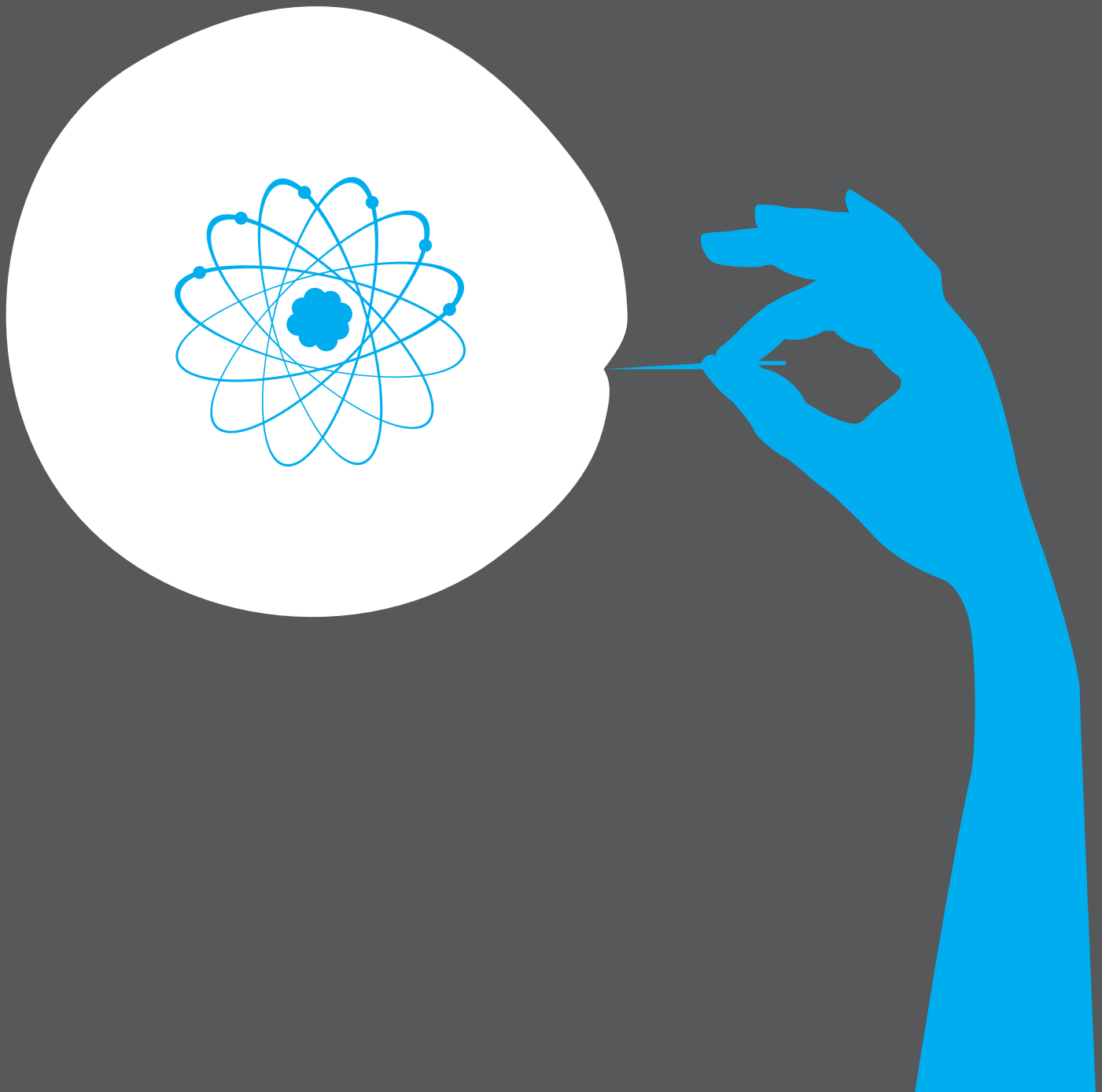
Carbon Tracker Initiative

Unburnable Carbon –
Are the world's financial markets carrying a carbon bubble?



About Carbon Tracker

The Carbon Tracker initiative is a new way of looking at the carbon emissions problem. It is focused on the fossil fuel reserves held by publically listed companies and the way they are valued and assessed by markets. Currently financial markets have an unlimited capacity to treat fossil fuel reserves as assets. As governments move to control carbon emissions, this market failure is creating systemic risks for institutional investors, notably the threat of fossil fuel assets becoming stranded as the shift to a low-carbon economy accelerates.

In the past decade investors have suffered considerable value destruction following the mispricing exhibited in the dot.com boom and the more recent credit crunch. The carbon bubble could be equally serious for institutional investors – including pension beneficiaries - and the value lost would be permanent.

We believe that today's financial architecture is not fit for purpose to manage the transition to a low-carbon economy and serious reforms are required to key aspects of financial regulation and practice firstly to acknowledge the carbon risks inherent in fossil fuel assets and then take action to reduce these risks on the timeline needed to avoid catastrophic climate change.

Carbon Tracker's goal is to prevent a carbon crash by:

- Working with capital market regulators and investors to assess systemic climate change risks and propose practical measures to minimise these risks to market stability and the operation of an orderly market.
- Revisiting the way fossil fuel companies are valued including the accounting treatment of fossil fuel-based reserves to ensure that carbon limits are fully integrated;
- Evaluating the concentration risk facing key global markets which are currently over-weight fossil fuels (such as the UK), and how indices, benchmarks and tracking products can be reformed to protect investors
- Improving the quality and utility of disclosures required by regulators and listings authorities to ensure that future carbon risks associated with fossil fuel reserves are fully dealt with to enable investors to make informed decisions;
- Updating the way fossil fuel companies are brought to the capital markets by investment banks;

We believe the regulatory regimes covering the capital markets need realigning to provide transparency for investors on the assumptions behind valuing unburnable carbon. With the global economy following the fortunes of the financial sector, it is essential to create capital markets which are robust enough to deliver an economy which can prevent dangerous climate change. Unless a more long-term approach is required by regulators, the shift in investment required to deliver a low carbon future will not occur.

Contents

Executive Summary 2

Introduction 4

Part A: The analysis 5

1. The global carbon budget 6
2. Global reserves of coal, oil and gas 7
3. Do listed fossil fuel reserves take us to unburnable carbon? 8
4. Top 200 listed companies by estimated carbon reserves 13
5. Focus on the UK 15

Part B: What this analysis means for those involved in raising capital on the financial markets 17

6. Valuation of companies 19
7. Corporate Disclosure 22
8. Capitalising carbon through the listing process 23
9. Regulators and stock exchanges 24
10. Relevance for investors 25
11. Recommendations for resolving the capital markets' carbon bubble 28

Appendix 1: Methodology 29

References 32

Executive Summary

Global carbon budget

Research by the Potsdam Institute calculates that to reduce the chance of exceeding 2°C warming to 20%, the global carbon budget for 2000-2050 is 886 $GtCO_2$. Minus emissions from the first decade of this century, this leaves a budget of 565 $GtCO_2$ for the remaining 40 years to 2050.

Global warming potential of proven reserves

The total carbon potential of the Earth's known fossil fuel reserves comes to 2795 $GtCO_2$. 65% of this is from coal, with oil providing 22% and gas 13%. This means that governments and global markets are currently treating as assets, reserves equivalent to nearly 5 times the carbon budget for the next 40 years. The investment consequences of using only 20% of these reserves have not yet been assessed.

Global warming potential of listed reserves

The fossil fuel reserves held by the top 100 listed coal companies and the top 100 listed oil and gas companies represent potential emissions of 745 $GtCO_2$. This exceeds the remaining carbon budget of 565 $GtCO_2$ by 180 $GtCO_2$.This means that using just the listed proportion of reserves in the next 40 years is enough to take us beyond 2°C of global warming. On top of this further resources are held by state entities. Given only 20% of the total reserves can be used to stay below 2°C, if this is applied uniformly, then only 149 of the 745 $GtCO_2$ held by listed companies can be used unabated. Investors are thus left exposed to the risk of unburnable carbon. If the 2°C target is rigorously applied, then up to 80% of declared reserves owned by the world's largest listed coal, oil and gas companies and their investors would be subject to impairment as these assets become stranded.

The carbon intensity of stock exchanges

The top 100 coal and top 100 oil & gas companies have a combined value of $7.42 trillion as at February 2011. The countries with the largest greenhouse gas potential in reserves on their stock exchanges are Russia, (253 Gt CO_2), the United States, (156.5 Gt CO_2) and the United Kingdom, (105.5 Gt CO_2). The stock exchanges of London, Sao Paulo, Moscow, Australia and Toronto all have an estimated 20-30% of their market capitalisation connected to fossil fuels.

London – a green capital?

The UK has less than 0.2% of the world's coal, oil and gas reserves, and accounts for around 1.8% of global consumption of fossil fuels. Yet the CO_2 potential of the reserves listed in London alone account for 18.7% of the remaining global carbon budget. The financial carbon footprint of the UK is therefore 100 times its own reserves. London currently has 105.5 $GtCO_2$ of fossil fuel reserves listed on its exchange which is ten times the UK's carbon budget for 2011 to 2050, of around 10 $GtCO_2$. Just one of the largest companies listed in London, such as Shell, BP or Xstrata, has enough reserves to use up the UK's carbon budget to 2050. With approximately one third of the total value of the FTSE 100 being represented by resource and mining companies, London's role as a global financial centre is at stake if these assets become unburnable en route to a low carbon economy.

Transferring risk to the markets

In addition to the coal, oil and gas reserves of established companies, new fossil fuel companies continue to list on exchanges to raise capital through share issues, in order to fund further exploration and development. Recently London has seen Glencore, Vallar/Bumi and Vallares list on its exchange with no consideration by the regulators of potential systemic risks to financial markets of the increased exposure to climate change risk. In addition, former state-owned companies are coming to the markets, bringing huge carbon reserves to western investment portfolios (e.g. Indian and Monglian coal mining companies).

The asset owners response

We believe investors need to respond to this systemic risk to their portfolios and the threat it poses of a carbon bubble bursting. Our research poses the following questions for asset owners:

- Which capital markets regulators are responsible for oversight of systemic risks and protecting your investments from systemic climate change risk?
- To what extent are you exposed to markets which have higher than average exposure to fossil fuels and are more prone to the stranding of assets?
- Are conventional fossil fuel-heavy indices still appropriate performance benchmarks for your portfolios?
- Are your asset allocation decisions based on obsolete data regarding the full risks facing fossil fuel reserves and what proportion of your investments may be unburnable carbon?

The reporting challenge

Corporate disclosure of carbon risks has improved markedly over the past decade, but arguably the most material climate change risk remains hidden from most reports issued by fossil fuel companies. For these companies, it is not the scale of operational emissions that is the strategic challenge, but the emissions associated with their products which are currently locked into their reserves. The potential carbon footprints of reserves are material numbers which are not transparent. The long-term viability of these businesses rests on their future ability to extract and sell carbon, rather than their past emissions. For investors to gain a greater understanding of these risks, a change of mindset is required to consider the scale of the systemic risk posed by fossil fuel reserves. This will require moving beyond annual reporting of last year's emissions flows to more forward-looking analysis of carbon stocks. This is a logical step as carbon reporting becomes mainstream and integrated with financial analysis.

The regulator's responsibility

The recent financial crisis has shown that capital markets were not-self-regulating and required unprecedented intervention; regulators were not monitoring the biggest systemic risks and so missed key intervention points. Listing authorities will need to take greater responsibility for reviewing the provision of information on embedded carbon by quoted companies. They need to ensure that taking the capital markets as a whole, systemic risks posed by the carbon asset bubble are addressed. Further regulation, guidance, and monitoring are needed to shift practices across the exchanges.

