CARBON AND WATER RISK FOR SOUTH AFRICA’S TOP COMPANIES, BONDS AND EQUITY FUNDS

How corporate emissions expose investors to carbon taxes and thirsty assets are vulnerable to climate change impacts
ABOUT TRUCOST
Trucost has been helping companies, investors, governments, academics and thought leaders to understand the economic consequences of natural capital dependency for over 12 years. Trucost data and insight enables clients to:
• identify natural capital dependency across companies, products, supply chains and investments
• manage risk from volatile commodity prices and increasing environmental costs
• build more sustainable business models and brands
Key to the company's approach is that it not only quantifies resource dependency in metric tonnes, cubic meters and hectares, it also puts a price on environmental impacts, enabling clients to embed them in everyday decision-making.

About WWF
WWF is one of the world's largest and most respected independent conservation organisations, with almost 5 million supporters and a global network active in over 100 countries. WWF's mission is to stop the degradation of the earth's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

WWF South Africa
WWF South Africa is a national office that is part of the WWF network. We are a local NGO that for more than 40 years has worked towards the aim of inspiring all South Africans to live in harmony with nature, for the benefit of our country and the well-being of all our people.

ABOUT THIS REPORT
This report forms the first in a five-part report series, *Navigating Muddy Waters: securing investment returns under carbon and water constraints*. The collaboration between WWF, Carbon Tracker, SinCo and Trucost aims to assess carbon and water risks for South African investors, and sustainable investment opportunities.

Climate change and water scarcity are two of the main drivers that governments, civil society and business need to seriously address in the transformation of the global economy into one that is resource efficient, low carbon, resilient and equitable. As a significant provider of financial capital, institutional investors play an important role in our ability to shape this transformation. On the other hand, these same investors face material financial risks if they are exposed to companies that are unprepared for this socio-economic transition.

The aim of the series is to provide empirical research to investors in and regulators of the securities markets that can guide policy and investment strategies to support the transition to a resource-efficient, low carbon, resilient and equitable global economy.

Part 1: Carbon and water risks for South Africa's top companies, bonds and equity funds
This report by Trucost provides evidence of the investment case for understanding the potential exposure to carbon and water scarcity through equity and bond investments in high-carbon, water-intensive companies. It includes an analysis of related financial risks for institutional investors, including the Government Employees Pension Fund (GEPF), demonstrates the availability of low-carbon capital market investment opportunities, and illustrates the need for the financial system to manage financial risk from carbon-intensive assets during the shift to a low-carbon economy.
Part 2: Unburnable carbon: budgeting carbon in South Africa
A report by Carbon Tracker that analyses what the planned South African carbon budget might mean for investors in coal mining companies in South Africa. The report contains analysis of this risk to the Government Employees’ Pension Fund (GEPF).

Part 3: Institutional Investor attitudes to addressing climate change risks in portfolios
A report by SinCo which, through interviews with both asset owners and managers representing institutional investors managing assets of close to ZAR 4 trillion (about US$ 470 billion), assesses the extent to which institutional investors are addressing the climate change risk in their portfolios.

Part 4: Responsible investing for climate change and water in South Africa, by WWF, uses a case study approach and empirical research from Trucost to investigate some of the investment mechanisms that are currently and potentially available to help decarbonise institutional investment portfolios, and demonstrates water stewardship from an investment perspective.

Part 5: Navigating Muddy Waters: securing investment returns under carbon and water constraints
A report by SinCo and WWF, which connects the findings of Parts 1 to 4 of the report series. The report synthesises key findings and provides recommendations on how to address the risks from investments in assets dependent on free, uncapped carbon emissions and unsustainable water use, and opportunities to investors that arise from the shift towards supporting a resource-efficient, low carbon, resilient and equitable economy from a carbon and water perspective.

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EXECUTIVE SUMMARY

WWF South Africa commissioned three studies into different aspects of exposure to carbon emissions in order to raise awareness of climate change risks in South Africa’s financial markets amongst financial market regulators, asset owners and institutional investment managers. This study by Trucost Plc aims to:

• provide evidence of the potential investment exposure to carbon costs through equity and bond stakes in high-carbon companies
• illustrate the need for the financial system to manage financial risk from carbon-intensive assets during the shift to a low-carbon economy
• understand equity exposure to water risk
• demonstrate that alternative, sustainable financial market investment opportunities are currently and potentially available
• encourage uptake of strategies to manage carbon risks embedded in existing portfolio holdings.

HIGHLIGHTS

Exposure to carbon risks among FTSE/JSE top 100 companies
Emissions from the largest companies listed on the JSE are significant. The largest 100 companies in the FTSE/JSE All Share Index (ALSI) directly emitted 148 million tonnes of carbon from their global operations (Scope 1 under the Greenhouse Gas Protocol) in 2011. This equates to 27% of South Africa’s annual greenhouse gas (GHG) emissions. Electricity use results in 28% of total emissions from the FTSE/JSE top 100 companies. Carbon is concentrated, with stocks in the Basic Resources and Oil & Gas sectors responsible for 79% of total emissions across the companies.

The South African government plans to introduce a carbon tax of R120 (US$15) per tonne. Under the carbon tax proposals, emissions from the operations of the companies could result in carbon costs of R5.8 bn (US$710 mn) in 2013/14. Emissions from electricity use could result in a further R4.1 bn (US$497 mn) in carbon liabilities passed through in higher electricity tariffs.

Carbon costs could be material to many companies in the ALSI. For 55 companies in the nine highest-emitting sectors, carbon costs for taxable operational emissions and 50% of carbon liabilities from electricity-related emissions would equate to 7% of earnings on average. At the expected carbon tax rate of R250 (US$30) per tonne in 2020/21, carbon liabilities could almost quadruple or fall, depending on the emissions pathway modelled under different scenarios. Plans to expand coal-fired power generation in South Africa could increase carbon liabilities from Scope 2 emissions, unless companies increase energy efficiency and switch to renewable sources of electricity.

If 52 companies in eight high-emitting sectors paid R120 per tonne for taxable Scope 1 emissions and 50% of carbon costs from electricity-related emissions in 2013/14, carbon liabilities would increase profit and credit risks most among Basic Resources, Oil & Gas, Construction & Materials, Chemicals and Food & Beverage companies.
The top 100 companies account for 97% of the value of the ALSI. Several institutional investors, including the Government Employees Pension Fund (GEPF), allocate a significant share of assets to domestic equities. They are therefore exposed to financial risk from emissions from the JSE-listed companies. In particular, weighted Basic Resources stocks account for 30% of the value of the FTSE/JSE top 100.

**Carbon risks embedded in bonds and equity funds**

There is a six-fold difference in the size of the carbon footprints of 45 equity portfolios analysed. 15 portfolios with larger carbon footprints than the FTSE/JSE top 100 are likely to be more exposed to carbon costs. The carbon footprint of aggregated holdings in GEPF equity portfolios invested in South Africa, valued at R541,061 mn (US$70,469 mn), was 9% smaller than the carbon footprint of the FTSE/JSE top 100. The fund is therefore likely to be less exposed to carbon costs.

Investors are also exposed to carbon risks through fixed income securities. The 215 corporate bonds in the BESA Corporate Credit Index have a carbon footprint of 14 tonnes of carbon per R mn revenue. Holders of bonds in the Basic Resources sector could be most exposed to corporate emissions through downgrade risk as rating agencies take account of carbon liabilities. GEPF bond holdings in South Africa are 18% more carbon efficient than the BESA Corporate Credit Index, mainly due to the relative carbon efficiency of debt holdings in the Basic Resources sector.

**Exposure to water risk**

Climate change impacts will contribute to growing water stress in South Africa. Together the FTSE/JSE top 100 companies use more than eight billion cubic metres (m³) of water globally in operations and through purchases of goods and services from first-tier suppliers. This equates to 64% of reliable water yields in South Africa. Investors in water-intensive companies are exposed to corporate water risk that can filter through in upward pricing pressure and supply chain disruption.

**Managing risks and opportunities**

Investors can examine opportunities to reduce portfolio exposure to carbon liabilities and resource constraints. These include low-carbon tracker funds based on carbon optimised indices to rebalance holdings within each sector based on carbon intensity.

Recommendations include a call for regulators to identify potential systemic climate risk in the economy, focusing on investor exposure to corporate GHG emissions and water stress. Institutional investors are encouraged to review available tools to assess asset exposure to climate change risk factors, and to develop opportunities to position funds for the transition to a low-carbon, climate-resilient economy.

**KEY FINDINGS**

**FTSE/JSE top 100 carbon profile**

- The largest 100 companies in the FTSE/JSE All Share Index (ALSI) emitted 335 million tonnes of carbon through their operations, electricity use and supply chains in 2011.
- Electricity purchases result in 92 Mt of carbon emissions, known as Scope 2 emissions under the GHG Protocol.
- A further 28% of emissions were driven by purchases of goods and services from other direct (first-tier) suppliers, as well as upstream supply chains. Data on sources of emissions can be used to identify exposure to carbon costs and opportunities to reduce risk.
• 98% of the top 100 companies’ carbon emissions came from nine sectors: Basic Resources, Oil & Gas, Food & Beverage, Industrial Goods & Services, Construction & Materials, Personal & Household Goods, Retail, Telecommunications and Chemicals.
• Wide variations in the carbon intensity of companies in several high-emitting sectors indicate opportunities to reduce dependence on carbon to generate revenue and returns.
• 97% of operational emissions data analysed are based on corporate disclosures.

Projected carbon liabilities in the FTSE/JSE top 100 companies
• If the companies analysed were to pay R120 (US$15) for each tonne of their global Scope 1 emissions from operations and Scope 2 emissions from electricity use, carbon liabilities would amount to more than R29 bn (US$3.5 bn). However, the majority of emissions in each sector would be exempt from a planned carbon tax under government proposals. Companies that are more carbon intensive than the average for their sectors, based on benchmark carbon performance, would pay more while companies that are relatively carbon efficient would pay less.
• Under the carbon tax proposals, carbon costs for Scope 1 and 2 emissions could total almost R9.9 bn in 2013/14. The external costs of damages caused by taxable GHG emissions amount to R25 bn (US$3 bn). This is 2.5 times higher than potential liabilities under the planned carbon tax.
• If 58 companies in the nine highest-emitting sectors were to pay for Scope 1 emissions and incur 50% of carbon liabilities for emissions from electricity purchases, carbon liabilities could total R7,825. Electricity use would drive 25% of these costs.
• At the expected carbon tax rate of R250 (US$30) per tonne in 2020/21, carbon liabilities could rise to R21.9 bn (US$2.7 bn) if business continues as usual. If companies cut emissions by more than 27%, future carbon liabilities could be 55% lower. However, plans for the country’s power generation energy mix could cause liabilities for Scope 2 emissions to triple, unless companies increase energy efficiency and switch to renewable electricity.

Financial risk from carbon liabilities in 2013/14
• If 52 companies in eight high-emitting sectors paid R120 per tonne for taxable Scope 1 emissions and 50% of carbon costs from electricity-related emissions in 2013/14, earnings would fall most (by 19% on average) in the Basic Resources sector.
• Average debt to earnings before interest, taxation, depreciation and amortisation (EBITDIA) would increase most in Construction & Materials (15%).
• In the Construction & Materials sector, carbon liabilities would reduce return on equity (ROE) by 25% and return on assets (ROA) by 23%. In the Oil & Gas sector, both ROE and ROA would fall by 16%.
• Falls in financial ratios due to carbon liabilities could lead to lower equity valuations and greater credit risk for several companies in the Index.

Equity exposure to carbon risk
• Companies in the FTSE/JSE top 100 emitted 78 tonnes of carbon for every R mn of revenue generated. They have a larger carbon footprint than five other major developed and emerging market equity indices analysed.
• The weighting of Basic Resources stocks in the FTSE/JSE top 100 (30%) contributes to the larger carbon footprint of the South African companies. Returns to portfolios benchmarked against the top 100 would therefore be exposed to financial risk from carbon liabilities in the sector.
• The carbon footprint of consolidated holdings in 45 of the largest equity portfolios domiciled in South Africa, valued at R155,460 mn (US$18,798 mn) is 80 tonnes of carbon per R mn. This is 2% larger than the equivalent carbon footprint of the FTSE/JSE top 100 companies.
For low equity exposure to carbon risk, Nedgroup Investments Stable Fund is ranked top, with the smallest average carbon footprint – 23 tonnes of carbon per Rmn. The carbon footprint of the Allan Gray Equity Fund, ranked bottom, is six times larger (137 tonnes of carbon/R mn). At R120 (US$15) per tonne of carbon apportioned to holdings, carbon costs would equate to less than 1% of operating income (EBIT) allocated to holdings for the Nedgroup Investments Stable Fund, and 8% of earnings for the Allan Gray Equity Fund.

The carbon footprint of GEPF equity holdings in South Africa was 72 tonnes of carbon per R mn.

**Taking carbon into account in credit risk**
- If issuers of bonds on the BESA Corporate Credit Index were to pay carbon costs for taxable emissions from operations and 50% of Scope 2 carbon liabilities in 2013/14, interest coverage would decline most in the Basic Resources (-7%) and Automobiles & Parts (-4%) sectors.
- If Eskom and Transnet were to pay the carbon tax rate of R120 in 2013/14 for taxable emissions from operations, credit risk would increase most for Eskom’s debt securities, with interest coverage potentially falling by 22% and ROE by 37%.

**Climate change impacts on water resources**
- Operations directly abstracted 29% of some 8.9 billion m³ of water consumed globally by the FTSE/JSE top 100 companies. Water utilities and other tier 1 suppliers are responsible for 71% of their water use.
- Water scarcity costs could total more than R56 bn (US$11 bn) for all water used globally by operations and first-tier suppliers.
- The Food & Beverage sector is 11 times more water intensive than the next most water intensive sector, Travel & Leisure (39,055 m³ per R mn vs. 3,679 m³ per R mn).
- The water footprint of GEPF equity holdings in South Africa is 6% smaller than that of the FTSE/JSE top 100.

**Managing investment exposure to carbon and water risk**
- The carbon footprint of the Nedbank Green Index is 15% smaller than that of the FTSE/JSE top 100 companies.
- Trucost created a hypothetical FTSE/JSE Carbon Optimised Top 100 Index, which is 12% less carbon intensive than the FTSE/JSE top 100 companies. A three-year back-test to assess total returns against the FTSE/JSE top 100 found that financial performance tracks the benchmark closely, outperforming it by 2.39% over the three years, with a tracking error of 0.65%.
- Indices and portfolios could be optimised to take account of variations in carbon and resource intensity to reduce exposure to related risks.

**Recommendations**

**Regulators**
- Create a task force to examine links between GHG emissions, climate change impacts, financial performance and returns across asset classes.
- Assess the potential implications of carbon emissions and water stress on equity risk premiums and interest rates.
- Facilitate opportunities to reduce the carbon exposure of investments.
- Encourage credit rating agencies to consider carbon and water risks in credit risk assessments.
- Promote energy efficiency and renewable energy investment through regulations and market-based policy mechanisms.
• Build knowledge of pension fund beneficiary and institutional investor exposure to carbon and water risk and opportunities to position portfolios to gain from the transition to a low-carbon, water-efficient economy.

**Institutional investors and fund managers**
• Develop processes to monitor risks from constraints on corporate GHG emissions and water use for stock and bond valuations and credit ratings.
• Develop investment policies on carbon and water risk and identify assets that contribute most to portfolio exposure.
• Identify opportunities to reduce exposure to climate-sensitive, high carbon assets through equity indices.
• Consider climate and water-related criteria in investment mandates and conditions for debt securities.
• Outline expectations for companies on carbon and water disclosure and management to strengthen active ownership activities.
• Engage with companies to encourage the development of responsible water stewardship strategies.
INTRODUCTION

ELECTRICITY GRID SLOW TO SWITCH TO LOW-CARBON FUELS

Switching to low-carbon electricity supplies is vital to put South Africa on a low-carbon path. Coal-dependent power generation is a major cause of the economy’s relatively high carbon intensity and could scupper low-carbon development unless there is major investment in renewable electricity. A 2010 Integrated Resources Plan (IRP), which identifies required investments in the electricity sector, shows projected absolute CO₂ emissions from electricity rising by 29% between 2010 and 2021 without carbon constraints. R835 bn (more than US$100 bn) would need to be invested in low-carbon capacity such as wind power in order to limit the rise in CO₂ emissions from electricity to 16% during the same period, and cap the sector’s annual emissions at 275 Mt CO₂ by 2025, as planned. Renewable energy, which would lower exposure to rising fuel costs, will be included in an IRP due in 2012. Eskom, the state-owned power company, provides approximately 95% of the electricity used in South Africa. Eskom emitted 231.9 Mt CO₂e in the financial year 2012, or 41% of the country’s GHG emissions in 2010. The government announced a Climate Change Policy Framework to reduce emissions from state-owned companies in July 2012. Potential shale gas extraction in the semi-arid Karoo region could fuel a switch to lower-carbon gas power generation. However, hydraulic fracturing to extract shale gas could cause water contamination and be unsustainable due to water scarcity in the region.

Higher temperatures and more frequent and severe floods and droughts are forecast for South Africa. Under a moderate-to-high emissions scenario in a world with an increasing population and regionally-oriented economic growth, temperatures are set to rise most in the northern interior – by 3°C by 2050 and up to 6°C by the end of the 21st century. The largely arid or semi-arid country is vulnerable to climate change impacts such as these. The South African Government’s latest report to the United Nations Framework Convention on Climate Change (UNFCCC) reveals that there is already evidence of clear, large-scale changes in the climate, particularly in a pattern of more hot days. Average temperatures in South Africa have increased and rainfall has become more variable – with more frequent and longer periods of intense rainfall followed by dry spells – since 1961. Change in water availability is likely to be the main risk to people, ecosystems and the economy from climate change impacts (see page 41).

South Africa is among countries participating in the UNFCCC international climate talks which recognise that deep cuts in global greenhouse gas (GHG) emissions are required in order to limit a global average temperature rise to below 2°C above pre-industrial levels. They also agree that urgent action is needed to meet this long-term goal, consistent with science used to inform policymaking.

The South African government aims to strike a balance between reducing or mitigating GHG emissions and adapting to climate change impacts. Domestic climate change policies support efforts to work with Brazil, India and China (the BASIC countries) to influence international negotiations under the UNFCCC. South Africa is one of the 20 largest emitters globally, with national emissions totalling approximately 547 million tonnes of carbon dioxide equivalents (Mt CO₂e) in 2010.

1 Eskom Integrated Report, 2012
3 Eskom In tegrated Report, 2012
4 http://wri.org/navigating_numbers_chapter2.pdf
A National Climate Change Response White Paper (2011) establishes carbon budgets that should eventually lead to a fall in GHG emissions. Under the budgets, GHG emissions:\(^5\)

- must peak between a lower limit of 398 million Mt CO\(_2\)e and an upper limit of 583 Mt CO\(_2\)e between 2020 and 2025
- may plateau within the range of 398 Mt CO\(_2\)e and 614 Mt CO\(_2\)e for up to 10 years
- from 2036 onwards, absolute emissions must decline to a range with a lower limit of 212 Mt CO\(_2\)e and upper limit of 428 Mt CO\(_2\)e by 2050.

This peak-plateau-decline trajectory will underpin sector level carbon budgets to put the economy on a low-carbon pathway. Carbon budgets will eventually be cascaded to high-emitting companies. Mandatory carbon reporting will be introduced for companies that emit more than 100,000 tonnes of CO\(_2\)e or whose electricity use results in emissions that meet the threshold. Companies responsible for more than 0.1% of industrial emissions from their sectors will be regulated under Section 29 (1) of the Air Quality Act 39 of 2004. High-emitting companies and sectors will need to develop mitigation and low-carbon development strategies by 2014 to help translate carbon budgets into company emissions reductions. Sector plans will also need to outline adaptation responses, focusing on issues including water.

Regulatory measures targeted to reduce or mitigate emissions will be complemented by market-based policies to drive behaviour change. The Treasury’s February 2012 budget outlined plans to introduce a carbon tax in 2013/14. This would provide a price signal that should nudge investment decisions to take into account the costs of carbon dioxide emissions. Based on the budget’s proposals, companies that are carbon efficient relative to their sector peers will pay less tax, while those that are more carbon intensive will pay more. This would help ensure that companies that have already improved their carbon efficiency will be rewarded. The government plans to consult on a second draft policy paper to ensure that the tax is designed to minimize negative impacts on industry competitiveness.

