



The Carbon Underground

The World's Top 200 Public Companies,
Ranked by the Carbon Content of their Fossil Fuel Reserves

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Executive Summary

The CO₂ emissions potential of the coal, oil and gas reserves of the world's 200 largest public fossil fuel companies continues to grow (8.4% since year-end 2010), despite the dwindling carbon emissions budget implied by a broad government policy agreement to avoid excessive global warming.

The Carbon Underground identifies the 100 largest public coal companies, and the 100 largest public oil and gas companies, based on estimates of the potential CO₂ emissions of their reported reserves as of November 2013. The trends evidenced in this report demonstrate that reserve growth continues to be the norm for both the oil and gas and the coal sectors as a whole. The 546 Gt CO₂ emissions potential estimated to be embedded in the reported reserves of the 200 firms - The Carbon Underground 200™ - represents over 400% of the firms' carbon budget allocation, based on their share of carbon emissions potential of global reserves. This report estimates an updated carbon budget based on the only IPCC climate scenario with a future less than 2° C above preindustrial levels with >66% probability. These estimates broadly confirm growing research on the exposure of public fossil fuel companies, especially those in the coal sector, to potential constraints and revaluation based on stranded assets.

This report identifies changes in the top 200 fossil fuel companies and emissions potential over time, with a specific focus on developments since 2010. The research highlights the concentration of reserves, and hence emissions potential, in a small number of large firms. Still, the dynamism of the coal and oil and gas sectors globally is apparent in the changes among the 200 over time, with 27 companies newly entering the list since 2010.

Introduction

Despite the risks posed by global warming, and a consensus on the part of most governments that actions should be taken to limit the planet's temperature increase to no more than 2° C above preindustrial levels,¹ total fossil fuel reserves globally have continued to grow with ongoing exploration and development.² In April 2014, the Intergovernmental Panel on Climate Change (IPCC) revealed that cumulative CO₂ emissions from the fossil fuel industry and cement production over the last forty years are double the emissions of the previous two hundred and sixty years.³ The Panel warned that the window for action is closing and by 2030 maintaining temperature change below 2°C will be substantially more difficult.⁴

Based on estimates of the International Energy Association (IEA), the energy sector is the largest contributor to this increase in greenhouse gases, accounting for two-thirds of all emissions.⁵ Analysis of the carbon emissions content of the reserves of the world's 200 largest public coal, oil and gas companies, as summarized in this report, shows that just as reserves have grown, so too have potential emissions from the public fossil fuel companies of the world.

Not surprisingly, climate scientists, financial analysts, and investors alike are increasingly paying attention to carbon budgets, and the potential for stranded assets in the energy sector. A "carbon budget" is the volume of CO₂ emissions which cannot be exceeded in order to avoid global warming in excess of a target threshold.⁶ A "stranded asset" is an asset that becomes obsolete or non-performing but must be recorded on the balance sheet as a loss. In this case, fossil fuel deposits that cannot be extracted and sold due to regulation or market forces, legislation, disruptive innovation, or societal norms become stranded.⁷

The IEA estimated the energy sector carbon budget and compared it to proven reserves in 2012. Their finding was that four-fifths of existing reserves would need to be constrained in order to meet an 80% probability of limiting the planet's temperature increase to 2° C.⁸ Based on the only climate scenario published in the IPCC's Climate Change 2014 deemed likely to limit global temperature increase to 2° C,⁹ the current energy sector carbon budget is estimated as:

66% probability of keeping temperatures below 2° C increase:

• Emissions budget: fossil fuels & land use change 2011 – 2050 ¹⁰	925 Gt CO ₂
• Fossil fuel emissions 2011 – 2013 ¹¹	(97 Gt CO ₂)
• Projected non-fossil fuel emissions 2011 – 2050 ¹²	(104 Gt CO ₂)
• Remaining energy sector carbon budget through 2050	724 Gt CO ₂

This updated carbon budget provides a benchmark for understanding the risk to both the firms owning potential CO₂ emitting reserves, and to the investors in those firms. Baseline scenarios presented by the IPCC in which current policies remain unchanged show emissions increasing by 50% over the next forty years and likely temperature increases over 4° C.¹³ The scenario likely to maintain global temperature increases less than 2° C, and used to calculate the carbon budget, decreases emissions by 10% over the same period. Even with this aggressive emissions reduction, the budget is exhausted in 22 years.¹⁴ at which time over three quarters of today's reserves will remain unburned. Yet exploration and development of fossil fuel resources continue unabated. According to calculations based on IEA documents¹⁵ and the World Energy Council,¹⁶ the total carbon emissions for proven reserves stands at 3,200 Gt CO₂,¹⁷ almost four and a half times the carbon budget.

The Carbon Tracker Initiative first linked carbon budgets with investor risk in its 2011 "Unburnable Carbon" report,¹⁸ which looked at the top 200 fossil fuel companies with publicly traded shares, ranked on the carbon content of their reserves. In its subsequent 2013 update, Carbon Tracker

analyzed 200 publicly traded fossil fuel companies and assumed that their allotted portion of the total carbon budget was proportional with their percentage of the emissions from all global reserves. Carbon Tracker found that these companies had reserves whose embedded emissions total 340% beyond their allotted budget, and concluded that, “65% to 80% of listed companies’ reserves cannot be burned unmitigated.”¹⁹ The result is potentially significant amounts of “unburnable carbon.”

Reports by the IEA²⁰, IPCC²¹, and Carbon Tracker²² have further explored the extent of unburnable carbon in this carbon budget framework. The conclusion that the extent of unburnable carbon is significant appears to stand up under a range of different measurement approaches, different target temperature increases, and different potential mitigating factors.

When reserves become unburnable, these assets, with valuations based on their extraction and burning, become stranded. When the stranded assets are not reflected in market pricing, the companies owning these assets become overvalued. The “carbon bubble” that analysts refer to now adds financial risk to climate risk as a growing concern for investors in these fossil fuel companies.

THE TOP 200 LIST – FROM CARBON TRACKER 2011 TO THE CARBON UNDERGROUND 2014 AND BEYOND

As part of its “Unburnable Carbon” analysis published in 2011, the Carbon Tracker Initiative identified the top 100 public coal companies in the world and the top 100 public oil and gas companies in the world, both reported to be ranked by the carbon emissions embedded in reserves reported as of year-end 2010. In July 2012, Bill McKibben gave enormous exposure to the analysis when he initiated the fossil fuel divestment movement with the publication of *Global Warming’s Terrifying New Math*.²³ Adopting this top 200 list, 350.org joined with As You Sow, the Responsible Endowments Coalition, and Energy Action to kick off a fossil fuel divestment campaign in November 2012. The list, originally an analytical element of a research report, was thereby transformed into an operational element of what is now a global campaign aimed at encouraging university endowments and foundations, pension funds, NGOs, and individual investors to divest from the top 200 public companies with fossil fuel reserves.