Do the maths

It's a simple formula:
Company-level: Reserves x carbon factor = carbon dioxide potential.
Exchange-level: Sum of company carbon dioxide potentials = Exchange total.
Global-level: Sum of exchange totals > Global carbon budget.

Today, these numbers do not add up. Moreover those responsible for the stability of financial markets have not yet started to collect this data or assimilate it into their risk models. It's time that asset owners and capital market regulators made sure they did.

Recommendations:

Regulators should:

- Require reporting of fossil fuel reserves and potential CO_2 emissions by listed companies and those applying for listing.
- Aggregate and publish the levels of reserves and emissions using appropriate accounting guidelines.
- Assess the systemic risks posed to capital markets and wider economic prosperity through the overhang of unburnable carbon
- Ensure financial stability measures are in place to prevent a carbon bubble bursting.
- Assess the systemic risks posed to capital markets and wider economic prosperity through the overhang of unburnable carbon.

Introduction

This research provides the evidence base which confirms what we have long suspected – that there are more fossil fuels listed on the world's capital markets than we can afford to burn if we are to prevent dangerous climate change. Having satisfied that curiosity, this report marks a new phase of dealing with the implications for the investment world.

The missing element in creating a low carbon future is a financial system which will enable that to happen. Political will, technology and behaviour change all play their part, but finance will be critical to tackling climate change. This analysis demonstrates why a greater focus on changing the financial system is required to align it with emissions reduction objectives.

The global nature of capital markets means that fossil fuel reserves are distributed very differently in terms of ownership compared to their physical location. This places the responsibility for financing the development of fossil fuel reserves in industrialising countries with western investors.

Now is the time to move into the second generation of investor action on climate change, which tackles the system that is locked into financing fossil fuels. Climate change poses a great threat to the global economy and it is not unrealistic to expect regulators responsible for assessing new systemic risks to address the carbon bubble.

The goal now is for regulators to send clear signals to the market that cause a shift away from the huge carbon stockpiles which pose a systemic risk to investors. This is the duty of the regulator – to rise to this challenge and prevent the bubble bursting.

Mark Campanale & Jeremy Leggett

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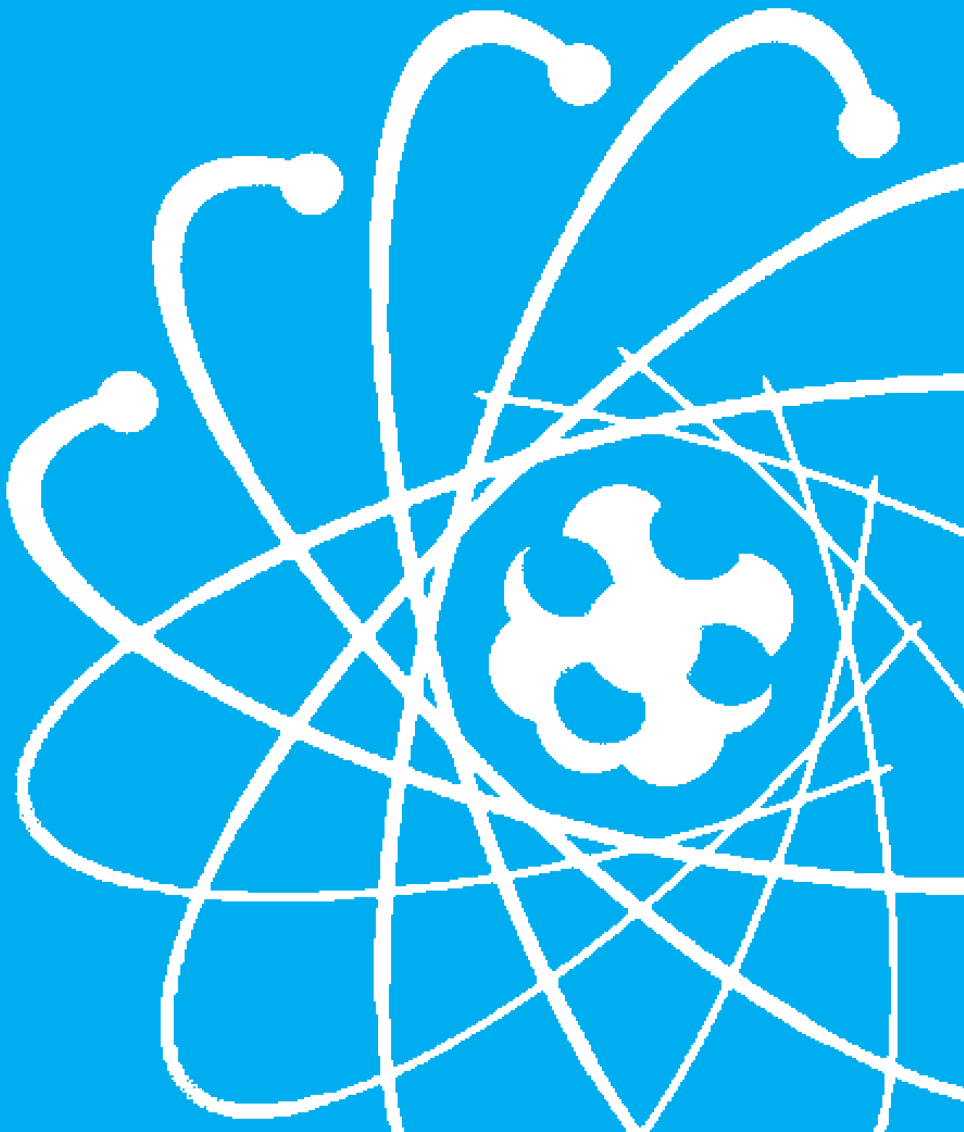
Part A:
The Analysis



1. The global carbon budget

The Cancun Agreement in December 2010 captured an international commitment to limit global warming to two degrees Celsius (°C) above pre-industrial levels. It also noted the potential need to tighten this target to 1.5°C.[1] This agreement provides a reference point against which global emissions scenarios can be compared to assess whether the world is on track to achieve the two degrees target. We are focused on how the world's financial markets are aligned with this pathway as it is clear a shift to a low carbon economy needs capital markets to rise to this challenge.

The Potsdam Climate Institute has calculated a global carbon budget for the world to stay below 2°C of warming. This uses probabilistic climate change modelling to calculate the total volume of carbon dioxide (CO_2) emissions permitted in the first half of the 21st century to achieve the target. This revealed that to reduce the chance of exceeding 2 °C warming to 20%, the global carbon budget for 2000 -2050 is 886 $GtCO_2$.[2] (N.B. All emissions are expressed in carbon dioxide only, rather than the equivalent of the full suite of greenhouse gases.)

What have we already used since 2000?

By 2011, the global economy has already used up over a third of that 50 year budget in the first decade alone. Calculations of global emissions published in Nature indicate 282 $GtCO_2$ have already been emitted in the first decade of this century from burning fossil fuels, with land use change contributing a further 39 $GtCO_2$.[3] This leaves a budget of around 565 $GtCO_2$ for the remaining 40 years to 2050. This budget could be further contracted if a position is adopted to limit global warming to 1.5°C or even lower.

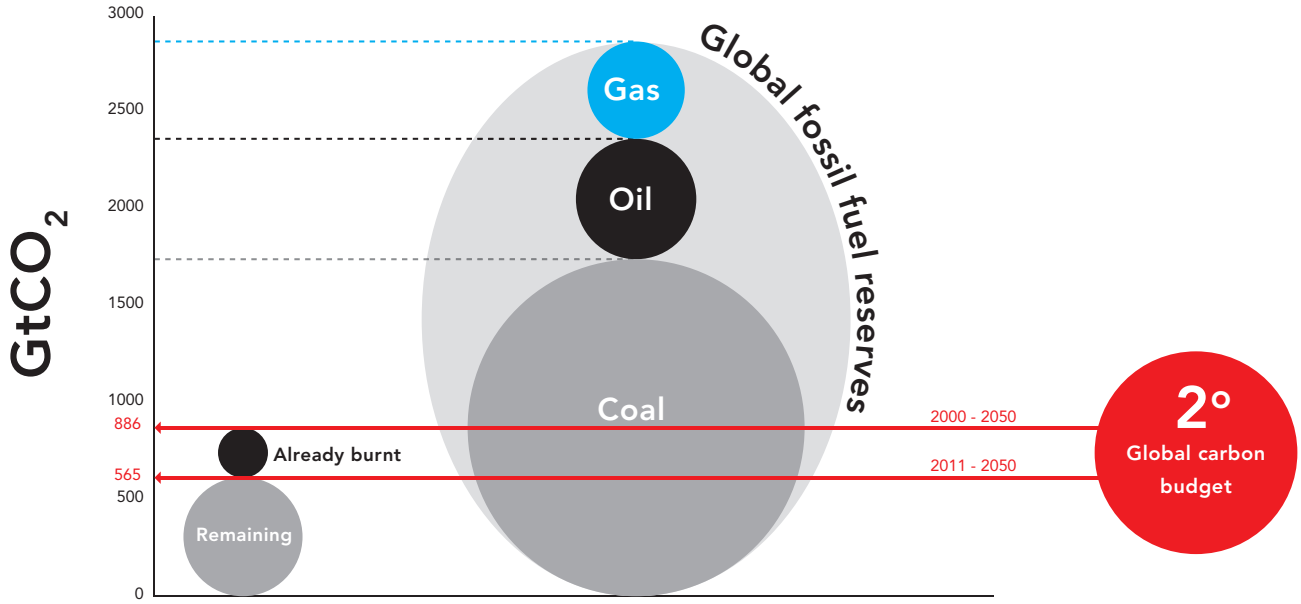
What are the potential emissions from global fossil fuel reserves?

The Potsdam Climate Institute also calculated the total potential emissions from burning the world's proven fossil fuel reserves (coal, oil and gas). This is based on reserve figures reported at a country level and UNFCCC emissions factors for the relevant fossil fuel types. Oil was split into conventional and unconventional types, whilst coal was split into three different bands to reflect the range of carbon intensity.

The total CO_2 potential of the earth's proven reserves comes to 2795 $GtCO_2$. 65% of this is from coal, with oil providing 22 % and gas 13%. This means that governments are currently indicating their countries contain reserves equivalent to nearly 5 times the carbon budget for the next 40 years. Consequently only one-fifth of the reserves could be burnt unabated by 2050 if we are to reduce the likelihood of exceeding 2°C warming to 20%.

Comparison of the global 2°C carbon budget with fossil fuel reserves CO_2 emissions potential

Fig.1



2. Global reserves of coal, oil and gas

The global distribution of fossil fuels reserves creates energy superpowers and consequently produces energy security issues for other nations, especially as political risk and catastrophic events ratchet up energy prices. The top ten countries for each of the three fossil fuels are shown below, with additional data for countries with major stock exchanges.

