fall by 50% in the first half of 2012 and credit ratings downgraded in June.[3] Patriot Coal filed for bankruptcy protection in September in order to refinance its debt.[4] In addition, the US shale gas boom has driven great global interest in unconventional gas. In Australia, coal seam gas extraction is increasing and exploration for shale gas has begun. However, both the economic viability of unconventional gas deposits outside of the US and the GHG implications are yet to be proven.

The growing uncertainty around the future markets for fossil fuels warrants much closer attention and the application of some alternative assumptions.

Following on from previous regional analyses of fossil fuel reserves listed in London[5] and South Africa[6], this research focuses on Australia. Its objective is to understand the scale of the risks facing the Australian coal, oil and gas sectors. It is our belief that the growing uncertainty around the future markets for fossil fuels warrants much closer attention and the application of some alternative assumptions.

2. Analysis of fossil fuels linked to Australia

The global nature of both the extractives industry and the investment world plays out in Australian reserves being owned by companies listed both in Australia and elsewhere. This means that investors around the world have interests in the Australian extractives sector.

The majority of this report focuses on Australian coal in particular, the reserves and resources of which have more than 35 times the potential $GtCO_2$ than that of Australian oil and gas. We do note however that there is a growing interest in commercialising Australia's oil and gas reserves with 60% more capital being deployed by ASX200 companies alone *each year* to develop these reserves.

2.1 Coal reserves and resources on the Australian Securities Exchange (ASX200)

Coal companies distinguish between reserves and resources according to the probability of their being exploited. Reserves have at least a 90% certainty of being exploited[7] and are reported by companies in line with the definition outlined by the Combined Reserves International Reporting Standards Committee (CRIRSCO).[8] In addition to reserves, companies also have an interest in resources they are working to prove are viable deposits. Industry standards define resources as having at least a 50% probability of being exploited. The coal data in this report has been provided by the Raw Materials Group (RMG) – a mining data provider which collects data at the mine level globally.[9]

The following table shows the Australian coal held by those companies listed on the Australian Securities Exchange (ASX) in the ASX200 benchmark index, converted into potential $GtCO_2$.

Ticker	Company	Reserves ($GtCO_2$)	Resources ($GtCO_2$)
BHP.AX	BHP Billiton Group	8.87	43.99
RIO.AX	Rio Tinto Plc	3.70	10.24
AGK.AX	AGL Energy	2.72	2.72
WHC.AX	Whitehaven Coal Ltd	2.09	10.43
WES.AX	Wesfarmers Ltd	1.14	2.48
AWC.AX	Alumina Ltd	0.09	0.09
LNC.AX	Linc Energy	0.00	2.03
AQA.AX	Aquila Resources Ltd	0.69	7.34
	SUB-TOTAL	**18.61**	**69.95**
	Non-ASX200 companies	4.57	45.15
	TOTAL	**23.18**	**115.10**

- The total level of resources is around five times the level of reserves listed on the ASX. Only 20% of reserves are held by companies outside the ASX200, whereas 45% of resources are outside the ASX200.
- If it is assumed that half of Australian coal resources, (as per the definition of at least a 50% probability of development), are developed and confirmed as reserves in the future, **this would result in 57.55GtCO$_2$ expected from resources listed on the ASX**. (This would include the 23.18GtCO$_2$ from reserves.) To put this in context, the total amount of potential coal listed on the ASX is approximately 115 times Australia's annual CO$_2$ emissions (excluding land use change) which for 2012 stood around 0.5 GtCO$_2$.[10] However, Australia is supplying the global market with coal, which has a limited carbon budget to use up (see section 4).
- There is also a further 4.80GtCO$_2$ of reserves listed on the ASX which are located outside of Australia. This international exposure is limited to BHP Billiton and Rio Tinto. BHP Billiton, Rio Tinto and Guildford Coal also have 23.66GtCO$_2$ of coal resources located outside of Australia.

Dual-listing

BHP Billiton and Rio Tinto, whose combined Australian coal reserves represent 12.57GtCO$_2$, are listed on both the ASX and London Stock Exchange (LSE). Given this, the two exchanges have the same level of exposure to Australian coal if the same amount of BHP and Rio's individual exposure is attributed to each exchange. We have only attributed their reserves and resources to the ASX to prevent double counting.

2.2 Coal reserves and resources listed on other stock exchanges

Country of listing	Reserves GtCO$_2$	Resources GtCO$_2$
UK (excluding BHP and Rio)	10.58	72.59
Japan	8.56	27.76
US	3.43	9.5
China	3.2	19.16
Thailand	1.03	5.2
Brazil	0.7	7.57
India	0.12	39.39
Korea	0.11	2.63
France	0.03	0.55
South Africa	0.00	0.65
TOTAL	**27.76**	**185.00**

- If the dual-listed reserves (12.57 GtCO$_2$) of BHP Billiton and Rio Tinto are also added to the London Stock Exchange it has the same level of coal reserves as the ASX in Australia.
- Assuming half of the resources become developed and used means **the equivalent of 92.5GtCO$_2$ is in the pipeline**, (which includes the 27.76GtCO$_2$ of reserves).

The majority of the coal reserves located in Australia are listed on stock exchanges other than the ASX. This exposes future Australian coal demand and production to financial regulators around the world, and to the growing requirements for disclosure of climate change risk.

London as a coal capital

The London Stock Exchange has the largest amount (in absolute terms) of Australian coal listed on it, which reflects the high concentration of fossil fuel reserves owned by companies listed there. Pressure has been rising in the UK for the Financial Policy Committee to mitigate the risk these 'sub-prime' fossil fuel assets on the LSE pose to economic stability.[11],[12] The Bank of England has now accepted that the Committee is responsible for assessing this risk, although it is not yet clear how they intend to monitor or manage the risk. After the UK, exchanges in Japan, the US and China have the highest carbon exposure.

Indian potential

Apart from the UK, India has the largest amount of Australian coal resources on its exchange. If these are developed into reserves this will propel the Indian exchanges up the ranking in the table above. The resources listed in India are at an earlier stage of commercialisation, requiring further investment to develop them into an export project.

Overseas listed companies

The following tables show the 10 foreign listed companies with the largest coal reserves and resources located in Australia, with the country of their primary listing (excluding dual-listed stocks). The exposure is concentrated in a fairly small number of companies who have significant assets in Australia.

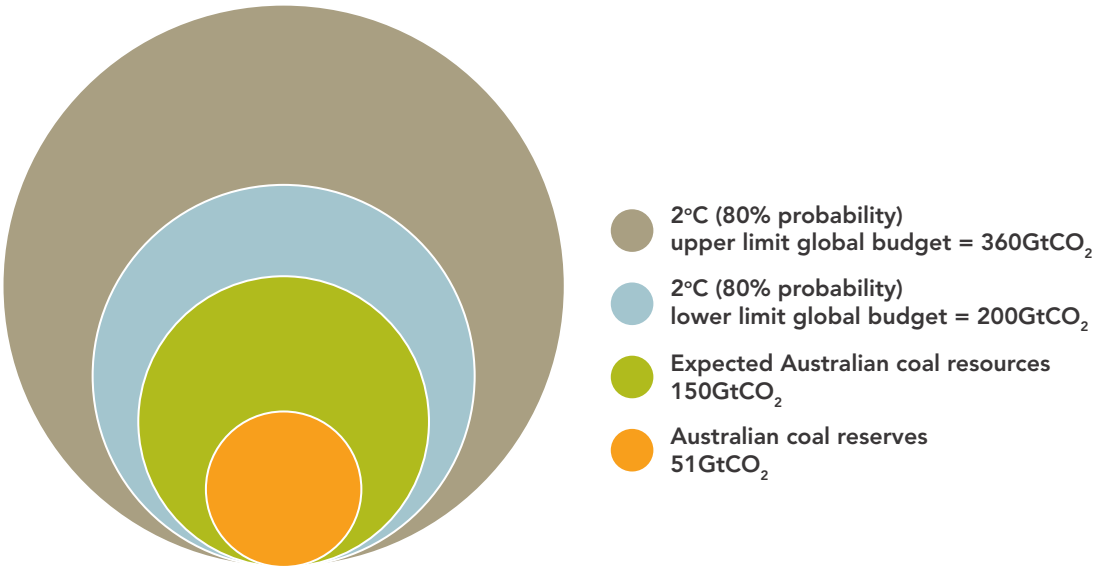
Ticker	Company	Listing	Reserves ($GtCO_2$)
XTA.LSE	Xstrata Plc (UK)	UK	7.92
8058:TK	Mitsubishi	Japan	4.96
BTU.NYSE	Peabody Energy Corp	US	3.26
AAL.LSE	Anglo American Plc	UK	2.66
1171.SEHK	Yanzhou Coal Mining Co Ltd	China	2.37
5019.TK	Idemitsu Kosan Co Ltd	Japan	1.59
8031.TK	Mitsui	Japan	1.18
BANPU.SET	Banpu Plc	Thailand	1.03
2.HK	CLP Holdings Limited of Hong Kong	China	0.83
VALE3.BM&FBOVESPA	Vale SA	Brazil	0.70
	SUB-TOTAL		**26.50**
	Other companies		1.26
	TOTAL		27.76