The reserves landscape continues to evolve, and the task of monitoring the top 200 companies is an ongoing one. With this report, Fossil Free Indexes presents The Carbon Underground 200™, the latest update to this list, based on reserves data reported as of November 28, 2013. In the course of preparing this update, Fossil Free Indexes has created a systematic process that will permit regular updating in the future.

Methodology

INTRODUCTION

Fossil Free Indexes has used a reserves-based methodology to create The Carbon Underground 200™, a consistent listing of the top 100 public coal companies globally and the top 100 public oil and gas companies globally, ranked by the potential carbon emissions content of their reported reserves. This approach follows that of Meinshausen from the Potsdam Institute for Climate Impact Research.²⁴ It is largely consistent with the methodology reported to be the basis of the original list published by the Carbon Tracker Initiative in 2011 and used by the fossil fuel divestment campaign when it was launched in 2012.²⁵

RESERVES DATA SOURCES

The core data underlying The Carbon Underground 200 is based on reported reserves. For coal, SNL Metals & Mining (formerly IntierraRMG) with its Raw Materials Data Coal Database (“RMD Coal Database”) was selected as the primary provider of reserves information. For oil and gas, Evaluate Energy with its Global Oil & Gas Database (“EE Oil & Gas Database”) and CANOILS Database (“EE CANOILS Database”) was selected as the primary provider of reserves information.

In each case, data from these primary providers were checked against and in some cases supplemented during the analysis with data from publicly available primary sources and from other secondary data providers. The primary use of supplemental data was to provide support for estimating the kind of coal predominating in a mine.

RESERVES DEFINITIONS AND APPROACH

Coal reserves are reported in the RMD Coal Database as the sum of proven and probable reserves. Reserves are the economically mine-able portion of a measured or indicated resource. The distinction between proven and probable reserves is the likelihood of extraction.

The reporting of reserves by coal mine on an annual basis is not consistent among companies with exchange listings, nor is it consistent for each mine in which a company has a controlling interest. Due to the sporadic reporting of reserves by listed companies, this analysis uses the last reported reserves amount by mine. Reserves were allocated to listed companies based on percentage ownership of individual mines.

Oil and gas reserves are distinguished between proven (1P) and proven and probable (2P). Proven reserves are defined in the oil and gas industry as having a 90% probability of near-term extraction. Probable reserves are defined as having a 50% probability of extraction. This analysis uses proven reserves (1P) as the basis for ranking the top 100 oil and gas companies. Most oil and gas companies report proven reserves, while fewer than half of the public oil and gas companies report proven plus probable reserves. This research does not include any portion of probable oil and gas reserves, nor does it include any status quo assumptions of continued discovery and development to replenish oil reserves as they are utilized, both of which would increase the potential CO₂ emissions from these firms.

In order to maintain a consistent data set, oil and gas reserves data are represented net of royalty payments. Royalties are the government’s share of a company’s reserves, and vary by country and by project. The convention to represent reserves data net of royalties is consistent across all Evaluate Energy databases.

DATE OF DATA USED

The calculations used to produce this first edition of The Carbon Underground 200 are based on reserves data available as of November 28, 2013. For the vast majority of companies, this data set includes year-end 2012 data, and for a small number of companies with fiscal years ending in March and June, a partial snapshot of 2013 data is included, as well. Corporate actions between November 28, 2013 and March 31, 2014 are included to ensure that all companies on the list were investable as of March 31, 2014.

EMISSIONS CALCULATION PROCESS

The Carbon Underground 200 relies on the IPCC *Revised 1996 Guidelines for National Greenhouse Gas Inventories*²⁶ as a methodological framework. The calculation of CO₂ emission potential requires several conversions to the raw reserves figures.

Categorization: Coal reserves are divided into five categories and petroleum reserves into four categories as follows:

Coal

- anthracite
- coking coal (metallurgical)
- other bituminous coal (thermal, PCI)
- sub-bituminous coal
- lignite

Petroleum

- oil
- natural gas liquids
- oil sands
- gas

In cases where the RMD database does not indicate the coal rank²⁷ for a specific mine, all available sources of information are used to estimate the coal rank, including the coal use and the predominant rank of coal in the basin, the coalfield, the state or province, the region, and/or the country. In cases where none of these sources provided sufficient information to estimate the coal rank, the most common global coal rank, bituminous, was assumed.

Evaluate Energy reports oil and natural gas liquids in aggregate. Reported annual production figures for oil and for natural gas liquids are used to estimate the relative proportion of oil reserves to natural gas liquids reserves. Additionally, where proven (1P) reserves are unavailable (five of the top 100), they are estimated using proven and probable (2P) reserves and a ratio based on the mean relationship between 1P and 2P for the companies that report both.

Normalization: Coal reserves are universally reported in millions of tons. Petroleum reserves are reported in a variety of volume units. All reserves figures are converted into gigagrams using average factors specific to each type of fossil fuel.

Energy and Carbon Content Factors: Fossil fuels vary widely in energy potential and carbon content across reserve types. Following the IPCC framework, net calorific values are assigned to each reserve type, to convert mass into energy units. IPCC carbon content factors indicating the amount of carbon released during combustion are assigned based on reserve type.²⁸

CO₂ Emission Calculation: Potential CO₂ emissions for reserves reported by each company are calculated based on the IPCC framework and the Potsdam Institute for Climate Impact Research formula $E = R \times V \times C \times F^{29}$, where E = emissions, R is reserves, V is net calorific value, and C is carbon content. F is a conversion factor accounting for transforming carbon into carbon dioxide and converting grams to gigatons.

LISTED COMPANIES

Given the continual mergers and acquisitions, closures, delisting, and IPO activities in the coal, oil and gas industries, this work is an ongoing best-efforts attempt at researching listed companies and basing the analysis on the latest available information. If subsidiaries are listed separately from their parent, and their reserves are reported separately from their parent, they are eligible to be included in The Carbon Underground 200. Companies that publicly trade only a portion of their overall shares are eligible to be included as well.

CONSTRUCTING THE CARBON UNDERGROUND 200™ LIST

Separate rankings have been created for the top 100 public coal companies globally and the top 100 public oil and gas companies globally.³⁰ The rankings are based on calculated carbon emissions data using reserves reported as of November 28, 2013. The ranking is then adjusted based on company mergers and acquisitions following the most recent reserve reports.

Data Accuracy

Fossil Free Indexes has utilized best efforts to include the most recent and consistent data available. Reserves data and company ownership interest data are only as accurate and as timely as the data contained within company reports. While starting with reserves database suppliers, a data verification process including a check of a sample of data points against primary sources was conducted. Going forward, each update to the list will incorporate the most recent data available at the time.