Fig.2

OIL

Country	Reserves (bbl)	% world
Saudi Arabia	264.6	17.9%
Canada	176.5	12.0%
Venezuela	172.3	11.7%
Iran	137.6	9.3%
Iraq	115	7.8%
Kuwait	101.5	6.9%
UAE	97.8	6.6%
Russia	74.2	5.0%
Libya	44.3	3.0%
Kazakhstan	39.8	2.7%
		82.9%
UK	3.1	0.2%
India	5.8	0.4%
China	14.8	1.0%
US	28.4	1.9%
World		**1476.4**

GAS

Country	Reserves (tn cm)	% world
Russia	44.38	23.7%
Iran	29.61	15.8%
Qatar	25.37	13.5%
Turkmenistan	8.1	4.3%
Saudi Arabia	7.92	4.2%
US	6.93	3.7%
UAE	6.43	3.4%
Venezuela	5.67	3.0%
Nigeria	5.25	2.8%
Algeria	4.5	2.4%
		76.8%
UK	0.29	0.2%
India	1.12	0.6%
China	2.46	1.3%
World	**187.49**	

COAL

Country	Reserves (tn cm)	% world
US	238308	28.9%
Russia	157010	19.0%
China	114500	13.9%
Australia	76200	9.2%
India	58600	7.1%
Ukraine	33873	4.1%
Kazakhstan	31300	3.8%
South Africa	30408	3.7%
Poland	7502	0.9%
Brazil	7059	0.9%
		91.5%
UK	155	0.02%
World	**826001**	

Source: BP Statistical Review of World Energy 2010[4]

The UK is a major global finance centre, but a relatively small country in terms of geographic size, which has less than 0.2% of the world's fossil fuel reserves. The rapidly industrialising economies of India and China have significant reserves of coal, but not oil and gas.

These reserves are split between those that are still owned by governments (National Oil Companies – NOCs), and those that are assets licensed to the private sector (International Oil Companies – IOCs). A number of state enterprises, particularly in the BRICS economies, are raising finance internationally via capital markets, in order to develop their coal and oil reserves. This trend is leading to a steady transfer of parts of the national companies to international investors.

The scale of the reserves held by these companies means that even a partial listing - such as Coal India in 2010 - can result in a significant addition of potential carbon emissions to the private sector and thus to the transfer of climate risk to the pension funds of ordinary citizens.

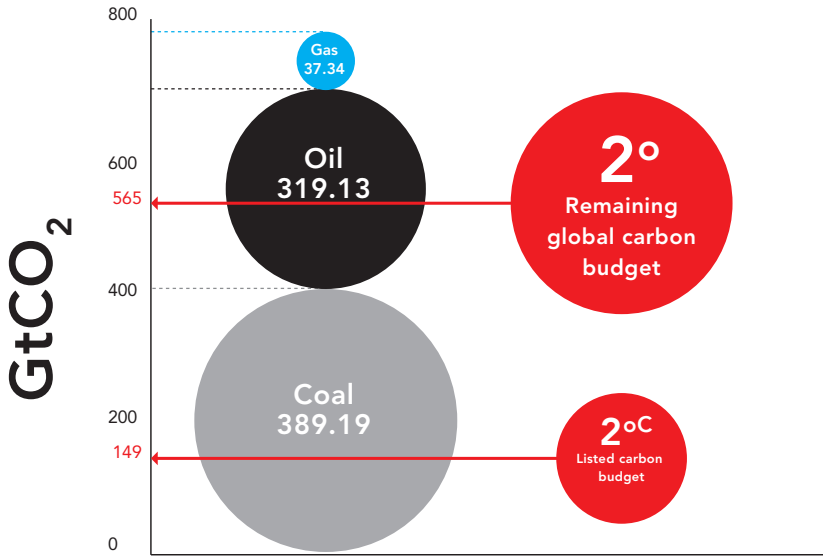
The figures used here are the proven reserves (i.e. those which have a 90% certainty of being extracted).[5] Companies also have probable (50% chance of being extracted) and possible (10% chance of being extracted) reserves which only add to the levels of unburnable carbon.

3. Do listed fossil fuel reserves take us to unburnable carbon?

We estimate the fossil fuel reserves held by the top 100 listed coal companies and the top 100 listed oil and gas companies represent potential emissions of 745 $GtCO_2$. This exceeds the remaining carbon budget of 565 $GtCO_2$ by 180 $GtCO_2$. The potential emissions from listed fossil fuel reserves show that just over half the carbon comes from coal reserves, whilst only 5% is attributable to gas.

Carbon dioxide emissions potential of listed fossil fuel reserves

Fig.3



'using just the reserves listed on the world's stock markets in the next 40 years would be enough to take us beyond 2°C of global warming.'

This has profound implications for the world's energy finance structures and means that using just the reserves listed on the world's stock markets in the next 40 years would be enough to take us beyond 2°C of global warming. This calculation also assumes that no new fossil fuel resources are added to reserves and burnt during this period – an assumption challenged by the harsh reality that fossil fuel companies are investing billions per annum to find and process new reserves. It is estimated that listed oil and gas companies had CAPEX budgets of $798 billion in 2010.[6] In addition, over two-thirds of the world's fossil fuels are held by privately or state owned oil, gas and coal corporations, which are also contributing even more carbon emissions.

Given that only one fifth of the total reserves can be used to stay below 2°C warming, if this is applied uniformly, then only 149 of the 745 $GtCO_2$ listed can be used unmitigated. This is where the carbon asset bubble is located. If applied to the world's stock markets, this could result in a repricing of assets on a scale that would dwarf past profit warnings and revaluation of reserves. This situation persists because no financial regulator is responsible for monitoring, collating or interpreting these risks.

How quickly would we reach unburnable carbon if emissions continue business as usual?

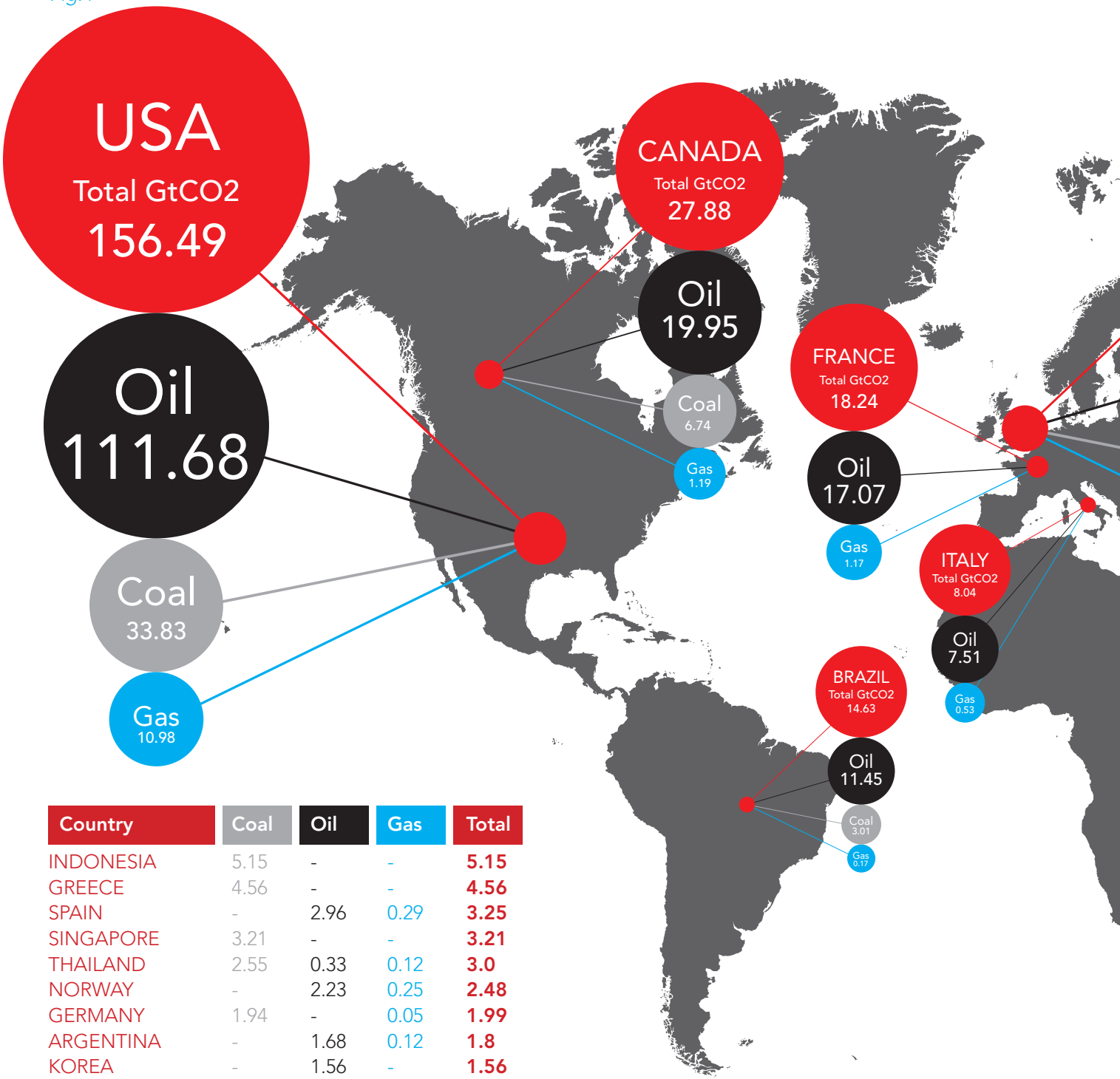
According to the latest IEA projections of energy-related fossil fuel CO_2 emissions, unburnable carbon will be reached in just 16 years if energy consumption continues unfettered.[7] This is based on global annual energy emissions increasing from 30.12 $GtCO_2$ in 2011 to 37.58 $GtCO_2$ in 2027, totalling 570.11 $GtCO_2$ over the period.

Where are these reserves listed?

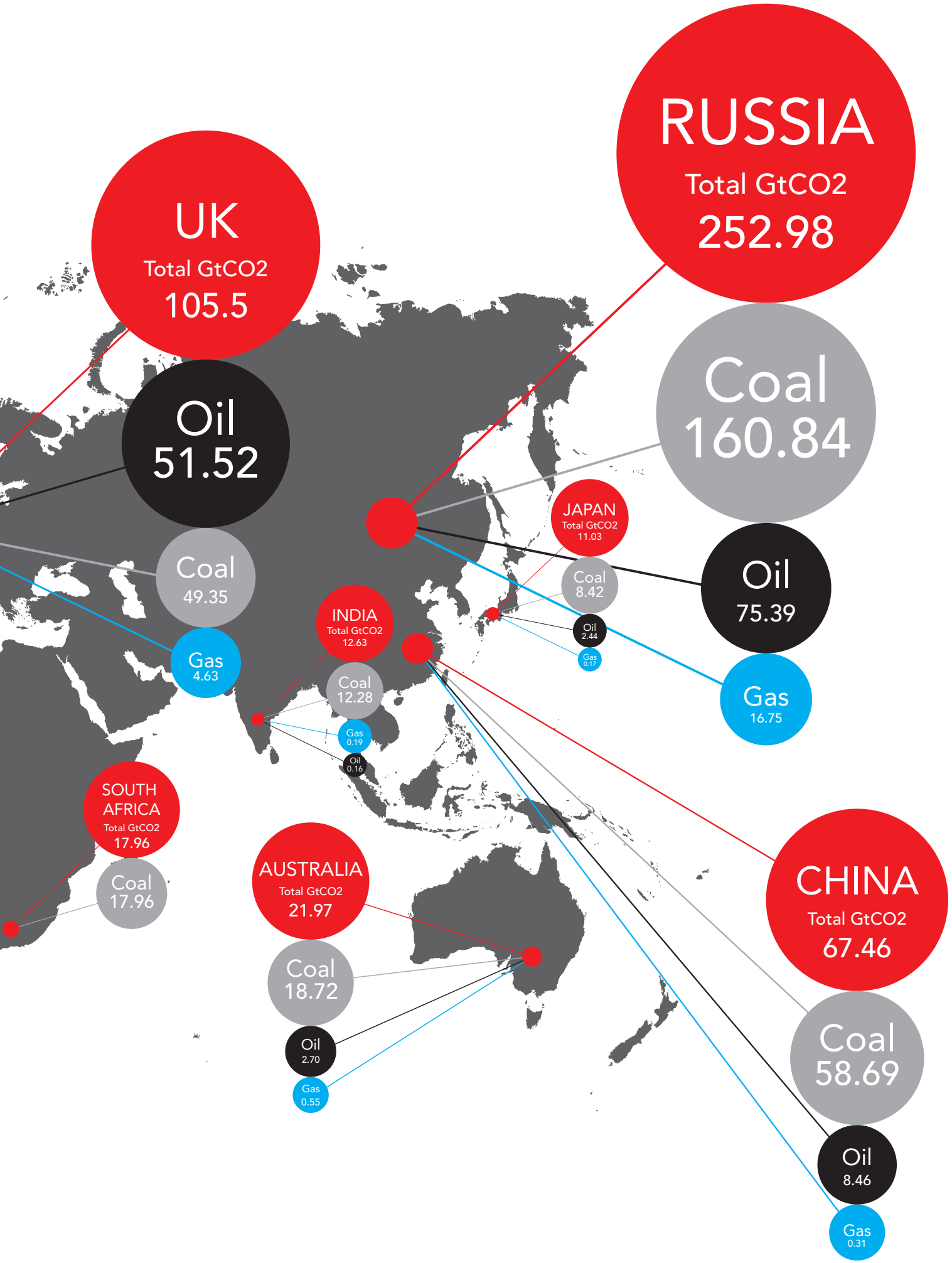
The following map shows the carbon dioxide emissions potential of the reserves that are listed in each country, broken down by the three types of fossil fuel. Russia, the US, the UK and China dominate the picture. However some exchanges, for example US and France, are skewed towards oil reserves, whilst Russia, China, Australia and South Africa are concentrated in coal reserves. This is in stark contrast to the limited fossil fuel reserves in the UK and the limited oil reserves in the US.