Companies listed in South Africa may be exposed to further carbon costs through emissions from facilities located in other countries with carbon constraints, such as members of the European Union (EU) and Australia (see box). Companies that develop lower carbon operations, supply chains, products and services stand to gain from carbon constraints; slow movers will be disadvantaged. Investors will need to understand and manage their exposure to winners and losers.

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\(^5\) See Appendix 1 on page 57.
CARBON PRICES IN AUSTRALIA AND EUROPE

The Australian government passed a Clean Energy Legislative Package in 2011 to reduce emissions and drive investment in renewable energy. Measures include a carbon pricing mechanism that requires many companies in Australia to pay for the GHGs they emit as of 1 July 2012. The mechanism covers approximately 60% of Australia’s carbon and includes emissions from electricity generation and industrial processes. High emitters now have to purchase a permit for every tonne of GHGs emitted by operations at A$23 (R193) per tonne in 2012, rising to A$25.40 (R213) per tonne in 2014-15. Carbon units will be auctioned from 1 July 2015 onwards, when a flexible emissions trading scheme (ETS) starts. The Australian Treasury assumes an initial market price for carbon of around A$29 (R244) per tonne of CO2e. Emissions-intensive, trade-exposed industries such as iron and steel are being allocated free carbon permits for a share of emissions.

The Australian ETS is expected to link to the EU Emissions Trading System (EU ETS), currently the world’s largest economy-wide carbon market. The EU ETS covers 12,000 energy and industrial installations in industries including energy, steelworks, refineries and cement producers. High-emitting facilities must submit an EU Allowance (EUA) for each tonne of CO2 emitted. Flights to and from Europe are now included under the system. Firms that reduce their emissions sufficiently can sell excess allowances, and firms that emit more than the number of allowances received must purchase regulated carbon credits. The economic slowdown in Europe has brought the EUA price down from a high of Euros 35 (R366) per tonne of CO2 in 2008 to €7.79 (R87) per tonne of CO2 in October 2012. Phase III of the EU ETS from 2013 to 2020 will include more sectors and GHGs, apply tighter caps on emissions, and increase auctioning. Stricter carbon constraints should support a stronger carbon price.

Links between risks in capital markets, pension funds and the economy

Climate change is a potentially large-scale systemic risk to the economy and a deeper understanding of the financial implications for assets is required in order to protect returns. Large institutional investors with diversified investments across asset classes and sectors over long time horizons are the permanent and “universal owners” of private enterprise. As such, the performance of their large, diversified investment portfolios is linked to the economy.

The health of the financial sector and pension funds returns are closely linked with economic growth in South Africa. Financial sector assets stood at more than 200% of gross domestic product (GDP) totalling R3 trillion in 2011. The sector grew at an annual 9.1% between 2000 and 2011, compared with average economic growth of more than 3% annually. The pension fund industry is one of the biggest providers of capital in South Africa, with the value of total pension assets reaching more than US$227 bn (R1.8 trillion) at the end of 2011. Pension assets as a share of economy grew from 51% of GDP in 2000 to 62% of GDP in 2011.

Institutional investors such as insurance companies and pension or retirement funds allocate a significant share of assets to equities and bonds in South Africa. Regulation 28 of the Pension Funds Act set limits on the share of assets that retirement funds can invest in each asset class. As of January 2012, pension fund trustees may invest up to 25% of assets outside of South Africa when making investment decisions. Up to 75% of assets can be invested in...
listed equities. The government aims to encourage use of passive investment strategies, which aim to replicate the financial performance of underlying benchmark indices such as the FTSE/JSE All Share Index (ALSI) from current levels of less than 10% of funds.\(^{13,14}\)

The large state-owned investment manager Public Investment Corporation Ltd (PIC) managed assets valued at R1,032 trillion as at 30 March 2011 on behalf of several funds. Almost half of PIC assets (R495.1 bn) were invested in equities as of 30 March 2011. Equity shares of companies listed on the JSE are the largest asset class within PIC.\(^{15}\) The next highest level of investments is in domestic capital or bonds – fixed income securities (R381 bn). PIC only deals in bonds traded through the Bond Exchange of South Africa or issued by government, state-owned organisations (parastatals) and companies listed on the JSE Limited.\(^{16}\) Equities and bonds accounted for more than 90% of a R120 bn increase in the portfolio in 2010/2011.\(^{17}\)

Approximately 90% of PIC’s assets under management are assets of the Government Employees Pension Fund (GEPF), Africa’s largest pension fund. It aims to provide more than 1.2 million active members and around 318,000 pensioners and beneficiaries with financial security in retirement. The fund’s assets, valued at more than R900 bn (US$100 bn),\(^{18}\) are equivalent to one-third of the country’s GDP. GEPF is one of the largest institutional investors in all sectors of the South African economy, and is therefore a universal owner.\(^{19}\) The defined benefits fund has long-term capital investment cycles and is likely to remain invested in stocks listed on the FTSE/JSE Index, as well as in South African bonds, for the foreseeable future. GEPF has identified climate change as a material risk.

The long-term insurance industry in South Africa is also dependent on the financial performance of listed companies and fixed income securities. Almost half of R1.45 trillion in the industry’s assets under management were invested in listed shares as of 31 December 2011.\(^{20}\) A further 11.9% of assets were invested in bonds. Institutional investors can also hold equities and bonds in South Africa through collective investment schemes (unit trusts), which had R1.04 trillion in assets as of 30 June 2012.\(^{21}\) At least 70% of their assets are allocated to domestic funds at all times.\(^ {22}\)

Asset managers acting on behalf of institutional investors are entrusted with the assets of beneficiaries. Workers and retirees invested in pension funds are the beneficial owners of companies. As such, they will collectively pay for the costs of corporate GHG emissions and negative climate change impacts such as water scarcity that affect capital markets, if pension fund returns are reduced in a lower-value investment universe. Beneficiaries of funds invested in companies exposed to carbon costs could be at risk from lower pension payments in the future, unless large institutional investors act to reduce exposure to carbon emissions. Failure to shift to a low-carbon, resource-efficient economy would slow the global consumption growth rate as a greater share of GDP would have to be invested in solving problems created by climate change, resource scarcity, and biodiversity loss.\(^ {23}\)

\(^{22}\) Asisa, local fund statistics, 30 June 2012
\(^{23}\) Dr. Jones, A. et al, Resource constraints: sharing a finite world, Implications of Limits to Growth for the Actuarial Profession, Report prepared on behalf of The Actuarial Profession, 2013 (TO BE PUBLISHED)
Portfolio performance is driven by asset allocation, stock selection and related trading activities. Strategic asset allocation involves building portfolios which weight the different asset classes to achieve portfolio objectives, such as a targeted rate of return and risk criteria to comply with mandate requirements such as portfolio time horizon. Large institutional investors – with stakes in an economy-wide cross-section of publicly traded securities – cannot manage systemic risks sufficiently through diversification or arbitrage. It is in the financial interest of fund beneficiaries that they address the carbon and water impacts of investments to reduce systemic risk and protect long-term returns.

GHG emitters and water users do not currently pay the cost of damages caused by climate change impacts and resource depletion, which are therefore external to markets and known as “externalities”. There is a lack of transparency around how externalities pass between the economy, private enterprise, capital markets and investors, and how they could affect credit ratings and returns. However, there is evidence that climate change impacts on the economy could have a nearly identical impact on a large institutional investor’s future cash flows. Weakening of company cash flows could affect capital investment in growth opportunities, which in turn can lower dividends and long-term asset values. Costs externalised by some holdings of universal owners that own a share of the economy might adversely affect other portfolio investments through taxes, insurance premiums, inflated input prices and the physical cost of disasters, for instance, reducing overall returns.

WWF South Africa commissioned three studies into different aspects of exposure to carbon emissions in order to raise awareness of climate change risks in South Africa’s financial markets amongst financial market regulators, asset owners and institutional investment managers. This study by Trucost Plc aims to:

- provide evidence of the investment case for understanding potential exposure to carbon costs through equity and bond investments in high-carbon companies
- illustrate the need for the financial system to manage financial risk from carbon-intensive assets during the shift to a low-carbon economy
- understand equity exposure to water risk
- demonstrate that alternative, sustainable financial market investment opportunities are currently and potentially available
- encourage uptake of strategies to manage carbon risks embedded in existing portfolio holdings.

**SCOPE OF STUDY**

This study primarily examines carbon risk across the largest listed companies on the Johannesburg Stock Exchange (JSE), the largest equity portfolios based in South Africa, and fixed and free floated corporate bonds on the Bond Exchange of South Africa.

Trucost focuses on exposure to carbon liabilities among the 100 largest stocks listed on the FTSE/JSE ALSI as a benchmark benchmark for equity portfolio investment performance in South Africa. The FTSE/JSE top 100 companies represent more than 97% of the value of 162 companies listed in the ALSI Index, based on the net market capitalisation of index constituents as of 30 June 2012. Asset owners with equity portfolios invested in the ALSI index would be largely exposed to the risks and returns of the FTSE/JSE top 100 companies. The companies are also included in portfolios benchmarked against the FTSE/JSE

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Shareholder Weighted All Share Index (SWIX), which has the same construction as the FTSE/JSE All Share Index, and only differs with regards to the weighting of constituents. This builds on analysis by Trucost of the carbon emissions of the 40 largest companies in the FTSE/JSE All Share Index, published in January 2012.28

The analysis for WWF South Africa is based on the latest available data on index constituents,29 valued at R7,277,734.70 mn (US$880,019.48 mn) as of 30 June 2012. Companies are analysed according to their Industry Classification Benchmark (ICB) supersectors, a classification system used by investors.30,31 The ICB, developed by the Dow Jones Index and FTSE Group, provides four levels of classification – industries, supersectors, sectors and subsectors.

The study assesses several categories of climate risk:

**Carbon profile of the FTSE/JSE top 100 companies**
- GHGs emitted globally across the largest 100 companies in the ALSI, based on market capitalisation.
- Absolute GHG emissions by scope and ICB supersector.
- The carbon intensity of the companies analysed. This is measured as emissions from operations, purchased electricity and other direct (tier 1) suppliers normalised by revenue. Most companies are not major direct emitters of greenhouse gases and adopting this method ensures that the study assesses the carbon impacts of business activities – such as extraction, production, transport and logistics – outsourced to companies excluded from this analysis. Trucost’s environmental profiling model is used to calculate tier 1 supplier emissions that are not disclosed by companies (see Appendix 1).
- Corporate carbon disclosure and the need for full, standardised, quantitative disclosure of carbon data by companies with publicly-traded capital.

**Financial risk from carbon liabilities**
- Financial risk from carbon liabilities across companies in the highest-emitting sectors. Trucost modelled the potential implications of the government’s planned carbon tax for companies in nine sectors that account for 98% of emissions from operations and purchased electricity.
- Trucost modelled potential exposure to carbon costs in 2013/14 and 2020/21 under a variety of scenarios.
- The implications for potential carbon costs in 2013/14 are calculated by examining impacts on financial ratios including earnings, return on equity, return on assets and debt to earnings before interest, taxation, depreciation and amortisation.

**Equity fund analysis**
- Variations in exposure to carbon costs among 45 of the largest equity portfolios in South Africa, where Trucost holds emissions data on at least 80% of the value of holdings, based on data provided by FactSet. The total value of holdings analysed amounted to R155,460 mn (US$18,798 mn), based on data as of 30 June 2012. This analysis builds on Trucost’s assessment of the carbon footprints of 10 of the largest pooled investment funds or “unit trusts” in the Dirty Feet: Portfolio Carbon report published in January 2012.32

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28 Dirty Feet: Portfolio Carbon, SinCo/Trucost, January 2012
29 We would like to thank the JSE for providing data on the FTSE/JSE top 100 companies
32 Dirty Feet: Portfolio Carbon, SinCo/Trucost, January 2012
The carbon footprint of equity portfolios in the Government Employees Pension Fund (GEPF) of South Africa, based on holdings data as of 30 March 2012.

**Bond portfolio analysis**
- Carbon footprint of the Bond Exchange of South Africa Corporate Credit Index, based on data as of 30 June 2012.
- The carbon footprint of bonds in the Government Employees Pension Fund (GEPF) of South Africa, based on holdings data as of 30 March 2012.
- Potential financial risk from carbon liabilities for holders of Eskom and Transnet bonds.

**Exposure to climate change impacts – water scarcity**
- Water consumption by the top 100 FTSE/JSE companies.
- The water footprint of equity portfolios in the Government Employees Pension Fund (GEPF) of South Africa, based on holdings data as of 30 March 2012. Trucost assessed two of the main contributors to the consolidated equity portfolio water footprint using a water risk filter tool developed by WWF and Deutsche Investitions-und Entwicklungsgesellschaft mbH (DEG).

**Carbon and water management investment opportunities**
- Nedbank Green Index carbon footprint.
- Opportunities for lower carbon benchmarks as one of the solutions to developing viable, low-carbon investment markets. Trucost created a hypothetical FTSE/JSE Carbon Optimised Top 100 Index to assess the potential for investors to carbon optimise portfolios. Carbon-efficient stocks are overweight relative to carbon-intensive stocks, while maintaining index sector weightings. A three-year back-test was conducted to assess total returns against the underlying benchmark.

**Trucost methodology overview**
Financial data for companies are for the financial year 2011. Financial data are calculated in South African Rands (R) and US$. In general, exchange rates used were as of 30 June 2011. However, company-level financial data were converted using exchange rates as of the end of each company’s financial year. GEPF portfolio holdings were analysed as of 30 March 2012, therefore the exchange rate as of the end of March was used in the case study.

Trucost maintains the world’s largest and most comprehensive database of standardised corporate carbon data. Carbon data in this study cover the global emissions of FTSE/JSE listed companies in 2011, including their emissions in South Africa. The study refers to greenhouse gas emissions in general as “GHG” or “carbon” emissions. GHG emissions are measured in carbon dioxide equivalents (CO₂e). The majority of GHG emissions are carbon dioxide from fossil fuel combustion. GHG emissions are measured according to the GHG Protocol, an international accounting standard developed by the World Business Council for Sustainable Development and World Resources Institute. Where corporate carbon data were not publicly available, Trucost’s proprietary model calculated likely emissions.

Data on JSE listed securities are free-float adjusted to calculate the carbon footprint of the FTSE/JSE top 100. Total operational and first-tier emissions from all companies listed in an index are normalised by their total revenues. Some companies analyzed may supply others in the index, but including emissions from first-tier suppliers helps account for GHGs which are effectively outsourced to third parties. The carbon footprint of the index, which takes account of company weightings based on market caps, is calculated as total tonnes of CO₂e per million Rand of revenue (R mn).

**Equity portfolio carbon and water footprint:** Trucost measures the emissions and water use through operations, electricity use and other tier 1 suppliers of companies held.
Carbon emissions and turnover generated by portfolio companies are allocated to each portfolio in proportion to ownership. Allocated emissions and revenues are summed up and normalised by total revenue apportioned to holdings to calculate the carbon footprint of the portfolio. The carbon footprint is expressed as tonnes of CO$_2$e emitted by the companies within each portfolio per R mn of revenue from holdings. This normalised measure of carbon performance enables comparison of funds and benchmarks irrespective of the type and size of different businesses and portfolios. Similarly, total cubic metres of water and revenues allocated to portfolios are summed up and normalised by total revenue apportioned to holdings to calculate the water footprint of the portfolio. The water footprint of portfolios is expressed as cubic metres of water use per R mn.

**Bond portfolio carbon footprint:** Trucost maps bonds to parent issuers and allocates carbon emissions from operations, electricity purchases and other first-tier suppliers for each constituent company to bond indices or portfolios based on the value of the bond as a proportion of the equity and total debt of each company. Total emissions aggregated across the index or portfolio are normalised by revenue generated by the issuing companies.

### CARBON PROFILE OF THE FTSE/JSE TOP 100 COMPANIES

<table>
<thead>
<tr>
<th>Highlights</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total GHG emissions</strong></td>
<td>335 million tonnes (Mt) of CO$_2$e from operations, electricity use and supply chains</td>
</tr>
<tr>
<td><strong>Emissions from operations</strong></td>
<td>148 Mt CO$_2$e, equivalent to 27% of South Africa’s emissions in 2010</td>
</tr>
<tr>
<td><strong>Emissions from electricity use</strong></td>
<td>92 Mt CO$_2$e, or 28% of total corporate emissions</td>
</tr>
<tr>
<td><strong>Carbon in supply chains</strong></td>
<td>Other direct (Tier 1) and upstream suppliers account for 95 Mt CO$_2$e</td>
</tr>
<tr>
<td><strong>Main contributors</strong></td>
<td>Basic Resources and Oil &amp; Gas account for 79% of total emissions across the Index. Their emissions are mainly from operations and electricity use. The Food &amp; Beverage, Industrial Goods &amp; Services, Construction &amp; Materials, Personal &amp; Household Goods, Retail, Telecommunications and Chemicals sectors emit a further 19% of carbon. In sectors such as Food &amp; Beverage, suppliers account for the bulk of emissions. Data on sources of emissions can be used to identify exposure to carbon costs and opportunities to cut carbon.</td>
</tr>
<tr>
<td><strong>Carbon intensity</strong></td>
<td>Wide variations in the carbon intensity of companies in the Construction &amp; Materials and Basic Resources sectors will contribute to variations in exposure to carbon costs.</td>
</tr>
<tr>
<td><strong>Disclosure</strong></td>
<td>97% of emissions data analysed are based on corporate disclosures.</td>
</tr>
</tbody>
</table>

### Carbon hotspots

The largest 100 companies by market capitalisation in the FTSE/JSE All Share Index (ALSI) directly emitted 148 million tonnes (Mt) of CO$_2$e in 2011. This equates to 27% of national GHG emissions in South Africa in 2010 (547 Mt CO$_2$e). The companies are directly exposed to carbon costs applied to these operational emissions, known as Scope 1 under the GHG Protocol. Sources include owned or controlled vehicles, blast furnaces, generators,
refrigeration and air-conditioning units. Measures to reduce emissions include energy efficiency, which can lead to cost savings and lower exposure to volatile fuel prices.

A further 92 Mt CO$_2$e is emitted as a result of electricity purchases by the 100 companies. These are known as Scope 2 emissions under the GHG Protocol. Companies can be exposed to carbon costs passed on by electricity suppliers in higher tariffs. The dominance of Eskom’s existing and planned coal-fired capacity will put the onus on JSE companies to reduce their Scope 2 emissions, or wait more than a decade for emissions from the electricity grid to start falling. Options to cut Scope 2 emissions include reducing energy consumption in buildings, processes and equipment, as well as switching to renewable sources of electricity. An electricity levy for power generated from non-renewable sources has gone up to 3.5 cents per kilowatt-hour, providing an incentive to switch to renewable energy.  

For the FTSE/JSE top 100 companies, other tier 1 suppliers (see Table 1), account for 40 Mt CO$_2$e. The rest of the companies’ upstream supply chain emits an estimated 55 Mt CO$_2$e. Emissions in supply chains can be measured using methods outlined in the GHG Protocol Initiative Corporate Value Chain Standard (2011). This study excludes downstream emissions from products in use to limit double-counting of emissions.

Table 1: Breakdown of emissions by GHG Protocol scope

<table>
<thead>
<tr>
<th>Scope</th>
<th>Description</th>
<th>Exposure to carbon liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope 1</td>
<td>Direct GHG emissions caused by an organisation’s refrigerant use, fuel combustion and owned or controlled industrial processes</td>
<td>Carbon costs are incurred directly through operations</td>
</tr>
<tr>
<td>Scope 2</td>
<td>Indirect emissions from the generation of electricity purchased from suppliers</td>
<td>Carbon liabilities can be passed on by electricity suppliers in utility bills</td>
</tr>
<tr>
<td>Scope 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other tier 1</td>
<td>Indirect emissions from other first-tier suppliers (excluding electricity suppliers) such as providers of packaging, logistics and vehicles not owned or controlled (leased)</td>
<td>Carbon liabilities can be passed through supply chains</td>
</tr>
<tr>
<td>Upstream supply chain</td>
<td>Indirect emissions from outsourced activities in tiers 2, 3, 4 etc of the supply chain, through to the extraction and production of purchased materials and fuels</td>
<td></td>
</tr>
<tr>
<td>Products in use</td>
<td>Excluded from this analysis</td>
<td>Clients can incur carbon costs</td>
</tr>
</tbody>
</table>

Emissions from operations, purchased electricity, other tier 1 suppliers and the rest of the supply chain amount to 335 Mt CO$_2$e. Operations and electricity use account for 72% of total emissions across the index (see Figure 1). Data on sources of emissions can be used to identify exposure to carbon costs and opportunities to cut emissions and reduce risk.