A Comparison of the Fossil Free Index and Carbon Tracker Methodologies and Results

There are some differences in methodology that determine estimates of projected emissions from oil reserves. Fossil Free Indexes estimated potential emissions from oil (as well as gas and coal) based on annually reported reserves. Carbon Tracker, which primarily sought to measure the fossil fuel sector's emissions potential relative to the carbon budget to 2050, assumed oil companies will replenish reserves through continued exploration and development. Accordingly, Carbon Tracker's estimates embed a business as usual approach that results in higher emissions estimates based on the inclusion of projected future production. Both approaches generate a substantially similar universe of companies that have the most exposure to fossil fuel assets and potential emissions from their reserves.

The Carbon Underground 200™

Rank	Coal Companies	Coal Gt CO ₂	Rank	Oil and Gas Companies	Oil Gt CO ₂	Gas Gt CO ₂	Total O&G Gt CO ₂
1	Coal India	57.722	1	Gazprom	6.248	37.292	43.540
2	Shenhua Group	31.523	2	Rosneft	10.059	1.979	12.039
3	Adani Enterprises	25.383	3	PetroChina	4.884	3.693	8.577
4	Shanxi Coking Company	18.445	4	ExxonMobil	4.143	4.038	8.181
5	BHP Billiton	13.469	5	Lukoil	5.666	1.280	6.946
6	Anglo American	12.985	6	BP	4.203	2.197	6.400
7	Inner Mongolia Yitai Coal	12.223	7	Petrobras	4.676	0.674	5.350
8	Datang Intl. Power	12.206	8	Royal Dutch Shell	2.140	2.332	4.473
9	China National Coal	12.071	9	Chevron	2.545	1.591	4.137
10	Peabody Energy	11.469	10	Total	2.130	1.683	3.813
11	Glencore Xstrata	10.453	11	Novatek	0.387	3.391	3.777
12	Datong Coal Industry	10.281	12	ConocoPhillips	1.661	1.069	2.730
13	Yanzhou Coal Mining	9.799	13	Tatneft	2.622	0.067	2.689
14	Public Power Corp (DEH)	9.339	14	ENI	1.418	1.142	2.561
15	Exxaro Resources	8.793	15	ONGC	1.449	0.703	2.152
16	Yangquan Coal Industry	7.298	16	Statoil	1.012	0.928	1.939
17	Mechel	6.739	17	Sinopec	1.204	0.367	1.571
18	Arch Coal	6.530	18	CNOOC	1.155	0.366	1.521
19	Alpha Natural Resources	5.482	19	BG	0.593	0.664	1.257
20	Mitsubishi	4.738	20	Occidental	0.950	0.303	1.253
21	Vale	4.401	21	Apache	0.586	0.461	1.047
22	Rio Tinto	4.338	22	Canadian Natural Resources	0.780	0.200	0.980
23	EVRAZ	4.235	23	Anadarko Petroleum	0.450	0.454	0.904
24	Raspadskaya	4.084	24	BHP Billiton	0.345	0.552	0.897
25	Asia Resource Minerals	3.181	25	Devon Energy	0.379	0.515	0.894
26	UC RUSAL	3.081	26	Chesapeake Energy	0.293	0.596	0.889
27	Neyveli Lignite	3.035	27	Bashneft	0.876	0.000	0.876
28	Pingdingshan Tianan Coal	3.023	28	Inpex	0.393	0.369	0.762
29	Cloud Peak Energy	2.881	29	Ecopetrol	0.580	0.157	0.737
30	Sasol	2.731	30	EOG Resources	0.392	0.258	0.650
31	Severstal	2.726	31	Suncor Energy	0.596	0.041	0.636
32	AGL Energy	2.704	32	Marathon Oil	0.473	0.151	0.624
33	Tata Steel	2.679	33	Hess	0.485	0.125	0.610
34	Teck Resources	2.603	34	Imperial Oil	0.561	0.027	0.587
35	Kuzbass Fuel	2.504	35	Encana	0.089	0.479	0.568
36	Polyus Gold	2.294	36	Energi Mega Persada	0.020	0.537	0.557
37	Energy Ventures	2.184	37	BASF	0.159	0.294	0.453
38	Whitehaven Coal	2.055	38	Repsol	0.182	0.265	0.446
39	Banpu	2.040	39	OMV	0.260	0.152	0.413
40	RWE	1.943	40	Noble Energy	0.141	0.271	0.412
41	Consol Energy	1.887	41	Woodside Petroleum	0.058	0.334	0.392
42	W H Soul Pattison	1.850	42	Pioneer Natural Resources	0.270	0.120	0.390
43	Resource Generation	1.818	43	Linn Energy	0.218	0.163	0.381
44	Bayan Resources	1.806	44	Cenovus Energy	0.309	0.053	0.362
45	Churchill Mining	1.745	45	YPF	0.235	0.121	0.356
46	NTPC	1.740	46	Range Resources	0.090	0.261	0.352
47	Adaro Energy	1.607	47	PTT	0.111	0.228	0.339
48	Nacco Industries	1.557	48	Husky Energy	0.212	0.122	0.334
49	Idemitsu Kosan	1.530	49	EQT	0.001	0.326	0.327
50	Alliance Resource Partners	1.475	50	Continental Resources	0.238	0.073	0.311