Ticker	Company	Listing	Resources ($GtCO_2$)
XTA.LSE	Xstrata Plc (UK)	UK	57.87
ADANIENT.NSE	Adani Enterprises Ltd (India)	India	20.47
GVKPIL.NSE	GVK Power and Infrastructure Ltd (India)	India	18.75
8058:TK	Mitsubishi (Japan)	Japan	16.07
1171.SEHK	Yanzhou Coal Mining Co Ltd (China)	China	12.28
AAL.LSE	Anglo American Plc (UK)	UK	10.06
BTU.NYSE	Peabody Energy Corp (US)	US	8.42
VALE3.BM&FBOVESPA	Vale SA (Brazil)	Brazil	7.57
CNOZ.SEHK	China National Offshore Oil Corp	China	6.05
BANPU.SET	Banpu Plc	Thailand	5.2
	SUB-TOTAL		**162.73**
	Other companies		22.26
	TOTAL		**185.00**

Comparing coal reserves and resources to carbon budgets.

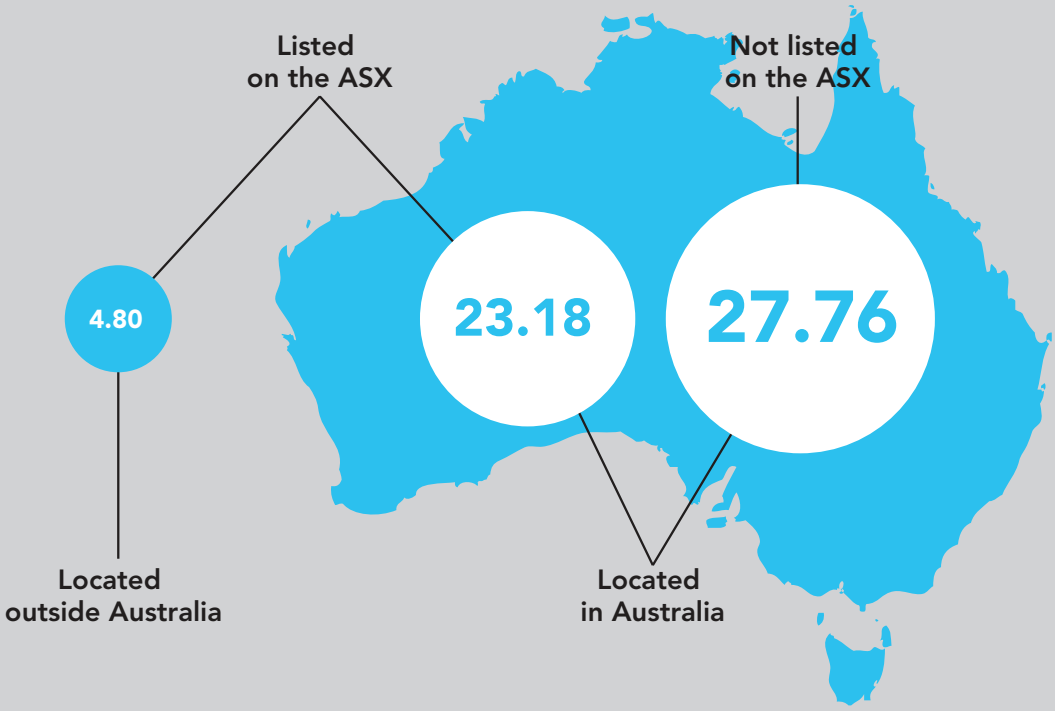
Maintaining the assumption that 50% of resources are developed into proven reserves means there is a potential 57.5$GtCO_2$ listed on the ASX and 92.5$GtCO_2$ listed on other exchanges. Together this equals 150$GtCO_2$ of expected Australian coal resources currently in the pipeline, nearly triple the existing proved listed coal reserves located in Australia and 300 times Australia's CO_2 emissions for 2012.

Australian coal against global coal budgets



Diagrams comparing the geographic location and primary listing of coal reserves and resources with Australian links.

Coal reserves ($GtCO_2$)



Coal resources ($GtCO_2$)

2.3 Capital developing more coal reserves

The reserves in Australia owned by listed companies totals 51GtCO_2. The resources total 300GtCO_2, but we assume they only have a 50% chance of being developed, which gives a CO_2 potential from these resources of 150GtCO_2. This indicates that listed mining companies globally have interests in Australian resources which could triple the current level of Australian reserves. Considerable CAPEX on long-lived extraction infrastructure will be required to develop these resources. Globally, US$674 billion of capital is invested each year on finding and developing more coal, oil and gas reserves. The question for extraction companies and their investors is whether this expenditure can still be justified in the context of future carbon regulation and expected lower demand.

Listed mining companies globally have interests in Australian resources which could triple the current level of Australian reserves.

Given that the world's fossil fuel reserves already have the CO_2 potential to take global average rise beyond 2°C, any further development of resources in the next few decades is incompatible with this scenario.

ASX200 listed companies

Ticker	Company	Coal CAPEX FY 2012 (AU$billion)	% of company total
BHP.AX	BHP Billiton Group	3.60	18.32
RIO.AX	Rio Tinto PLC	1.29	10.06
AGK.AX	AGL Energy	0.09	11.92
WHC.AX	Whitehaven Coal Ltd	0.28	100
WES.AX	Wesfarmers Ltd	0.39	14.69
AWC.AX	Alumina Ltd	0.00	0
AQA.AX	Aquila Resources Ltd	0.05	37.47
LNC.AX	Linc Energy	0.01	3.32
	TOTAL	**5.71**	

Source: Bloomberg

Annually, Australian listed coal companies spend AU$5.71 billion annually on replacing or developing reserves that cannot be burnt unmitigated in a 2°C world. This represents capital that might be better deployed elsewhere to position companies for a low-carbon economy, or paid out to shareholders as dividends.

The companies spending the majority of their CAPEX on coal resources development are basing their business model around, in our view, an optimistic view of the future coal market that is hard to rationalise in the context of increasing carbon regulation. Diversified mining companies or conglomerates have other businesses to provide revenue streams. However any loss of revenues should be of concern for investors.

2.4 Analysis of investment in oil and gas reserves and resources in Australia

Australian companies report hydrocarbons according to the Society of Petroleum Engineers' Petroleum Resources Management System, which is based on the economic viability and geological certainty of the reserves.[13] Reserves data was provided by Evaluate Energy – a leading oil and gas data company.[14] Reserves are reported as P1 (Proved reserves) and P2 (Proved plus Probable reserves).

