INTEGRATING WATER STRESS INTO CORPORATE BOND CREDIT ANALYSIS

Benchmarking companies in three sectors

Summary and Guidance

Edited by Liesel van Ast, Global Canopy Programme; Simone Dettling, Deutsche Gesellschaft für Internationale Zusammenarbeit; Anders Nordheim, UN Environment Programme Finance Initiative; and Henrik Ohlsen, German Association for Environmental Management and Sustainability in Financial Institutions

Authors: Michael Ridley and David Boland

Commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ).

About GIZ

The wide range of services offered by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH are based on a wealth of regional and technical expertise and on tried and tested management know-how. We are a German federal enterprise and offer workable, sustainable and effective solutions in political, economic and social change processes.

Most of our work is commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). However, GIZ also operates on behalf of other German ministries and public and private bodies in Germany and abroad. These include governments of other countries, European Union institutions, such as the European Commission, the United Nations and the World Bank. We are equally committed to helping our clients in the private sector attain their goals.

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About the Emerging Markets Dialogue on Green Finance

The goal of the Emerging Markets Dialogue Programme (EMD) on Green Finance is to increase capital flows to green investments and thereby enable the transformation towards sustainable economies. To achieve this aim, the EMD works with public and private organisations from Emerging Markets and Europe to overcome barriers and gaps to increasing eco- and climate-friendly investments. For example, the EMD works with financial institutions from G20 Emerging Markets and Europe to integrate environmental indicators into lending and investment decisions, risk management and product development.

GIZ was commissioned to implement the EMD Green Finance by the German Federal Ministry for Economic Cooperation and Development (BMZ).

About the Natural Capital Declaration

The NCD was launched at the UN Conference on Sustainable Development (Rio+ 20 Earth Summit) in 2012 Green Finance by UNEP FI and the UK-based non-governmental organisation, Global Canopy Programme (GCP). It is a worldwide finance led initiative to integrate natural capital considerations into financial products and services, and to work towards their inclusion in financial accounting, disclosure and reporting. Signatory financial institutions are working towards implementing the commitments in the Declaration through NCD projects. These are overseen by a steering committee of signatories and supporters and supported by a secretariat formed of the UNEP FI and GCP. This project to co-develop the Corporate Bonds Water Credit Risk Tool is included in a work programme to build capacity for asset managers and banks to integrate natural capital into financial products and services. To find out more, see www.naturalcapitaldeclaration.org/working-group-2/

About The Global Canopy Programme (GCP)

The Global Canopy Programme (GCP) is a tropical forest think tank working to demonstrate the scientific, political and business case for safeguarding forests as natural capital that underpins water, food, energy, health and climate security for all. GCP works through its international networks – of forest communities, science experts, policymakers, and finance and corporate leaders – to gather evidence, spark insight, and catalyse action to halt forest loss and improve human livelihoods dependent on forests. The Global Canopy Programme is a registered UK charity, number 1089110.

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The United Nations Environment Programme Finance Initiative (UNEP FI) is a unique global partnership between the United Nations Environment Programme (UNEP) and the global financial sector. UNEP FI works closely with over 200 financial institutions who are Signatories to the UNEP FI Statements, and a range of partner organizations to develop and promote linkages between sustainability and financial performance. Through peer-to-peer networks, research and training, UNEP FI carries out its mission to identify, promote, and realise the adoption of best environmental and sustainability practice at all levels of financial institution operations.

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The Verein fuer Umweltmanagement und Nachhaltigkeit in Finanzinstituten (VfU) is an association and network of financial institutions from Germany, Switzerland, Austria and Lichtenstein working towards the development and implementation of innovative and sustainable solutions for financial managers. VfU brings together financial and environmental know-how in order to promote the contribution of the financial industry to sustainable development. VfU´s main focus is on:

- The advancement of sustainable internal business operations, including environmental management and controlling guidelines and indicators.
- Internal and external communication and reporting of sustainable performance and action on climate change.
- Environmental, Social and Governance (ESG) factors in lending and investing processes.

Integrating Water Stress into Corporate Bond Credit Analysis – Benchmarking companies in three sectors; GIZ, NCD and VfU 2015

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The project team has developed a methodology and Corporate Bonds Water Credit Risk Tool in partnership with Michael Ridley, a Fixed Income specialist, and David Boland, an Ecological Economist and Founder and Managing Director of DBRM Associates.

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Project Partner Financial Institutions:

- **Bancolombia**
- **Banorte**
- **Calvert Investments**
- **Pax World**
- **Robeco**
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- **UBS AG**

Expert Council Members:

Su Gao, Bloomberg
Cate Lamb, CDP
Monika Freyman, Ceres
Sean Kidney, Climate Bonds Initiative
Allan Provins, Eftec
Annelise Vendramini, FGV
Dr. Axel Borchmann, Federal Ministry of the Environment, Nature Conservation, Building and Nuclear Safety
Dr. Martina Flörke, Center for Environmental Systems Research (CESR), University of Kassel
Susan Staples, KPMG Australia
Archie Beeching, Principles for Responsible Investment (PRI)
Dr. Matthias Retter, PwC
Mike Wilkins, Standard and Poor's Ratings Services
Wolfgang Busch, Helmholtz Centre for Environmental Research GmbH – UFZ
Ivo Mulder, United Nations Environment Programme (UNEP)
Professor Dolf de Groot, Wageningen University
Anne-Leonore Boffi, World Business Council for Sustainable Development (WBCSD)
Paul Reig, World Resources Institute (WRI)
Oliver Männicke, WWF Australia