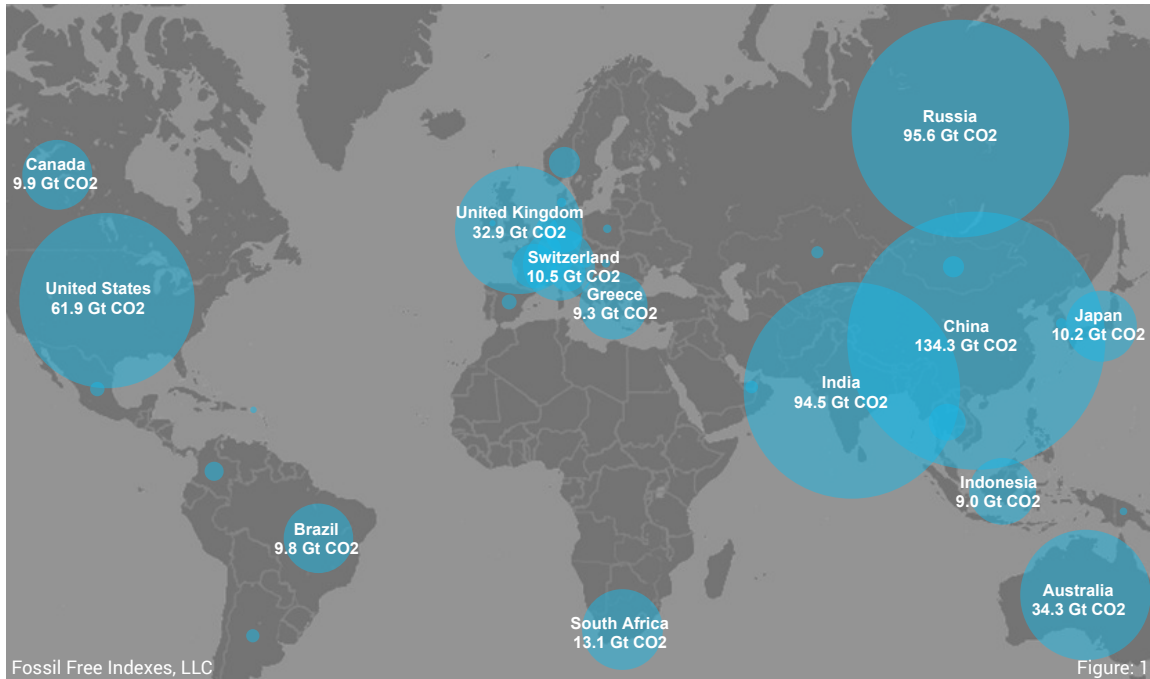
The Carbon Underground 200™

Rank	Coal Companies	Coal Gt CO ₂	Rank	Oil and Gas Companies	Oil Gt CO ₂	Gas Gt CO ₂	Total O&G Gt CO ₂
51	Huolinhe Opencut Coal Ind	1.387	51	Talisman Energy	0.111	0.199	0.310
52	Coalspur Mines	1.380	52	KazMunaiGas EP	0.298	0.000	0.298
53	Mitsui	1.366	53	JX Holdings	0.271	0.000	0.271
54	Golden Energy Mines	1.354	54	WPX Energy	0.069	0.188	0.258
55	Coal of Africa	1.339	55	Santos	0.033	0.204	0.237
56	Novolipetsk Steel	1.288	56	SK Innovation	0.226	0.000	0.226
57	Wesfarmers	1.094	57	QEP Resources	0.078	0.143	0.220
58	Tata Power	1.062	58	Southwestern Energy	0.000	0.219	0.219
59	Magnitogorsk Iron & Steel	1.046	59	Consol Energy	0.000	0.218	0.218
60	Sherritt International	1.012	60	Cabot Oil & Gas	0.010	0.201	0.212
61	Kazakhmys	0.998	61	SandRidge Energy	0.134	0.077	0.211
62	New World Resources	0.972	62	Newfield Exploration	0.112	0.096	0.207
63	Mongolian Mining	0.903	63	Murphy Oil	0.144	0.062	0.206
64	Itochu	0.878	64	Dragon Oil	0.159	0.044	0.203
65	Westmoreland	0.864	65	Freeport-McMoRan	0.155	0.028	0.183
66	Cockatoo Coal	0.851	66	Maersk Group	0.174	0.000	0.174
67	Shanxi Meijin Energy	0.784	67	Concho Resources	0.116	0.057	0.173
68	Jizhong Energy Resources	0.742	68	Ultra Petroleum	0.008	0.162	0.169
69	Bandanna Energy	0.731	69	Denbury Resources	0.139	0.026	0.166
70	Polo Resources	0.726	70	GDF SUEZ	0.045	0.117	0.162
71	Allete	0.723	71	MEG Energy	0.155	0.000	0.155
72	CLP Holdings	0.696	72	Whiting Petroleum	0.139	0.012	0.151
73	Aspire Mining	0.670	73	RWE	0.037	0.111	0.148
74	Walter Energy	0.641	74	MOL	0.084	0.061	0.146
75	Aquila Resources	0.627	75	Crescent Point Energy	0.135	0.010	0.145
76	Coal Energy	0.614	76	Polish Oil & Gas	0.036	0.108	0.144
77	China Resources Power	0.567	77	Mitsui	0.048	0.095	0.142
78	Indika Inti	0.485	78	Penn West Petroleum	0.111	0.029	0.140
79	ArcelorMittal	0.464	79	Pacific Rubiales Energy	0.104	0.028	0.132
80	FirstEnergy	0.458	80	Oil India	0.073	0.059	0.132
81	Black Hills Corp	0.431	81	Cimarex Energy	0.062	0.068	0.130
82	Wescoal Holdings	0.430	82	Energen	0.082	0.044	0.126
83	Grupo Mexico	0.420	83	TAQA	0.065	0.055	0.121
84	African Rainbow Minerals	0.379	84	Oil Search	0.028	0.088	0.117
85	Shanxi Coal Intl Energy	0.376	85	ARC Resources	0.044	0.065	0.109
86	Capital Power	0.367	86	Canadian Oil Sands	0.109	0.000	0.109
87	PTT Public	0.359	87	Genel Energy	0.105	0.000	0.105
88	Lanhua	0.338	88	SM Energy	0.057	0.045	0.102
89	Fortune Minerals	0.328	89	Sasol	0.004	0.085	0.089
90	Cardero Resources	0.323	90	National Fuel Gas	0.018	0.071	0.088
91	Zhengzhou Coal Ind & Elec	0.319	91	Tullow Oil	0.080	0.008	0.088
92	Steel Authority of India	0.307	92	Pengrowth Energy	0.051	0.037	0.088
93	Jindal Steel & Power	0.301	93	Xcite Energy	0.084	0.001	0.085
94	Shougang Fushan Resources	0.299	94	Vermilion Energy	0.069	0.013	0.082
95	Jingyuan CE	0.297	95	Peyto E&D	0.009	0.070	0.079
96	Stanmore Coal	0.287	96	Quicksilver Resources	0.017	0.061	0.077
97	Prophecy Coal	0.272	97	Petroceltic International	0.026	0.050	0.077
98	Marubeni	0.265	98	Forest Oil	0.026	0.050	0.076
99	Cliffs Natural Resources	0.247	99	Tourmaline Oil	0.009	0.065	0.074
100	NSSMC	0.237	100	Bonavista Energy	0.027	0.045	0.072

Market Dynamics: ---

Changes in The Carbon Underground 200™ since 2010

Top Countries Mapped by Company Headquarters 2014
Total Coal, Gas, and Oil Reserve Emissions Potential (GT CO₂)



HISTORICAL RESEARCH AND COMPARISONS

Historical versions of The Carbon Underground 200 lists dating back to 2004 were produced using the same methodology as described above. This section describes changes in The Carbon Underground 200 list based on the most recent data compared to The Carbon Underground 200 calculated by Fossil Free Indexes for 2011 based on year-end 2010 data.

A Note on Dates

The 2014 list published here is based on reserves data as of November 28, 2013 and ownership data as of March 31, 2014. In light of reporting cycles, this represents primarily reserves reported as of December 31, 2012. The 2011 list is based on reserves and ownership data as of December 31, 2010.