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34 [http://www.ghgprotocol.org/standards/scope-3-standard](http://www.ghgprotocol.org/standards/scope-3-standard), accessed 12 October 2012


Carbon and water risk for South Africa’s top companies, bonds and equity funds - 9
The Basic Resources and Oil & Gas sectors account for 79% of total emissions from operations, electricity use and supply chains across the FTSE/JSE top 100 companies. This reflects the absence of utilities companies in the index, the dominance of mining and metals companies (15 companies analysed and almost 30% of the value of the index), and the carbon intensity of the only Oil & Gas company in the index, Sasol Ltd. Sasol, which emitted more than 80 Mt of CO$_2$e from operations and electricity use in 2011, is the second largest corporate contributor to carbon in South Africa, after Eskom. The nine sectors shown in Figure 2 account for over 99% of Scope 1 emissions and 96% of Scope 2 emissions across the top 100 companies.

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**Footnotes:**
36 Based on the market capitalisation of listed companies as of 30 June 2012
Opportunities to reduce emissions from each source vary by sector. In the five sectors with the highest emissions from all three scopes, operations account for more than half of total emissions in the Oil & Gas and Construction & Materials sectors (see Figure 3). Carbon mitigation strategies in these sectors could be most effective by focusing on “hot spots” of GHG emissions that companies own or have direct control over. Electricity use drives 40% of emissions across the Basic Resources sector.

Other tier 1 suppliers are a “hot spot” in the Food & Beverage sector, where they account for 27% of emissions. Remaining supply chain carbon represents more than 40% of total emissions in both the Food & Beverage and Industrial Goods & Services sectors. Extracting and processing raw materials, dairy farming, fertiliser use in crop production, water provision, packaging and logistics can be major contributors to upstream emissions.

A handful of suppliers often account for a big chunk of supplier emissions. Companies can use procurement criteria and engagement to encourage mitigation and manage exposure to supply chain carbon costs that may trickle through into higher input prices.

**Figure 3: Breakdown of FTSE/JSE top 100 total emissions within the top five sectors**

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**CARBON INTENSITY**

Trucost compared the carbon intensity of FTSE/JSE top 100 companies, measured as tonnes of CO₂eq from operations, purchased electricity and other tier 1 suppliers per R mn (US$ mn) of revenue. Companies that are more carbon intensive than the average for their sectors are more exposed to carbon costs. They will therefore be under greater upward pricing pressure to pass a share of these costs on to customers. Differences in business activities, energy use, materials, processes and distribution systems can contribute to variations in carbon intensity.

Carbon intensity varies most in the Construction & Materials sector (see Figure 4). The most carbon-intensive company in the index is a cement manufacturer, Pretoria Portland Cement Co. Ltd (824 tCO₂eq/R mn), while an engineering and construction services company has the lowest carbon intensity in the sector (35 tCO₂eq/R mn). Sasol, the only Integrated Oil & Gas company analysed, is the second-most carbon intensive company in the Index. Processes to create petroleum through the conversion of coal-to-liquids (CTL) are particularly carbon intensive and the company’s focus on commercialising CTL technology internationally is likely to increase Sasol’s carbon intensity.
Research by the South African Treasury found that the CTL industry is likely to be most affected by the planned carbon tax, with output projected to fall by 78% at a carbon tax rate of R100 (US$12) per metric tonne. Based on proposals in the government’s February 2012 Budget, a tax rate of R120 (R15) per tonne is expected in 2013/14, rising by 10% annually until the end of the first phase in 2019/20. However, the majority of petroleum industry emissions will be exempt from the tax during the first phase. According to the Treasury paper, at rates above R600 (US$73) per tonne, CTL plants will no longer be viable. The carbon tax is likely to hit R648/tonne by 2031, assuming the rate continues to rise by 10% annually. Demand for CTL fuels is likely to fall well before then.

Figure 4: Average and range in carbon intensity in five high-emitting supersectors

The most carbon-intensive Basic Resources company is 12 times more carbon intensive than the least carbon-intensive. The most carbon intensive is a steel manufacturer that emits 557 tCO₂e per R mn. Iron and steel production is energy intensive. Processes can include the use of raw materials including coking coal in furnaces to make steel. Heating processes to produce coke can release significant emissions including methane, and the combustion of coal and coke to convert iron ore to iron in blast furnaces emits carbon dioxide emissions. The proposed carbon tax would apply concessions for process emissions and trade-exposed sectors such as iron and steel. Six Basic Resources companies are more carbon intensive than the sector average (193 tCO₂e per R mn). The least carbon-intensive Basic Resources company (45 tCO₂e per R mn) is a General Mining company.

The ICB supersectors analysed include companies that operate in different subsectors. Where more than one company is in a subsector, Trucost assessed variations in carbon intensity (see

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39 ibid
40 ibid
The widest range in carbon intensity at a subsector level is among Gold Mining companies. There is a five-fold difference between the carbon intensity of the least and most carbon intensive General Mining companies. Variations in carbon intensity indicate potential for companies that emit more than the average level of carbon per R mn for their industries to improve carbon efficiency. Variations within sectors also provide opportunities for investors to reduce exposure to carbon emissions, while maintaining sector allocations (see page 51).

Table 2: Range in carbon intensity in subsectors with more than one constituent (tCO₂e/R mn)

<table>
<thead>
<tr>
<th>Supersector</th>
<th>Subsector</th>
<th>Lowest</th>
<th>Average</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction &amp; Materials</td>
<td>Heavy Construction</td>
<td>35</td>
<td>39</td>
<td>43</td>
</tr>
<tr>
<td>Basic Resources</td>
<td>General Mining</td>
<td>45</td>
<td>150</td>
<td>235</td>
</tr>
<tr>
<td></td>
<td>Gold Mining</td>
<td>99</td>
<td>264</td>
<td>454</td>
</tr>
<tr>
<td></td>
<td>Paper</td>
<td>130</td>
<td>146</td>
<td>161</td>
</tr>
<tr>
<td></td>
<td>Platinum &amp; Precious Metals</td>
<td>128</td>
<td>147</td>
<td>189</td>
</tr>
<tr>
<td>Food &amp; Beverage</td>
<td>Food Products</td>
<td>25</td>
<td>96</td>
<td>167</td>
</tr>
<tr>
<td>Industrial Goods &amp; Services</td>
<td>Business Support Services</td>
<td>11</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Diversified Industrials</td>
<td>6</td>
<td>30</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Marine Transportation</td>
<td>5</td>
<td>9</td>
<td>13</td>
</tr>
</tbody>
</table>
97% of the data analysed by Trucost were disclosed by companies or derived from corporate disclosures. 20% of FTSE/JSE top 100 companies reported absolute carbon data for operational (Scope 1) emissions in line with the GHG Protocol in annual reports, environmental reports, on websites or to the Carbon Disclosure Project (CDP) in 2011. A further 39% provided data on fuel use or emissions from parts of their operations that could be used to derive global emissions. Together these companies account for 97% of GHG emissions analysed across the top 100 companies (see Figure 5). The remaining emissions analysed for companies that did not disclose data were calculated using Trucost’s model (see Appendix 1).

The high level of disclosure suggests that most high-emitting companies have systems in place to measure and report on carbon performance, as part of good corporate governance. Companies that monitor emissions will be better placed to reduce them and manage exposure to carbon costs. They will also be better prepared to comply with the planned mandatory carbon reporting rules in South Africa.

Companies often disclose carbon emissions in sustainability reports or on company websites. Carbon data are likely to be increasingly reported in annual reports under the JSE corporate reporting framework. Companies listed on the JSE must comply with the King Code of Governance Principles for South Africa 2009 (King III). They must issue an integrated annual
report, defined as “a holistic and integrated representation of the company's performance in terms of both its finance and its sustainability”. Integrated reports should “provide stakeholders with a concise overview of an organisation, integrating and connecting important information about strategy, risks and opportunities and relating them to social, environmental, economic and financial issues”.

In addition, the JSE requires mining companies to disclose, where applicable, a summary of environmental management and funding in annual reports. Standardised, accurate and comparable data is essential to make it easier for investors to take account of all relevant information in financial analysis. Investors can use carbon data to inform decision-making and engagement programmes.

Companies that are also publicly listed in countries such as the UK, the US or Hong Kong must comply with local listing requirements for financial reporting and, where relevant, rules and guidance for reporting on environmental issues. Under the UK Companies Act 2006, directors of quoted companies must include meaningful strategic, forward-looking information in business reviews in annual reports and accounts. This should reveal how directors have performed their duty “to promote the success of the company”, with regard to issues including the impact of the company’s operations on the environment.

The US Securities and Exchange Commission (SEC) requires disclosure of material environmental issues such as climate change, which can include describing the material effects of government regulation on a business and environmental issues that may affect the company’s utilization of assets. The Hong Kong Stock Exchange (HKEx) has published guidance on “recommended disclosures” on environmental, social and governance (ESG) issues, to be appended to its listing rules from 2013. An ESG report “should state the issuer’s ESG management approach, strategies, priorities, objectives and explain how they relate to the business.” The HKEx plans to refer to the GHG Protocol in frequently asked questions (FAQs) about the ESG reporting obligations, which will be applied on a “comply or explain” basis by 2015.

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## Projected carbon liabilities for FTSE/JSE top 100

### Highlights

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the FTSE/JSE top 100 companies were to pay for all of their global Scope 1 and 2 emissions, carbon costs would amount to more than R29 bn (US$3.5 bn).</td>
<td>The government plans to introduce a carbon tax in 2013/14. If the companies analysed were to pay R120 for each tonne of their global GHG emissions from operations and electricity use in 2011, carbon liabilities of more than R29 bn (US$3.5 bn) would equate to 4% of their combined operating income.</td>
</tr>
<tr>
<td>Under the proposed carbon tax design, companies could pay R9.9 bn (US$1 bn). This equates to just 35% of the potential cost of Scope 1 and 2 emissions across the Index.</td>
<td>60% of emissions in each sector would be exempt from the tax, on average. Based on benchmark carbon performance, companies that are more carbon intensive than the average for their sectors would pay more, while relatively carbon-efficient companies would pay less. This study models exposure to carbon costs based on corporate carbon intensities relative to supersector averages.</td>
</tr>
<tr>
<td>Carbon liabilities for operational emissions would total R5.8 bn (US$710 mn) in 2013/14. Electricity-related emissions could amount to R4.1 bn (US$497 mn).</td>
<td>If just 50% of carbon costs were passed on in higher electricity tariffs in 2013/14, Scope 2 emissions could increase carbon liabilities by over one-third, or R2.05 bn (US$248 mn). Scope 1 and 2 carbon liabilities could reduce earnings by 4% on average.</td>
</tr>
<tr>
<td>The external costs of damages caused by GHG emissions are 2.5 times higher than potential liabilities under the planned carbon tax.</td>
<td>At the median external carbon cost of R104 (US$13), carbon liabilities internalised for Scope 1 emissions would amount to more than R15 bn (US$1 bn). External costs for Scope 2 emissions could amount to R9.5 bn (US$1 bn).</td>
</tr>
<tr>
<td>If 58 companies in the nine highest-emitting sectors were to pay for operational emissions and incur 50% of carbon liabilities for emissions from electricity purchases, carbon liabilities could total R7,825 million. 25% of these costs would be driven by electricity use.</td>
<td>Scope 1 carbon costs and half of Scope 2 carbon liabilities would equate to 7% of earnings on average. Exposure to carbon liabilities varies by sector, with electricity use accounting for the majority of carbon costs in sectors including Basic Resources.</td>
</tr>
<tr>
<td>Trucost assessed potential future carbon liabilities among the 58</td>
<td>Projected carbon liabilities vary under different scenarios that reflect a range of potential emissions</td>
</tr>
</tbody>
</table>
Highlights

companies based on a 10% annual increase in the carbon tax rate, which would reach R250 (US$30) per tonne by 2020/21.

pathways. If business continues as usual, carbon costs could almost quadruple to R21.9 bn (US$2.7 bn). If companies reduce emissions by more than 27%, future carbon liabilities could be 55% lower. However, plans for the country’s power generation energy mix could cause liabilities for Scope 2 emissions to triple, unless companies increase energy efficiency and switch to renewable electricity.

If the FTSE/JSE top 100 companies were to pay the expected 2013/14 tax rate of R120 (US$15) for each tonne of their global Scope 1 emissions from operations and Scope 2 emissions from electricity use, carbon costs would amount to more than R29 bn (US3.5 mn). This equates to 1% of the companies’ combined revenues and 4% of their total operating income in 2011.

Global company-wide emissions data are not broken down by business activity. Some of the emissions analysed may be emitted outside of South Africa, and therefore exempt from the carbon tax. However, they may be covered by other carbon regulations or pricing mechanisms in other jurisdictions, such as Australia, Europe, South Korea and China, now or by 2015. Carbon reporting rules that require a breakdown of Scope 1 and 2 emissions by country or under different carbon pricing mechanisms would enable a more granular assessment of carbon risk. The carbon costs in this study indicate their potential financial implications for companies in order to illustrate the need for a more detailed assessment of systemic carbon risk by regulators and the investment industry.

Taking account of the government’s February 2012 Budget proposals, Trucost applied the expected carbon tax rates to global Scope 1 and 2 emissions in 2011. The proposed carbon tax in South Africa would initially be designed around a basic tax-free threshold of 60%, based on industry carbon intensity benchmarks. Companies will only pay for emissions above sector benchmark thresholds. Additional relief will be considered for firms that reduce their carbon intensity. The tax-free threshold will be increased by up to 10% for process emissions in the cement, iron and steel, aluminium and glass sectors, and by up to 10% for companies in trade-exposed sectors such as iron and steel, aluminium and petroleum.

Companies can also offset 10% of carbon emissions by purchasing carbon credits under the UN Kyoto Protocol Clean Development Mechanism (CDM). CDM carbon credits, known as certified emission reductions (CERs), can be purchased for emissions-reduction projects in developing countries. One CER is equivalent to one tonne of CO\textsubscript{2}. Companies in South Africa could sell or trade CERs for others to use to help meet their voluntary or mandatory carbon reduction targets. CERs were trading at R33 (US$4) per tonne at the time of analysis. The
The majority of emissions in South Africa will therefore be exempt for the tax initially. The methodology to assess exposure to carbon costs in 2013/14 is shown in Table 3 below.

**Table 3: Methodology to analyse operational exposure to carbon costs**

<table>
<thead>
<tr>
<th>South Africa tax proposals</th>
<th>Trucost analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tax Proposals Budget 2012</strong></td>
<td><strong>Carbon risk scenario 1 – 2013/14</strong></td>
</tr>
<tr>
<td>Basic tax-free threshold of 60%, based on carbon intensity.</td>
<td>Operational carbon exposure: Basic tax-free threshold of 60%, based on carbon intensity.</td>
</tr>
<tr>
<td>Formula: ( Z = \frac{Y}{X} ).</td>
<td>Formula to calculate taxable Scope 1 emissions based on threshold: ( Z = \frac{Y}{X} ).</td>
</tr>
<tr>
<td>X is the carbon intensity of firm measured as carbon emissions per unit of output.</td>
<td>X is the carbon intensity of the firm measured as Scope 1 carbon emissions per R M revenue.</td>
</tr>
<tr>
<td>Y is the benchmark carbon intensity for the sector.</td>
<td>Y is the average carbon intensity of sectors, measured as the average Scope 1 carbon intensity of each ICB supersector in the FTSE/JSE top 100 companies.</td>
</tr>
<tr>
<td>The adjustment to the tax-free threshold is then determined by multiplying the original percentage threshold by ( Z ).</td>
<td>The adjustment to the tax-free threshold is then determined by multiplying the original percentage threshold by ( Z ).</td>
</tr>
</tbody>
</table>

**E.g., FTSE/JSE top 100 – Basic Resources sector.**

Basic tax-free threshold is 60%.  
Y is 62 tCO$_2$e/R M.  
The carbon intensity of Anglo American (X) is 42 tCO$_2$e/R M  
\[ Z = \frac{Y}{X} = \frac{62}{42} = 147\% \]  
Adjusted tax-free threshold = \( Z \times \) basic tax-free threshold = \( 147\% \times 60\% = 88\% \).  
Estimated tax-free emissions based on adjusted basic threshold = \( 88\% \times 9,365,706 \) tonnes of CO$_2$e = 8,255,067 tonnes of CO$_2$e.  
Remaining Scope emissions (1,110,639 tonnes of CO$_2$e) are then reduced by a further 10% to allow for exemptions for trade exposure/process emissions.  
For a further 10% of emissions, the CER carbon price of R33 (US$4) was applied to reflect the lower cost of offsetting.  
Taxable emissions: The tax rate of R120 (US$15) was applied to any remaining Scope 1 emissions.

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**SCENARIO 1 - CARBON EXPOSURE IN 2013/14**

**Operational exposure to carbon costs**
Trucost’s analysis shows that the FTSE/JSE top 100 companies could be liable for taxes on more than 47 million tonnes of operational carbon emissions, or 32% of total Scope 1 emissions. Modelled carbon liabilities for taxable Scope 1 emissions are estimated at R5,873 mn (US$710 mn) in 2013/14. This equates to less than 1% of the companies’ combined earnings. The analysis does not take account of additional exemptions for process emissions for iron and steel, aluminium, cement, glass & ceramics, chemicals, agriculture/forestry/land use, waste or fugitive emissions from coal.

**Exposure to carbon liabilities through Scope 2 emissions**
Trucost modelled potential exposure to carbon costs passed on in electricity prices across the FTSE/JSE top 100 companies. 60% of Scope 2 emissions were assumed to be exempt due to the basic tax-free threshold. The analysis assumes that electricity providers purchased CERs for 10% of remaining emissions and paid the R120 (US$15) tax rate for the rest. Results show that the 100 companies could incur carbon credit or tax liabilities for more than 36 million tonnes of electricity-related emissions, or 40% of total Scope 2 carbon.

- **100% pass through of Scope 2 carbon costs in 2013/14:** This assumes 100% of carbon costs are passed on in electricity prices. Applying R120 to Scope 2 emissions results in indirect carbon costs of some R4.1 bn (US$497 mn).
- **50% pass through of Scope 2 carbon costs in 2013/14:** If just 50% of carbon costs were passed on in electricity prices in 2013/14, Scope 2 emissions would result in carbon costs of more than R2.05 billion (US$248 mn).

Scope 1 carbon costs and 50% of Scope 2 carbon liabilities could cut earnings by 4% on average across 94 companies that had positive operating income in 2011.

**External costs of carbon**

The external cost of carbon is the monetised cost of damages from each additional tonne of CO$_2$e emitted into the atmosphere. The Treasury plans to use the carbon tax rate to reflect the marginal external cost of carbon. However, given the absence of an international climate change agreement and a global emissions pricing system, the Treasury aims to partially, rather than fully, internalise the external cost of carbon into producers’ costs as an interim measure.

The carbon tax is expected to be aligned with the external cost of carbon over time in order to deliver an appropriate price signal that incentivises behavior change to reduce emissions. Estimates of marginal external costs range from approximately R41-R248 (US$5-US$30) per tonne. At the median external cost of R104 (US$13), carbon liabilities internalised for Scope 1 emissions from the FTSE/JSE top 100 companies would amount to more than R15 bn (US$1 bn). This is more than double the estimated carbon liabilities for Scope 1 emissions under the proposed carbon tax in 2013/14. Similarly, external carbon costs for Scope 2 emissions could amount to more than R9.5 bn (US$1 bn), over double the potential carbon liabilities for emissions from electricity purchases.