- The total oil and gas P1 reserves located in Australia equal 4.93GtCO_2.
- The total oil and gas P2 reserves located in Australia equal 8.40GtCO_2.

The following table shows the CO_2 potential of the oil and gas reserves currently reported by ASX200 companies, alongside the CAPEX they spend each year on finding and developing more reserves.

Ticker	Company	1P Oil GtCO_2	1P Gas GtCO_2	2P Oil GtCO_2	2P Gas GtCO_2	CAPEX FY 2012 (AU$bn)
BHP.AX	BHP Billiton	1.81	0.79	3.3	1.43	5.67
WPL.AX	Woodside Petroleum	0.54	0.67	0.84	0.84	3.19
STO.AX	Santos	0.24	0.38	0.44	0.69	3.10
OSH.AX	Oil Search	0.18	0.17	0.32	0.28	1.72
AWE.AX	AWE Limited	0.06	0.02	0.11	0.04	0.16
BPT.AX	Beach Energy	0.04	0.01	0.08	0.02	0.27
	TOTAL	**2.89**	**2.04**	**5.09**	**3.31**	**14.11**

CAPEX data source: Bloomberg

In terms of CO_2 emissions potential, Australia's coal reserves vastly outweigh those of oil and gas combined. However, by its nature oil and gas is more capital intensive than coal, meaning AU$14.11 billion is being deployed each year by ASX200 listed companies in this sector, compared to AU$5.71 billion for coal.

Dash for gas

Unconventional gas is still a relatively immature industry in Australia, but the IEA predicts it will account for half of the increase in global natural gas production to 2035, of which Australia will contribute 12%.[15] Coal seam gas (CSG), in particular, is rapidly emerging in Australia due to its plentiful supply. Gas could be considered an intermediate step from coal to low-carbon energy sources. A consensus has yet to be achieved, however, to the extent of methane emissions during the extraction of unconventional gas. In theory, CSG should have lower levels of escaped methane than shale gas due to simpler drilling, production, storage and treatment processes - it is estimated only 30-40% of CSG wells require hydraulic fracturing in Australia. Despite this, research in early 2013 on the Australian wells suggests methane emissions could still be as high as 4.4% of total gas production.[16] Given the higher global warming potential of methane compared to carbon dioxide, it is critical to understand the likely GHG contribution of this fuel in the future to gauge the scale of its benefits over coal.

Limited disclosure

Currently, there is very little in the way of proven unconventional gas reserves in Australia and so this potential is not reflected in the current corporate reporting of reserves. Santos is presently leading the charge to exploit coal seam gas, having entered commercial production in August 2012, but companies are not currently required to report coal seam gas separately so, ultimately, there is little transparency on this sector.[17] The growth of shale gas in the US has prompted investors to push for much greater transparency on a company's exposure to this extraction technique, and the related GHG emissions.[18] Investors should be demanding more information on the amount of capital being poured into unconventional gas both in Australia and elsewhere in the world.

3. The world's changing energy markets

Australia's large coal endowments have led to a highly emissions-intensive energy sector and an economic focus on fossil fuel exports. While in the past these have provided the country with cheap (if polluting) power and a substantial source of income, they present material risks to Australia's competitiveness in a world where carbon emissions are constrained.

Australia has a heavy reliance on coal in terms of both energy production and the economy. After decades of growth, both production and consumption fell in 2011. Approximately 75% of Australia's emissions are created by the energy sector, including stationary energy, transport and fugitive emissions.[19] Electricity generation in Australia is predominantly coal-powered (68%), although the proportion has fallen in recent years.[20] The development of LNG technology has enabled Australia to tap into its natural gas reserves and become a net exporter of gas. The country consumes around twice as much oil as it currently produces; since 2000, production has declined and consumption has grown.[21]

There are a range of factors which are coming in to play to change the dynamics of Australia's energy mix. These include the improving economics of renewable energy, water availability, labour costs, emissions regulations, energy efficiency, commodities prices and changes in economic activity. The future of Australia's fossil fuel reserves will not be determined by a single obvious factor, and are interwoven with a number of major exports markets. What is clear is that if Australian coal is at the high end of the cost curve, it is vulnerable to reductions in demand and price.

3.1 The changing economics of power generation

As with most new technologies past the development phase, the costs of renewable energy continue to tumble. Take-up has been accelerated in some markets by feed-in tariffs and other policy measures which help achieve scale and drive innovation. Grid parity with fossil fuel based options has already been achieved in some instances, but there is constant speculation about when renewables will achieve grid parity in key growth markets such as India and China.[22] [23] Recent predictions suggest that this could be seen in the next few years, which would challenge the economic arguments for investing in more coal. Even without renewables, gas is also a major threat to new coal-fired power generation capacity.

In Australia, recent analysis has shown that new-build wind power is now cheaper than new-build coal or gas powered generation. Electricity can be supplied from a new wind farm in Australia at a cost of AU$80 (US$84) per megawatt hour, compared with AU$143 a megawatt hour from a new coal-fired power plant or AU$116 from a new station powered by natural gas when the cost of carbon emissions is included.[24] This means that new coal plants are firmly down the pecking order when it comes to investing in new sources of power and, combined with carbon risks, it is unlikely that anyone will build new coal-fired generation capacity in Australia in the future.

In Australia, recent analysis has shown that new-build wind power is now cheaper than new-build coal or gas powered generation.

3.2 Australia's reliance on coal export markets

In addition to Australia's heavy reliance on coal for power generation, Australia's wealth of energy resources, combined with its relatively small population, sees it positioned as a prominent global energy exporter. Of Australia's total annual production, 97% of metallurgical coal, 84% of oil, 71% of thermal coal and 50% of gas is exported overseas.[25] Australia's fossil fuel market is, therefore, very exposed to changes in a number of major overseas markets beyond its control.

Australia's coal is exported annually for a total annual value of AU$48 billion, which represents 15% of Australia's total goods and services trading.[26] A distinction should be made between metallurgical and thermal coal as they supply different markets for different purposes. However the use of either still results in the emissions of GHGs, so contribute to using up the carbon budget.

The tables below show the destinations for Australian thermal and metallurgical coal exports over the last two years.

Australian thermal coal export destinations (Mt)	2011/12	2010/11	Australian metallurgical coal export destinations (Mt)	2011/12	2010/11
Japan	69.73	66.96	Japan	40.20	42.61
Korea	28.85	28.19	India	29.30	30.91
China	28.46	16.67	EU 27	17.63	17.07
Taiwan	17.52	20.12	China	9.84	9.64
EU 27	0.04	0.14	Korea	8.86	8.10
			Taiwan	4.51	4.06
			Brazil	2.34	2.88
Other	42.32	27.90	Other	29.76	25.18
Total	**186.92**	**159.98**	**Total**	**142.44**	**140.45**

Source: Australian Government Bureau of Resources and Energy Economics, December Quarter 2012

3.3 The waning appetite of Australia's export partners

With such a large exposure to export markets, prospects for Australian fossil fuels are exposed to the changing demand of coal importing countries. The main importers of Australian coal are Japan, China, the Republic of Korea, India and Taiwan – all of whom have significant emissions reductions commitments (outlined in the next section). Beyond these emissions reduction commitments, however, there are other drivers that undermine the belief that the world's demand for Australian coal will continue to grow. We take a closer look at the energy markets of some of Australia's main export partners below, as well as the forces behind Australia's decreasing competitiveness in the global coal market.