COMPANIES, GEOGRAPHY & THEMES: 2010 TO 2014

The Carbon Underground 200 represents the top publicly traded companies globally, ranked by the carbon emissions potential of their fossil fuel reserves. The total potential CO₂ emissions from these reserves has risen by 8.4% since year-end 2010. There has been significant movement and change in the companies on the current list. Merger and acquisition activity, bankruptcy, privatization, and nationalization, along with ongoing reserves discoveries and better reserves reporting, have all impacted the rankings.

Global Carbon Budget vs. Reported Reserves

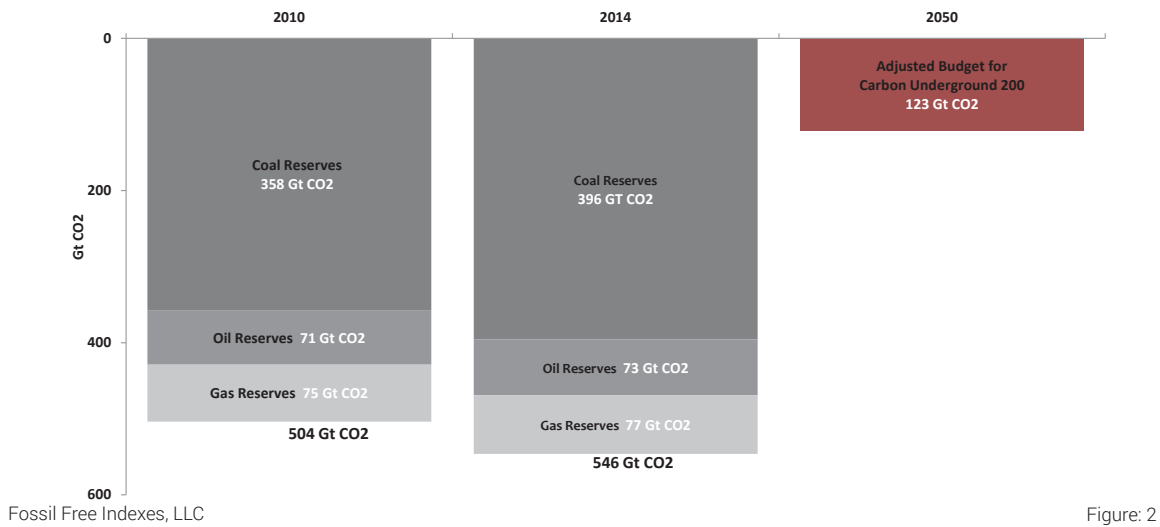
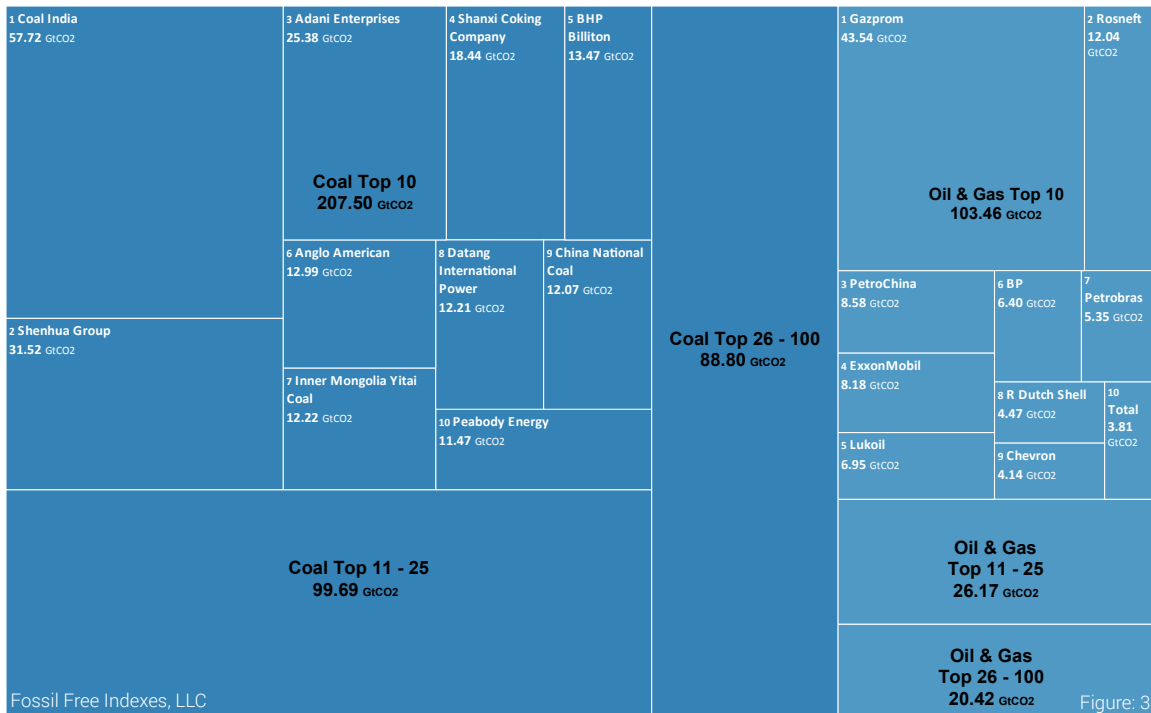


Figure: 2

Overall, a total of 27 companies have entered the list since year-end 2010, with 22 companies already on the list moving up in the rankings by 10 or more spots, and 12 companies already on the list moving down 10 or more. Activity is global and evenly split between coal, and oil and gas companies. However, market dynamics and geographical considerations are very different for each reserve type, and they are discussed individually below.

The total CO₂ emissions potential of the reserves of the 200 largest oil and gas and coal companies measured in this report is 546 Gt. Adjusted for their share of the emissions embedded in global reserves, the carbon content of reserves held by The Carbon Underground 200 exceed the carbon budget by over 400%.

Relative Rankings of The Carbon Underground 200™



THE CARBON UNDERGROUND OIL & GAS 100

The Carbon Underground Oil & Gas 100 covers 98% of proven gas reserves from listed companies, and 97% of proven oil reserves from listed companies. The oil and gas exploration and production industry is dominated by state-controlled companies³¹ (often referred to as NOCs or national oil companies), most of which are 100% nationalized and unavailable to investors. However, some state-controlled companies do turn to the equity markets to raise capital. There are 21 state-controlled companies, accounting for about 62% of the total CO₂ emissions, in the Carbon Underground Oil and Gas 100.

Regardless of ownership status, the oil and gas exploration and production industry is highly concentrated. The top five companies contribute roughly 53% of the total carbon emissions potential on The Carbon Underground Oil & Gas 100; the bottom half comprise about 5%.