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44 Excluding earnings from six companies that had zero or negative EBITDA
Carbon liabilities in high-emitting sectors

Trucost analysed potential carbon costs for 58 companies analysed in the Basic Resources, Chemicals, Construction & Materials, Food & Beverage, Industrial Goods & Services, Oil & Gas, Personal & Household Goods, Retail and Telecommunications sectors, which accounted for 98% of Scope 1 and 2 emissions across the Index. They represent 75% of the value of the FTSE/JSE top 100 companies as of 30 June 2012, and their combined earnings (R619,393 mn or US$74,897 mn) equate to more than 81% of earnings across these companies in 2011.

Scope 1 emissions from the 58 companies could result in R5,848 mn (US$707 mn) in carbon costs. 39 of the 58 companies were less carbon intensive than their FTSE/JSE top 100 ICB supersector averages. They would pay less carbon tax than industry peers that have above average carbon intensities. For 27 companies, exemptions could result in zero liabilities for Scope 1 emissions. Carbon exposure is therefore concentrated. For 10 companies that are more carbon-intensive than sector peers, annual operational carbon costs would total more than R50 mn (US$6 mn) each. The highest exposure at a company level amounts to R2,964 mn (US$358 mn). The Oil & Gas and Basic Resources sectors would incur the highest carbon costs (see Table 4).

Scope 2 emissions could result in carbon liabilities of R3,955 mn (US$478 mn). If 55 companies in these sectors that were profitable in 2011 were to pay for taxable Scope 1 emissions and 50% of carbon costs from Scope 2 emissions were passed on in electricity prices, carbon liabilities would equate to 7% of earnings on average.

The Oil & Gas sector has the highest level of operational carbon costs. If companies were to pay for 100% of Scope 2 carbon costs passed through in higher electricity prices, taking account of the tax exemption for 60% of electricity emissions and the potential to purchase CER credits for 10% of emissions, carbon liabilities would be highest in the Basic Resources sector. Its liabilities from Scope 2 emissions would be almost 50% higher than carbon costs from operations. If carbon costs from electricity-related emissions were passed through fully in electricity prices, these carbon liabilities would be more significant than operational carbon costs in the Basic Resources, Retail and Telecommunications sectors. If just 50% of carbon costs from Scope 2 emissions were passed through in electricity prices, electricity-related emissions could account for 25% of R7,825 mn in carbon liabilities across the 58 companies.

Table 4: Overview of carbon exposure under scenario 1 by sector

<table>
<thead>
<tr>
<th>Supersector</th>
<th>Scope 1 and Scope 2 carbon liabilities (R mn)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scope 2 (100%)</td>
</tr>
<tr>
<td>Basic Resources</td>
<td>2,057</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>2,964</td>
</tr>
<tr>
<td>Construction &amp; Materials</td>
<td>380</td>
</tr>
<tr>
<td>Food &amp; Beverage</td>
<td>163</td>
</tr>
<tr>
<td>Industrial Goods &amp; Services</td>
<td>126</td>
</tr>
<tr>
<td>Retail</td>
<td>17</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>38</td>
</tr>
<tr>
<td>Personal &amp; Household Goods</td>
<td>44</td>
</tr>
<tr>
<td>Chemicals</td>
<td>59</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,848</strong></td>
</tr>
</tbody>
</table>
SCENARIO 2 - EXPOSURE TO CARBON COSTS IN 2020/21

Trucost assessed potential future carbon liabilities among the 58 companies in high-emitting sectors in the FTSE/JSE top 100 companies. Based on a 10% annual increase in the carbon tax, the rate would reach R250 (US$30) per tonne by 2020/21. Projected CER prices, based on market forecasts, could reach R111 (US$13) per tonne by then.

The Scenario 1 methodology is used to calculate company-level carbon intensity relative to sector averages in order to adjust the basic tax-free threshold to reward carbon efficient companies and penalise companies that are carbon-intensive relative to sector peers. Tax-free thresholds will be reduced during the second phase from 2020 to 2025, and may be replaced with absolute emission thresholds in phase 3. This analysis assumes the basic tax-free threshold is reduced to 50%. 10% of Scope 1 emissions are considered exempt for trade exposure. A 50% pass through of carbon liabilities from electricity-related emissions is assumed.

Trucost assessed potential future liabilities in 2020/21 based on three scenarios:

a. **Business as usual (BAU):** Assumes that without carbon constraints, company-level emissions increase by 43% by 2020/21 in line with projected national emissions in a business-as-usual (BAU) scenario. After removing tax-free emissions, CER prices are applied to 10% of Scope 1 and 2 emissions. Scope 2 emissions are projected to increase by 43% for each company. After the 50% exemption for Scope 2 emissions, the remaining half of emissions are priced at R250 (US$30) per tonne.

b. **Long Term Mitigation Scenario (LTMS) – 34% below BAU:** Based on the government’s LTMS in which emissions are limited at 34% below BAU emissions and an upper limit of 583 MtCO$_2$e by 2020, projected company-level emissions increase by 7% by 2020/21. Liabilities for Scope 2 emissions are modelled similarly to Scenario 2a, but with a 7% increase by 2020/21.

c. **LTMS with 27% reduction, mitigation costs and the sale of CERs:** Assumes a 27% cut in company-level Scope 1 emissions by 2020/21, based on potential emissions reductions from the commercial and industrial sectors between 2010 and 2020. The scenario assumes that companies pay R30 per tonne to abate 7% of Scope 1 carbon emissions in 2020/21, reducing carbon liabilities. It also assumes that companies benefit from the sale of CERs for reducing 10% of their taxable Scope 1 emissions. Scope 2 emissions are projected to increase by 23% due to the projected 29% increase in electricity emissions estimated in the government’s 2010 Integrated Resource Plan (IRP) and 7% reduction in energy use due to energy efficiency demand-side management (EEDSM) policies.

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Table 5: Exposure to carbon liabilities under scenarios in 2020/21

<table>
<thead>
<tr>
<th>Sector</th>
<th>2a. Business as usual (R mn)</th>
<th>2b. LTMS – 34% below BAU (R mn)</th>
<th>2c. LTMS with 27% cut, mitigation costs and CER sales (R mn)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scope 1</td>
<td>Scope 2 (50%)</td>
<td>Scope 1</td>
</tr>
<tr>
<td>Basic Resources</td>
<td>8,009</td>
<td>5,821</td>
<td>5,993</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>11,242</td>
<td>787</td>
<td>8,412</td>
</tr>
<tr>
<td>Construction &amp; Materials</td>
<td>1,204</td>
<td>81</td>
<td>901</td>
</tr>
<tr>
<td>Food &amp; Beverage</td>
<td>529</td>
<td>202</td>
<td>396</td>
</tr>
<tr>
<td>Industrial Goods &amp; Services</td>
<td>421</td>
<td>137</td>
<td>315</td>
</tr>
<tr>
<td>Retail</td>
<td>61</td>
<td>244</td>
<td>45</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>127</td>
<td>121</td>
<td>95</td>
</tr>
<tr>
<td>Personal &amp; Household Goods</td>
<td>150</td>
<td>70</td>
<td>112</td>
</tr>
<tr>
<td>Chemicals</td>
<td>196</td>
<td>36</td>
<td>146</td>
</tr>
<tr>
<td>Total</td>
<td>21,938</td>
<td>7,500</td>
<td>16,415</td>
</tr>
</tbody>
</table>

As shown in Table 5, carbon costs from Scope 1 emissions could be almost four times higher than in 2013/14, reaching R21.9 bn (US$2.7 bn) by 2020/21 under scenario 2a. Electricity-related carbon liabilities would almost quadruple to R7.5 bn (US$908 mn). If companies limit the increase in operational emissions to 7% (scenario 2b), carbon costs would almost triple, compared with liabilities in 2013/14. Reducing operational emissions by 27%, mitigating carbon by a further 7% in 2020/21 and selling CERs for 10% of emissions would result in the lowest project operational carbon costs. However, the potential increase in carbon costs from electricity purchases under existing power generation plans could cause liabilities for Scope 2 emissions to triple.

An increase in large and distributed small-scale electricity generation from renewable sources is vital to reduce the carbon impacts of electricity-intensive businesses and limit upward pricing pressures from carbon liabilities. Shifting to a low-carbon economy will require greater energy efficiency plans and investment in clean energy, with electricity tariffs adjusted to support investment in low-carbon power generation. A survey of 32 companies in South Africa found that several mitigation activities, such as energy efficiency, renewable energy and fuel switching, increased significantly in the period 2008-2010 compared to 2005-2007. An increase in large and distributed small-scale electricity generation from renewable sources is vital to reduce the carbon impacts of electricity-intensive businesses and limit upward pricing pressures from carbon liabilities. Shifting to a low-carbon economy will require greater energy efficiency plans and investment in clean energy, with electricity tariffs adjusted to support investment in low-carbon power generation. A survey of 32 companies in South Africa found that several mitigation activities, such as energy efficiency, renewable energy and fuel switching, increased significantly in the period 2008-2010 compared to 2005-2007.48 Companies are at different stages of rolling out energy efficiency technologies, and several are planning to improve energy efficiency for the first time in the period 2011-2015. Differences in cost structures and patterns of investments are expected to contribute to a varied pace of adaptation to rising electricity prices, even within the same industries.49

Modelling of potential future exposure to carbon costs could take account of factors including fuel switches, energy efficiency, other industry-specific abatement measures, and capital expenditure on carbon-intensive plant and infrastructure. Analysts could consider mitigation

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* Ability of firms to adjust to higher energy costs, DNA Economics, October 2011
strategies, carbon targets, supply chain carbon management and potential income from the sale of CER credits. They could model scenarios using different discount rates for future cash flows and expected carbon performance benchmarks.

Analyses could assess potential carbon risks from emissions in other countries, as the roll out of climate policies across countries and regions closes loopholes for free riders. Many companies that emit GHGs through operations outside of SA, or are dual listed on stock exchanges elsewhere, could be exposed to other existing or planned policy measures to price carbon, set emissions limits and strengthen disclosure rules. For instance, BHP Billiton, which is also listed on stock exchanges in the US, UK and Australia, reported to the US Securities and Exchange Commission (SEC) on its Form 20-F in 2011 that it is likely to see changes in the “cost position” of “greenhouse-gas-intensive assets and energy-intensive assets as a result of regulatory impacts” in the countries in which it operates.\(^5^0\) BHP is among companies in the FTSE/JSE top 100 that are exposed to carbon costs under policy tools including the EU Emissions Trading System (EU ETS) and Australian carbon pricing mechanism. BHP Billiton reports Scope 1 and 2 emissions totalling 2.6 Mt CO\(_2\) in Australia.\(^5^1\) If it were to pay the Australian carbon price of A$25.40 (R213) for these emissions in 2014/15, carbon costs in the country could total R546 mn (US$66 mn). The company generates 20% of revenue in Europe and almost 8% in Australia.

A study by the United Nations University found that an escalating tax rate that reaches R250 (US$30) per tonne in 2022, the rate modelled in Scenario 2 in this report, would achieve the national emissions reductions targets set for 2025.\(^5^2\) The study shows that border tax adjustments that impose taxes on the carbon content of imports (and rebate domestic exporters) can help address the risk of carbon-intensive supply chains shifting to countries without carbon constraints. Border tax adjustments could improve welfare and employment in South Africa, while maintaining the same emissions reductions. Recycling carbon tax revenues, for instance by reducing corporate taxes on capital earnings, would influence distributional outcomes, with tradeoffs between growth and equity. Carbon tax revenues could be used to reduce employment tax,\(^5^3\) and to support the transition to a low-carbon economy through market-based mechanisms such as renewable energy feed-in-tariffs, skills development and green job creation. Unless government policies are implemented to reduce emissions, the economy will face higher costs for dealing with climate change impacts.

Lack of carbon constraints could damage terms of trade.\(^5^4\) Fund managers could consider the carbon intensity of products and services in carbon risk assessments. Many of the companies in the FTSE/JSE top 100 generate revenues in countries, such as France, that are implementing carbon constraints and considering imposing carbon tariffs on carbon-intensive imports from countries with inadequate carbon controls.\(^5^5\) This could combine with an expected fall in demand for carbon-intensive products and services to reduce the competitiveness of carbon-dependent industries such as coal and coal-to-liquids producers, as companies with lower-carbon alternatives gain an edge.

\(^{55}\) France plans to revive EU carbon tariff, The Guardian, 18 May 2012
Financial risk from carbon liabilities in 2013/14

Highlights

Findings show that if 52 companies in eight high-emitting sectors paid R120 per tonne for taxable Scope 1 emissions and 50% of carbon costs from electricity-related emissions in 2013/14, carbon liabilities could be material to several companies in the index. Carbon liabilities would increase risks to profit and credit most among Basic Resources, Oil & Gas, Construction & Materials, Chemicals and Food & Beverage companies in the FTSE/JSE top 100. Companies that are less exposed to carbon liabilities than sector peers may find it easier to pass a share of these costs on in higher prices.

Earnings would fall most (by 19% on average) in the Basic Resources sector. Earnings would fall by 11% on average in the Oil & Gas and Construction & Materials sectors.

Average debt to earnings before interest, taxation, depreciation and amortisation (EBITDA) would increase most in the Construction & Materials (15%), Oil & Gas (12%) and Basic Resources (11%) sectors, with credit risk rising sharply for some companies.

Carbon liabilities would reduce return on equity (ROE) and return on assets (ROA) most in the Construction & Materials (25% and 23% respectively), Oil & Gas (16%), Chemicals (7%) and Basic Resources (5%) sectors. Falls in profitability ratios can lead to lower equity valuations.

Company cash flows are coming under growing pressure from a resource crunch that is driving volatility in energy and materials prices, and tighter environmental regulations which can drive up pollution liabilities. Companies that are more resource efficient than sector peers and invest in abatement will likely be better positioned to maintain pricing competitiveness. For investors, understanding the natural resource dependence and emissions of companies in portfolios is vital to manage exposure to future credit risk from resource pressures and carbon constraints. As governments increasingly apply the “polluter pays” principle, companies will have to meet the costs of reducing emissions or pay the cost of damages.
The global financial crisis that started in 2007 has put pressure on rating agencies to become more rigorous in their assessments of corporate credit risk.\textsuperscript{56,57} The investible universe, value of stocks and corporate cost of capital are influenced by ratings by agencies such as Moody’s Investors Service and Standard & Poor’s (S&P). Credit ratings are opinions of relative creditworthiness. Company and industry “event” risk to the ability of companies to pay dividends and repay debt obligations on time include failure to anticipate shifts in the company’s markets, rising raw materials costs and regulations. Events that adversely affect a whole industry can have a blanket effect on the bonds of index constituents in the sector.\textsuperscript{58} Credit ratings can take account of a variety of factors including the regulatory environment and a company’s strategic direction.

A general approach to assessing creditworthiness is credit scoring, which takes account of the potential effects of adverse events and economic conditions that could put creditors’ returns at risk. Ratings agencies focus on business risks such as competitive positioning and peer group comparisons of profitability, as well as financial risk such as cash flow adequacy and liquidity. They take account of factors including margin stability – the average percentage change in profit margins.\textsuperscript{59} Financial risk indicators that can be used to predict bond ratings, yields and credit risk include return on assets (ROA), debt to earnings and interest coverage.\textsuperscript{60} S&P evaluates credit risk by looking at factors that include the risk that bond issuers will not be able to pay interest and principal according to contractual terms. S&P examines the solvency ratio of corporate debt relative to earnings before interest, taxation, depreciation and amortisation (EBITDA) for credit ratings, and considers debt to EBITDA ratios of less than 1.5% as minimal risk, while ratios greater than five are considered highly leveraged.\textsuperscript{61}

Trucost estimated the potential changes in financial ratios among companies in eight high-emitting sectors in the FTSE/JSE top 100 if estimated carbon liabilities in South Africa in 2013/14 were internalised. The analysis is based on potential carbon costs from a share of operational emissions and a 50% pass through of carbon liabilities for Scope 2 emissions in electricity prices, modelled in Scenario 1b (see page 19). Trucost calculated potential financial risk to returns for 52 companies (excluding three companies in these sectors that had no net income in 2011).

Trucost assessed:

- The potential change in operating income (earnings before interest and taxes or EBIT), a component of several ratios used to assess investment risk and the selection and valuation of debt and equity securities. For instance, a price to earnings (P/E) ratio is typically used as an indicator in valuations that inform investment decision making.
- The potential impacts of carbon liabilities on the companies’ debt to earnings before interest, taxation, depreciation and amortisation (EBITDA) ratio. A higher debt to EBITDA ratio indicates greater financial risk.
- Based on estimated changes in earnings after carbon liabilities, Trucost assessed the potential percentage change in return on equity (ROE), measured as net income or earnings before interest and taxation or EBIT-preferred dividends/average common equity). ROE can indicate the ability of a company to finance itself and reflect efficiency and operating profitability.

\textsuperscript{57} http://www.sabinetlaw.co.za/economic-affairs/articles/treasury-seeks-tighten-regulation-credit-rating-agencies, accessed 12 October 2012
\textsuperscript{58} http://www.investinginbonds.com/learnmore.asp?catid=5&subcatid=19&id=192, accessed 12 October 2012
\textsuperscript{59} Rating Methodology: Global Paper & Forest Products Industry, Moody’s Investors Service, 2006
\textsuperscript{60} International Financial Statement Analysis (CFA Institute Investment Series), By Thomas R. Robinson, CFA, Elaine Henry, CFA, Wendy L. Prie, CFA, Michael A. Broihahn, CFA, 1986
\textsuperscript{61} Criteria Methodology: Business risk/Financial Risk Matrix Expanded, Standard & Poor’s, 2009
Based on estimated changes in earnings after carbon liabilities, the potential percentage change in return on assets (ROA), measured as net income (EBIT)/average total assets, which are financed by both equity and debt, such as bonds. A company that takes on financial leverage would have a lower ROA than ROE.

Findings show variations in financial risk from carbon liabilities across sectors (see Table 6).

Table 6: Percentage changes in financial ratios after carbon liabilities under Scenario 1b in 2013/14

<table>
<thead>
<tr>
<th>Supersector</th>
<th>% change in operating income (EBIT)</th>
<th>% change in Debt/EBITDA</th>
<th>% change in ROE</th>
<th>% change in ROA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Highest</td>
<td>Average</td>
<td>Highest</td>
</tr>
<tr>
<td>Basic Resources</td>
<td>-19</td>
<td>&gt;100</td>
<td>11</td>
<td>&gt;100</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>-11</td>
<td>-11</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Food &amp; Beverage</td>
<td>-2</td>
<td>-12</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Industrial Goods &amp; Services</td>
<td>-1</td>
<td>-7</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Retail</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Personal &amp; Household Goods</td>
<td>-&lt;1</td>
<td>-1</td>
<td>&lt;1</td>
<td>1</td>
</tr>
<tr>
<td>Chemicals</td>
<td>-5</td>
<td>-10</td>
<td>6</td>
<td>11</td>
</tr>
</tbody>
</table>

*Excluding data from 3 companies in these sectors with zero or negative earnings

Findings show that under Scenario 1b in 2013/14, carbon liabilities could be material to several companies in the index (see Table 6). Carbon liabilities would increase risks to profit and credit most among Basic Resources, Oil & Gas, Construction & Materials, Chemicals and Food & Beverage companies, which represents 46% of sector weightings across the FTSE/JSE top 100. Companies that are less exposed to carbon liabilities than sector peers may find it easier to pass a share of these costs on in higher prices. In the eight sectors analysed, carbon liabilities would have the smallest impact on earnings, returns or interest coverage for Personal & Household Goods, Retail, and Industrial Goods & Services companies.

Earnings would fall most (19% on average) in the Basic Resources sector. Carbon risks are concentrated within sectors. Excluding one Basic Resources company that would make a loss if carbon costs were internalised, the average fall in earnings across the sector would be limited to 6%. Earnings would fall by 11% on average in the Oil & Gas and Construction & Materials sectors.

Average debt to EBITDA would increase most in the Construction & Materials, Oil & Gas and Basic Resources sectors, with credit risk rising sharply for some companies.

The fundamental profitability ratios that measure the ability of companies to generate profits from assets would be hit hardest in the Construction & Materials, Oil & Gas, Chemicals and Basic Resources sectors. A fall in a company’s ROE ratio can indicate a less sustainable growth rate that could lead to lower valuations. Lower ROA can indicate a weaker balance sheet.
Financial data cover the 2011 financial year and do not take account of earnings forecasts or changes in equity or debt during 2012-2014. Findings are therefore illustrative only. Actual exposure to carbon costs may vary from estimates, depending on factors such as future earnings and capital structures, tax exemptions, the ability of companies to pass through carbon costs to other businesses or consumers, and changes in energy and carbon management. Companies that reduce their dependence on carbon to generate revenues at a faster pace than sector peers will be less exposed to carbon liabilities and reduced short term liquidity and financial leverage as credit ratings and equity and bond valuations begin to identify carbon outliers.