Distribution of fossil fuel reserves between stock exchanges

Fig.4



Country	Coal	Oil	Gas	Total
INDONESIA	5.15	-	-	**5.15**
GREECE	4.56	-	-	**4.56**
SPAIN	-	2.96	0.29	**3.25**
SINGAPORE	3.21	-	-	**3.21**
THAILAND	2.55	0.33	0.12	**3.0**
NORWAY	-	2.23	0.25	**2.48**
GERMANY	1.94	-	0.05	**1.99**
ARGENTINA	-	1.68	0.12	**1.8**
KOREA	-	1.56	-	**1.56**
AUSTRIA	-	1.02	0.06	**1.08**
CZECH REPUBLIC	1.07	-	-	**1.07**
NETHERLANDS	0.62	-	-	**0.62**
SWEDEN	-	0.47	0.00	**0.47**
COLOMBIA	-	0.35	0.01	**0.36**
MEXICO	0.26	-	-	**0.26**
HUNGARY	-	0.19	0.01	**0.2**
CROATIA	-	0.17	-	**0.17**


RUSSIA
Total GtCO2
252.98
UK
Total GtCO2
105.5
Coal
160.84
Oil
51.52
JAPAN
Total GtCO2
11.03
Coal
8.42
Oil
2.44
Gas
0.17
Oil
75.39
Coal
49.35
Gas
4.63
INDIA
Total GtCO2
12.63
Coal
12.28
Gas
0.19
Oil
0.16
Gas
16.75
SOUTH
AFRICA
Total GtCO2
17.96
Coal
17.96
AUSTRALIA
Total GtCO2
21.97
Coal
18.72
Oil
2.70
Gas
0.55
CHINA
Total GtCO2
67.46
Coal
58.69
Oil
8.46
Gas
0.31

How much of each exchange's market capitalisation is based upon these reserves?

It is difficult to produce accurate figures due to the involvement of diversified mining companies who also extract metals and minerals other than coal. It would exaggerate the proportion of the market capitalisation linked to fossil fuels if, for example, the whole figure for Rio Tinto or BHP Billiton were included. If a conservative estimate is used which reduces the contribution from mining companies, then we believe 20 - 30% of the market capitalisation is linked to fossil fuel extraction in on the Australian, London, MICEX, Toronto and Sao Paulo exchanges. Paris, Shanghai, Hong Kong and Johannesburg are currently less exposed with less than 10% market capitalisation linked to fossil fuel extraction.

What proportions of global reserves are listed?

The companies assessed here represent the majority of listed reserves, with companies below this threshold contributing less than 0.15 $GtCO_2$ each to the total. These top 200 coal, oil and gas extraction companies are equivalent to the potential emissions from:

- 20% of global coal reserves
- 50% of global conventional oil reserves
- 12% of global unconventional oil reserves
- 10% of global gas reserves.

Combined, these top 200 companies are equivalent to around 27% of the global proven fossil fuel reserves, in terms of their carbon dioxide emissions potential. Oil therefore has a much higher representation on the financial markets. The low proportion of gas listed reflects the concentration of reserves in Russia and the Middle East, where oligarchs and National Oil Companies (NOCs) are dominant.

An unmitigated disaster?

Energy and emissions predictions often include potential solutions such as carbon capture and storage (CCS) which would allow some fossil fuels to be burnt with a much lower rate of carbon emissions. Viable CCS would certainly provide some extra carbon budget in the medium term. However it could only be applied to power generation by coal and gas, leaving the entire oil-based transport system unmitigated. It is also worth noting that even fossil fuel companies believe commercial application is at least a decade away and doesn't appear to be getting much closer. This means that the global carbon budget may be used up before CCS can even start to make a contribution. Cleaner combustion technologies will also stretch the budget, but will not address the fundamental problem.

Unconventionals

The figure for unconventional oil is artificially low, we believe, due to Canadian accounting practices which result in oil sands reserves not being booked upon discovery. Instead, they are only reported under Canadian rules once production is believed to be 'imminent'. The Canadian stock exchanges in particular may therefore have some hidden CO_2 potential as a result.

There has recently been more interest in unconventional gas deposits, for example shale gas, which are also not included in these figures and have a higher carbon factor than traditional gas. The current limited treatment of unconventionals suggests the reserve figures may be even higher and more carbon intensive, cancelling out mitigation gains.

4. Top 200 listed companies by estimated carbon reserves

Fig.5

Rank	Coal Companies	COAL (GtCO2)	Oil & Gas Companies	OIL (GtCO2)	GAS (GtCO2)
1	Severstal JSC	141.60	Lukoil Holdings	42.59	0.97
2	Anglo American PLC	16.75	Exxon Mobil Corp.	38.14	2.89
3	BHP Billiton	16.07	BP PLC	32.68	1.92
4	Shanxi Coking Co. Ltd.	14.98	Gazprom OAO	14.87	13.96
5	Exxaro Resources Ltd.	13.37	Chevron Corp.	20.11	1.11
6	Xstrata PLC	11.60	ConocoPhillips	18.11	1.03
7	Datang International Power Generation Co. Ltd.	11.21	Total S.A.	16.90	1.12
8	Peabody Energy Corp.	10.23	Royal Dutch Shell PLC	14.11	2.09
9	Mechel OAO	8.90	Petrobras	11.45	0.17
10	Inner Mongolia Yitai Coal Co. Ltd.	7.78	Rosneft	10.70	0.08
11	China Shenhua Energy Co. Ltd.	6.91	ENI S.p.A.	7.51	0.53
12	Coal India Ltd.	6.69	Occidental Petroleum Corp.	7.36	0.22
13	Arch Coal Inc.	5.57	Bashneft	7.25	0.01
14	Rio Tinto	5.23	SINOPEC Shandong Taishan Petroleum Co. Ltd.	6.61	0.22
15	Evraz Group S.A.	4.86	Canadian Natural Resources Ltd.	4.35	0.14
16	Public Power Corp. S.A.	4.56	Devon Energy Corp.	3.77	0.42
17	Consol Energy Inc.	4.50	Suncor Energy Inc.	3.74	0.07
18	Yanzhou Coal Mining Co. Ltd.	4.46	Apache Corp.	3.32	0.33
19	Mitsubishi Corp.	4.31	Anadarko Petroleum Corp.	3.14	0.33
20	Datong Coal Industry Co. Ltd.	4.30	Hess Corp.	3.01	0.12
21	Bumi Resources	3.28	Repsol YPF S.A.	2.75	0.29
22	United Co. Rusal PLC	3.02	BG Group PLC	2.29	0.48
23	Vale SA	3.01	Marathon Oil Corp.	2.51	0.12
24	Pingdingshan Tianan Coal Mining Co. Ltd.	2.97	Inpex Corp.	2.44	0.10
25	Tata Steel Ltd.	2.96	Statoil ASA	2.23	0.25
26	Teck Resources Ltd.	2.70	BHP Billiton	1.82	0.20
27	Banpu PCL	2.55	CNOOC Ltd.	1.85	0.09
28	Sasol Ltd.	2.51	Husky Energy Inc.	1.76	0.06
29	United Industrial Corp. Ltd.	2.48	YPF S.A.	1.68	0.12
30	Polyus Gold OAO	2.47	Novatek	-	1.73
31	Alpha Natural Resources Inc.	2.29	Talisman Energy Inc.	1.47	0.19
32	Magnitogorsk Iron & Steel Works	2.20	Pioneer Natural Resources Co.	1.50	0.11
33	Raspadskaya OJSC	2.09	SK Holdings Co. Ltd.	1.56	-
34	Kuzbassenergo	2.03	Petroleum Development Corp.	-	1.51
35	RWE AG	1.94	Cenovus Energy Inc.	1.40	0.06
36	Massey Energy Co.	1.93	Nexen Inc.	1.40	0.02
37	Eurasian Natural Resources Corp. PLC	1.93	EOG Resources Inc.	0.97	0.38
38	Wesfarmers Ltd.	1.86	Noble Energy Inc.	1.04	0.12
39	Churchill Mining PLC	1.74	OMV AG	1.02	0.06
40	Idemitsu Kosan Co. Ltd.	1.58	Chesapeake Energy Corp.	0.39	0.57
41	Tata Power Co. Ltd.	1.49	Penn West Petroleum Ltd.	0.91	0.03
42	Alliance Resource Partners L.P.	1.47	Oil Search Ltd.	0.91	-
43	NACCO Industries Inc. (Cl A)	1.33	Woodside Petroleum Ltd.	0.54	0.27
44	Novolipetsk Steel OJSC	1.30	Canadian Oil Sands Ltd.	0.78	-
45	New Hope Corp. Ltd.	1.30	Imperial Oil Ltd.	0.75	0.01
46	TransAlta Corp.	1.23	Murphy Oil Corp.	0.69	0.03
47	Sherritt International Corp.	1.15	Whiting Petroleum Corp.	0.70	0.01
48	PT Bayan Resources	1.14	EnCana Corp.	0.24	0.47
49	New World Resources N.V.	1.07	Plains Exploration & Production Co.	0.67	0.04
50	Mitsui & Co. Ltd.	1.03	Newfield Exploration Co.	0.53	0.11