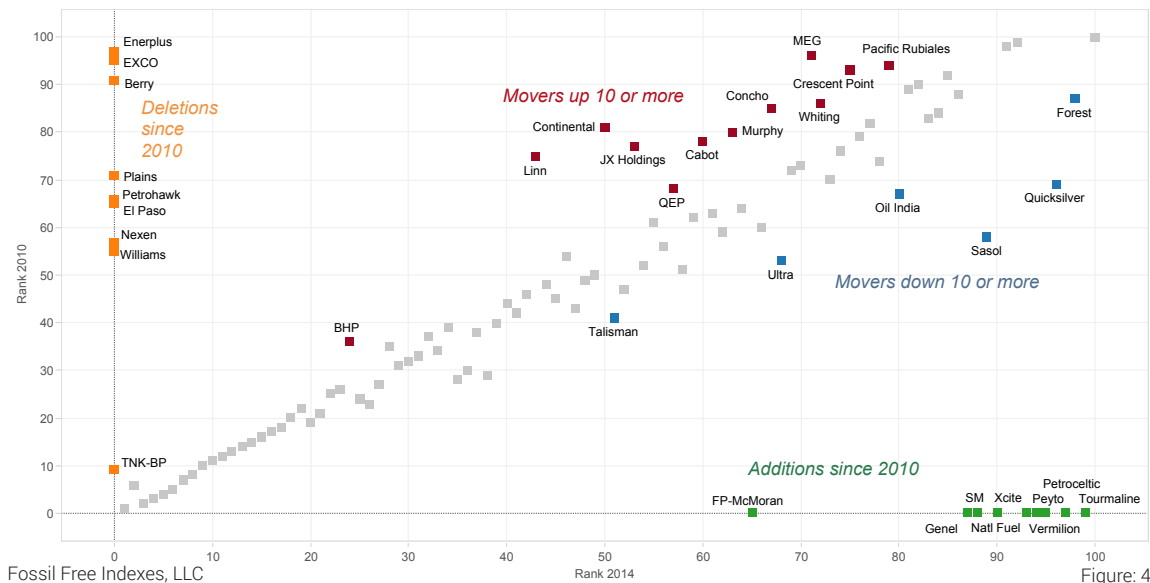
Recent acquisitions have contributed to industry concentration. Of the top five companies with the greatest absolute increase in emissions, Rosneft, BHP Billiton, and CNOOC grew primarily through acquiring companies already on the list. Novatek grew through acquisition of companies off list and through development. Only Chevron of the top five increased reserves solely via exploration and development.

Topping the list is Gazprom, which is 50.002% controlled by the Russian Federation. Gazprom has ranked number one every year since 2004, throughout the full history of Fossil Free Indexes' oil and gas database. While gas is the least carbon intensive fossil fuel (roughly 27% the carbon intensity of crude oil), Gazprom represents 29% of the total carbon emissions in the list.³² Its gas reserves and their associated carbon potential dwarf those of other companies on the list, whether the reserves are gas, oil, or oil sands.

Aggregated gas reserves included in the list mirror worldwide reserves growth over the past two years (about 2% for gas), but public company oil reserves have only experienced about one-third the growth of oil reserves worldwide.³³ Nonetheless, when compared against rankings compiled using historical data for the same period, oil reserves drive the emissions growth for the biggest emitters.

ExxonMobil is the top ranked company with 100% public ownership. Like Gazprom, ExxonMobil has held this position since at least 2004. Unlike Gazprom, ExxonMobil's portfolio of reserves has shifted in composition over the past decade. The combined oil and gas reserves (excluding oil sands) have held steady in total, but shifted out of oil and into gas. The shift is not great, but represents movement out of international oil assets and into US-based unconventional gas led by the 2010 acquisition of XTO Energy. ExxonMobil increased holdings in Canadian oil sand reserves five-fold between 2004 and 2012. Due to the overall size of ExxonMobil's fossil fuel reserves, the company's potential CO₂ emissions rank did not change. Smaller companies taking advantage of the same market shifts moved up in rankings the most.

Carbon Underground Oil and Gas Top 100
Rank Changes 2010-2014



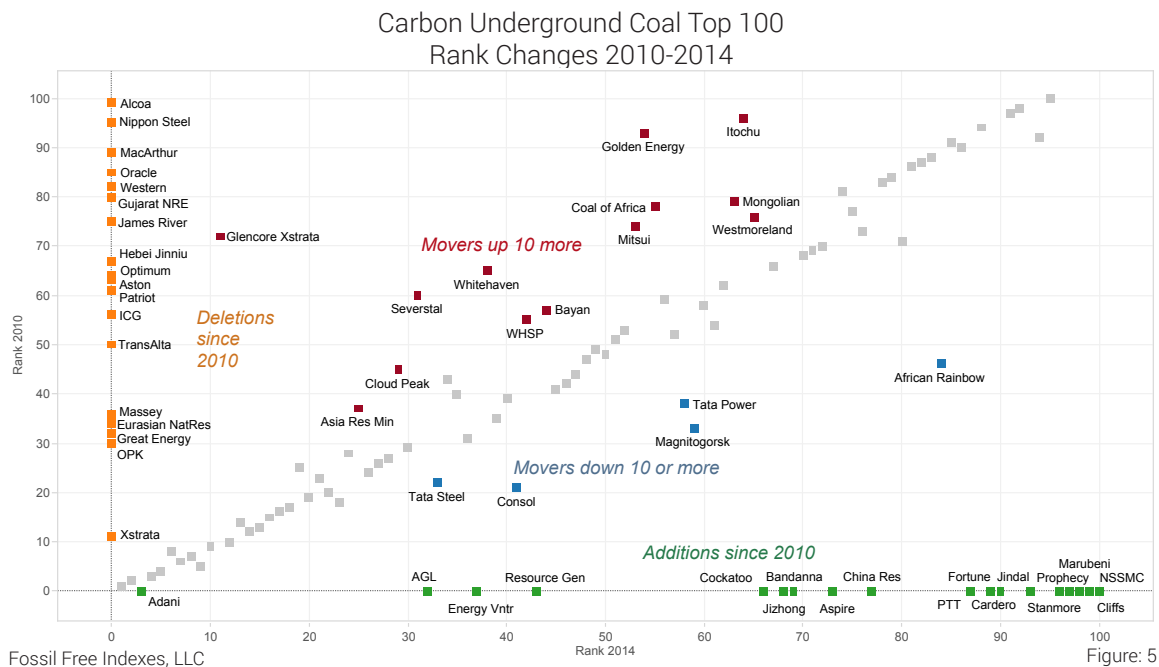
Over the past two years, North America has experienced tremendous growth in both oil and gas reserves, primarily attributable to US shale oil, Canadian oil sands and US Marcellus gas reserves (see chart above, companies showing in dark red). Comparing current rankings with historical data, only two of the dozen companies that moved up 10 or more places are based outside of the United States or Canada. The growth of one of the international companies can also be attributed to acquisitions in the US shale oil reserves. As a group, the oil reserves of these 12 expanded at nearly twice the pace of gas reserves.