Incorporating estimated carbon liabilities into traditional financial ratios can be useful to identify exposure to carbon risk. Many institutional investors are exposed to the companies analysed through equity and bond portfolios. For instance, the GEPF holds 14% of equity in Sasol Ltd, which could see its ROA fall by 16% if estimated carbon liabilities were internalised. Funds can be exposed to carbon emissions through reduced future cash flows for companies held in portfolios and lower future dividends. Findings indicate the importance of understanding equity and bond portfolio exposure to carbon risk through holdings in high-emitting sectors. Investors can also measure the carbon footprints of their equity and bond portfolios to understand sources of investment risk.
## Equity exposure to carbon risk

### Highlights

<table>
<thead>
<tr>
<th>Highlight</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The weighting of Basic Resources stocks in the FTSE/JSE top 100 companies (30%) contributes to the larger carbon footprint of the South African index.</td>
<td>Passive equity portfolios benchmarked against the FTSE/JSE top 100 are also likely to be overweight in the Basic Resources sector. Returns would therefore be exposed to financial risk from carbon liabilities in the sector.</td>
</tr>
<tr>
<td>The carbon footprint of the FTSE/JSE top 100 companies was 78 tonnes of carbon for every R mn of revenue. The companies have a larger carbon footprint than five major developed and emerging market equity indices analysed.</td>
<td>This indicates greater weighted exposure to emissions from operations, electricity use and other first-tier suppliers for portfolios benchmarked against the Index.</td>
</tr>
<tr>
<td>Trucost analysed assets of more than R155,460 mn held in 45 of the largest equity portfolios domiciled in South Africa. The carbon footprint of consolidated holdings is 80 tonnes of carbon per R mn, which is 2% larger than the carbon footprint of the FTSE/JSE top 100 companies.</td>
<td>If a carbon price of R120 (US$15) were applied to emissions allocated to holdings, carbon liabilities would total R1 bn (US$ 121 mn). This equates to 6% of operating income (EBIT) allocated to holdings.</td>
</tr>
<tr>
<td>There is a six-fold difference in the size of the carbon footprints of equity portfolios analysed. Portfolios with smaller carbon footprints are likely to be less exposed to carbon costs. At R120 per tonne of carbon apportioned to holdings, carbon costs would equate to less than 1% of EBIT allocated to holdings for the Nedgroup Investments Stable Fund, and 8% of earnings for the Allan Gray Equity Fund. Investors can use an understanding of how stock selections and sector allocations contribute to fund carbon exposure to identify opportunities to reduce risk.</td>
<td>Nedgroup Investments Stable Fund is ranked top with a carbon footprint of 23 tonnes of carbon per R mn, while Allan Gray Equity Fund is ranked bottom (137 tonnes of carbon/R mn). Levels of investment in Basic Resources and Oil &amp; Gas contribute most to the sizes of the smallest and largest carbon footprints. Basic Resources holdings are more carbon intensive than the average for the largest FTSE/JSE listed sector peers in two portfolios with larger carbon footprints than the index.</td>
</tr>
<tr>
<td>The carbon footprint of aggregated holdings in GEPF equity portfolios invested in South Africa was 72 tonnes of carbon per R mn. This is 9%</td>
<td>Trucost analysed assets valued at more than R541,061 mn in GEPF equity portfolios. Variations in the carbon footprint of aggregated holdings in GEPF equity portfolios are significant.</td>
</tr>
</tbody>
</table>

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Carbon and water risk for South Africa’s top companies, bonds and equity funds - 28
smaller than the carbon footprint of the FTSE/JSE top 100 companies used as a benchmark.

intensity of Basic Resources stocks held suggest potential to reduce exposure to carbon liabilities.

**CARBON FOOTPRINTS OF EQUITY INDICES**

Trucost measured the carbon footprint of all companies in the FTSE/JSE top 100, taking account of their weightings. The carbon footprint is measured as tonnes of Scope 1, Scope 2 and other first-tier supplier emissions per R mn (US$ mn) of revenue. Aggregated emissions amounted to 78 tonnes of carbon for every R mn of revenue.

The carbon efficiency of the FTSE/JSE top 100 companies was measured against several developed market indices to assess potential differences in exposure to carbon costs for equity portfolios benchmarked against these indices. The S&P/IFCI LargeMidCap Index covers companies in emerging market countries, many of which are key trading partners for South Africa and which also have relatively fast growing and expanding economies. The ASX 200 Index covers Australia, and Basic Resources constituents have a relatively high weighting in that index, as in the FTSE/JSE top 100 companies. The MSCI World Index provides a global benchmark to assess the relative carbon intensity of the FTSE/JSE top 100 companies. The aggregated carbon footprint of the 100 companies is ranked sixth when compared to the carbon footprints of six major equity indices, as shown in Table 7.

<table>
<thead>
<tr>
<th>Index</th>
<th>Number of companies</th>
<th>Carbon footprint (tonnes of CO₂e per R mn)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK FTSE All Share</td>
<td>429</td>
<td>43</td>
<td>1</td>
</tr>
<tr>
<td>ASX 200</td>
<td>178</td>
<td>43</td>
<td>2</td>
</tr>
<tr>
<td>MSCI Europe</td>
<td>423</td>
<td>48</td>
<td>3</td>
</tr>
<tr>
<td>MSCI World</td>
<td>2,355</td>
<td>51</td>
<td>4</td>
</tr>
<tr>
<td>S&amp;P/IFCI Carbon Efficient</td>
<td>868</td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>FTSE/JSE top 100</td>
<td>100</td>
<td>78</td>
<td>6</td>
</tr>
<tr>
<td>S&amp;P/IFCI LargeMidCap</td>
<td>893</td>
<td>80</td>
<td>7</td>
</tr>
</tbody>
</table>

Indices and equity portfolios with larger carbon footprints are more exposed to companies that are relatively dependent on emitting carbon to generate revenue. Investors tracking the FTSE/JSE top 100 are therefore likely to be exposed to companies that have potential to reduce carbon risk.

The only index analysed that has a larger carbon footprint than the FTSE/JSE top 100 companies is the S&P/IFCI LargeMidCap Index, which is often used as a benchmark for emerging markets portfolios. Investors’ exposure to carbon-intensive companies is generally greater when investing in emerging market indices as they tend to have larger carbon footprints than developed market indices. The absence of the Utilities sector in the FTSE/JSE top 100 companies drives their carbon efficiency relative to the emerging markets index. The relatively overweight position of Basic Resources stocks in the FTSE/JSE top 100 companies
(29.79% vs. 9.72% in the S&P/IFCI LargeMidCap Index) has a negative effect on their collective carbon footprint. Passive equity portfolios that are benchmarked against the FTSE/JSE top 100 companies are therefore also likely to be overweight in the sector. This finding, combined with the results on financial risk from carbon liabilities in the sector, suggests that an understanding of exposure to carbon costs among Basic Resources stocks is particularly relevant to analysing systemic investment risk. On average, Basic Resources stocks in the FTSE/JSE top 100 are 12% less carbon intensive than peers in the S&P/IFCI LargeMidCap Index. However, the carbon intensity of companies in the sector varies widely.

S&P has used substantial variations in the carbon intensity of companies within sectors to construct a carbon optimised index using the S&P/IFCI LargeMidCap Index as its benchmark. The carbon efficient tilt is designed to track the financial performance of the mainstream emerging markets index while providing an opportunity to mitigate against risk from carbon costs. Stocks were rebalanced within each sector on the basis of carbon intensity to carbon optimise the index, overweighting companies that are carbon efficient relative to industry peers, and underweighting those that are more carbon intensive, while maintaining similar exposure to other factors. As a result, the S&P/IFCI Carbon Efficient Index is 32% less carbon intensive than the parent index. Its carbon footprint is also 30% smaller than that of the FTSE/JSE top 100, largely because Sasol is 48% more carbon intensive than the average for Oil & Gas sector peers in the S&P/IFCI Carbon Efficient Index (628 tonnes of CO₂e/R mn vs. 85 tonnes of CO₂e/R mn).
CARBON FOOTPRINTS OF EQUITY FUNDS IN SOUTH AFRICA

Asset owners around the world are currently measuring the carbon or environmental footprints of their holdings in order to identify exposure to pollution and resource risks. Trucost has measured the carbon footprints of almost US$3.7 trillion in portfolio assets globally. The UK Environment Agency Pension Fund and several Australian superannuation funds – including VicSuper and Australian Super – have implemented policies to monitor carbon exposure within their portfolios and use the analysis to manage potential financial risk to returns from carbon costs. The GHG Protocol Product Life Cycle and Corporate Value Chain (Scope 3) Accounting and Reporting Standards provide guidance on how financial institutions can begin to take stock of emissions linked to portfolios.

Trucost measures the carbon footprint of equity portfolios by

1. Using data on the value of portfolio holdings in each company to allocate tonnes of CO₂e emissions from each company to each portfolio. The same share of equity ownership was used to allocate each company’s sales revenue to each portfolio.

2. The total emissions and revenues from each company are summed across each portfolio to calculate its carbon footprint as total tonnes of CO₂e normalised by R million in revenue.

3. Emissions and revenues attributed to each portfolio are aggregated to calculate the carbon footprint of consolidated holdings.

Portfolios with larger carbon footprints than their benchmarks are more exposed to carbon costs. Trucost’s carbon footprint assessment identifies stocks and sectors that contribute most to portfolio exposure to emissions from the operations, electricity use and tier 1 suppliers of companies held. The contribution of a company to the portfolio carbon footprint is a function of both the level of assets invested in it and the carbon intensity of the company relative to peers in the index selected as a benchmark.

Trucost analysed assets of more than R155,460 mn (US$18,798 mn) held in 45 of the largest equity portfolios domiciled in South Africa. The funds have holdings in all of the FTSE/JSE top 100 companies. Some 147 of the 201 companies analysed are held in more than one fund. For instance, Anglo American Plc and Telecommunications company MTN Group Ltd are held in 34 of the funds analysed, reflecting the concentration of holdings in listed equities in South Africa. Investment risk from carbon liabilities can be compounded through holdings in dual-listed companies in non-domestic equity portfolios. Investors can hold the same company several times over where they have multiple listings in a variety of indices in different jurisdictions.

Emissions from all 201 companies held across the funds were allocated to holdings in proportion to ownership. More than eight million tonnes of carbon emissions were allocated to combined fund holdings. If a carbon price of R120 (US$15) were applied to emissions allocated to holdings, carbon costs would amount to R1 bn (US$ 121 mn). This equates to 1% of revenue and 6% of operating income (EBIT) allocated to holdings.

The carbon footprint of consolidated holdings is 80 tonnes of CO₂e per R million. This is 2% larger than the carbon footprint of the FTSE/JSE top 100 companies. The slightly larger carbon footprint is mainly driven by a negative sector allocation effect. This is based on the
proportion of fund assets allocated to less/more carbon-intensive sectors, relative to the weightings of FTSE/JSE top 100 securities in these sectors. The negative sector allocation effect in the consolidated equity portfolio is largely due to an overweight position in Oil & Gas (7% of the value of holdings in the top 45 funds compared to 5% of the value of stocks in FTSE/JSE top 100). This is countered to an extent as the weighted average carbon intensity of the three Oil & Gas stocks in the top 45 funds is lower than that of Sasol (468 tonnes of CO2e per R mn in the consolidated fund vs. 628 tonnes of CO2e per R mn in the FTSE/JSE top 100). However, Basic Resources stocks held are more carbon intensive on average than index sector peers (130 tonnes of CO2e per R mn for Basic Resources holdings vs. 126 tonnes of CO2e per R mn for the largest listed Basic Resources companies).

Fifteen of the funds have a larger carbon footprint than the FTSE/JSE top 100, and are therefore likely to be more exposed to carbon costs. Trucost ranked the 20 funds with the smallest and largest carbon footprints (excluding property portfolios) in Table 8.

Table 8: Carbon footprint ranking of top and bottom 10 equity portfolios*

<table>
<thead>
<tr>
<th>Fund</th>
<th>Number of companies analysed</th>
<th>Carbon footprint (tonnes CO2e/ R mn)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nedgroup Investments Stable Fund</td>
<td>24</td>
<td>23</td>
<td>161</td>
</tr>
<tr>
<td>STANLIB SA Equity Fund</td>
<td>29</td>
<td>36</td>
<td>255</td>
</tr>
<tr>
<td>STANLIB Equity Fund</td>
<td>29</td>
<td>36</td>
<td>255</td>
</tr>
<tr>
<td>STANLIB Balanced Fund</td>
<td>29</td>
<td>36</td>
<td>255</td>
</tr>
<tr>
<td>Nedgroup Investments Value Fund</td>
<td>23</td>
<td>42</td>
<td>300</td>
</tr>
<tr>
<td>SIM Value Fund</td>
<td>37</td>
<td>44</td>
<td>312</td>
</tr>
<tr>
<td>ABSA Absolute Fund</td>
<td>52</td>
<td>46</td>
<td>326</td>
</tr>
<tr>
<td>PSG Flexible Fund</td>
<td>35</td>
<td>51</td>
<td>366</td>
</tr>
<tr>
<td>Satrix DIVI</td>
<td>29</td>
<td>52</td>
<td>367</td>
</tr>
<tr>
<td>Investec Managed Fund</td>
<td>26</td>
<td>54</td>
<td>379</td>
</tr>
<tr>
<td>FTSE/JSE top 100 companies</td>
<td>100</td>
<td>78</td>
<td>573</td>
</tr>
<tr>
<td><strong>Consolidated holdings</strong></td>
<td><strong>201</strong></td>
<td><strong>80</strong></td>
<td><strong>584</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fund</th>
<th>Number of companies analysed</th>
<th>Carbon footprint (tonnes CO2e/ US$ mn)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nedgroup Investments Rainmaker Fund</td>
<td>36</td>
<td>89</td>
<td>630</td>
</tr>
<tr>
<td>Coronation Top 20 Fund</td>
<td>19</td>
<td>89</td>
<td>633</td>
</tr>
<tr>
<td>Nedgroup Investments Positive Return Fund</td>
<td>41</td>
<td>90</td>
<td>638</td>
</tr>
<tr>
<td>SIM Index Fund</td>
<td>41</td>
<td>90</td>
<td>638</td>
</tr>
<tr>
<td>Satrix 40</td>
<td>41</td>
<td>90</td>
<td>638</td>
</tr>
<tr>
<td>Investec Absolute Balanced Fund</td>
<td>51</td>
<td>105</td>
<td>752</td>
</tr>
<tr>
<td>Coronation Equity Fund</td>
<td>29</td>
<td>108</td>
<td>768</td>
</tr>
<tr>
<td>Investec Value Fund</td>
<td>39</td>
<td>119</td>
<td>856</td>
</tr>
<tr>
<td>Investec Equity Fund</td>
<td>29</td>
<td>128</td>
<td>906</td>
</tr>
<tr>
<td>Allan Gray – Equity Fund</td>
<td>34</td>
<td>137</td>
<td>968</td>
</tr>
</tbody>
</table>

*Excluding eight property funds. Where funds include holdings in other asset classes, Trucost only analysed equity holdings.
Findings show a six-fold variation in the carbon footprints of funds, from 23 tonnes of CO2e per R mn for Nedgroup Investments Stable Fund to 137 tonnes per R mn for the Allan Gray Equity Fund. Funds with large carbon footprints are likely to be more exposed to carbon costs. For instance, at R120 per tonne of carbon apportioned to holdings, carbon costs would equate to less than 1% of EBIT allocated to holdings for the Nedgroup Investments Stable Fund, and 8% of earnings for the Allan Gray Equity Fund.

Funds with different investment styles are among those with the smallest and largest carbon footprints (e.g., value funds, which generally invest in high-yielding stocks with stable rather than rapid earnings growth, are ranked 5th and 43rd on their carbon footprints). This supports findings in other Trucost studies of equity portfolios that show that sector allocation and stock selection effects are more of a driver of carbon footprints than investment styles per se. For this reason, this research does not examine portfolio investment styles.

Differences between the largest and smallest carbon footprints of portfolios are driven by the effects of both sector allocation and stock selection decisions. For instance, the relative carbon efficiency of the top five portfolios is largely driven by their underweight position in Basic Resources compared with the FTSE/JSE top 100, and their exclusion or underweighting of Oil & Gas stocks. The portfolio with the smallest carbon footprint – Nedgroup Investments Stable Fund – also holds stocks that are more carbon efficient on average than sector peers. Four of the bottom five South African funds have larger carbon footprints than the FTSE/JSE top 100, mainly due to being overweight Sasol – the only Oil & Gas company held in the five funds. Two of the bottom five funds – Investec Value Fund and Investec Opportunity Fund – have a negative stock selection effect from investments in Basic Resources stocks with higher average carbon intensities than sector peers.

**CASE STUDY: Government Employees Pension Fund carbon exposure – equities**

Trucost analysed the carbon footprints of equity portfolios held by the Government Employees Pension Fund of South Africa (GEPF). GEPF’s investment strategy includes lower and upper limits for assets allocated to domestic equity (45%-55%) and domestic bonds (22%-40%). Domestic equity and bond investments can therefore account for up to 95% of asset allocations. GEPF holds approximately 8% of the value of stocks in the FTSE/JSE top 100 companies.

The FTSE/JSE top 100 companies account for 98% of the value of GEPF equity holdings analysed by Trucost. The equity portfolio analysis covers 152 companies and assets valued at more than R41,061 mn (US$70,469 mn). This equates to 99% of the value of GEPF’s equity portfolio in South Africa as of 30 March 2012 and approximately 60% of the fund’s assets.

The carbon footprint of aggregated holdings in GEPF equity portfolios invested in South Africa was measured against the FTSE/JSE top 100 companies. As shown in Table 9, the carbon footprint of the GEPF consolidated equity portfolios is 72 tonnes of carbon per R mn. The carbon footprint of equity holdings is 9% smaller than that of the benchmark.

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62 For instance, see Carbon Risks in UK Equity Funds, WWF-UK, Trucost Plc and Mercer Investment, 2009 and Carbon Counts USA, The Carbon Footprints of Mutual Funds in the US, Trucost Plc, 2009

63 Based on exchange rates as of the portfolio company financial year ends
Table 9: Carbon footprint of GEPF equity portfolios in South Africa vs. benchmark

<table>
<thead>
<tr>
<th>Carbon footprint (tonnes of CO₂e/R mn)⁶⁴</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GEPF equity portfolios in South Africa</td>
<td>72</td>
</tr>
<tr>
<td>FTSE/JSE top 100 companies</td>
<td>78</td>
</tr>
</tbody>
</table>

The proportion of fund assets allocated to less and more carbon-intensive sectors, relative to the weightings of securities in these sectors in the index, has a positive sector allocation effect on the portfolio carbon footprint against the index. This is particularly driven by the relatively underweight position of GEPF portfolio holdings in the high-carbon Basic Resources sector (20% of the value of holdings) compared with the index sector weighting (30%). However, the sector accounts of the largest share of GEPF equity holdings in South Africa. The next largest asset allocation is to Banks (12% of the value of holdings). The fund is therefore exposed to financial risk from carbon liabilities in the Basic Resources sector.