Table continues overleaf

Rank	Coal Companies	COAL (GtCO2)	Oil & Gas Companies	OIL (GtCO2)	GAS (GtCO2)
51	Kazakhmys PLC	0.99	Denbury Resources Inc.	0.60	0.00
52	African Rainbow Minerals Ltd.	0.95	Continental Resources Inc. Oklahoma	0.54	0.02
53	International Coal Group Inc.	0.95	Linn Energy LLC	0.49	0.03
54	Patriot Coal Corp.	0.94	Pacific Rubiales Energy Corp.	0.50	0.02
55	Aston Resources Pty Ltd.	0.93	Crescent Point Energy Corp.	0.47	0.00
56	AGL Energy	0.89	Concho Resources Inc.	0.44	0.02
57	Tokyo Electric Power Co. Inc.	0.89	Quicksilver Resources Inc.	0.36	0.08
58	Cloud Peak Energy Inc.	0.85	PTT PCL	0.33	0.12
59	CLP Holdings Ltd.	0.83	Berry Petroleum Co. (Cl A)	0.40	0.03
60	Polo Resources Ltd.	0.82	Range Resources Corp.	0.27	0.11
61	Whitehaven Coal Ltd.	0.79	Energen Corp.	0.34	0.04
62	Mongolian Mining Corp.	0.75	Enerplus Corp.	0.34	0.03
63	PT Adaro Energy	0.74	Tullow Oil PLC	0.36	0.01
64	Allete Inc.	0.72	Ecopetrol S.A.	0.35	0.01
65	Optimum Coal Holdings Ltd.	0.67	Santos Ltd.	0.19	0.17
66	ArcelorMittal	0.62	SandRidge Energy Inc.	0.33	0.03
67	Coal of Africa Ltd.	0.59	Cairn Energy PLC	0.35	0.00
68	James River Coal Co.	0.57	Arc Resources Ltd.	0.30	0.03
69	Westmoreland Coal Co.	0.56	El Paso Corp.	0.23	0.10
70	Aquila Resources Ltd.	0.53	Pengrowth Energy Corp.	0.30	0.02
71	Macarthur Coal Pty Ltd.	0.53	Lundin Petroleum AB	0.31	0.00
72	FirstEnergy Corp.	0.50	Petrobank Energy & Resources Ltd.	0.31	0.00
73	Western Coal Corp.	0.49	Baytex Energy Corp.	0.30	0.00
74	Cliffs Natural Resources Inc.	0.47	Forest Oil Corp.	0.22	0.07
75	Wescoal Holdings Ltd.	0.46	Mariner Energy	0.27	0.02
76	Walter Energy, Inc.	0.45	ATP Oil & Gas Corp.	0.24	0.01
77	Huolinhe Opencut Coal Industry Corp. Ltd.	0.41	Bankers Petroleum Ltd.	0.25	-
78	Gujarat NRE Coke Ltd.	0.40	Soco International PLC	0.25	-
79	Straits Asia Resources Ltd.	0.39	Zhaikmunai L.P.	0.22	0.01
80	Capital Power Corp.	0.38	Cimarex Energy Co.	0.18	0.05
81	Fushan International Energy Group Ltd.	0.34	Questar Corp.	0.12	0.11
82	Noble Group Ltd	0.34	GDF Suez S.A.	0.17	0.05
83	Itochu Corp.	0.34	Swift Energy Co.	0.20	0.01
84	Jizhong Energy Resources Co. Ltd.	0.30	Compania Espanola de Petroleos S.A.	0.21	-
85	Northern Energy Corp. Ltd.	0.29	PetroBakken Energy Ltd.	0.21	0.00
86	NTPC Ltd.	0.28	Premier Oil PLC	0.18	0.03
87	Prophecy Resource Corp.	0.28	Bonavista Energy Corp	0.18	0.03
88	Mitsui Matsushima Co. Ltd.	0.28	MOL Hungarian Oil and Gas Plc	0.19	0.01
89	Fortune Minerals Ltd.	0.28	SM Energy Co.	0.17	0.02
90	Black Hills Corp.	0.27	Williams Cos.	-	0.18
91	Jindal Steel & Power Ltd.	0.26	EQT Corp.	0.01	0.17
92	Grupo Mexico S.A.B. de C.V.	0.26	Oil & Natural Gas Corp. Ltd.	-	0.18
93	Gansu Jingyuan Coal Industry & Electricity Power	0.26	Global Energy Development PLC	0.17	0.00
94	Bandanna Energy Ltd.	0.25	Oil India Ltd.	0.16	0.01
95	Irkutskenergo	0.23	Venoco Inc.	0.16	0.01
96	Alcoa Inc.	0.23	INA-Industrija Nafte	0.17	-
97	Homeland Energy Group Ltd.	0.23	PA Resources AB	0.16	-
98	Neyveli Lignite Corp. Ltd.	0.19	Ultra Petroleum Corp.	-	0.16
99	Zhengzhou Coal Industry & Electric Power Co. Ltd.	0.15	Resolute Energy Corp.	0.16	0.00
100	Gujarat NRE Coking Coal Ltd.	0.12	Southwestern Energy Co.	0.00	0.16
Grand Total		**389.19**	**Grand Total**	**319.13**	**37.34**

5. Focus on the UK

The established home of fossil fuel companies

The UK market is the financial home to many of the world's largest oil, gas and coal companies, including BP, Royal Dutch Shell, Rio Tinto, BHP Billiton, Anglo American, and Xstrata. Recently these established stocks have been joined by Glencore in the FTSE100. Fossil fuel asset acquisition vehicles Vallar and Vallares are also aiming to enter this benchmark index. This wave of capital raising for fossil fuel extraction on the London Stock Exchange suggests the appetite of investors remains undiminished.

Raising capital

The London Stock Exchange has a higher number of foreign listed companies than any other exchange and is one of the leading centres for foreign equity trading. It is also one of the leading locations for raising capital with 13% of global further share issues in 2009 and 9% of international Initial Public Offerings (IPOs).[8] In the first 24 weeks of 2011, 70.8% of new IPO's in London were for mining companies.[9] UK fund managers are responsible for over £4.1 trillion in assets. Two-thirds of these represent savings of UK citizens through, for example, pensions and life assurance policies.[10]

UK Carbon budget

The UK has established emissions reductions targets through the Climate Change Act 2008 to cut emissions by 34% by 2020 and 80% by 2050 against a 1990 baseline.[11] The UK's domestic carbon budgets put the significance of its financial markets in context. London currently has 105.5 $GtCO_2$ of fossil fuel reserves listed on its exchange. This compares with the UK's carbon budget for 2011 to 2050, which is estimated as 9.5 – 10.5 $GtCO_2$, depending on the precise rate of reduction achieved, (N.B. this excludes non-CO_2 greenhouse gas emissions).[12] The LSE therefore currently has reserves equivalent to around ten times the UK CO_2 budget between now and 2050.

Individual companies such as BP, Royal Dutch Shell, Xstrata, BHP Billiton and Anglo American, each have greater CO_2 potential in their reserves than can be emitted under the UK carbon budget to 2050. We take it as a positive sign that the Financial Reporting Review Council took measures to require Rio Tinto to augment its reporting of environmental and social risks in its annual reporting,[13] but more scrutiny is required across the board.

UK Carbon footprint

Conventional assessments of a country's carbon footprint merely look at the emissions generated within its borders and fail to include emissions embedded in trade or investment flows. Just as the UK's carbon performance deteriorates significantly once the emissions embedded in its imports are included, so London's over-weight position in fossil fuels makes the financial transition to a low-carbon economy that much harder. The bulk of these assets will not only be located outside the UK, but will also be consumed outside the UK. But the carbon risks associated with these assets rebound back onto the UK market and those who invest in it, including the bulk of the savings and investments of its ordinary citizens.

Overweight?

The UK has less than 0.2% of the world's coal, oil and gas reserves and accounts for around 1.8% of global consumption of fossil fuels.[14] The carbon dioxide potential of the reserves listed in London account for 18.7% of the remaining global carbon budget. So the UK is the financial home to the CO_2 potential of around 100 times its own reserves. It has already been identified that the extent to which the FTSE100 has become dominated by mining, oil and gas companies leaves those tracking the index exposed to commodities prices risk. It follows that this also constitutes a carbon exposure risk.[15]

Green capital?

London's strong position in capitalising fossil fuels could expose the UK economy, which is centred on its financial markets, to a disproportionate systemic risk due to a concentration of value placed in coal, oil and gas stocks. It has been identified by political leaders that London's financial centre has an opportunity to become part of the solution to climate change, as a green finance centre. A significant reallocation of capital is required to shift London from perpetuating the dominance of fossil fuels.

Boris Johnson, Mayor of London, has set out his vision for the city's future:
'A century ago London was cashing in on carbon, but I am determined we now harness the wealth of investment opportunities coming from the shift away from the use of increasingly costly fossil fuels' (Boris Johnson, London Major, April 2011)[16].

Climate change Minister Greg Barker launched the Capital Markets Climate Initiative (CMCI) in 2010, stating:
"We want the City of London, with its unique expertise in innovative financial products, to lead the world and become the global hub for green growth finance. We need to put the sub-prime disaster behind us and focus back on investment in genuine wealth creation and in ways that don't damage the environment".[17]

We support these objectives. However, the government will need to address both sides of the equation; renewables will not develop to the extent required to meet climate change targets until fossil fuel risk is re-priced by the capital markets.

Financial stability

The UK government has been conducting a number of reviews of the financial sector as it deals with the fallout from the financial crisis. It envisages that the Financial Policy Committee (FPC) will contribute to the Bank of Englands financial stability objective by 'identifying, monitoring, and taking action to remove or reduce, systemic risks with a view to protecting and enhancing the resilience of the UK financial system'. An important initial task will be to undertake preparatory work and analysis into potential macro-prudential tools.

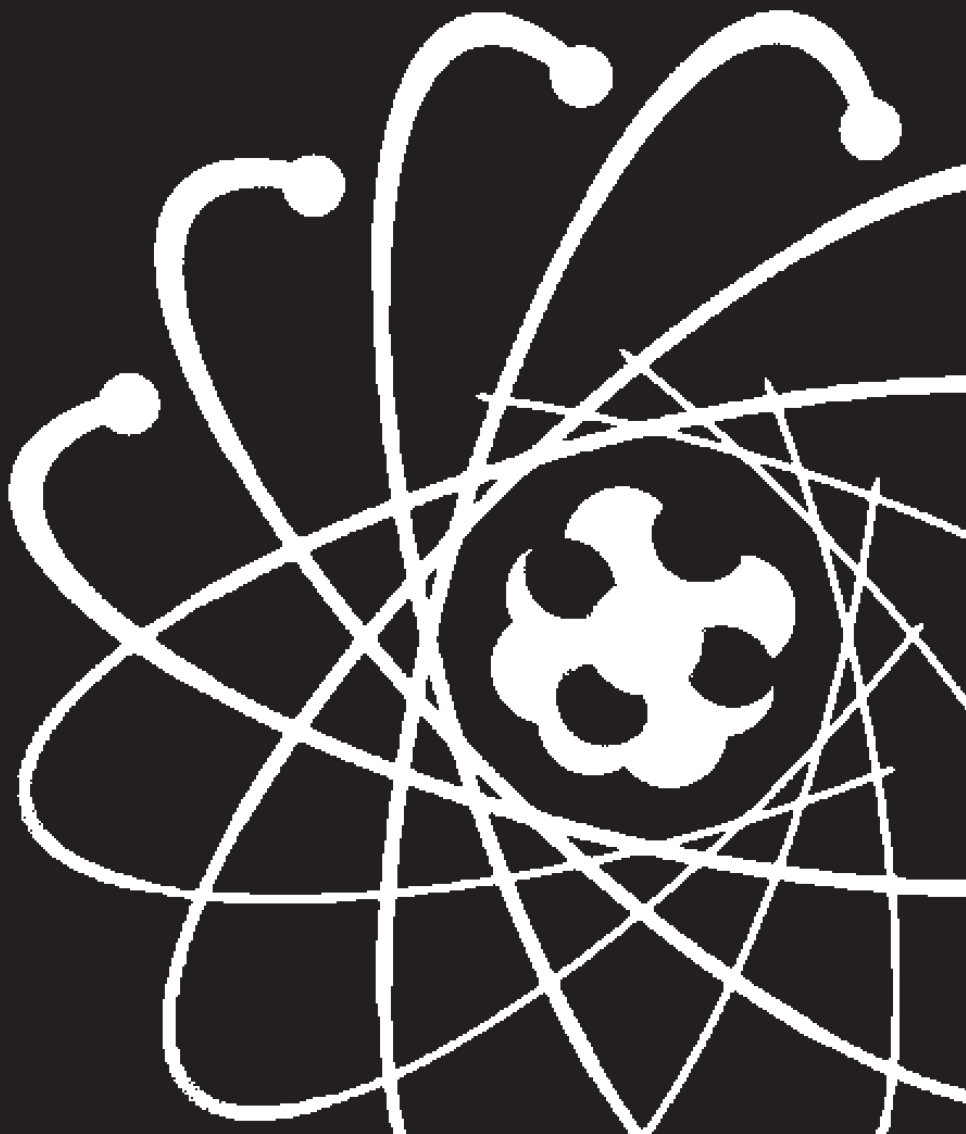
Chancellor George Osbourne described the role of the FPC is to:[18]
"Monitor overall risks in the financial system, identify bubbles as they develop, spot dangerous inter-connections and deploy new tools to deal with excessive levels of leverage before it is too late".