Post-nuclear Japan

Following the Fukushima nuclear disaster in 2011, Japan has announced aims to significantly reduce its reliance on nuclear power. Government policies indicate renewable energy will feature heavily in making up this capacity deficit – the feed in tariff for solar photovoltaic (PV) systems launched in July 2012 produced total installations of 2GW by the end of the year.[27]

In the short-term, the lack of nuclear capacity has increased Japan's dependence on imported fuel. An estimated ¥3.1 trillion (AU$32 billion) will be added to the cost of importing fuel for oil, gas and coal power stations in the 12 months up to March 2013.[28] This provides Japan with an incentive to develop cheaper alternative sources of energy that are not subject to international commodity prices. In light of this target and wider policies being introduced the IEA predicts Japan will see their coal imports in 2035 be 26% below 2010 levels.[29] Japan sourced 62% of coal imports from Australia in 2011, which contributed to it being the largest buyer of Australian coal.[30] The uncertainty around the future of this market is a major factor in assessing future demand levels.

The changing face of China's electricity sector

Currently, a common response to national and regional coal demand fluxes is to point to the perceived insatiable demand of China and India, who import large quantities of coking (metallurgical) coal. Australian coal companies have invested heavily in new mines on the belief this demand will continue to grow strongly.[31]

However, in the first 10 months of 2012, coal-fired power stations made up just 27% of new capacity installed in China, less than half the level of 2005 – hydro, wind and nuclear power accounted for 72% of investment.[32] These pressures led to coal's share of electricity generation in China to drop from 85% to 73% in just six months in 2012.[33] Recent announcements from China indicate that coal consumption for the current five year plan could peak below 4 billion tonnes, similar to 2012's level. The IEA previously expected China's peak coal consumption to occur around 2020.

This level of ambition has not come as a surprise to the Australian coal industry association which follows the Chinese markets.[34] A recent Deutsche Bank report indicated that: 'Global shipments of thermal coal could be 18% lower than forecasted by 2015 should China, the biggest importer, toughen measures to curb air pollution to safe levels'.[35] It is clear that China's 4 billion tonne target sends a strong political signal of intent that could change the future dynamics of the international energy market.

'Global shipments of thermal coal could be 18 % lower than forecasted by 2015 should China, the biggest importer, toughen measures to curb air pollution to safe levels'. [35]

Are the boom times over for the steel industry?

Australia has an exceptionally high exposure to variations in the steel sector as 97% of domestically produced metallurgical coal, a material essential to the steelmaking process, was exported in 2011-12 worth AU$30,708m.[36] China is a world leader in steel production and a major consumer of Australian metallurgical coal. The Australian Bureau for Resources and Energy Economics predicts Chinese steel production to display steady growth in forthcoming years.[37] Similarly, exporting nations were buoyed by China's 2011 and early 2012 record levels of steel production. However, it has now become apparent that China's steel sector is in a far more unpredictable position as a result of vast levels of oversupply from this boom in production. By August 2012, inventories were 26% higher than in 2011 resulting in a price crash and a fall of 95.8% in steelmakers' profits, a ten year low.[38]

Forecasts for 2013 suggest that weak price rises and subdued demand will put company earnings under severe pressure. Bruno Bolfo, chairman of Duferco, the world's biggest steel trader states *'the overall industry will remain [with a large amount of] over-capacity [leading to] low [profit] margins, with consequent unsatisfactory results for the steel mills'*.[39] The performance of the steel industry greatly influences the business of upstream industries with far reaching impacts on the economic environment of a raw material-exporting country like Australia. The Chief Executive of BHP Billiton declared that *'further investment [in the company's metallurgical coal operations] is much less likely as the record prices we experienced over the past decade, driven by the demand shock, will not be there to support returns over the next 10 years'*.[40]

The Chief Executive of BHP Billiton declared that 'further investment [in the company's metallurgical coal operations] is much less likely as the record prices we experienced over the past decade, driven by the demand shock, will not be there to support returns over the next 10 years'.[40]

Coal pool pricing in India

India has increased coal imports to cover production shortfalls from domestic producers such as Coal India.[41] Prices of Australian and Indonesian coal have risen to a level that is no longer economically viable for India's private sector power producers. Consequently, the Indian government has approved in principle a coal price pool scheme which could be implemented as early as June 2013. This policy will mix expensive imported coal with cheaper, locally produced coal, to supply a blended product made available to all power producers at a price averaged from the two sources. It is hoped this will ensure enough affordable coal for power generation to reach the required levels.

3.4 Australian coal is becoming less competitive

This adds up to a picture where demand for coal may not be as strong in the future as it has been in the past. This leads to a question over whether Australia is well placed to compete where coal demand remains the same or declines.

Australian thermal coal is becoming less competitive on the global market with rising costs of production. This trend is being driven in part by the appreciation of the Australian dollar against the US dollar in recent years but also by the geographic isolation of the coal mining activity. This remoteness increases the costs of bringing in labour along with the requisite operational and social infrastructure. This is exacerbated by competition with other non-mining sectors and large energy projects in the same pool of labour and infrastructure developers.

Some coal projects also face significant opposition from environmental groups. In particular major coal projects which require new export routes through the Great Barrier Reef are facing campaigns over putting this iconic wilderness area at risk. These expensive projects are likely to face delay, increased costs or even derailment as a result.[42]

According to the IEA Australia holds only 6% of global coking/steam coal reserves yet competes with Indonesia to be the world's largest exporter.[43] The IEA concludes that *'while global coal resources will not be a limiting factor for production growth over the coming decades, the costs of production are expected to face further upward pressure as mines currently in production are depleted and new investments shift to less attractive deposits or are located further from existing demand centres or transport infrastructure'*.[44]

Conclusion

There are some clear signs that raise warning bells for Australian coal:
- Cheaper alternative sources of energy are becoming available
- Key markets are capping coal use and seeking to reduce reliance on imports
- Australian thermal coal is not cost-competitive in the fight for the remaining market

As a result it seems increasingly uncertain that Australian coal can maintain its current level of performance.

4. Carbon budget

4.1 International climate policy

The United Nations Framework Convention on Climate Change (UNFCCC) conference in 2011 ('COP17') marked a breakthrough on the international community's response to climate change. It was agreed that negotiations would begin towards another legal instrument, like the Kyoto Protocol, or an agreed outcome with legal force, in order to reduce emissions. These negotiations are set to be concluded by 2015 to take effect in 2020. The UNFCCC conference in 2012 ('COP18') served to cement this outcome.

This agreement was deeply significant for several reasons. Firstly, it has been agreed that the legal instrument due for 2020 will, for the first time, be 'applicable to all countries'. Whereas previously developed countries have shouldered the effort, it is widely perceived that developing countries will be included in future binding commitments. In terms of fossil fuel markets, this universal participation will mean there is no escape from carbon constraints.

The second key development was in committing signatories of the Kyoto Protocol to a second commitment period spanning from the start of 2013 to either the end of 2017 or up to 2020. This extension ensures that international climate effort is maintained whilst negotiations are ongoing towards a new legal instrument. Overall, recent international climate policy has established a thorough outlook for the forthcoming decade. Finally the negotiations agreed a clear objective of limiting global warming to 2°C.

A role for carbon capture and storage?

For point sources of emissions, such as power stations, carbon capture and storage is mooted as a technology to mitigate emissions from fossil fuel use on a large scale and, therefore, could play a role in global carbon budgets. However it cannot be applied to the majority of oil use (in the internal combustion engine for transport), and heat generation. There are some demonstration projects planned such as Shell's plant at the Gorgon gas fields in Western Australia. However around the world there are still unanswered questions regarding the costs, the long-term viability of the storage, and the legal framework to establish liabilities.

It is estimated that for CCS to achieve the scale required to limit global warming to 2°C, investments in the region of US$260 – 370 billion a year over the next 20 years are required.[45] The Unburnable Carbon 2013 report revealed that even in an idealistic scenario, which achieves full investment, CCS only extends the carbon budget to limit global warming to 2°C by 12-14%.[46] Furthermore, in this scenario, CCS is not at a significant commercial scale until the 2030s by which point there is a risk the carbon budget could be used up anyway. The costs of retrofitting to existing generation at that point may also be prohibitive, which would limit the proportion of generation which may be using CCS. For investors it is difficult to see them being able to invest based on current policies and incentives. By comparison grid parity for renewables generation is much closer and certain - indeed is already appearing in some markets.