Carbon risk is compounded by the high carbon intensity of Basic Resources stocks held in the fund, compared with benchmark sector peers, with an average carbon intensity of 149 tonnes of carbon/R mn compared with 126 tonnes of carbon/R mn in the benchmark. The carbon intensity of Basic Resources stocks held ranges from 33 tonnes of carbon/R mn to 2,744 tonnes of carbon/R mn. The portfolio invests in all five companies ranked most carbon intensive out of 20 in the index sector. Understanding variations in the carbon intensity of stocks held can be used to identify sources of the greatest risk and opportunities to reduce exposure. The fund could be exposed to further climate change risks through bonds and infrastructure investments such as energy, water and transport.⁶⁵

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⁶⁴ Figures are rounded up
Taking carbon into account in credit risk

<table>
<thead>
<tr>
<th>Highlights</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investors in fixed income securities could be most exposed to carbon costs through downgrade risk.</td>
<td>Credit rating agencies are taking account of carbon in corporate ratings. Downgrades can lead to a higher cost of capital, reduce the investible universe available to pension funds, and lower asset values.</td>
</tr>
<tr>
<td>The BESA Corporate Credit Index has a carbon footprint of 14 tonnes of CO$_2$ e per R mn revenue. If bond issuers were to pay carbon costs for taxable emissions from operations and 50% of Scope 2 carbon liabilities in 2013/14, interest coverage would be most at risk in the Basic Resources and Automobiles &amp; Parts sectors.</td>
<td>Trucost analysed exposure to carbon liabilities across 215 corporate bonds in the Bond Exchange of South Africa (BESA) Corporate Credit Index. Interest coverage, measured as EBIT/interest, would decline most in the Basic Resources (-7%) and Automobiles &amp; Parts (-4%) sectors.</td>
</tr>
<tr>
<td>If Eskom and Transnet were to pay the carbon tax rate of R120 in 2013/14 for taxable emissions from operations, credit risk would increase most for Eskom’s debt securities.</td>
<td>Carbon liabilities could cut Eskom’s interest coverage by 22% and Transnet’s ROE by 3%. Changes in the credit worthiness of their debt securities could reduce returns for investors including the GEPF.</td>
</tr>
<tr>
<td>GEPF bond holdings in South Africa are 18% more carbon efficient than the BESA Corporate Credit Index, mainly due to the relative carbon efficiency of debt holdings in the Basic Resources sector.</td>
<td>Trucost calculated a carbon footprint of 12 tonnes of carbon per R mn for GEPF’s bond holdings in South Africa, valued at more than R21.2 bn.</td>
</tr>
</tbody>
</table>

Investors take account of credit ratings in investment decisions. Credit risk is made up of default risk and downgrade risk. Credit analysts assess the ability of issuers of debt securities to pay interest and principal on debt obligations – default risk. Bonds trade on the

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secondary market based on yield in South Africa. The value of bonds can fluctuate with factors such as inflation and interest rate movements, ratings of companies or bond issues, and the value of underlying assets (e.g., conversion value for securities that can be exchanged for common stock). The price of capital (interest) is determined by the amount of risk that lenders take on when lending. Bondholders can be exposed to falls in corporate earnings due to carbon liabilities, which can negatively affect financial ratios used to assess credit risk (see page 24). Higher default risk can lower prices and reduce liquidity.

Investment grade bonds are rated between AAA and BBB- for S&P and between Aaa and Ba3 for Moody’s. Bonds below these ratings are classed as speculative, with higher default risk. Agencies often place bonds on a “creditwatch” status, which also tends to cause price declines, before downgrading them. Lower ratings can affect the credit quality of issuers by leading to a higher cost of capital for the borrowing firm and a fall in bond and stock prices. Downgrades in corporate or bond credit ratings can reduce the investible universe available to pension funds, if securities are no longer investment grade. For instance, PIC is only able to invest in domestic banks that have credit ratings of A2 and above.

Credit rating agencies are increasingly taking account of carbon and other environmental issues in ratings. S&P’s analysis of carbon risk considers direct and supply chain emissions, including the embedded cost of carbon in raw materials, policymaking to set carbon prices, abatement opportunities and cost pass-through. An S&P study of environmental liabilities among power utilities globally found that stricter environmental regulations may dampen their credit quality. The amount of environmental costs and the time utilities need to recover those costs through higher electricity prices affects creditworthiness.

Carbon-intensive utilities with greater earnings exposure to carbon costs could see their credit ratings downgraded as carbon liabilities are included in corporate credit assessments, making it more difficult for them to borrow money. S&P has begun to incorporate carbon risk into its rating methodology for companies globally, focusing first on the most exposed industries including oil & gas, transportation, metals & mining, building materials and chemicals. Environmental risk is also emphasised in new corporate governance and management criteria introduced by the agency in October 2012.

CARBON FOOTPRINTS OF BONDS IN SOUTH AFRICA

Corporate debt issuers represent more than one-third of listed debt in South Africa. Trucost analysed the carbon footprint of 215 corporate bonds in the Bond Exchange of South Africa (BESA) Corporate Credit Index. The companies analysed have combined EBITDA of over R985 bn (US$94 bn), which represents 16% of aggregated revenues, although profit margins vary widely across the bond issuers. This analysis provides insight into potential carbon risk in corporate fixed income portfolios.

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70 Feedback Effects of Credit Ratings, Manso, G, MIT Sloan School of Management, 2011; The Stock Market Impact of Corporate Bond Rating Changes: New Evidence from the UK and Australian Stock Markets, Taib, HM et al, RMIT University, September 2011
72 Utilities Will Feel The Squeeze as Europe Tightens Its Grip on CO2 Emissions in 2013, S&P Global Credit Portal, July 2011
74 Credit Indices Guide, Standard Bank, December 2007
After mapping underlying bonds to parent issuers, carbon emissions from operations, electricity purchases and other first-tier suppliers for each constituent company are allocated to bond indices or portfolios based on the value of the bond as a proportion of the equity and total debt of each company. Total emissions aggregated across the index or portfolio are normalised by revenue generated by the issuing companies.

The Credit Index has a carbon footprint of 14 tonnes of CO2e per R mn revenue. Banks account for almost 68% of the value of the index and this sector accounts for 41% of the total GHG emissions apportioned to the index. Due to the nature of the bond listing mechanisms, much of the debt issued by banks is for corporations in other industry sectors. Matching the bond to the source of the funds is a methodological challenge when analysing this sector. Financial institutions are more exposed to climate risk through their equity, property and infrastructure investments and loans than through direct and upstream supply chain emissions. The insurance industry also contributes significantly to emissions (17%). This is mainly due to Scope 2 emissions from electricity purchases.

Other sectors that contribute most to GHG emissions in the BESA Index are Industrial Goods & Services, Telecommunications and Automobiles & Parts, which together make up 31% of operational and first-tier carbon emissions apportioned to the index. Corporate debt analysed in the Basic Resources sector is carbon intensive at 300 tonnes of CO2e per R mn, but these bonds represent less than 1% of the value of the South African credit index and 2% of emissions allocated to the index.

**BOND EXPOSURE TO CARBON COSTS**

At a carbon price of R120 (US$14) per tonne, the BESA index is exposed to R4,200 (US$508) in carbon costs for every R mn in revenue generated by the bond issuing companies. Carbon liabilities would represent a greater share of interest payments for corporate bond issuers. The interest coverage of an issuer, measured as operating income relative to net interest expense, provides an indication of solvency and credit default risk. Trucost assessed potential changes in interest coverage, measured as EBIT/interest – a metric used by S&P – if carbon costs modelled under scenario 1b were internalised. Higher interest coverage indicates greater solvency and assurance that earnings are expected to service debt.75

The sectors with the greatest contribution to emissions allocated to the BESA Corporate Credit Index and lowest average interest coverage after carbon costs are Healthcare and Financial Services (see Table 10). If the bond issuers were to internalise carbon costs for taxable Scope 1 emissions and 50% of carbon liabilities for electricity-related emissions in 2013/14 (see page 19), interest coverage would decline most in the Basic Resources and Automobiles & Parts sectors.

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75 For the purposes of sector analysis, companies with negative interest coverage are excluded
Table 10: BESA Corporate Credit Index carbon contribution and financial risk from carbon liabilities under scenario 1b in 2013/14

<table>
<thead>
<tr>
<th>Contribution to total GHG apportioned to index (%)</th>
<th>Carbon footprint (tCO2e/R mn)</th>
<th>Average interest coverage after carbon costs under scenario 1b in 2013/14</th>
<th>Change in interest coverage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banks</td>
<td>41</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Goods &amp; Services</td>
<td>20</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Insurance</td>
<td>17</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>6</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Financial Services</td>
<td>5</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Automobiles &amp; Parts</td>
<td>5</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Healthcare</td>
<td>2</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Basic Resources</td>
<td>2</td>
<td>300</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>98</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Credit risk in state-owned enterprises

Corporate debt issue is secured if there is some form of collateral pledge to ensure debt payments. Secured bonds include government guaranteed debt for state-owned enterprises. Although some bonds issued by state-owned companies such as Eskom and the transport business Transnet are guaranteed by the government, their value is at risk from ratings downgrades, which can increase the cost of capital and credit spread. Investments in bonds issued by Eskom and Transnet are exposed to carbon liabilities.

Eskom secured some R32.9 billion (US$4.285 bn)\(^76\) in bonds by the end of financial year to 31 March 2012. This represents almost 37% of the R90 billion (USD11.72 billion) sought from bondholders to support largely coal-fired capacity expansion plans to 2017. Bonds account for 30% of Eskom’s total funding requirements of R300 billion (US$39 bn).\(^77\) Commercial paper is the next largest source of finance targeted (23% of the R300 bn).

Eskom has warned that transferring some assets and transmission functions to an independent system and market operator (ISMO) could reduce its ability to borrow and result in a credit rating downgrade.\(^78\) The government has proposed separating transmission and distribution functions from power generation, which could make it easier for low-carbon independent electricity providers to supply power to the grid. In October 2012, S&P downgraded the credit rating of Eskom Holdings SOC Ltd from BBB+ to BBB,\(^79\) with a negative outlook, following a revision of South Africa’s sovereign credit outlook.\(^80\) Risks identified included Eskom’s “significant exposure to coal prices and supply” and inability to make “full and timely adjustments in tariffs to reflect rising input costs”.\(^81\) The National Energy Regulator of South Africa has limited Eskom’s tariff increase to 16% for the 2012/13 financial year, and S&P has warned that a delay in tariffs that reflect supply costs could add...
pressure to Eskom’s profitability and cash flow generation. This could cause its stand alone credit profile to deteriorate and lead to a further credit rating downgrade.\(^{82}\)

Expanding renewable capacity in the electricity grid would help reduce exposure to rising fuel costs and lower the carbon intensity of customers, including Transnet, which faces the challenge of expanding infrastructure while reducing its carbon footprint. This is largely driven by electricity use by freight rail, which contributes most to the company’s revenues.\(^{83}\) Transnet provided data showing that its operations emitted 571,188 tonnes of CO\(_2\) in 2011/12, while electricity use resulted in more than 3.7 Mt CO\(_2\)e. Transnet has raised R11.1 bn from sources including domestic bonds, for capital investments including the acquisition of electric and diesel locomotives. Transnet is investing more than R15 bn in a pipeline to channel diesel, gas, jet fuel and petrol from Durban to Johannesburg from 2014.\(^{84}\) R33,478 million of Transnet’s Rand denominated bonds represent 60% of its long-term borrowings.\(^{85}\) Transnet’s credit rating was downgraded to BBB, from BBB+, in October 2012.\(^{86}\)

The company recognises the risk of increased operational costs due to carbon taxes on fossil fuels and capital goods, customers requiring Transnet to reduce its carbon footprint, and the physical vulnerability of infrastructure to climate change. Rail’s potential low carbon intensity relative to road freight could provide an opportunity to expand market share.

Trucost modelled potential carbon liabilities under the proposed carbon tax for Eskom and Transnet. The analysis of Eskom’s carbon data covers Scope 1 emissions from operations (231.9 million tonnes of CO\(_2\)e). After exempting 60% of emissions, if Eskom purchased CERs for 10% of emissions and paid R120 for each tonne of remaining taxable emissions, carbon liabilities would total R9.9 bn (US$1.3 bn).\(^{87}\) The potential effects on Eskom’s financial ratios were analysed, assuming that Eskom could pass on half of its carbon costs in higher tariffs.

The scenario analysis of Transnet’s exposure to carbon costs assumes that 60% of Scope 1 emissions would be exempt and the company would purchase CERs for 10% of emissions, before paying R120 for remaining operational carbon. Potential operational carbon costs amount to R22 mn (US$3 mn). If 60% of emissions from electricity use were exempt from the tax, and 50% of electricity-related carbon costs were passed through in higher prices, Scope 2 carbon liabilities would amount to R83 mn (US$10 mn).

The potential effects of carbon liabilities in 2013/14 on key financial ratios for Eskom and Transnet are shown in Table 11. Eskom could find it more difficult to meet interest payments and Transnet could see its interest coverage fall by 1%. Changes in the credit worthiness of their debt securities could reduce returns for investors including the GEPF.

<table>
<thead>
<tr>
<th>Potential carbon liabilities (R mn)</th>
<th>% change in interest coverage (EBIT/interest)</th>
<th>% change in ROE after carbon liabilities*</th>
<th>% change in ROA after carbon liabilities**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eskom 4,959</td>
<td>-22</td>
<td>-37</td>
<td>-37</td>
</tr>
<tr>
<td>Transnet 106</td>
<td>-1</td>
<td>-3</td>
<td>-3</td>
</tr>
</tbody>
</table>

Based on carbon and financial data in 2012 integrated reports; * Calculated as ((Net income-carbon liabilities/equity)-ROE)/ROE; ** Calculated as ((Net income-carbon liabilities/average total assets)-ROA)/ROA

\(^{82}\) S&P warning on Eskom tariff hikes, Business Day, 2 April 2012
\(^{85}\) At the end of the financial year ending 31 March 2012, Transnet, Integrated Report, 2012
\(^{87}\) Exchange rate as of the end of Eskom’s financial year to 31 March 2012
Credit risks could increase through loans for new carbon-intensive, long-lived infrastructure such as power plants. For instance, capital providers for the construction of Kusile power station in South Africa, one of the world’s largest coal-fired plants currently being built by Eskom, include Standard Bank Group. The 4,800 megawatt (MW) plant will increase CO₂ emissions from its completion in 2018. Standard Bank Group, which has adopted the Equator Principles (see box), is providing some R4,673 mn (US$565 mn) towards a R8,022 mn (US$970 mn) loan in a syndicate of lenders backing the power station. The bank is providing a further R1,819 mn (US$220 mn) line of credit for Eskom’s other major coal-fired power station under construction, the Medupi Power Project (4,764 MW). This is expected to emit almost 30 million tonnes of CO₂ annually. Together, the two plants could increase South Africa’s annual CO₂ emissions by 11%. Both plants are exposed to carbon pricing and regulations in South Africa, as well as reputational and market risk. Their process and cooling water requirements could be exposed to water stress.

**CASE STUDY: Government Employees Pension Fund carbon exposure – bonds**

Trucost assessed the carbon footprint of GEPF’s corporate bond holdings valued at more than R21.2 bn (US$2.7 bn) in South Africa, based on data as of 30 March 2012. The GEPF SA bond portfolio carbon footprint was measured against the benchmark Bond Exchange of South Africa (BESA) Corporate Credit Index. As shown in Table 12, GEPF bond holdings in South Africa are 18% more carbon efficient than the BESA Corporate Credit Index, mainly due to the relative carbon efficiency of debt holdings in the Basic Resources sector.

**Table 12: Carbon footprints of GEPF bond assets in South Africa vs. benchmark**

<table>
<thead>
<tr>
<th>Carbon footprint (tonnes of CO₂e/R mn)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GEPF SA bond portfolio&lt;sup&gt;69&lt;/sup&gt;</td>
<td>11.80</td>
</tr>
<tr>
<td>BESA Corporate Credit Index</td>
<td>14.34</td>
</tr>
</tbody>
</table>

However, bonds issued by Eskom and Transnet represent 14% and 5% of the value of GEPF’s holdings in fixed income securities in South Africa. Returns could therefore be exposed to downgrade risk due to carbon liabilities driven by the emissions of Eskom in particular.

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<sup>69</sup> Based on portfolio data as of 30 March 2012
# CLIMATE CHANGE IMPACTS ON WATER RESOURCES

## Highlights

<table>
<thead>
<tr>
<th>Climate change impacts will add to growing water stress in South Africa. Together the FTSE/JSE top 100 companies use more than eight billion cubic metres (m$^3$) of water globally in operations and through purchases of goods and services from first-tier suppliers. This equates to 64% of reliable water yields in South Africa.</th>
<th>Operations directly abstract 29% of the water consumed. Water purchased from utilities accounts for 4% of total water use, while process water use by other tier 1 suppliers is responsible for 66%. The Basic Resources, Food &amp; Beverage, and Personal &amp; Household Goods industries account for 91% of water use across the Index.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water scarcity costs could total more than R56 bn (US$7 bn) for all water used globally by operations and first-tier suppliers.</td>
<td>If FTSE/JSE top 100 companies were to pay the indirect value of water that reflects water stress in South Africa, each m$^3$ of water would cost an additional R6.26.</td>
</tr>
<tr>
<td>The most water-intensive sector is Food &amp; Beverage, which requires 39,055 cubic metres (m$^3$) of water by operations and first-tier suppliers to generate every R mn in company revenues, on average.</td>
<td>The Food &amp; Beverage sector uses 11 times more water per R mn revenue than the next most water intensive sector, Travel &amp; Leisure. Company-level variations in water intensity indicate potential to reduce exposure to water stress and improve efficiency.</td>
</tr>
<tr>
<td>The water footprint of GEPF equity holdings in South Africa is 6% smaller than that of the FTSE/JSE top 100. External costs for water attributed to GEPF holdings could total more than R8 bn (US$983 million). Mining companies largely drive the fund’s water footprint.</td>
<td>Water allocated to GEPF portfolio holdings in proportion to equity ownership amounts to more than 1 billion m$^3$. Among the main contributors to the fund’s water footprint are Anglo American and Gold Fields. The WWF-DEG water risk filter shows that both are exposed to water risk.</td>
</tr>
<tr>
<td>Investors can use water footprints of funds to identify holdings that drive water risk, and focus in-depth analysis on companies most relevant to reducing exposure.</td>
<td>Water footprints, scarcity values and risk tools indicate sources of portfolio water risk. Investors can manage exposure to develop more climate-resilient portfolios.</td>
</tr>
<tr>
<td>The government reported to the UNFCCC in 2011 that based on current trends of GHG emissions and expected climate change impacts, rainfall patterns that are already uneven are</td>
<td></td>
</tr>
</tbody>
</table>

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Carbon and water risk for South Africa’s top companies, bonds and equity funds - 41
projected to become more variable. Expected decreases in rainfall in the west and interior would lead to severe water management challenges, with potential socio-economic repercussions. Meanwhile, more intense summer rainfall in the east would exacerbate sedimentation in dams, potentially affecting water supply and treatment infrastructure.

The expected temperature rise would increase evaporation, partly offsetting any increase in rainfall and resulting in dryer conditions. This would affect agricultural natural capital, with potential declines in the production of crops including maize, soybean and wheat. Knock-on effects include risk to regional food security and exports. Crop net revenues in South Africa could fall by up to 5% by 2050 and up to 90% by 2100 due to climate change, depending on adaptation measures. The agricultural sector contributed R66 bn (US$7.98 bn) to the economy in 2009 and, with multipliers, up to 12% of GDP. The government’s National Climate Change Response white paper warns that crop failures could therefore have a significant economic impact.

Agriculture currently uses roughly 60% of available surface water resources and the main restriction on expanding production is water availability. More than 95% of stored water is allocated for domestic, industrial and agricultural use, as well as to support the ecological functioning of rivers. Surface water resources are over-allocated and at least five of 19 water management areas (WMAs) face water stress. In parts of South Africa, water requirements already exceed available water resources.

Economic and population growth, increased urbanisation and industrial development, including electricity generation, are projected to drive up demand by 32% (17 billion cubic metres) by 2020. This will add to water stress. Water resources are also exposed to contamination and pollution from urban, industrial and agricultural sources, as well as from water treatment works, landfills and mines. The white paper says that based on current projections, South Africa will exceed the limits of economically viable land-based water resources by 2050. The government identifies water availability as a key climate change-related vulnerability that would affect people, ecosystems and the economy. Climate change therefore exacerbates risks to water security, with knock-on effects on water-intensive sectors such as agriculture, electricity generation and some mining and industrial activities.