As the UK revises the structure of its financial regulatory bodies in 2011/12, it should consider how to address systemic risks including climate change. We believe it is essential that the FPC addresses the carbon bubble.

Minister for Business, Innovation and Skills, Vince Cable, has initiated an independent review of investment in UK equity markets, which will be conducted by Professor John Kay.[19] The review follows BIS's call for evidence entitled *"A long-term focus for corporate Britain"*, which identified that short-termism was a structural problem in the investment chain. The Kay review is specifically tasked with making recommendations on altering the timescales applied in investment practices and improving transparency, which would appear very relevant to tackling the carbon bubble.

'In the first 24 weeks of 2011, 70.8% of new IPO's in London were for mining companies.'

Part B:
What this analysis means for those involved in raising capital on the financial markets

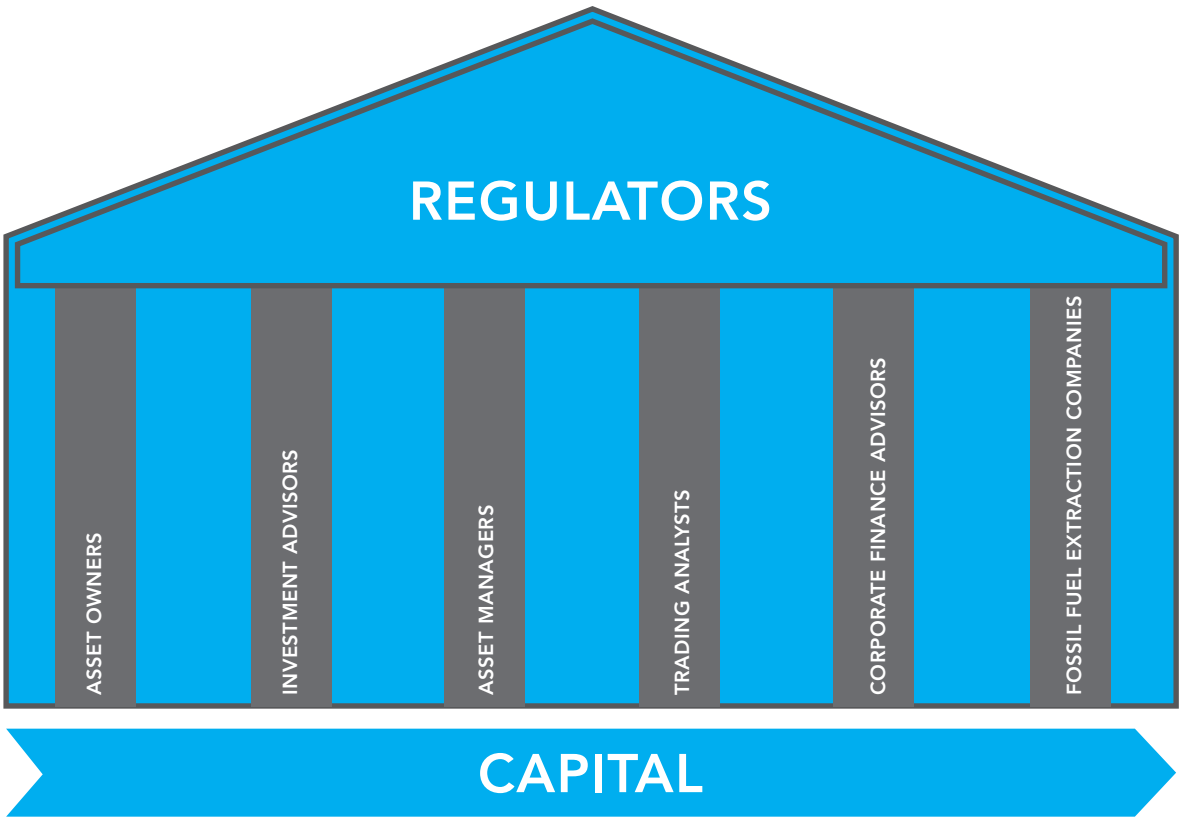


What this analysis means for those involved in raising capital on the financial markets

New players continue to come to the markets to raise capital for exploration and development. But the figures show that five times the fossil fuel reserves needed to take us to 2°C warming have already been found. Current energy consumption trends are set to use up the global carbon budget in approximately 16 years. In this context it is clear the capital markets are continuing to finance new exploration, adding new reserves which are unlikely to be developed if we are to tackle climate change.

The following types of organisation are involved in the investment process which continues to make capital available to finance further exploration and development of reserves and resources which may be unburnable carbon.

Fig.6



The current system of market oversight and regulatory supervision is not adequate to send the required signals to shift capital towards a low carbon economy at the speed or scale required. The current short-term approach of the investment industry leaves asset owners exposed to a portfolio of assets whose value is likely to be seriously impaired.

Until international regulatory frameworks and accounting methodologies for valuing reserves change, it is perfectly logical for investors, and their advisors, analysts, and brokers, to ignore long-term problems for fear of missing out on short term gain. Corporates are driven by the same quarterly results cycle and in the extractives sector are valued for increasing reserves.

Active shareholders need to push harder for actions which would reflect their long-term ownership position. Few to date have shifted down a gear in terms of their exposure to fossil fuel assets. In the same way that universal owners held Lehman Brothers and HBOS to their collapse, asset owners cannot accept that a problem exists until the carbon asset bubble bursts. Only changes in market oversight and regulation will drive the improvements in transparency, risk assessment and reserves valuation practices which are required to deliver the shift in capital to finance the low carbon future we need.

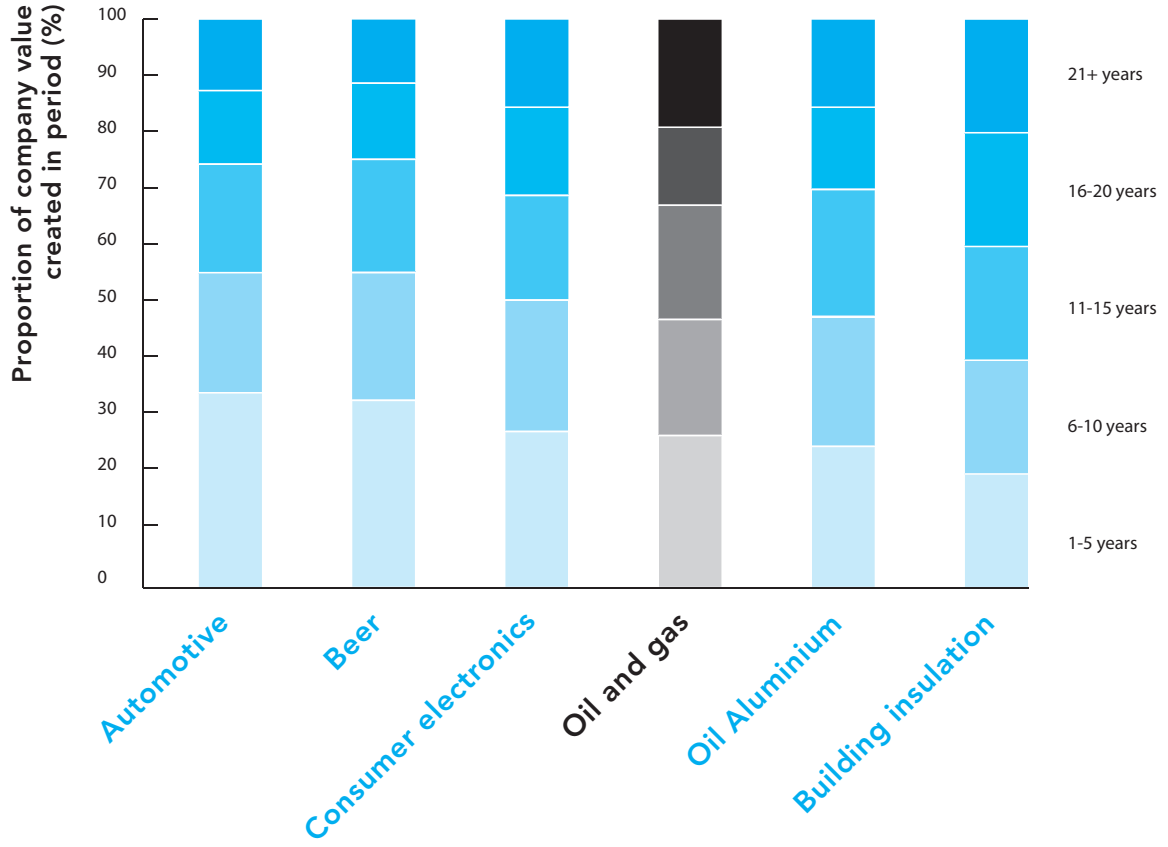
6. Valuation of companies

For extractives companies the level of reserves and the company's success in replacing them as they are exploited feed directly into the valuation placed on the company. The huge investment made by oil and gas companies in exploring for future production demonstrates the importance to the sector of securing access to production to come onstream over the next decade as more mature fields decline.

Analysis by McKinsey and the Carbon Trust demonstrates that greater than 50% of the value of an oil and gas company resides in the value of cash flows to be generated in year 11 onwards.[20] The context for accessing, exploiting and utilising reserves should look very different in 10 years time. This poses a significant risk to the value tied up in the extractives sector.

The significance of reserves for a company's share price was demonstrated by the impact of Shell restating its reserves in January 2004. Shell reduced its level of reserves by around 20% which saw the share price drop by 10% in a week, removing around £3billion of the company's value.[21] This also indicates that an oil major's reserves contribute around 50% of the financial value attributed to the company by investors.

Fig.7



Source: Carbon Trust and McKinsey & Co. analysis
Note: Analysis based on discounted cash flow valuations of hypothetical but typical companies, using typical company discount rates.