4.2 Climate policy context in key export markets

Analysis by The Climate Institute has captured the existing policy commitments of the key markets.[47] This is also reflected in the basecase New Policies scenario outlined in the IEA's World Energy Outlook, which assumes governments deliver on current commitments.

Japan

- Japan ratified the Kyoto Protocol and has agreed to an emissions target of 80% reductions on 1990 levels by 2050. An interim target of a 25% reduction by 2020 on 1990 levels has been set, but is under review by the new government.
- The Tokyo metropolitan trading scheme was launched in 2010 to achieve this goal, which covers around 1,400 of the top emitters.
- Through increasing energy efficiency, Japan aims to cut final energy consumption by 2030 at least 19% from 2010 levels. It aims to cut at least 10% of electricity consumption by 2030.

China

- Ambitious carbon intensity reduction targets have been set with China seeking a 40-45% reduction on 2005 levels by 2020. This stipulates a 17% reduction during 2011-2015, which equates to around 3.5% a year and is currently being exceeded.[48]
- The global steel sector consumes approximately 70% of all metallurgical coal, and China is the largest producer worldwide. However, a new industrial carbon emissions plan was recently published, requiring the steel sector to cut its CO_2 intensity by 18% by 2015 compared with 2010 levels.[49]
- China is piloting carbon trading schemes across a number of provinces and cities and an agreement has been signed with the EU to promote the transition towards a low-carbon economy, which many feel will lead to the consolidation of the two schemes.[50]
- Strict air quality regulations were established in 2012 that required 27 provincial capitals and three key industrial belts to monitor hazardous particles. A further 113 cities will be required to conduct air quality monitoring in 2013.[51]

South Korea

- South Korea has committed to reduce its GHG emissions by 30% by 2020 against 1990 levels.
- In 2012, South Korea's lawmakers approved a national emissions trading scheme to be introduced in 2015. This scheme will cover two-thirds of domestic emissions in a bid to rein in emissions which have doubled since 1990.[52]