Less water availability, flooding, droughts, and contamination would affect all economic sectors. South Africa’s adaptation plans include the development of a climate change response in the National Water Resource Strategy, use of water pricing to drive efficiency, as well as limits to water rights during droughts. The government started consulting on a second draft National Water Resources Strategy in August 2012. It outlines the strategic direction for water resources management over the next 20 years, and provides a framework for managing water at a catchment level. Proposals include consolidating the existing 19 WMAs into nine

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90 South Africa’s Second National Communication under the UNFCCC, Department of Environmental Affairs, 2011
91 Ibid
94 Ibid, page 78
95 Ibid, page 78
order to improve water management.\textsuperscript{101} The strategy highlights the need to fill a 50% funding gap in the R670 bn (US$81 bn) required for water infrastructure over the next 10 years.\textsuperscript{102}

Water demand management will need to include water-efficient technologies and urban design. The water industry must balance the allocation of limited water resources amongst major agricultural, industrial and urban users, while ensuring fair access to water for domestic users, as well as sufficient water to maintain ecosystems and the services they provide. These include soil formation; the provision of food, fresh water, wood and fibre; and protection from storm surges and floods.

Adaptation strategies will be included in sectoral plans and are being developed for water supply systems for areas that together generate more than 80% of national GDP. Climate change considerations will be integrated into water planning processes across relevant sectors such as agriculture, industry, economic development, health, science and technology.\textsuperscript{103} Agricultural, industrial and mining operations and development plans in particular will need to consider water stress and water quality. The government is strengthening regulation of the water sector and revising water pricing, including removing a cap on water price increases and exemption for some water users from “return on asset” tariffs.\textsuperscript{104}

\section*{WATER FOOTPRINT OF THE FTSE/JSE TOP 100}

Trucost assessed levels of water use by the FTSE/JSE top 100 companies. Where reported, global water data disclosed by companies are analysed. The direct water requirement is the amount of water used by the company’s operations to produce final products and services, including both process and cooling water. Since the majority of companies purchase water from utilities, quantities of purchased water are also taken into account. The analysis also includes data on process water use linked to purchases from first-tier suppliers, such as electricity and packaging providers. It excludes data on water use further up the supply chain. While the focus of this report is on exposure to climate change impacts through dependence on water resources, broader water risk assessments should also take account of water pollution impacts, which can add to local water stress and regulatory risks. Water risk is a function of factors including absolute quantities of water use, water efficiency, the level of water stress at the locations where water is consumed, impacts on water resources, and compliance with regulatory controls on water withdrawals and wastewater discharges.

Operations of the FTSE/JSE top 100 companies directly abstracted 2.6 billion m$^3$ of process and cooling water. As shown in Table 13, 59\% of operational water data analysed were disclosed in environmental/corporate social responsibility/sustainability reports, in annual reports or regulatory filings, or to the CDP Water Disclosure Project, which received information from 26 companies in South Africa in response to an information request.\textsuperscript{105} A further 37\% of operational water data were derived from data disclosed by companies such as partial data. The remaining 5\% were estimated using Trucost’s environmental profiling model, which calculates likely water withdrawals by companies that do not disclose adequate data. Estimates are based on sector averages calculated using an input-output model and

\footnotesize{\begin{tabular}{ll}
103 & http://rava.qsens.net/themes/theme_emissions/111012nccr-whitepaper.pdf, accessed 2 October 2012 \\
\end{tabular}}
combining data from corporate financial reports and public environmental and economic accounts (see Appendices 1 and 2).

The companies purchased more than 383 million m$^3$ of water. 99% of purchased water data were disclosed by companies or derived from information obtained from corporate disclosures. Water consumed in the processes of other tier 1 suppliers, such as packaging providers, amounted to almost 6 billion m$^3$. All data for tier 1 suppliers are calculated using Trucost’s environmental profiling model. Purchases from water utilities and other first-tier suppliers account for 71% of total water use across the 100 companies. This highlights the importance of corporate measurement and reporting of water use by suppliers in order to monitor and manage related risks, such as supply disruption and higher input costs.

Table 13: Breakdown of water data for the FTSE/JSE top 100 companies

<table>
<thead>
<tr>
<th>Source</th>
<th>Quantities of water (m$^3$)*</th>
<th>% of data disclosed by source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Disclosed</td>
</tr>
<tr>
<td>Direct</td>
<td>2,615,201,574</td>
<td>59</td>
</tr>
<tr>
<td>Purchased</td>
<td>383,582,651</td>
<td>48</td>
</tr>
<tr>
<td>Other first-tier suppliers</td>
<td>5,590,633,900</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>8,949,418,124</td>
<td></td>
</tr>
</tbody>
</table>

*Figures are rounded up. To find out more about water data, see Appendix 2.

Together the 100 companies use more than 8.9 billion cubic metres (m$^3$) of water globally in operations and through purchases of goods and services from first-tier suppliers. This is equivalent to 64% of reliable water yields in South Africa.\footnote{http://www.dbsa.org/Research/DPD%20Working%20papers%20documents/DPD%20No12.pdf, accessed 12 October 2012} Many of the companies and their first-tier suppliers use water outside of South Africa, and information on where water is sourced from is vital to understand the water risk profiles of companies through their operations and suppliers.

Water scarcity costs

Water supply costs are often not recovered fully through charges, as water is supported by government subsidies. Undervaluing natural resources in transactions can contribute to their depletion and degradation. Trucost has calculated the indirect economic value of water as a natural asset. A monetary value can be applied to quantities of water use to account for externalities. Water valuations can be adjusted to reflect water scarcity and provide a proxy to identify where water is being used in areas of water stress. Applying local water scarcity values to operational and upstream water use can be useful to indicate potential risks from supply disruption and rising raw materials and commodities prices due to water shortages. Values per cubic metre can also be compared with water tariffs to assess potential price increases to support ecological functions.

Trucost has conducted a literature to review to calculate the external value of water scarcity, reflecting the impact of water extraction on freshwater replenishment, habitat maintenance, groundwater recharge, water quality maintenance and waste assimilation. The global price is adjusted for average levels of water scarcity in South Africa. For every cubic metre of water use in South Africa, the external indirect cost of environmental damages is approximately R6.26 (US$0.76). This indirect value of water consumption takes account of average levels of water stress, based on 25% of total actual renewable water resources withdrawn in South Africa in 2000. The price reflects the total annual volume of groundwater and surface water withdrawn from sources by agricultural, domestic and industrial sectors, relative to the total
volume of water available annually through the hydrological cycle (total renewable water resources). The value would be higher for water taken from water basins that are under greater water stress. To find out more about Trucost’s indirect water values, see Appendix 3.

If the FTSE/JSE top 100 companies were to pay R6.26 for each m$^3$ of water used by operations and first-tier suppliers, water scarcity costs could total approximately R56 bn (US$7 bn). If the companies were charged South Africa’s average approved 2012/13 raw water charge of R0.025\(^{107}\) per m$^3$ for the 8.9 billion m$^3$ used globally by operations and first-tier suppliers, they would currently pay R224 million (US$27 mn). This is less than 1% of the true value of water in South Africa.

Companies can internalise the indirect costs through water pricing, inflationary pressure, stricter limits in abstraction licensing conditions, lower than expected revenues due to reduced productivity, declines in water quality and the degradation or depletion of natural capital. Local effects can ripple across industries and supply chains, with negative effects on financial ratios used in valuations.

**Water use by sector**

The number of companies in each supersector, combined with the productivity of business segments in which they operate and water efficiency of operations, contribute to levels of water use by each industry. The Basic Resources, Food & Beverage, and Personal & Household Goods industries account for more than 90% of total water use across the index (see Figure 6).

**Figure 6: Breakdown of direct and first-tier water use by sector – FTSE/JSE top 100 companies**

In three of the five sectors with the highest levels of water use, more water is consumed in the production of purchased goods and services than in operations (see Figure 7). More than half of the water used by Basic Resources and Oil & Gas companies is directly abstracted or purchased. In contrast, other tier 1 suppliers account for at least 69% of water use in the Food & Beverage, Personal & Household Goods and Industrial Goods & Services sectors.

Water use by sectors such as Food & Beverage is largely upstream in supply chains, so exposure to water scarcity is greatest through supply disruptions and rising commodities prices. Retailers and Food Producers are exposed to water stress through rising food prices due to higher irrigation costs, crop losses and lower productivity. For instance, Pick n Pay Holdings Ltd highlights water demand and erratic rainfall among key concerns to local produce suppliers that affect the company’s ability to provide food at affordable prices.\textsuperscript{108}

Levels of water consumption, efficiency and local water stress contribute to water risk. Geographical water risk assessments can focus on water-intensive companies that contribute most to water use in an index or portfolio. The Food & Beverage sector has the highest average water intensity in the JSE top 100 (see Table 14, which shows five of the six most water-intensive sectors). Food & Beverage companies’ operations and first-tier suppliers use 39,055 m$^3$ of water for every R mn of revenue, on average. Travel & Leisure and Basic Resources are next most water intensive (see Table 14). Water intensity at a company level varies most within the Food & Beverage sector (4,212 m$^3$ per R mn to 145,604 m$^3$ per R mn). Variations in water intensity are driven by factors including differences in business activities, efficiency and water management. Variations in water intensity can indicate varied exposure to disruptions to supplies and rising embedded water costs, as well as potential to improve efficiency.

Table 14: Water intensity by supersector in the FTSE/JSE top 100

<table>
<thead>
<tr>
<th>Supersector</th>
<th>Water intensity (m$^3$/R million)</th>
<th>Lowest</th>
<th>Average</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food &amp; Beverage</td>
<td>4,212</td>
<td>39,055</td>
<td>145,604</td>
<td></td>
</tr>
<tr>
<td>Travel &amp; Leisure</td>
<td>900</td>
<td>3,679</td>
<td>6,458</td>
<td></td>
</tr>
<tr>
<td>Basic Resources</td>
<td>1,494</td>
<td>3,416</td>
<td>9,078</td>
<td></td>
</tr>
<tr>
<td>Personal &amp; Household Goods</td>
<td>36</td>
<td>2,826</td>
<td>10,155</td>
<td></td>
</tr>
<tr>
<td>Industrial Goods &amp; Services</td>
<td>67</td>
<td>1,193</td>
<td>5,367</td>
<td></td>
</tr>
</tbody>
</table>

*Excluding Oil & Gas, which only has one constituent (Sasol Ltd) with a water footprint of 1,490 m$^3$/R mn

\textsuperscript{108} http://www.picknpay-co.za/financials/annual_reports/2012/sustainability-overview.php, accessed 2 October 2012
Companies that are less water-intensive than sector peers could be more resilient as pressure on water resources grows. Investors could examine the implications of water stress for holdings and explore opportunities to position portfolios for the shift towards a water-efficient, climate-resilient economy. Investors can assess the water footprints of equity portfolios to identify companies that contribute most to fund exposure to water risk.

**CASE STUDY: Water exposure of GEPF equity holdings**

Since GEPF equity holdings are largely invested in the FTSE/JSE top 100 companies, those assets are also exposed to the financial implications of water risks for their operations and supply chains. Trucost therefore analysed the water footprint of GEPF’s R541 billion equity holdings. The analysis covers data on cubic metres (m³) of water abstraction and use by companies held. This includes process and cooling water abstracted from sources including groundwater and surface water, water purchased from utilities suppliers, and water consumed due to the production of goods and services purchased from tier 1 suppliers. Water consumption further upstream in supply chains was excluded from the analysis.

The water footprint of the portfolio is measured against the FTSE/JSE top 100. More than 1 billion m³ of water were allocated to GEPF portfolio holdings in proportion to equity ownership of 152 companies. This includes water abstracted by operations and linked to purchases from water utilities and other tier 1 suppliers. Applying the external value of water in South Africa (R6.26) to each cubic metre of water attributed to GEPF holdings results in indirect external water scarcity costs totalling more than R8 bn (US$983 million).

**Table 15: Water footprints of GEPF equity assets in SA vs. FTSE/JSE top 100**

<table>
<thead>
<tr>
<th></th>
<th>Water footprint (m³/R mn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEPF equity portfolios in South Africa</td>
<td>3,306</td>
</tr>
<tr>
<td>FTSE/JSE top 100</td>
<td>3,503</td>
</tr>
</tbody>
</table>

The water footprint of the fund is 6% smaller than that of the benchmark. Basic Resources and Industrial Goods & Services companies were the main drivers of the portfolio water footprint. Six mining companies contributed most to the water footprint. Among them are Gold Fields Ltd and Anglo American Plc. As these companies are among the largest contributors to the fund’s water footprint, and disclose at least some data on water use by location, Trucost assessed their exposure to water risk based on the locations of their operations using a water risk filter tool developed by WWF and Deutsche Investitions-und Entwicklungsgesellschaft mbH (DEG).

Trucost filled in the tool’s online questionnaire using publicly available information to compare Anglo American Plc and Gold Fields Ltd on exposure to water risk. Table 16 shows the percentage of questions in each section that could be answered using adequate company-level information disclosed publicly. Greater transparency on management of regulatory and reputational risk in particular would enable a more precise assessment of water risk profiles. Where information requested was not publicly available, assumptions were made and therefore actual risk profiles for each company may vary from estimates.
Both of the mines assessed for Gold Fields are based in the Limpopo Basin. For Anglo American, aggregated data on water consumption in South Africa were available for 35 mines. As data were not disclosed at a facility level and the majority of mines are in the Limpopo Basin, the assessment is based on the filter’s risk factors for this location. More detailed information on water consumption and management at a facility level would enable a more precise estimate of water risk and management. In general, a score of 1 indicates limited risk, while a score of 5 indicates high risk.

Based on operations in South Africa, Anglo American and Gold Fields both have relatively high exposure to water risk due to physical water stress. Results show that external water management is a concern due to issues including pollution and levels of water withdrawn in relation to physical water scarcity. Basin-related risks from factors such as physical impacts of water use on ecosystems are also relatively high. The filter shows that both Anglo American and Gold Fields are exposed to risks from climate change impacts. Both companies are also exposed to regulatory and reputation risk, due to factors such as planned regulatory changes and the importance of the companies to stakeholders within the water basin. Mining companies that operate in regions such as the Witwatersrand Gold Fields and Mpumalanga may be exposed to risks from acid mine drainage, which can cause contamination of groundwater resources and river systems required for agricultural and human consumption, flooding of underground infrastructure and poor water quality.

Companies and investors can use high-level analysis to focus in-depth assessments of basin-related, company-level risks based on the GPS location of facilities in specific industries. The water risk filter provides maps on water scarcity, biodiversity, and climate change in different countries. Findings can inform water risk management. The assessment shows the potential

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to drill down into water-intensive sectors that drive portfolio water risk. Investors could encourage companies to disclose more detailed information on water risk management.
MANAGING INVESTMENT
EXPOSURE TO CARBON AND WATER RISK

Highlights

Investors can examine opportunities to invest in tools that reduce exposure to carbon costs.

Examples of investment opportunities include the BGREEN Exchange Traded Fund that tracks the Nedbank Green Index, which has a carbon footprint that is 15% smaller than that of the top 100 companies in the FTSE/JSE ALSI.

Investors can also invest in low-carbon tracker funds based on carbon optimised indices to rebalance holdings within each sector based on carbon intensity. Trucost created a hypothetical FTSE/JSE Carbon Optimised Top 100 Index, which is 12% less carbon intensive than the FTSE/JSE top 100 companies. A three-year back-test to assess total returns against the underlying index found that financial performance tracks the benchmark closely, with a tracking error of 0.65% and a slight out performance of 2.39% over the three years.111

Indices and portfolios could be optimised to take account of variations in resource intensity to reduce exposure to water risk and volatile prices for inputs such as raw materials and agricultural commodities.

Some financial institutions and service providers have begun to create opportunities for investment in carbon efficient companies, and those positioning their businesses for the transition to a low-carbon economy, to meet expected demand from investors. Institutional investors could explore opportunities to invest in low-carbon assets through funds and indices such as the Mergence Low Carbon Equity Fund112 and the JSE SRI Index.113 Among readily-

111 The returns data are for the FTSE/JSE top 100 and (hypothetical) FTSE/JSE Top 100 Carbon Optimised index constituents and weights as of 30 June 2012. The back test does not include a reweighting of the index historically:

available investment opportunities is the BGREEN Exchange Traded Fund\textsuperscript{114}, which tracks Nedbank’s Green Index. Index constituents are selected from stocks of the top 100 largest South African companies listed on the JSE, based on scores for climate change information disclosed to the Carbon Disclosure Project; the development of CERs in South Africa under the UN CDM programme (see page 17), which indicates that they are reducing their carbon impacts; and criteria on liquidity.

Trucost’s analysis shows that the Nedbank Green Index carbon footprint is 15\% smaller than that of the FTSE/JSE ALSI top 100 companies.\textsuperscript{115} Basic Resources and Construction & Materials stocks held are more carbon-intensive than index sector peers on average. This may reflect the fact that CERs are only registered for mitigation activities that displace carbon-intensive activities. Companies that sell CERs are therefore likely to be carbon-intensive initially, and reduce their emissions as CDM projects are completed. The sale of credits enables the mitigation opportunity to be accounted for by third parties. A positive sector allocation effect, driven largely by underweighting Sasol Ltd, makes the index more carbon efficient than the benchmark. The Nedbank Green Index can also be used as the basis for segregated mandates for institutional investors. Fund managers could develop investments based on the Index.

Investors can also invest in low-carbon tracker funds based on carbon optimised indices to rebalance holdings within each sector based on carbon intensity. This approach, developed by Trucost, can be used for any passive or active investment strategy, while typically reducing a fund’s carbon footprint by 25-50\% and achieving financial performance in line with benchmark returns. The S&P/IFCI Carbon Efficient Index, designed to reduce investment exposure to carbon-intensive companies while maintaining a low tracking error through sector and country neutrality, \textsuperscript{116} is least carbon intensive of those analysed (see Table 18). There is potential to create a carbon optimised FTSE/JSE Top 100 fund to reduce carbon risk.

Table 18: Carbon footprints of Trucost FTSE/JSE Top 100 Carbon Optimised Index and Nedbank Green Index\textsuperscript{117}

<table>
<thead>
<tr>
<th>Index</th>
<th>Number of companies</th>
<th>Carbon footprint (tonnes of CO\textsubscript{2}e/R mn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;P/IFCI Carbon Efficient Index</td>
<td>868</td>
<td>55</td>
</tr>
<tr>
<td>Nedbank Green Index</td>
<td>42</td>
<td>67</td>
</tr>
<tr>
<td>Trucost FTSE/JSE Top 100 Carbon Optimised Index</td>
<td>100</td>
<td>68</td>
</tr>
<tr>
<td>FTSE/JSE top 100 companies</td>
<td>100</td>
<td>78</td>
</tr>
<tr>
<td>S&amp;P/IFCI LargeMidCap Index</td>
<td>893</td>
<td>80</td>
</tr>
</tbody>
</table>

**CARBON OPTIMISING THE FTSE/JSE TOP 100**

Trucost created a hypothetical FTSE/JSE Carbon Optimised Top 100 Index to assess the potential for investors to carbon optimise portfolios benchmarked against the top 100

\textsuperscript{114} http://www.nedbank.co.za/website/content/Capital-BgreenETF/, accessed 5 November 2012

\textsuperscript{115} Based on constituent data as of 30 June 2012

\textsuperscript{116} Find out more at http://www.trucost.com/financial-institutions, accessed 12 October 2012

\textsuperscript{117} Based on data as of 30 June 2012. The FTSE/JSE Top 100 companies are ALSI weighted constituents. Listed securities are free-float adjusted in each index.
companies. Where there is more than one stock in a sector, carbon efficient stocks are overweight relative to carbon intensive stocks, while maintaining the sector weightings of the parent index. Stocks that have a carbon intensity that is less than or equal to 25% of the portfolio carbon footprint are excluded from the reweighting. For those companies included in the optimisation, a cap and floor is put in place at 75% to limit outliers within each supersector. The stocks are reweighted to be sector neutral from the underlying index. The resulting FTSE/JSE Carbon Optimised Top 100 Index is 12% less carbon intensive than the benchmark as of end June 2012, and therefore less exposed to the costs of emissions under carbon pricing or constraints. There may be potential to reduce exposure to carbon emissions further in the FTSE/JSE All Share Index, due to the larger number of constituents.