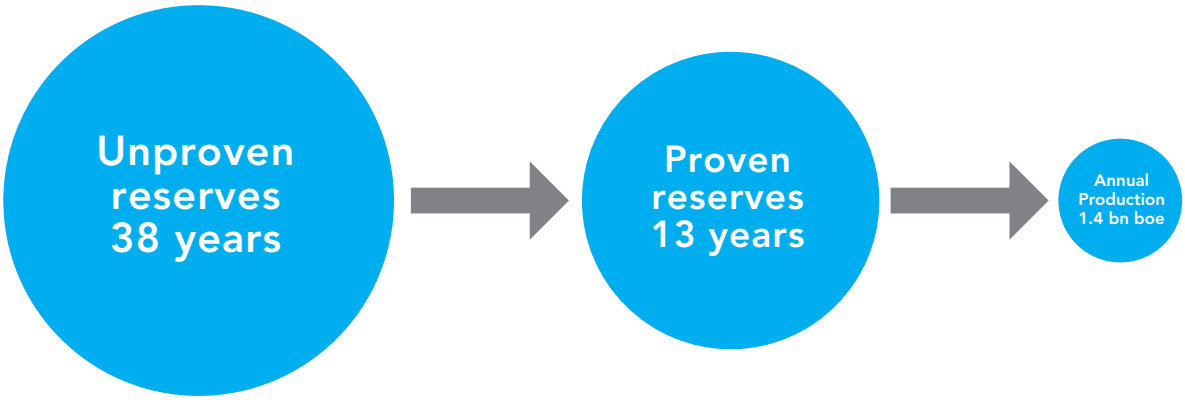
Existing listed carbon stocks

The reserves of companies already listed on exchanges are updated regularly to reflect depletion, revisions and new finds. For example, oil companies focus on their reserves replacement ratio which indicates whether they have found new reserves to at least replace the amount they have produced that year. The reserves-to-production ratio indicates the number of years of production at current rates a company could enjoy from existing reserves. For example Shell has a production-to-reserves ratio of 11.5 years, yet is still investing $25-27 billion CAPEX each year to develop more production.[22]

BP has around 13 years of proven reserves at its current level of production and a CAPEX of around $17bn [23]. However waiting in the wings for BP is a further 35 years of unproven reserves, waiting to be further developed and proven so they can be added to the official stockpile. This means there is an even larger unproven reserves bubble hidden on the capital markets.

The relationship between BP's unproven and proven reserves

Fig.8



There is obviously a time lag involved in the exploitation of any new asset, with 5 to 10 years passing between exploration and the start of its ultimate development which may then continue for decades. The reserves data feeds into the valuations placed on a company's shares and assumes exploitation of the assets at a certain production level and price at a discounted rate going forward. If 'proven' reserves become less viable they may have to be reclassified as 'contingent' reserves.

"Valuations of the oil and gas sector still assume that they will be able to take all proven and probable reserves out of the ground and burn them. Based on credible data we cannot be allowed to do that, because it is likely to leave us north of 700 parts per million (ppm) of CO_2 in the atmosphere." (Steve Waygood, Aviva Investors)[24]

The conventional wisdom on the world's stock markets is that all listed reserves will be exploited and burnt. However, analysis in this report shows that this would lead to emissions exceeding the level regarded as necessary to control global warming. One clear implication is that a significant proportion of current listed reserves – as well as future reserves that are generated from current CAPEX – will need to remain in the ground. The imposition of this carbon constraint will act as a de facto reduction in demand threatening a reduction in the value of these assets. The key issue for markets and investors is that this rebalancing takes place with as little damage to investment values as possible.

More analysis is required to identify which reserves are more likely to be burnt and which will be stranded. There will be winners and losers in such a scenario. The outcomes will also depend on how sudden a transition is required and what hedging strategies are employed by different companies. This leads to questions such as:

- Which of the assets you have an interest in are amongst the 20% of fossil fuel reserves we can afford to burn in the next 40 years?
- If you sanction capital expenditure on finding and developing more reserves, just how likely is it that those new reserves can ever be burned?
- What discount rates would it be prudent for investors to use when valuing reserves? Are historical discount rates too optimistic given the likely haircut to reserves values that corporate owners of fossil fuels are likely to have to take?

Furthermore, as the regulators of the capital markets will need to look closely at disclosures and reporting requirements around how reserves are presented, accountants and auditors will need to revise guidelines on how value is recorded:

- If not all reserves that are exchange listed can be burnt, how should auditors account for these stranded assets?
- What assumptions need to be reviewed in order to create a reliable assessment of which assets are contingent or impaired?

7. Corporate disclosure

Carbon Flows & Carbon Stocks: From voluntary to mandatory disclosure

Voluntary efforts to provide investment analysts with standardised data on climate risks across and within sectors have been developed by the Global Reporting Initiative and the Carbon Disclosure Project. Many oil, coal and gas companies have provided information on their annual direct carbon emissions and management strategies. A few have also published estimates of the emissions associated with the use of their products (Scope 3 emissions under the GHG Reporting Protocol).

While disclosure of carbon flows is becoming established, there is little reporting on the carbon stocks represented by fossil fuel reserves. As a result, arguably the most material climate change risk remains hidden from corporate reports as the future of the business rests on future licenses to emit carbon rather than past emissions.

A change of mindset is required to consider whether stocks of fossil fuel reserves may pose a long-term systemic risk.

This will require moving beyond annual reporting of last year's production and emissions flows to a much more forward-looking analysis. Essentially what is needed is a mandatory requirement for extractives companies to apply scope 3 in a forward looking way to cover the future emissions embedded in reserves.

From standalone to integrated reporting

The materiality of climate change for fossil fuel corporations means that standalone reports are insufficient. Truly integrated reporting means that all issues are considered together, applying the same tests of materiality and reliability. The International Federation of Accountants has brought out a revised version of its sustainability framework which acts as a reference point for accountants working with an integrated reporting approach.[25]

The trend towards integrated reporting has become global with the establishment of the International Integrated Reporting Committee (IIRC).[26] This offers an opportunity to consider how to marry the reporting of reserves and carbon reporting in the primary output of an extractives company of its material issues. South Africa is leading the way with the Johannesburg Stock Exchange releasing a draft framework for integrated reporting in 2011.

The Integrated Reporting Council of South Africa released a guide at the start of 2011 which is seeking to initiate a fundamental shift in how companies provide information to their stakeholders. It states:[27]

"The overarching objective of integrated reporting in general, and the integrated report in particular, is to report to stakeholders on the strategy, performance and activities of the organisation in a manner that enables stakeholders to assess the ability of the organisation to create and sustain value over the short, medium and long-term. Further, it is to foster appreciation, both within the organisation and among its stakeholders, of the extent to which the organisation's ability to create and sustain value is based on financial, social, economic and environmental systems and by the quality of its relationships with its stakeholders."

8. Capitalising carbon through the listing process

Key global IPO statistics

The equity markets continue to be a major source of capital to the extractive industries, either through initial public offerings or further share issues. The materials and energy sectors raised $61.7bn in 2010 in a weak market. The top 5 exchanges in terms of total capital raised were Hong Kong ($57.4bn), New York ($34.7bn), Shenzhen — SME ($30.2bn), Shanghai ($27.9bn), Tokyo ($14.3bn).[28]

More recently, the rapidly developing economies of China, Brazil, India and Russia have also been bringing their state enterprises to the markets. Shenhua Energy, Petrobras, Coal India, and Gazprom are examples of this trend. This leads to a truly global market linking western investors with fossil fuel giants around the world. There is continuing competition between the major markets to be the leading stock exchange and capital market centres of choice for fossil fuel developers.

IPO Prospectuses

Reserves continue to be listed on markets with limited reference to potential climate change risk. The current system places the responsibility for the contents of an IPO prospectus firmly with the entity seeking to raise capital. The book runners and listings authorities disclaim responsibility for the accuracy and reliability for the contents of these documents. Such documents do sometimes make reference to potential climate change risks. However, this can appear as more of a catch-all approach to mention all risks rather than a clear description of what is most material.

There has been much debate around not introducing onerous carbon reporting requirements on companies. Shareholders should be able to expect a company to make a clear statement of its reserves and translate these into potential carbon dioxide emissions. This simple requirement would enable regulators to produce cumulative figures and indicate which direction the carbon intensity of the market is heading. Additionally, those responsible for market stability would be able to see broad market risks, much called for post the banking collapse.

Bookrunners

In our view, the Investment banks which advise on the preparation of prospectuses and are the lead bookrunners and managers for IPOs should apply environmental and social risk policies in the advisory services they provide. There has been some consideration of this under extending the scope of application of the Equator Principles and following the development of the Climate Principles.[29] For example HSBC states its Energy policy applies as follows:

"The financial services covered by the policy include all lending and other forms of financial assistance, debt and equity capital markets activities, project finance and advisory work."[30]

However, according to the 2011 Climate Principles review the signatories have struggled with implementation across investment banking functions such as underwriting share issues.[31] It is not uncommon for an investment bank with a dedicated climate change research division to put its name on an IPO prospectus for a fossil fuel company which fails to even mention climate change.[32]

The American investment banks dominate equity capital-raising services, with JPMorgan, Morgan Stanley, Goldman Sachs and Bank of America Merrill Lynch all earning more than $1bn in fees in 2010 during a slow year on the markets.[33] 2011 is predicted to be a bumper year for IPOs as prices strengthen and companies have more confidence in going to the markets.

9. Regulators and stock exchanges

The structure of stock exchanges and their regulators varies around the world. A government body will be the listing authority regulating the market and, in some cases, they may also run the stock exchange as a public entity. In other jurisdictions the stock exchange has been privatised.

The World Federation of Exchanges (WFE) has hosted dialogues on sustainable stock exchanges over the last couple of years and in 2010 UNCTAD sponsored a publication outlining options for more sustainable stock exchanges.[34] It is encouraging to see the UN and the world's exchanges recognising this role and we would encourage them to promote specific disclosures by corporate owners of embedded carbon on exchanges. The suggestions for integrating sustainability at exchanges included:

- Enhancing the Environmental, Social & Governance (ESG) due diligence capacity in the pre-IPO ecosystem
- Supporting efforts to quantify ESG criteria and define reporting KPIs by sector and incorporate them into guidelines
- Assisting in the development of integrated financial reporting and comparable financial statements across borders
- Supporting collaborative initiatives which work towards eradicating market short termism.

Investors representing $1.6trillion under management are working with the UNPRI to engage with exchanges about their plans to integrate ESG issues into listing requirements.[35] Greater focus on these areas by stock exchanges would certainly contribute to aligning the world's financial markets with the climate change policy agenda.

Changing behaviour?

The research conducted by the Climate Disclosure Standards Board (CDSB) on behalf of DEFRA concludes that the regulator needs to act:

"The scale of environmental investing is expected to grow only if the entire market would first swing towards it and that without structural intervention of some sort, an impasse is likely to remain."[36]

This indicates that the benefits of voluntary measures have now peaked and those that are likely to choose to act have already done so. The UK is proud of its role as a global financial centre. Indeed the UK economy has become increasingly reliant on it. However, if the UK is to take a leadership position on climate change it cannot continue to ignore the failure of its financial market to change its fundamental approach and decarbonise energy investment.

Taking responsibility

We believe listing authorities need to take greater responsibility for reviewing the provision of information by listed companies and ensuring that systemic risks are addressed. Further regulation, guidance, and monitoring will be needed to shift practices across exchanges with a much more active role required from the listings authorities.

10. Relevance for investors

Exposure

The UK and US markets account for around three quarters of global mutual funds and had $0.88 trillion under management invested in index-tracker funds. Beyond this, even actively managed mainstream funds rarely deviate significantly from the sector distribution of the major indices. This can be partly explained by the tendency for performance to be measured against a benchmark index. In the UK, 72.6% of corporate pension funds used an index benchmark as the primary investment objective in 2009.[37]

Knock-on effects

Exchanges with above average investment in fossil fuel assets expose their domestic and international investors to, as yet, unquantified risks of stranded carbon. These risks increase in direct proportion to their absolute exposure to fossil fuels. Where exchanges have a high proportion of listed fossil fuel companies owning unburnable carbon the knock-on effects to others within the financial markets risks are worth noting. Pension funds risk funding shortfalls to their member pension entitlements if they are unable to realise value from their fossil fuel investments. Bank lending exposures to the sector may mean that central bank regulators will require significant haircuts to be taken to the value of their fossil fuel loan books. Savers as a group will face considerable uncertainty as to the true value of their portfolios if their investments blindly track carbon intensive markets.