Oklahoma-based Continental Resources was edged out by Linn Energy from Houston for the largest jump up the Carbon Underground Oil and Gas 100 rankings. Linn Energy grew through the acquisition of Berry Petroleum, balancing out their gas heavy reserves portfolio with Berry's western US oil assets. Continental Resources acquired rights to undeveloped acreage becoming the largest leaseholder of Bakken formation reservoirs.³⁴ The Bakken shale oil formation spans North Dakota, Montana, Saskatchewan and Manitoba, and was largely unrecoverable until recent technological advances. Continental Resources pioneered horizontal drilling and fracture

stimulated extraction technologies widely referred to as “fracking”. Their dual strategy of innovative technology and aggressive lease acquisition results in net new reserves (and potential carbon emissions). Linn Energy’s growth represents the consolidation of previously developed reserves.

Comparing current rankings with historical data, nine companies joined the Carbon Underground Oil and Gas 100 since year-end 2010. The companies entering the list are evenly split between potential carbon emissions increases attributable to oil reserves and to gas reserves. Only one of the nine companies represents reserves outside North America. Of course, the nine company additions resulted in another nine companies dropping from the list. Over two-thirds of the companies leaving the list were acquired by other companies in the top 100, and their carbon potential remains in the list. The potential growth in overall emissions of about 3% implies that companies maintaining the status quo, especially in the last 10 spots, could easily slip from the top 100 rankings. The two companies not acquired dropped into the 101-120 range.

THE CARBON UNDERGROUND COAL 100



The Carbon Underground Coal 100 covers 98% of proven and probable coal reserves from listed companies. Similar to the Carbon Underground Oil & Gas 100, coal reserves are highly concentrated at the top of the coal list with 52% of potential CO₂ emissions coming from the top 10 coal companies. This concentration is unchanged from year-end 2010. Total potential CO₂ emissions from the top 100 coal companies have risen by 10.6% since 2010.

Company changes in the Carbon Underground Coal 100 are weighted towards Asia and Australia, with nine companies from Australia and China entering the list since 2010, and four exiting. North America accounts for considerable activity as well, with three Canadian companies entering and two exiting, and one American company entering with five exiting. A total of 18 companies have been added to the top 100 since 2010, accounting for 9.7% of the total potential CO₂ emissions of the top 100, and a corresponding total of 18 companies have exited the list since 2010.

Merger, acquisition and joint venture activity accounted for six of the 18 companies entering the current rankings. Of the remaining company additions, eight came on to the list due to significant changes in reported reserves either through mine acquisitions or newly proven reserves. The remaining four entered by virtue of their moving up into the bottom of the list. The majority of the exits from the list, 13 of the 18 companies exiting the current rankings, were due to merger, acquisition and joint venture activity. Of the remaining companies exiting the list, two were due to a decline in reserves, two due to suspending activity at several mines, and one was a result of dropping off of the bottom of the list.

The increase in Australian and Chinese coal companies on the list and as upward movers in the rankings reflects the pronounced role of increasing Chinese and Indian energy demand on global coal markets. This demand has prompted increased feasibility studies for mine construction and renewed merger and acquisition activity within the immediate geographic region, which is most evident among the Australian companies on the list. Three Australian companies, AGL, Energy Ventures, and Resource Generation – absent on the 2010 list – are now in the top 50 of the current list: Resource Generation due to new mine projects where reserves were first reported in 2012, and AGL and Energy Venture due to direct acquisition. AGL now fully owns Great Energy Alliance, previously a joint venture between AGL Energy and Tokyo Electric Power Company, and Energy Ventures purchased Aviva in 2013.

The trend of increased mining activity is also evident amongst companies that have been in the top 100 since 2010. Three Australian companies have moved up in rank by 20 or more spots due to mine acquisitions and increases in reported reserves from increased mine exploration and construction. There have also been similar increases in coal mine exploration resulting in reporting of increased reserves among companies with interests in Russian, South African, Mongolian and Indonesian coal mines.

In terms of new mine development, the Indian conglomerate Adani Group is the most notable new company. Adani has entered the current list at the number three spot, with their 2010 acquisition of Galilee Basin coal deposits in Australia from Linc Energy. These reserves had previously been deemed unrecoverable due to the lack of infrastructure for mining and transportation, but the 2012 Adani announcement of plans to build the \$10 billion Carmichael Coal mine, rail, and port project brings these reserves into play and onto the list.

The trend is slightly reversed in North American listed coal companies. While coal continues to dominate U.S. power generation, the drop in U.S. companies on the list echoes the significant drop in both U.S. coal production and consumption since 2010, with competition from burgeoning shale gas production and increasing pressure from U.S. emissions regulations.

Emerging Metrics to Gauge Stranded Asset Exposure

The “HSBC Oil and Gas/Climate Change Europe Report January 2013” looks at the implication for European oil and gas companies of the IEA’s 450 scenario, which limits global warming to 2° C with a 50% probability. That scenario assumes that coal consumption falls 30%, and oil 12%, between 2010 and 2035. HSBC finds that reserves at risk of being undeveloped under this scenario vary widely between companies, ranging from as high as 25% of 2P resources. Value at risk, measured as reserves at risk to market capitalization, varied as well, from negligible to 17%. More compelling, perhaps, HSBC assesses the potential impact of lower oil and gas prices, imposing the exaggerated assumption of Brent \$50/bbl, and gas at USD9/mm BTU. Not unrealistic in a low carbon world with aggressive policy response to accelerating climate risk, these prices would push exposure to “40% to 60% of the market capitalization of affected companies.”³⁵