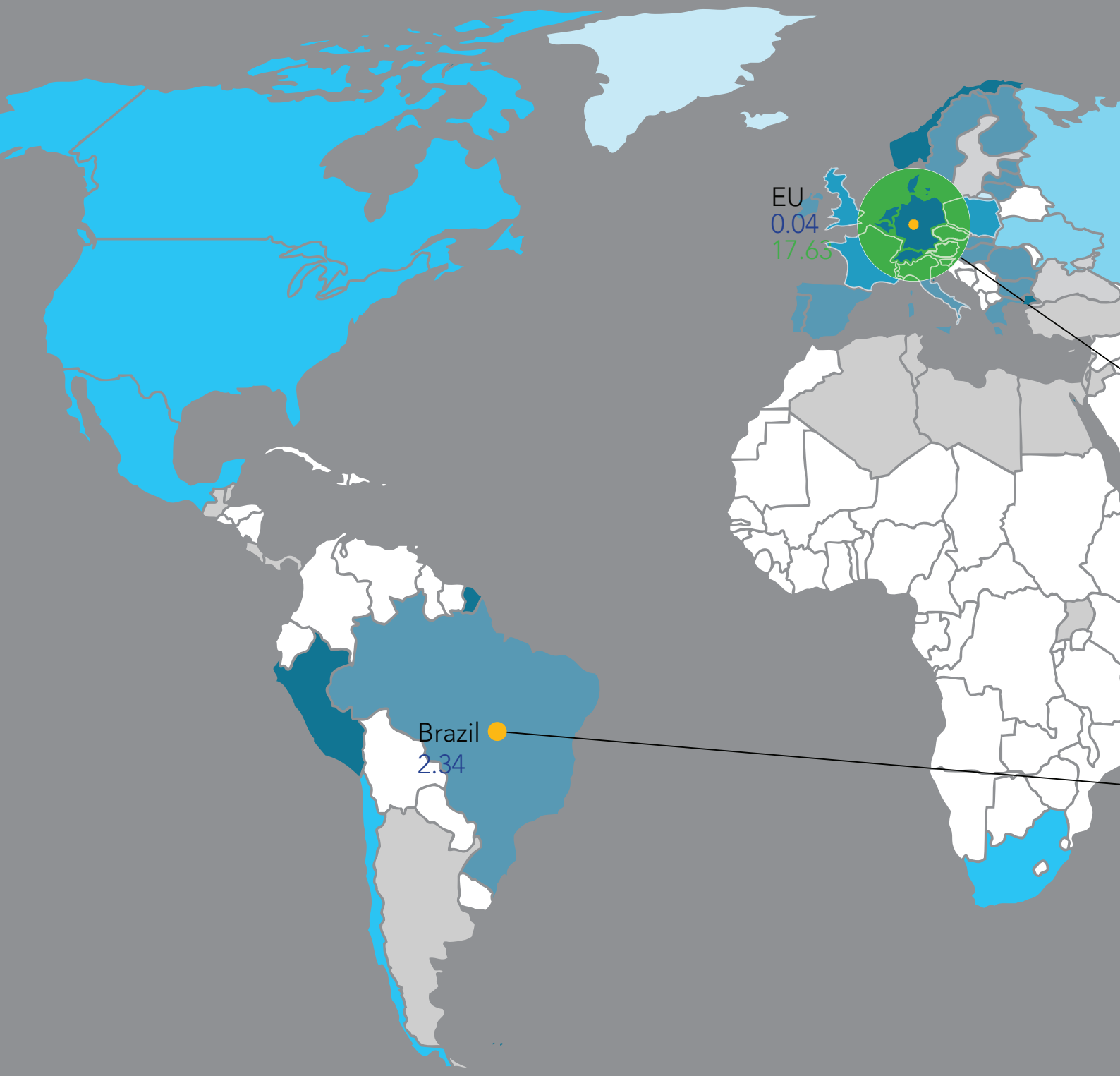
India

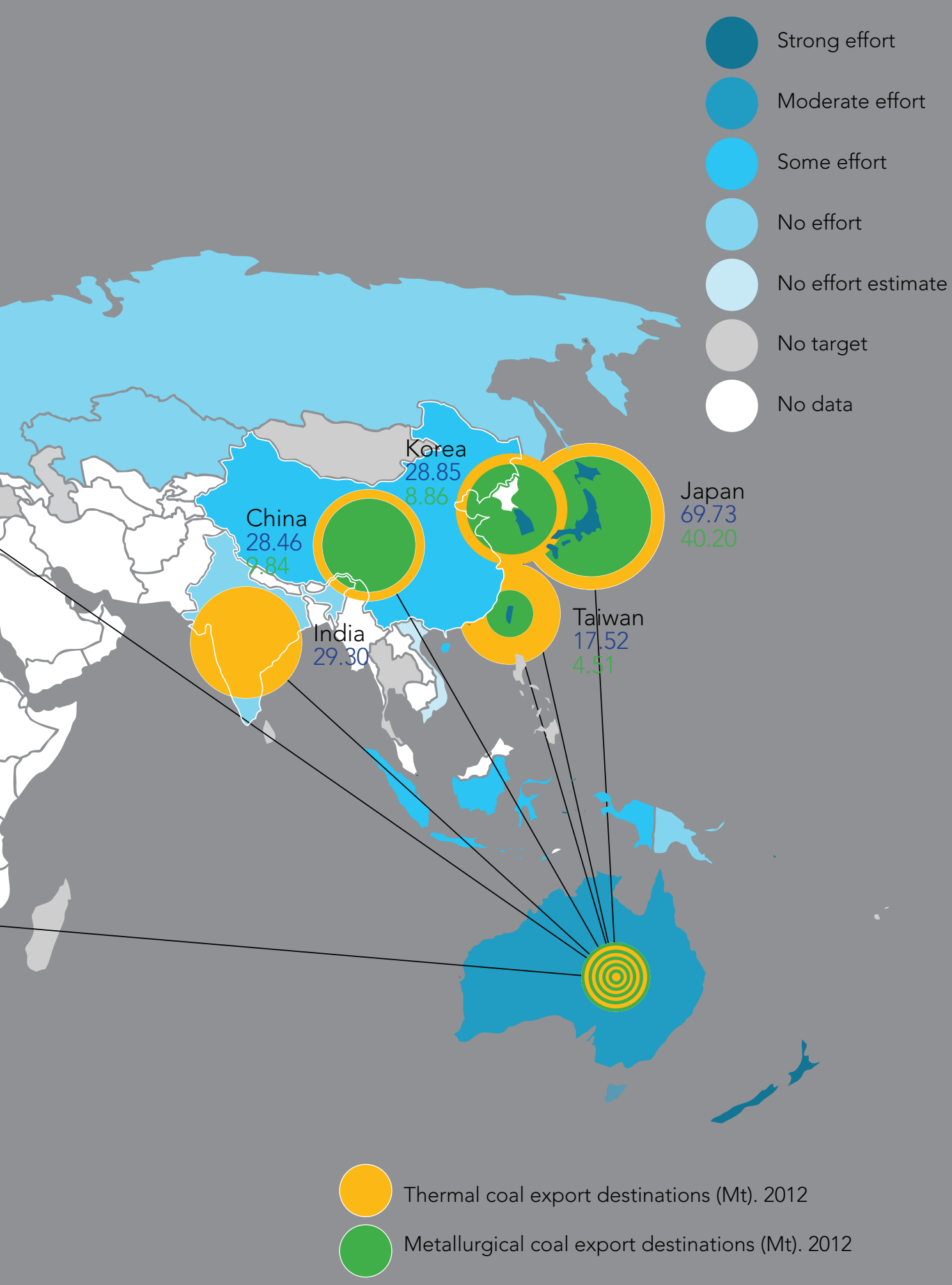
- As part of the Copenhagen Accord in 2009, India pledged to reduce its GHG intensity (relative to GDP), by 20-25% by 2020 against 2005 levels.
- Under the latest five year plan, a target has been set to achieve 15% of electricity supply from renewable energy sources by 2017.[53]

Taiwan

- Although not subject to UNFCCC reduction commitments, voluntary targets have been established that stipulate emissions are returned to 2008 levels between 2016-2020; returned to 2000 levels by 2025; and to half of 2000 levels by 2050.[54]

Climate policy measures in Australia's coal export markets




Strong effort
Moderate effort
Some effort
No effort
No effort estimate
No target
No data
Korea
28.85
8.86
China
28.46
7.84
Japan
69.73
40.20
India
29.30
Taiwan
17.52
4.51
Thermal coal export destinations (Mt). 2012
Metallurgical coal export destinations (Mt). 2012

4.3 Domestic climate policy

Australia does not have a carbon budget in place like that which has been applied in the UK and is being considered in South Africa,[55] however, the independent Climate Change Authority is considering how a budget may be applied.[56] Instead, Australia has made a number of international GHG emissions reductions pledges and limits. These commitments include:

- Under the UNFCCC: to reduce emissions by 5-15 or 25% below 2000 levels by 2020. The 5% target is unconditional and the higher targets are dependent on specific conditions, including commensurate international reduction pledges. This target range is supported by both major political parties in Australia.
- Under the Kyoto Protocol (first commitment period): to limit emissions during the first commitment period (2008-2012) to no more than 108% of 1990 levels. Under the second commitment period Australia has agreed to reduce average emissions from 2013-2020 to 99.5% of 1990 levels. In addition, Australia retains the option of increasing its 2020 target range if target conditions relating to the extent of global action are met.
- Under the Copenhagen Accord: limit global warming to 2°C.

Australia's emissions trading scheme is the principal mechanism for achieving emissions reduction targets. The Clean Energy Act 2011 implements a carbon pricing mechanism that switches from a fixed price to a cap-and-trade scheme in 2015. The Australian emissions trading system will be linked to its European counterpart from July 2015. The EU-Australia scheme will initially operate as a one-way relationship, with Australian businesses able to purchase EU carbon units to meet their emissions liabilities. Other significant policies also focus on increasing domestic abatement such as:

- Renewable Energy Target, which requires 45,000GWh of electricity to be generated from renewable energy sources by 2020.
- Clean Energy Finance Corporation and the Australian Renewable Energy Agency.
- Energy Efficiency Opportunities program.
- Carbon Farming Initiative.

Whilst these are all good measures to reduce Australia's carbon emissions, the importance of a carbon budget lies in the fact that the magnitude of climate change is not determined by emissions in any given year, but the total level of pollution released over time. It is for this reason that carbon budgets are essential as a policy tool – both in Australia and globally.

The importance of a carbon budget lies in the fact that the magnitude of climate change is not determined by emissions in any given year, but the total level of pollution released over time.

4.4 Applying a carbon budget to major coal exporters

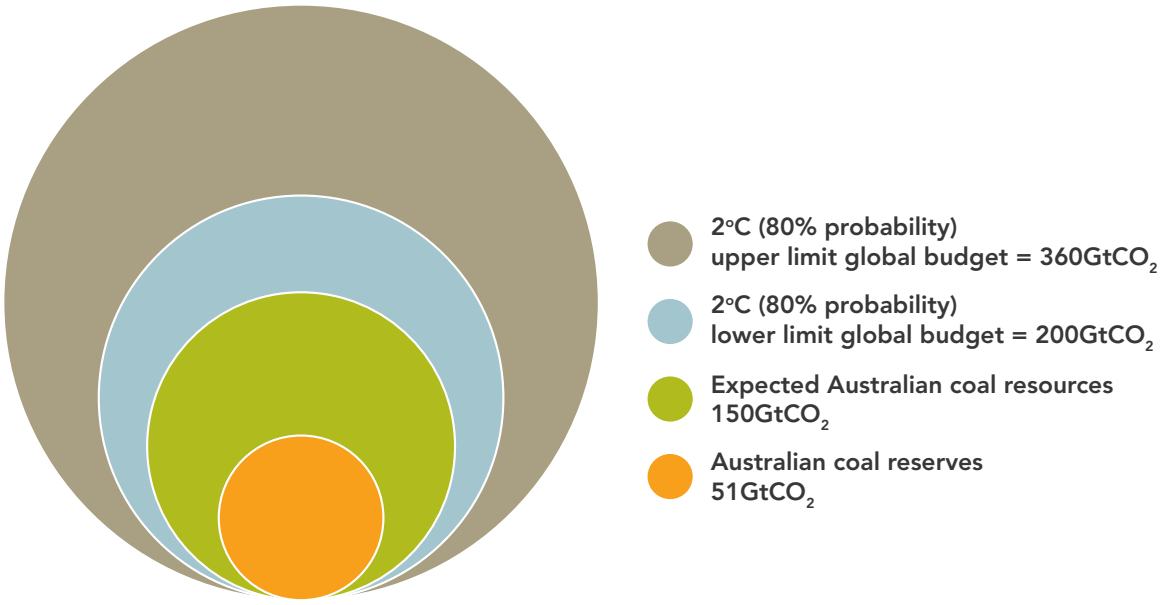
Although energy and climate change measures taken by Australia and their key export markets represent a certain level of progress, more needs to be done to prevent catastrophic climate change and ensuing economic upheaval. If an 80% probability of achieving the two degree target is desired this equates to a budget of between 500GtCO_2 and 900GtCO_2, (depending on the climatic assumptions made).[57] The upper range of these budgets assumes a greater level of aerosols in the atmosphere, which has a net-cooling effects, and larger reductions in non-CO_2 emissions, such as methane, which have higher global warming potential.