Gross capital misallocation

The latest UNEP report into creating a green economy starts by describing an 'era of gross capital misallocation'. In describing the crises of climate, biodiversity, fuel, food, water, and of late in the financial system and the economy as a whole, UNEP state:

"Although the causes of these crises vary, at a fundamental level they all share a common feature: the gross misallocation of capital. During the last two decades, much capital was poured into property, fossil fuels and structured financial assets with embedded derivatives, but relatively little in comparison was invested in renewable energy, energy efficiency, public transportation, sustainable agriculture, ecosystem and biodiversity protection, and land and water conservation."

Universal ownership and systemic risk

The LAPFF guide for trustees to address climate change outlines why it is important for them to address systemic issues:

"Institutional investors are often viewed as 'universal owners' and, as such, the performance of their portfolios is tied to the performance of the markets, economies and sectors they invest in as much as that of individual companies. This vested interest in the general long-term health of economies provides a strong case for addressing issues that are systemic in nature – particularly for passive managers whose fortunes are tied up with those of the market. To a large extent exposure to climate change and its impacts is systemic in nature. It has the potential to impact a broad range of sectors and the value at risk from climate change can be of the same magnitude as that of other investment risks. All managers, both passive and active, are exposed to risks associated with climate change which makes it an area of concern for trustees."[38]

Fiduciary duty

The responsibilities of those entrusted with managing the assets of others; from pension fund trustees to fund managers, have been cited as both a justification for and a barrier against addressing environmental and social risks. It has been suggested by the 'Freshfields II' report from UNEPFI that failing to address non-financial risks could be a breach of fiduciary duty.[39] In our view, pension fund members certainly have a right to know how those managing their fund are addressing systemic risks including the climate change risk identified in this report.

From the investor perspective, the continuing short-term approach of investing in assets that attempt to generate benchmark beating returns means that fund managers are incentivised to focus upon quarterly returns and not to deviate too far from the overall market to reduce the risk of underperforming.

Performance benchmarks

This is a structural problem that is reflected in the benchmarks that are used to measure the performance of active equity managers and the indices that are used as the basis for passive, tracker funds. It would be almost impossible for a mainstream asset manager in Australia or the UK, for example, to reduce her/his weighting to fossil fuel assets compare to the global average without seriously questioning the market risk this would involve given the way that risk is measured in terms of beta. This means that, even with rising awareness of climate change as an investment challenge, there is limited scope in current market frameworks to make informed choices. Passive funds have no ability to reduce their carbon risk through active management and so the structural constraints are even more fundamental.

Investment policy

A recent survey conducted by the investor groups working on climate change found that 98% of asset owners view climate change issues as a material investment risk/opportunity across their organisation's entire investment portfolio.[40] More than 80% of asset managers and 57% of asset owners make specific reference to climate change risk in their investment policy.

The survey identified that further analysis is needed around portfolio level risk and opportunity exposure. A key constraint on improved investor practice was cited as being the lack of comprehensive and comparable data on carbon emissions, emissions reductions, and energy efficiency cost savings associated with assets.

The survey concluded: *"the question of materiality remains a key issue, which is closely linked to a wider industry problem of "short-termism" and policy. It was suggested that asset owners have a critical role to play in signalling to their managers that they are long-term investors and consider climate-related risks and opportunities material to their strategic long-term investment decisions".*

In the UK, 72.6% of corporate pension funds used an index benchmark as the primary investment objective in 2009.[37]

Climate change policy risk in asset allocation

A study from Mercer proposing scenarios as a means of factoring in climate change to strategic asset allocation was sponsored by some of the world's largest pension funds.[41] This research indicates that uncertainty around climate change policy presents significant portfolio risk to institutional investors; equivalent to 10% of total risk factors (for a portfolio with 47% in equities). Our analysis provides a further layer to consider; sector level risk associated with the distribution of overcapitalised fossil fuel reserves across exchanges. We believe the evidence presented in this report demonstrates the need for investors to increase their engagement with the exchanges and regulators around the listing process and disclosure requirements so that they are able to assess systemic climate change risk.

Forward-looking data requirements

Despite the efforts of voluntary initiatives, a recent survey by the CDSB indicated that nearly 60% of the investment community are dissatisfied (in varying degrees) with company carbon reports in terms of their appropriateness, completeness and reliability for portfolio analysis.[42]

There is a surprisingly limited amount of information available through mainstream financial data providers on the levels of fossil fuel reserves. In sourcing data for this research, the coverage of reserves data was not sufficient to provide a clear overview, even for the most traded global stocks. Some efforts have been made to integrate carbon emissions data into research platforms and climate change risk into ratings. However, there is an opportunity to develop a comprehensive database on reserves and CO_2 potential for investors and provide analysis of the figures.

Investor demand

The Institutional Investors Group on Climate Change (IIGCC) has also produced a 'Global Climate Disclosure Framework for Oil & Gas companies'. This provides reporting templates which include emissions throughout the lifecycle of products, including product use. The template also asks for reserves data, split by different types of hydrocarbon (gas, conventional oil, heavy oil, other).[43] In the US, CERES has produced a guide to disclosing climate risks and opportunities in SEC filings which calls for reporting of:

- Estimated future direct and indirect emissions of greenhouse gases from their operations, purchased electricity, and products/services.

These requests from investor groups demonstrate that there is a strong requirement for more forward-looking information. The current limitations of voluntary reporting also demonstrate the need for investors to push for revised disclosure requirement by listing authorities.

11. Recommendations for resolving the capital markets' carbon bubble

Our report shows that fossil fuels appear to be overcapitalised. The capital markets have financed future fossil fuel development based on a false assumption: that what the corporate sector have asked investors to finance can actually be burnt. We believe this poses a large and currently unappreciated risk for the capital markets. In our view, the regulators charged with ensuring financial stability, tackling systemic risks and promoting long-term investment need to produce a common understanding of the financial consequences of unburnable carbon. We urge other stakeholders in the capital markets to give the regulators a strong message that they need to act to prevent the carbon bubble bursting.

Regulators

- Require reporting of fossil fuel reserves and potential CO_2 emissions by listed companies and those applying for listing
- Aggregate and publish the levels of reserves and emissions using appropriate accounting guidelines
- Assess the systemic risks posed to capital markets and wider economic prosperity through the overhang of unburnable carbon
- Ensure financial stability measures are in place to prevent a carbon bubble bursting
- Assess the systemic risks posed to capital markets and wider economic prosperity through the overhang of unburnable carbon.

Asset owners

- Review how the scale and concentration of fossil fuels on stock exchanges fits with long-term investment policies on climate change
- Review your exposure to systemic risk through passively invested funds tracking fossil fuel intensive indices
- Assess whether you have interests in potentially stranded assets if only 20% of the world's fossil fuel reserves can be burnt
- Revise performance benchmarks for fund managers to disconnect incentives from the short-term performance of fossil-fuel intensive indices.

Investment Consultants / Brokers / Analysts / Ratings Agencies / Data Providers

- Review the potential risks of asset allocation related to the overcapitalisation of reserves
- Explore how this analysis impacts on the valuation of reserves and ultimately companies
- Provide data on CO_2 potential of stocks and indices.

Investment Banks

- Apply environmental and social risk policies to advisory services, i.e. underwriting share issues and assessing risks during the IPO process.

Accountants

- Integrate reporting of reserves, emissions, climate change risk and asset valuation to take account of the potential for unburnable carbon and the resulting impaired assets.

Extractives Companies

- Report potential climate change emissions and material risks associated with fossil fuel reserves.

We would welcome the opportunity to work with you on tackling this challenge and improving understanding of the potential systemic risk this poses to the world's capital markets.

Appendix 1:
Methodology

Reserves data

Coal reserves data was provided by Raw Materials Group (RMG). More information is available at www.rmg.se
Oil and gas reserves data was provided by Evaluate Energy. More information is available at www.evaluateenergy.com

The reserves data was based on the most recent reported information on proven reserves at the end of 2010. 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. The research providers are leaders in their sectors and have the most complete dataset available. However, reporting of reserves and ownership in some parts of the world is not as transparent as others.

Carbon dioxide emissions factors

The formula for calculating the carbon emissions from the reserves was taken from the methodology used by the Potsdam Climate Institute. This estimates potential emissions from proven recoverable reserves of fossil fuels, according to $E = R \times V \times C \times f$, where E 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 ($GtCO_2/tC$).[44] V and C come from the IPCC Guidelines for National Greenhouse Gas Emissions Inventories.[45] The Potsdam methodology applies CO_2-only factors to the fuels, as IPCC factors for all the Kyoto gases to give CO_2-equivalent are specific to the use of the fuels. The total level of greenhouse gases will therefore be higher; however the CO_2-only data is used consistently throughout for calculating both the budgets and emissions from reserves. Care must be taken if you wish to compare these figures to CO_2e data.

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.

Canadian tar sands reserves figures

We believe the figures used for Canadian tar sands underestimate the reserves held by companies. This is due to the reserves booking approach stipulated by the Canadian Oil and Gas Evaluation Handbook whereby *"quantities must not be classified as reserves unless there is an expectation that the accumulation will be developed and placed on production within a reasonable timeframe."*

Typically Canadian companies interpret this as meaning that production is imminent. Given the start-stop history of tar sands projects with fluctuations in the oil price there is a precautionary approach to booking reserves. This results in companies with tar sands assets, which are known physical reserves, not always booking them due to uncertain economic viability. The SEC has produced more guidance on this topic which is starting to come through in the latest reserve reporting for US listed companies. This stipulates that unconventional reserves must be broken out from an overall oil reserves figure, and that economic viability should be based on the average of the 12-month average crude price of the first day of each month in the reporting period, rather than the end of year price.

Equity basis

Reserves, and therefore potential emissions, were attributed to each company on an equity ownership basis. Where companies still had a government interest of more than 10% only the publicly listed proportion was attributed to the stock, and therefore its exchange.

Exchange allocation

The reserves were attributed to the primary exchange of the company. For companies with dual listings the reserves were split equally between the two exchanges. This provides an indication of the primary regulator for the company. However, many companies have several listings often using depositary receipts and other mechanisms to access other markets.

Top 100 selection

The companies selected to be included in this assessment were the top 100 coal companies and the top 100 oil and gas companies, assessed on the potential carbon emissions from their reserves. There will be further fossil fuel reserves listed on the world's financial markets. However, the levels of reserves reported by these companies would not significantly affect the findings of this report. Each company beyond the top 100 coal and oil & gas companies considered here has less than 0.15 $GtCO_2$ in reserves. This extra carbon only adds to the overall volume that is listed on the world's stock markets.

Market Capitalisation

Verification of the stock listings and their market capitalisation was completed in February 2011. Obviously this will be changing on a daily basis and new listings, mergers and acquisitions and corporate restructures are occurring all the time.

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 believe the dataset to be of sufficient quality to test the overall hypothesis that there is sufficient carbon listed to use up the global carbon budget to 2050 and give a reasonable representation of the geographical distribution across the exchanges. We welcome comments on how to improve the analysis and suggestions of useful outputs for future versions.

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Carbon Tracker Initiative

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