A three-year back-test was conducted to assess total returns against the underlying index, with the optimised index reweighted annually based on constituents at the end of June each year. Findings show that financial performance of the FTSE/JSE Carbon Optimised Index tracks the FTSE/JSE top 100 closely, with a tracking error of 0.65% and a slight outperformance of 2.39% over the three years.118

Figure 8: Trucost FTSE/JSE Carbon Optimised Top 100 vs. benchmark

Indices and portfolios can be tilted to take account of variations in carbon intensity to reduce exposure to related risks, while maintaining financial performance. Large institutional investors that have a fiduciary duty to diversify equity holdings can use low-carbon passive or active funds to manage exposure to high-carbon equities and increase asset allocations to carbon-efficient stocks. This in turn can encourage companies to compete for capital on carbon efficiency and drive growth in demand for low-carbon energy, buildings, technologies, goods and services.

Carbon optimised indices tend to have smaller water footprints than underlying parent indices. This may be because carbon emissions are largely driven by energy-intensive activities which can be water intensive. Water intensity could be factored into tilts to reduce exposure to water risks. Rebalancing of stocks could take account of variations in water

118 The returns data are for the FTSE/JSE top 100 companies and FTSE/JSE Top 100 Carbon Optimised Index constituents and weights as of 30 June 2012. The back-test involves reweighting the index on 30 June annually for the last three years. The performance data are from 31 April 2009 to 31 August 2012.
intensity within sectors. Indices and portfolios could be optimised to take account of variations in resource intensity to reduce exposure to rising and volatile prices for inputs such as fossil fuels, raw materials and agricultural commodities.

Investors may require higher yields to compensate for inflation. Core inflation measures such as the Consumer Price Index (CPI) indicate the average change in price of a diversified basket of goods and services, including food and energy prices. Headline CPI inflation in South Africa fell from 7.1% in 2009 to 4.3% in 2010, before rising to 5% in 2011.¹¹⁹ Treasury forecasts show expectations that prices for food, imports and items such as energy and water¹²⁰ will push CPI inflation to more than 5% between 2012 and 2014.¹²¹ Analysis of returns can be inflation adjusted to reflect the long-term investment cycles of institutional investors.

SYSTEMIC CARBON AND WATER RISK MANAGEMENT

This report demonstrates that through equity investments in some of South Africa’s major listed companies, investors are exposed to risks from carbon emissions as well as the most significant climate change impact, water scarcity. Policy measures such as pricing carbon to create an incentive to cut emissions is essential to drive investments that will put economic growth on a low-carbon footing, in order to limit the costs of climate change impacts. Externalities including greenhouse gas emissions caused by companies could significantly affect the value of capital markets, or their potential for growth, and with that, the value of diversified portfolios.¹²² The costs of emissions and water scarcity are concentrated in key sectors such as Basic Resources and Electricity, but can trickle across companies and their supply chains to increase risks and lower the value of returns across major asset classes including equities and bonds. Further risks can be incurred through falls in demand for carbon-intensive products such as coal and coal-to-liquid fuels. Levels of high-carbon holdings suggests that few institutional investors are comprehensively assessing investment risks from emissions embedded in portfolios or positioning investments for an expected fall in the value of carbon-intensive assets.

The government plans to ensure financial regulations and a climate finance strategy enhance the financial sector’s capacity to incorporate climate change in risk and investment decisions. As of January 2012, pension fund trustees must take environmental, social and governance (ESG) factors into account when making investment decisions under Regulation 28 of the Pension Funds Act. This gives trustees the opportunity, where they deem it in the best interests of their members, to align their investment policies more consistently with national goals,¹²³ such as the shift to a low-carbon economy. The government is considering extending the provisions of the Pension Funds Act to give members of public-sector funds the same protections offered to members of private-sector funds.¹²⁴

Institutional investors and their services providers must also adhere to a Code for Responsible Investment in South Africa (CRISA) on a comply or explain basis. These drivers for ESG integration, along with climate policy measures such as carbon taxes and strategies to address energy and water supply and demand, are likely to support requests from asset owners for

¹²⁰ Known as “administered prices”
¹²⁴ Ibid
fund managers to incorporate climate change criteria into investment decision-making to manage risks and opportunities.

Strengthening institutional investors’ understanding of climate-related risk is essential to effectively manage the exposure of ultimate fund beneficiaries. GEPF was among 285 investors that backed the 2011 Global Investor Statement on Climate Change calling for policymakers to address climate change risks. Investors representing US$20 trillion that backed the statement recognising that “climate change presents major long-term risks to the global economy and to the assets [they] invest in”. Since the statement, membership of the global investor networks on climate change such as IIGCC, the Investor Network on Climate Risk, Investor Group on Climate Change Australia/New Zealand has grown in regions including Asia, supporting engagement with policymakers to promote low-carbon investment opportunities. GEPF is also among four asset owners in South Africa that are signatories to the United Nations-backed Principles for Responsible Investment (UN PRI), committed to integrating ESG issues into investment analysis and decision-making. One of the other South African PRI signatories is Eskom Pension and Provident Fund, with assets of more than R67.5 billion (US$8.16 bn). Its Responsible Investment Report on Proxy Voting and Engagement activities does not refer to climate change. PRI signatories will need to demonstrate how they are implementing the principles through a new framework for disclosure of responsible investment activities that will become mandatory for asset owners and investment manager signatories in 2013. The framework includes environmental criteria on issues such as climate change.

Energy efficiency, demand management and switching from fossil fuels to renewable energy sources in power generation are expected to provide the greatest cost-effective mitigation opportunities. Investment in new infrastructure will have to consider climate change impacts to avoid the lock-in of emissions-intensive technologies and infrastructure, and there will be opportunities to invest in low-carbon energy, buildings, plant and equipment. There will also be opportunities for investment in water-efficient infrastructure and measures to make the built environment more resilient to floods and drought. Institutional investors are essential to drive investments in low-carbon, water-efficient and climate-resilient technologies, processes and infrastructure.

Investors can assess the water footprints of equity portfolios to identify companies that contribute most to climate risk. Investors could engage with the most exposed companies to encourage disclosure of more detailed information on issues such as carbon and energy management, water consumption by location and management of exposure to future water stress. They can develop climate-related criteria for investment analysis and develop expectations on water and carbon management for companies held in portfolios.

Recommendations include:

Regulators

- Identify potential systemic climate risk in the economy, focusing on investor exposure to corporate GHG emissions and water constraints.
- Create a task force to examine links between GHG emissions, water scarcity under climate change impacts, financial performance and returns across asset classes.
- Assess the potential implications of carbon emissions and water stress on equity risk premiums and interest rates.

126 http://www.eppf.co.za/, accessed 12 October 2012
Facilitate opportunities to reduce the carbon and water exposure of investments by providing policy certainty on related regulatory frameworks and market-based measures, and recycling carbon tax revenues to support the transition to a low-carbon economy.

Strengthen corporate reporting requirements on climate-related risks.

Include climate-related criteria in terms for credit guarantees and publicly financed projects and entities.

Encourage credit rating agencies to consider carbon and water risks in credit risk assessments.

Promote energy efficiency and decentralised renewable energy investment through regulations and market-based policy mechanisms.

Build knowledge of pension fund beneficiary and institutional investor exposure to carbon and water risk and opportunities to position portfolios to gain from the transition to a low-carbon, water efficient economy.

Institutional investors and fund managers

Review available tools to assess asset exposure to climate change risk factors.

Develop processes to monitor risks from constraints on corporate GHG emissions and water use for stock and bond valuations and credit ratings.

Assess the potential implications of carbon emissions and water stress on equity risk premiums and interest rates.

Develop investment policies on carbon and water risk and identify assets that contribute most to portfolio exposure.

Identify opportunities to reduce exposure to climate-sensitive, high carbon assets through equity indices.

Review opportunities to reduce the carbon exposure of bonds.

Consider climate and water related criteria in investment mandates and conditions for debt securities.

Outline expectations for companies on carbon and water disclosure and management to strengthen active ownership activities.

Engage with companies and financial institutions to encourage them to develop responsible water stewardship strategies and to use tools such as the WWF DEG Water Risk filter and World Business Council for Sustainable Development Global Water Tool to assess current and future risks.

Companies

Disclose data on greenhouse gas emissions in line with the Greenhouse Gas Protocol in integrated reports. Indicate the level of emissions under carbon pricing mechanisms in different jurisdictions and strategies to reduce financial risk.

Develop carbon management strategies with absolute or intensity-based emissions reduction targets.

Develop systems to monitor exposure to carbon costs through operations and supply chains.

Identify opportunities to reduce exposure to carbon costs from electricity-related emissions.

Explore cost benefits from energy efficiency measures and renewable energy in energy management systems and capital expenditure programmes, taking account of rising electricity and carbon costs.

Strengthen measurement and management of water risks to operations and supply chains.
APPENDICES
APPENDIX 1: TRUCOST METHODOLOGY

Assessing corporate environmental performance
Trucost has developed a comprehensive approach to quantify environmental impacts across organizations, supply chains and investment portfolios. Trucost maintains a database that includes company-specific environmental data. This study includes the latest available data on corporate GHG emissions, measured in metric tonnes of carbon dioxide equivalents (CO₂e), in the database. This includes GHG emissions data provided through direct communications with companies, or disclosed publicly. Trucost reviews company annual reports and accounts, environmental/sustainability reports, corporate websites and other public disclosures, such as responses to the Carbon Disclosure Project (CDP). Trucost included CDP corporate carbon data published in 2011 in this study.

Where a company only discloses data for part of its overall activities, Trucost might standardise or normalise quantities in order to calculate the carbon impacts of the business’s entire operations in line with the Greenhouse Gas Protocol corporate accounting standard. Where reported, Scope 1 and 2 emissions data are included in Trucost’s database. Where companies only disclose resource use such as fuel consumption, this information is used to derive environmental data where possible.

Where companies report Scope 3 emissions, data is usually provided for business travel or logistics. For other supply chain impacts and where companies do not disclose adequate data, GHG emissions are calculated using Trucost’s advanced environmental profiling model. This describes resources used through economic interactions between each sector based on census data from the US Bureau of Economic Analysis, adapted to generate global input-output modelling. Quantitative data on industrial facilities’ economic productivity and resource use is combined with information on environmental indicators such as pollutant releases from national emissions registries. Production data on business activities in 464 sectors is used to calculate corporate environmental impacts including GHG emissions. Information on a company’s revenues in different industries is used to model its likely direct and supply chain emissions, based on industry averages. Calculations incorporate disclosed quantitative data on industrial facilities’ actual resource use and pollutant releases where available.

Trucost engages with companies so that they have the opportunity to verify environmental profiles and provide additional information. Analysts quality check any further disclosures made, which are exclusive to Trucost and further augment the database. Environmental profiling using an input-output model is a “best efforts” attempt to understand environmental impacts in the absence of sufficient and comparable company disclosures on the environmental impacts of operations and supply chains. Adopting this method prevents companies effectively outsourcing environmental external costs. Trucost’s comprehensive coverage ensures that all companies in an index or portfolio are analyzed, not just those that disclose environmental information.

Carbon intensity
To compare the carbon efficiency of companies of all sizes and sectors, Trucost normalises greenhouse gas emissions from operations and direct (first-tier) suppliers by revenue (tonnes of CO₂e per R mn (US$ mn) revenue. First-tier emissions are upstream from the company’s direct suppliers, such as logistics and business travel providers.
Assessing the carbon footprints of equity and bond portfolios

To limit any issues associated with double counting GHG emissions, Trucost analysed emissions from operations (Scope 1), electricity purchases (Scope 2) and other first-tier suppliers to calculate the carbon footprints of funds. Data on the value of portfolio holdings in each company were used to allocate tonnes of CO₂e emissions from each company to each portfolio. The same share of equity ownership was used to allocate each company’s sales revenue to each portfolio. The total emissions and revenues from each company are summed across each portfolio to calculate its carbon footprint as total tonnes of CO₂e normalised by R mn (US$ mn) revenue.

The carbon footprints of bond portfolios include direct GHG emissions from operations and emissions from direct (first-tier) suppliers only. Trucost maps bonds to parent issuers and allocates carbon emissions from operations, electricity purchases and other first-tier suppliers for each constituent company to bond indices or portfolios based on the value of each bond as a proportion of the equity and total debt of each company. Total emissions aggregated across the index or portfolio are normalised by revenue generated by the issuing companies. The GHG emissions and revenue allocated to each portfolio are summed up to calculate the carbon footprint of bond portfolios.

Water footprints of equity portfolios

Trucost calculated water footprints by allocating water use by each company to each portfolio on the basis of equity ownership. The analysis includes cubic metres (m³) of process and cooling water directly abstracted by companies from sources including groundwater, artificial reservoirs, lake, rivers & streams. It also includes water purchased from utilities, and water use linked to purchases of products and services from other first-tier suppliers. The total water use and revenues from each company are summed across each portfolio to calculate its water footprint as m³ of water normalised by R mn (US$ mn) revenue.

APPENDIX 2: WATER DATA

How are quantities of operational process water use calculated?

Every year Trucost researches, standardises and validates environmental impact data on the world’s largest companies. As a result of this research process, Trucost’s Environment Register holds environmental and financial data on the largest 100 companies in the FTSE/JSE All Share Index. For this study, operational water use was analysed as quantities of process water directly abstracted from groundwater or surface waters, as well as water used for cooling. Trucost’s data on quantities of corporate water use incorporate information disclosed by companies in annual reports and accounts, environmental reports, sustainability or corporate social responsibility reports and on company websites. Trucost’s Environment Register also includes data that are publicly disclosed by companies through third parties, such as the Carbon Disclosure Project Water Disclosure Initiative.

Where a company only discloses data for part of its overall activities, Trucost may normalise quantities in order to estimate the environmental impacts of the business’s entire operations. Trucost standardises quantities of water use in cubic metres to allow for direct comparison across companies, industrial sectors and geographies. Where quantities are adjusted through methods such as these, this study classifies data as “derived”. Where companies do not comprehensively disclose resource use and pollution impacts in quantitative terms, Trucost uses advanced environmental input-output modelling to calculate companies’ likely water use.
All companies are given the opportunity to review Trucost’s calculations as part of the annual research process. All data on quantities of water used correlate with each company’s relevant fiscal year to enable the costs associated with environmental impacts to be compared with each company’s financial results.

**How does Trucost calculate water use in the absence of company disclosure?**
Trucost uses advanced environmental input-output (EIO) modelling to calculate likely levels of water use by companies that do not adequately disclose data. Overseen by an academic advisory panel, Trucost’s EIO model combines company financial data with government census and survey data to identify industry-specific quantities of water use per unit of output across each tier of the corporate supply chain. The model includes data from the US Toxic Release Inventory, Australia National Pollution Inventory, Federal Statistics Office of Germany (Destatis) and the UK Environmental Accounts. Quantitative data on industrial facilities’ water use is combined with economic data from sources such as the US Bureau of Economic Analysis to analyse interactions between economic productivity and water use. Trucost’s EIO model analyses business activities in 464 sectors based on the North American Industrial Classification System (NAICS). Trucost primarily uses data from FactSet and company accounts to identify segmental revenue data and map each company to sectors. The model calculates a company’s water impacts in proportion to revenues generated from business activities in relevant sectors.

**How does Trucost calculate water use and hot spots in supply chains?**
Water is used during the extraction, production and transportation of raw materials and products and services at various stages of the manufacturing process through the supply chain. The analysis of the FTSE/JSE top 100 companies includes process water use in the first tier of the supply chain, calculated using Trucost’s advanced environmental input-output (EIO) model (see above). The EIO model describes the economic interactions between each sector to estimate the amount of process water and other resources (the inputs) that a company’s suppliers use to produce goods or services (outputs). The EIO model calculates the likely purchases made by a company and its suppliers, and resultant quantities of water consumption. Water use in supply chains is calculated based on resource use by suppliers in each subsector and supply chain tier. This analysis can be used to assess supply chain water dependence of a company of any size, industry sector or geography.

Although water data analysed in this study are limited to tier 1 supply chain impacts, Trucost’s model can distinguish between any tier in the supply chain. The analysis can incorporate actual expenditure and revenue data to analyse impacts of first-tier suppliers that the company buys from, as well as their suppliers, and so on until reaching the suppliers that extract raw materials. In this way, Trucost can calculate the upstream water use “embedded” in purchases. Water use by each supplier can be allocated to each company in an index based on modelled or actual expenditure as a proportion of supplier revenues.

The model shows which sectors use the majority of water in a given supply chain. By mapping water use in different sectors across all tiers in supply chains, Trucost is able to combine expenditure data with secondary data from EIO modelling to identify water hot spots in supply chains. This enables companies to prioritise suppliers in critical sectors to measure and manage water consumption linked to purchasing. Findings can help select suppliers for more detailed risk assessments on water management practices and local water stress.
The economic definition of the use value of water is based on market economics. The indirect use value of water is based on environmental economics to reflect the indirect contribution of water to human wellbeing. Indirect use values account for the ecosystem functions generated by water. Ecosystem functions can be defined as the biological processes that allow ecosystems to be proficient and maintained.

**Figure 1: Relationships between ecosystems and wellbeing**

In general, water generates three categories and five sub-categories of ecosystem functions (see Table 1 below). Trucost’s valuation of the indirect value of water use is based on calculations of values for each of the five sub-categories.

**Table 1: Indirect use values of water categories and sub-categories**

<table>
<thead>
<tr>
<th>Ecological functions</th>
<th>Hydrological functions</th>
<th>Biogeochmometric functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat maintenance</td>
<td>Freshwater replenishment</td>
<td>Water quality maintenance</td>
</tr>
<tr>
<td></td>
<td>Groundwater recharge</td>
<td>Waste assimilation</td>
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</table>

Trucost calculated the indirect values of water by establishing the relationship between water scarcity and water indirect values, and estimating the indirect value of water that reflects the level of water stress in South Africa. The causal link between water scarcity and water indirect values relies on a value transfer approach which uses indirect water values calculated in different areas with different levels of water scarcity. Since indirect values for water come from biological processes directly linked to the concentration of water, results show a causal link between water scarcity and the indirect value of water. Using the statistical software R, Trucost modelled the relationship between the water instream values and the water scarcities of the sample. The model obtained is summarised in Figure 2.

**Figure 2: Linear regression between instream value and water scarcity**
The low p value obtained expresses that water scarcity is a strong explanatory variable for water instream value and that the mathematical relationship modeled can be used to calculate the indirect value of water from water scarcity and vice versa.

The conclusions extracted from this statistical analysis are:

- The water instream value in one location can be explained by the water scarcity of that location
- The five indirect values of water can be determined by water scarcity
- An increasing water scarcity implies an increasing indirect value for water
- Indirect values for water are related to water scarcity with an exponential function

Results were used to establish the mathematical relationships between the five indirect water values and water scarcity. The value curve was adjusted in order to build the relationships between habitat maintenance, freshwater replenishment, groundwater recharge, water quality maintenance and waste assimilation and water scarcity. For the five water indirect use values, Trucost conducted a literature review in order to calculate five weighted average values. All valuation estimates were standardised to 2012 in US dollar equivalents per m$^3$ per year to provide a consistent basis comparison. Trucost calculated the weighted average water scarcity of relevant zones.

The obtained weighted average indirect use values and weighted average water scarcities have been used to adjust the founding curve into five indirect use value curves. Findings show that the groundwater recharge ecosystem function is the strongest driver of an increase in the indirect use value of water under growing water scarcity.

Ecosystem services are not usually monetized, so calculating the indirect use value to society involves assumptions and uncertainties. Thus, the numerical conclusions of indirect use values studies only provide a proxy for the non-market value of ecosystem goods and services delivered by water.

**Apply the relationship between water scarcity and indirect values in SA**

For the purposes of this study, the indirect water use value was adjusted to reflect overall levels of water scarcity in South Africa. The latest available information from the UN Food and Agriculture Organization’s AQUASTAT global information system on water and
agriculture shows that freshwater withdrawals represent 25% of total actual renewable water resources in South Africa, based on data for the year 2000. Incorporating this figure as an indicator for water scarcity into the formula outlined above results in an indirect water value of R6.26 (US$0.76) per m³.
REPORT HIGHLIGHTS

R56 BILLION
The external cost of water use by the companies and their direct suppliers, if water were priced to reflect its scarcity in SA

78
Tonnes of carbon emitted for every million rand of revenue generated by the 100 largest companies in the FTSE/JSE All Share Index

19%
The percentage of earnings at risk from carbon liabilities in the Basic Resources sector on average

6X
The difference in carbon footprints of 45 equity funds analysed

R7.8 BILLION
Potential carbon liabilities linked to operations and electricity use in the 9 highest emitting sectors

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