To derive a global budget for coal to analyse against Australian coal reserves, the latest CO_2 emissions numbers from the IEA on fuel combustion have been applied. They found that coal made up 43% of 2010 CO_2 emissions from producing energy, with oil contributing 36% and gas 20%.[58] This percentage could be expected to fall as coal has to decline the most in order to achieve the 450ppm scenario. On this basis, if coal is allocated a generous 40% of the total budgets to have an 80% chance of limiting climate change to 2°C to 2050, it would give coal a budget of 200 – 360 $GtCO_2$.

As the diagram illustrates, Australian coal reserves represent 25% of the lower range budget for coal consumption globally. If all of the Australian coal resources are developed and burnt, this will occupy 75% of the same budget. Even if the more generous upper range carbon budget is used, then the listed reserves represent 15% and the resources 42% of this budget.

Companies with Australian coal interests are clearly running a high risk of coal assets being stranded when climate change regulations are implemented.

Australian coal against global coal budgets



These are vast proportions of the global budget to be attributed to a single country. This is especially true given that Australia produces only 11% of the total global coal production.[59] This means companies with Australian coal interests are clearly running a high risk of coal assets being stranded when climate change regulations are implemented, or alternative energy sources become cheaper. Even if Australian reserves were to get a share of the global budget proportional to its scale of production, the existing reserves do not all have a market. This confirms that developing further resources is completely inconsistent with achieving global climate targets.

In this scenario, investors need to know which reserves are most likely to be burnt and which will not. Political issues aside, the most obvious way to conduct this analysis is to apply a ceiling to a cost curve that cuts off the most expensive projects. At present this means that many Australian coal projects represent value at risk as they are the most expensive potential sources.

5. Investor exposure

Domestic focus

A typical Australian superannuation fund will invest 29% of its assets in Australian listed equities. It is common for funds in any country to have a domestic bias, and therefore a stronger interest and higher exposure to locally listed companies. BHP Billiton and Rio Tinto make up a signficant proportion of the ASX indices by market cap (10% of the ASX200). This concentration is diluted however by the diversification of these companies across a range of minerals.

It is some of the pure coal companies like Whitehaven Coal and Aquila Resources that provide the highest risk at a stock level, as they have significant resources they are investing in developing. Beyond the ASX200 there are also a number of smaller companies focused on developing their resources into proven reserves. There is a question here for investors about how many of these companies will ever realise the value that is currently expected of these assets.

Reserves intensity

Australia has a significant amount of coal listed on the ASX, but it is not the largest market by overall market capitalisation. The total market capitalisation of the ASX200 is around 43% of that of the FTSE 250 Index. If the coal owned by BHP Billiton and Rio Tinto is split equally between London and Australian markets, the ASX has 34% of the level of coal listed in London, but only 6% of the amount of oil listed in London (based on comparing CO_2 potential).

Global exposure

Australian coal is spread around the world's stock markets, meaning investors globally need to understand the risk. Our analysis shows that there is more Australian coal listed outside Australia than domestically. However the largest concentration is still at home. Previous analysis has shown that a third of the coal listed in London is located in Australia for example. The dual listings of Rio Tinto and BHP Billiton in Australia and London provides an interesting connection between these two markets.

The links to other financial markets have also been recognised by campaign groups. In June 2012, Greenpeace lodged a complaint with the Securities and Exchange Board of India regarding alleged misleading disclosures on environmental approval of an Australian project by GVK.[60] This demonstrates how capital markets are drawing increasing attention from campaign groups.

Systemic issue

There are other sectors which have exposure to fossil fuels: eg utilities, transport, infrastructure and engineering. The high exposure to the financial sector raises the issue of the degree of leverage of banks, and the increased requirements for assets on the balance sheet. Of concern is that traditional metrics will classify fossil-fuel based assets as low risk assets, due to the failure to integrate climate risk. If the value of these assets is impaired due to carbon constraints, this could leave banks overexposed. There is a risk that banks are retreating into fossil fuel sectors, as cleantech and renewable infrastructure has not yet been recognised as high quality assets.

Focus on implications for valuation of these companies

Including potential carbon constraints into the financial analysis of fossil fuel and extractives companies is a new area. Analysts may have included some consideration of carbon prices for companies further along the value chain who burn fossil fuels, but have not typically done any macro analysis on demand changes relating to a carbon budget. Analysts such as the equities team at Citi have started looking at the issue of unburnable carbon for Australian equities, and have outlined the risks they see through their analysis lens.[61] This confirms that the risk exists, however the strategy recommended depends on the timing and depth of its impact on the fossil fuel sector. The analysis represents short-term investment advice, which concludes that divesting from fossil fuels too early could present a risk to investors. This reflects the fact that equity analysis is not set up to address systemic risks; instead it pursues immediate returns until the last second, which also increases the risk

of not getting out in time. We support the idea that companies should cut CAPEX into new production with low margins, and that investors should reduce exposure to the assets with the greatest risk of stranding (identified as thermal coal).

In putting together a valuation of a company, analysts frequently use a mix of earnings multiples and discounted cashflow (DCF) analysis. Earnings multiples assume that recent historical performance will be repeated, which relies on the company's ability to reproduce similar levels of returns on capital employed. If the market weakens with reduced demand for high-carbon commodities, lowering the price and the level of sales, then returns will not meet expectations. If the demand is expected to decline over the long-term, this removes the need to finance fresh investment in reserves through the pricing of the commodities.

DCF models also make assumptions about production levels, costs and prices. They adjust the value of future revenues according to a discount rate which determines the net present value (NPV) of the project or company – that is, it translates the value of future cashflows into today's money. If carbon constraints reduce the predicted revenues then the value of the company will be reduced.

Analysts can adjust various elements of their valuation models to reflect what may happen in the future. They can choose to adjust revenues, earnings multiple factors or discount rates. They may also take a view on the variation in exposure across the sector to apply company-specific adjustments. Analysts also determine the period over which they wish to run their analysis, often based on the level of certainty they can assign to the major factors.

Coal mining analysis

Despite the short-termism of markets, the valuation models can go out reasonably long-term for the mining sector. The opinions expressed by analysts may influence short-term share-holding positions of asset managers, but can be based on performance predictions over decades. A research note (September 2012) from an Australian analyst on coal mining stocks stated:

'Half of these companies' valuations relate to deposits that would be exploited in 10 years; a third relates to activities 15 years or more away.'[62]

This suggests that uncertainty over policy, technology and markets in the energy sector of 10 years' time is relevant to the valuation of coal companies today.

The level of impact on specific companies is also important to understand. A research output from a UK coal analyst (June 2012) indicated that:

'Under a 450ppm scenario up to 44% of a global mining companies coal EBITDA could be lost.'[63]

This modelling integrated a global downturn in coal demand, and shows that coal revenues could be hit significantly. Diversified mining companies may have alternative minerals to rely on but pure coal companies do not have any other revenues sources to sustain the company, representing major risks to investors.

For the large diversified players listed on the Australian market, based on the proportion of their current revenue that is derived from coal (10-12%), BHP Billiton and Rio Tinto could lose 4-5% of their market value.[64] For pure coal producers, the impact would be much more dramatic. And if a carbon budget is applied that has a higher probability of limiting climate change, the effect could be amplified across the board.

Oil and gas analysis

The implications of a reduced emissions pathway were also found to be profound for the oil and gas sector. Analysts found that the highest cost unconventionals were already dismissed as non-commercial. The reduction in demand would reduce revenues however the major impact on company value was the low oil price that would result.[65] Perhaps even more tellingly HSBC concluded that in this situation: 'The potential value at risk could rise to 40-60% of market cap. Because of its long-term nature, we doubt the market is pricing in the risk of a loss of value from this issue.'