Notes

1. In 2010, 91 governments at a United Nations climate change conference collectively agreed to take sufficient action to limit the average global temperature increase to no more than 2° C above preindustrial levels, with the possibility of revising this down to 1.5° C. Meetings and conferences under the sponsorship of the U.N. are planned for spring and summer 2014, building toward a new global agreement expected to be finalized in 2015. The legal obligations of the forthcoming agreement, however, will not become effective until 2020. Presently, the absence of any agreed-to mechanism for enforcing the collective action remains a concern.
2. A Fossil Free Indexes analysis based on BP (2013), "BP Statistical Review of World Energy June 2013," Conglin Xu & Laura Bell. "Worldwide Reserves, Oil Production Post Modest Rise." *Oil and Gas Journal*. 12/02/2013; IEA (2013), "World Energy Outlook 2013." IEA.
3. IPCC, "Twelfth Session of Working Group III – Summary for Policy Makers, 2014", p. 6.
4. IPCC, "Twelfth Session of Working Group III – Summary for Policy Makers, 2014", p. 16.
5. IEA (2013), "World Energy Outlook 2013," IEA.
6. "Unburnable Carbon 2013: Wasted capital and stranded assets." Carbon Tracker Initiative in collaboration with Grantham Research Institute on Climate Change and the Environment.
7. Generation Foundation, "Stranded Carbon Assets," October, 30 2013, Appendix A, p. 21.
8. IEA (2013), "World Energy Outlook Special Report: Redrawing the Energy Climate Map," IEA. Meinshausen, Allen, Frame, Frieler, Hare Knutti, (April 30, 2009). "Greenhouse-gas Emission Targets for Limiting Global Warming to 2°C." *Nature* 458.7242 p. 1158. Friedlingstein, Hough, Marland, Hackler, Boden, Conway, Cranadel, Raupach, Ciais, Le Quere, (November 21, 2010) "Update on CO₂ Emissions." *Nature Geoscience* 3 pp. 811-812.
9. IPCC, "Twelfth Session of Working Group III – Summary for Policy Makers, 2014", Table SPM.1, RCP 2.6 pathway.
10. IPCC, "Twelfth Session of Working Group III – Summary for Policy Makers, 2014", Table SPM.1, RCP 2.6 pathway.
11. 32.6 GtCO₂ (emitted 2011, "EIA, International Energy Statistics") + 31.6 GtCO₂ (emitted 2012, "World Energy Outlook 2012, Redrawing the Energy Climate Map 2013," IEA) + 32.4 GtCO₂ (emitted 2013, "Redrawing the Energy Climate Map 2013" IEA, "Trends in Global CO₂ Emissions 2012," PBL, Fossil Free Indexes estimate).
12. van Vuuren, D., M. den Elzen, P. Lucas, B. Eickhout, B. Strengers, B. van Ruijven, S. Wonink, R. van Houdt, 2007. Stabilizing greenhouse gas concentrations at low levels: an assessment of reduction strategies and costs. *Climatic Change*, doi:10.1007/s/10584-006-9172-9, RCP 2.6.
13. IPCC, "Twelfth Session of Working Group III – Summary for Policy Makers, 2014", Table SPM.1, RCP 8.5 pathway.
14. Wwan Vuuren, D., M. den Elzen, P. Lucas, B. Eickhout, B. Strengers, B. van Ruijven, S. Wonink, R. van Houdt, 2007. Stabilizing greenhouse gas concentrations at low levels: an assessment of reduction strategies and costs. *Climatic Change*, doi:10.1007/s/10584-006-9172-9, RCP 2.6.
15. IEA (2013), "World Energy Outlook Special Report: Redrawing the Energy Climate Map," IEA.
16. World Energy Council (2014), "World Energy Resources: Survey 2013."

17. Proven (1P) oil and gas reserves as of 12/31/2012 and proven coal reserves as of 12/31/2011.
18. Carbon Tracker (2011), "Unburnable Carbon – Are the world's financial markets carrying a carbon bubble?"
19. "Unburnable Carbon 2013: Wasted capital and stranded assets." Carbon Tracker Initiative in collaboration with Grantham Research Institute on Climate Change and the Environment.
20. IEA (2013), "World Energy Outlook Special Report: Redrawing the Energy Climate Map," IEA.
21. IPCC, "Fifth Assessment Report, Working Group 1, Summary for Policymakers, 2013."
22. "Unburnable Carbon 2013: Wasted capital and stranded assets." Carbon Tracker Initiative in collaboration with Grantham Research Institute on Climate Change and the Environment.
23. Bill McKibben, "Global Warming's Terrifying New Math," *Rolling Stone*, July 19, 2012.
24. Malte Meinshausen, et. al., "Greenhouse gas emissions targets for limiting global warming to 2 degrees centigrade," *Nature*, 458:7242 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf .
25. Carbon Tracker (2011), "Unburnable Carbon – Are the world's financial markets carrying a carbon bubble?"
26. http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf.
27. Coal rank is the industry term for type of coal based on the level of organic metamorphism or carbonization.
28. Both calorific and carbon content factors come from the IPCC *Revised 1996 Guidelines* http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf .
29. <http://www.nature.com/nature/journal/v458/n7242/extref/nature08017-s1.pdf> .
30. Some of the top 100 coal and top 100 oil and gas companies are actually conglomerates and not fossil fuel companies, but their reserve ownership places them in the top 100.
31. Silvana Tordo, Brandon S. Tracy, Noora Arfaa. "National Oil Companies and Value Creation." *World Bank Working Paper* No. 218. 2011.
32. It should be noted that the rankings rely solely on carbon emissions in keeping with the IPCC Tier I framework. Natural gas, however, is primarily composed of methane, another potent GHG. In the US, methane inadvertently released during production, processing and transmission has twice the global warming potential of the carbon emitted by all the natural gas burnt deliberately as a fuel annually (EPA, "Inventory of US Greenhouse Gas Emissions and Sinks," 2/21/2014. IPCC, "Climate Change 2007: The Physical Science Basis"). No corresponding statistics are available for Russia.
33. Conglin Xu & Laura Bell. "Worldwide Reserves, Oil Production Post Modest Rise." *Oil and Gas Journal* 12/02/2013.
34. Continental Resources, Inc. "Continental Resources Announces New Five-Year Plan To Triple Production And Proved Reserves [press release]." Oklahoma City, Oct. 8, 2012.
35. "Oil and Gas/Climate Change Europe Report," HSBC, January 2013.

Updates

Fossil Free Indexes will update The Carbon Underground 200™ quarterly and publish the updated list annually. Between annual publications, updates to the list will be available on a subscription basis, as will electronic versions of The Carbon Underground 200™ in Excel (including tickers and primary exchanges).

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For More Information

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Fossil Free Indexes was formed to provide benchmarks and strategies for ethical investing with an initial focus on broad market indexes ex-fossil fuels defined exactly in line with the divestment movement.

We are developing a family of fossil free indexes that capture broad markets in the US, in developed markets beyond the US, and in emerging markets. The indexes specifically exclude the top 100 public coal companies globally and the top 100 public oil and gas companies globally, ranked by the carbon content of their reserves. These indexes will serve as benchmarks and will be licensed for investable products to meet the needs of index investors who want to divest from the largest fossil fuel companies.

The 200 companies in this report are an appropriate focus for further scrutiny and research by investors, lenders, and policy makers. In addition to its ongoing research program to keep The Carbon Underground 200™ updated, Fossil Free Indexes also offers portfolio-specific research that drills deeper into the risks associated with these owners of fossil fuel reserves.



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