Independent oil and gas companies have been driven to pursue ever more difficult, carbon and water intensive and expensive reserves. There are no more big, undiscovered, easily extractable oil fields expected to be found. State-owned entities own the majority of the remaining 'easy oil'. This puts the assets of the listed companies at the wrong end of the cost curve.

'The potential value at risk could rise to 40-60% of market cap. Because of its long-term nature, we doubt the market is pricing in the risk of a loss of value from this issue.'

The Santos GLNG project in Australia for example is right at the extreme end of the cost curve requiring an oil price of over US$90 to break even.[66] Analysts already recognise that there is risk around this high cost project, however, it could become more acute if oil prices weaken. One of the key assumptions underlying any research in this sector is the oil price. Current valuations typically assume the Brent oil price will continue to be around the US$100 mark out to 2020.

6. Recommendations

6.1 Investors

As observed by Nicholas Stern investment strategies present a major contradiction between climate policy (2°C warming) and the current market position (6°C warming).[67] Investors need to factor the carbon budget into their investment strategy to reduce exposure to carbon intensive activities. Further research needs to be undertaken which integrates carbon constraints into valuation methodologies. This analysis should be used to reallocate a portion of a portfolio into low-carbon investments – investments that are likely to *benefit* from the transition to a low-carbon economy.

Be an active investor

For a large number of investors, particularly those like superannuation and pension funds that manage over US$50trn of assets globally, it is not viable to simply divest their portfolio from all investments related to fossil fuels. These investors need to use their influence to improve the way investee companies measure, monitor and manage carbon-related risks. As universal owners – investors that are exposed to the entire global economy by virtue of their diversified investments – these investors should be truly motivated to look beyond short-term gains if they yield long-term consequences.

In particular, investors should be looking to measure value-at-risk – particularly the impact on valuations of fossil fuel owners should capital markets align with a 2°C world. Investors should be actively challenging and changing the capital investment strategy of their fossil fuel holdings, which promote reserves replacement for assets that may not be developed in a 2°C world.

There is an opportunity to determine the nature of the future energy infrastructure being financed. Given that approximately AU$20 billion is spent annually on reserves development in Australia, this capital could be more prudently deployed in to other sectors of the economy, particularly in light of these assets potentially becoming uneconomic or stranded.

6.2 Companies

Disclose the forward-looking numbers

Traditionally, GHG reporting has only covered disclosure of historical annual emissions performance, not the emissions potential of fossil fuel reserves (in the case of extractive companies) or other forward-looking indicators. In an investment world looking at future risks and opportunities, this information gap needs to be closed. This is a simple conversion of reserves into CO_2 which can enable investors and regulators to understand the systemic risk they are facing.

Incorporate the carbon budget into long-term/strategic decisions and discussions

For all businesses, but especially those businesses that have high emissions intensity and are exposed to future carbon regulation, when long-term capital investment decisions are taken, corporates will need to factor in the many risks associated with climate change. We believe that most companies are already aware of the material risk to their business, and therefore to their value, that climate change represents, but most fossil fuel companies have failed to adequately disclose this information to their shareholders and to the broader market. Directors should be explaining their strategy in the context of a carbon budget, and reporting on how the business model is being adapted to ensure carbon viability going forward. Given the clear materiality of carbon and climate change related information to many businesses, especially capital intensive ones exposed to carbon regulation over the coming decades, it is important that these businesses keep the market and investors informed.

6.3 Accountants/audit

Understand and incorporate carbon impacts in reporting

To our knowledge, no auditor has publicly disclosed the assumptions they use in their valuation of fossil fuel-related assets regarding the path of future carbon prices, demand for fossil fuels or regulation of GHG emissions. We are interested in hearing how broadly-recognised carbon budget estimations are being factored into Australian companies' and investors' valuations of their assets, in particular the long-lived assets used by emissions-intensive companies. More work needs to be undertaken on the valuation of their fossil fuel reserves and resources and, in particular, the development of guidance accompanying impairment valuations.

6.4 Regulators

Improve disclosure of climate risk

Climate change is a systemic risk, which is already starting to have an impact through changing energy sources and increased frequency of extreme weather events. The financial markets have proven they are not currently set up to respond adequately to systemic risks, with the current structures too focused on short-term returns. Australian companies and investors clearly have a high exposure to the coal sector in particular, and therefore the market needs to respond to this issue. Other regulators have already started to issue guidance on the disclosure of climate-related risk (for example, the SEC in the US[68]) and monitor the level of market exposure (the Bank of England).[69]

Australia needs to introduce similar measures to monitor and manage this risk, working in collaboration with other regulators facing the same issue at a global level. The regulator can only understand the level of risk if disclosure of relevant data is made mandatory. We therefore recommend that the Australian regulator requires levels of embedded CO_2 in reserves to be reported annually. The collated figures should then be made available by the regulator to provide an indicator of whether the risk is increasing or decreasing.

Appendix: Methodology

Reserves and resources data

Coal reserves and resources data was provided by Raw Materials Group (RMG). More information is available at www.rmg.se. RMG collect data from companies and amalgamate it in their databases. Australian listed companies report reserves and resources according to the Australasian Code for Reporting of Explorations Results, Mineral Resources and Ore Reserves (the 'JORC Code') which feeds into the Australian company reporting requirements.

The reserves and resources data is based on the most recent reported information on reserves as disclosed at September 2012. As with any snapshot analysis, ownership of reserves will continue to change and reserves will be extracted and added to a company's portfolio of assets, subject to the annual reporting cycle, and the economic context. RMG was selected as having the most complete dataset available.

Oil and gas reserves data was provided by Evaluate Energy. More information is available at www.evaluateenergy.com. Not all companies provide both 1P (proven reserves) and 2P (prospective resources) data, some provide a combined figure. In these instances, Evaluate Energy estimated the split using industry norms for relative proportions.

To build on the previous global analysis we also considered resources with less certainty of feasible extraction and economic viability. It was important to at least highlight the existence and scale of these resources as the capital investment strategies of these companies are directed towards developing them.

Data accuracy

The approach taken is based on the best available data and provides a conservative estimate of the total reserves and potential resulting emissions attributable to listed entities and their associated stock exchanges. We rely on third parties for the reserves and resources data. We believe the dataset to be of sufficient quality and give a reasonable representation of the exposure of listed entities. We welcome comments on how to improve the analysis and suggestions of useful outputs for future research.

Carbon dioxide emissions factors

The formula for calculating the CO_2 emissions from the reserves was taken from the methodology used by the Potsdam Institute in calculating the global carbon budget. This estimates potential emissions from proven recoverable reserves of fossil fuels, according to $E = R \times V \times C \times f$, where E[70] are the potential emissions ($GtCO_2$), R the proven recoverable reserves (Gg), V the net calorific value (TJ/Gg), C the carbon content (tC/TJ) and f a conversion factor ($GtCO_2$/tC).[71] V and C come from the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Emissions Inventories.[72] The Potsdam Institute methodology applies CO_2-only factors to the fuels, as IPCC factors for all the Kyoto gases to give CO_2-equivalent (CO_2e) are specific to the use of the fuels.

Reserves classification

The fossil fuel reserves were split into six classes, again mirroring the Potsdam Institute methodology. These types correspond with the data tables for the elements which make up the carbon emissions formula. The six classes were:

- Natural Gas
- Oil Conventional
- Oil Unconventional
- Coal (Bitumous & Anthracite)
- Coal (Sub-Bitumous)
- Coal (Lignite)

Not all coal assets in the RMG database indicate the type of coal in the mine. Where this data was not available it was assumed it was bitumous coal, the most common type.

Equity basis

Reserves, and therefore potential emissions, were attributed to each company on an equity ownership basis.

Allocation to stock exchanges

For this national analysis, the reserves were attributed to the company in their entirety, as investors would have exposure to the full risk of the company. However, many companies also have listings on other markets so it is not only through the Australian Securities Exchange that investors may be exposed to these corporations.

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