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GLOSSARY OF TERMS

Concept	Explanation
Shadow price of water	In order to include environmental indicators in economic analysis, their costs and benefits need to be expressed in monetary terms. Due to inadequate market pricing or regulation, the price paid for water often does not reflect the actual costs and benefits of water to all potential users at its source. Therefore, it is necessary to adjust the price paid by users to reflect a more accurate valuation of the resource. The resulting adjusted or estimated price is called a "shadow price".[1]
Total economic value (TEV)	The Total Economic Value (TEV) concept is drawn from environmental economics. A TEV framework provides a structured approach to estimating the economic value of the benefits that environmental assets provide to society. In this study we apply the TEV framework to assess the value of water by calculating values for the direct and indirect benefits of water use in U.S. Dollars per cubic metre of water (US$/m^3). We sum the estimated economic value of benefits of water use in four categories: Agriculture, domestic supply, human health and environmental services (supporting biodiversity). The function includes two independent variables – water stress and population. Our approach only takes account of the "use values" of water (direct use, indirect use, option) in the TEV framework, and excludes "non-use values" (existence, bequest, intrinsic). Our method may therefore underestimate the full value (or TEV) of water, and the result is therefore more accurately referred to as a shadow price. In this paper, the term "TEV" relates to the environmental economics framework used to estimate the value of water, while "shadow price" refers to the result of this estimation using our analysis framework.
Water stress	Water stress measures the ratio of total water withdrawals in a catchment in a given year (the sum of domestic, industrial, and agricultural) to the total available water (the amount available in the same catchment averaged over a long time period). Higher values indicate more competition among users. Water stress is one independent element of the shadow price calculation, alongside population. This paper uses the terms water stress and water scarcity interchangeably. Source: World Resource Institute.

1 UN Department of Economic and Social Affairs, Statistics Division (2012) System of Environmental-Economic Accounting for Water

FOREWORD FROM BMZ

Climate change and the degradation of our ecosystems are among the main challenges of the 21st century. Some consequences, such as droughts, increasing water scarcity, rising sea levels and more frequent flooding are already felt across the globe and impact economic activity as well as human lives. The effects of climate change and ecosystem degradation will disproportionately affect the poor and already vulnerable, as their livelihoods depend most directly on natural resources and they are least equipped to absorb economic shocks. Climate change and ecosystem degradation are thus important topics for German development cooperation.

In order to limit climate change to two degrees and to halt the degradation of our ecosystems, we need to develop low-carbon, resource-efficient and environmentally sustainable economies. Achieving this transformation will require substantial investments in green technology, sustainable infrastructure and resource-efficient production methods. It will require a reallocation of our financial capital away from carbon- and resource-intensive economic activities with a high environmental impact and towards sustainable production methods that minimize the impact of human and economic activities on our ecosystems.

Financial institutions, such as banks, asset managers and pension funds play a central role in the green transformation of our economies, as their lending and investment decisions strongly influence the allocation of capital in our economic system. It is thus crucial that we hardwire environmental indicators into their decision-making processes. We need to ensure that their lending and investment decisions reflect not only the return a project or economic activity provides to its shareholders and lenders, but also the costs and benefits it entails for society as a whole.

Consequently, German development cooperation works with the financial sector to integrate environmental indicators into lending and investment decisions and to mobilize private capital for green investments. As part of this effort, the tool that is presented in this report was developed, which enables finance professionals to integrate water stress in their credit risk assessment. It represents one step forward in our endeavor to change decision making in the financial system. I would like to thank the seven financial institutions, the United Nations Environment Programme Finance Initiative, the Natural Capital Declaration, the Global Canopy Programme, GIZ and the German Association for Environmental Management and Sustainability in Financial Institutions (VfU) for the great partnership in developing this tool.

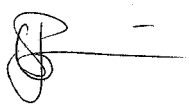
Susanne Dorasil
Head of the Economic Policy, Financial Sector Division,
German Federal Ministry for Economic Cooperation and Development (BMZ)

FINANCIAL INSTITUTION PROJECT PARTNERS' FOREWORD

Water scarcity can be significant and is affecting companies in several sectors, in various places, right now. Localised water shortages currently span four continents. Parts of Brazil, the United States, South Africa and China that are dependent on water for agriculture, energy and industry are facing severe supply constraints. Companies rarely report on the effects of supply constraints on their financial statements, making it difficult to track the effects of misalignment of water supply and demand on credit risk. Most water-related costs, such as higher water tariffs, water restrictions due to lack of supply or re-allocations, and capital expenditure to mitigate risks or adapt to physical constraints, are embedded in line items in financial statements. This makes it difficult to identify how water scarcity is currently affecting the financials of companies, and how they could be affected in the future. Opaque and anecdotal information on water-related costs and pricing has left water relatively invisible in the data flows and analytics used to inform investment decisions, despite it being a key input in many production processes and costing business billions of US Dollars annually.

The Corporate Bonds Water Credit Risk Tool provides a systematic approach to modelling corporate exposure to water stress so that it can be factored into credit analysis. It incorporates ratios of supply and demand to identify exposure to water stress and the resulting risk faced by companies into traditional financial analysis. The model's approach of combining geospatial information and corporate water data, with an overlay of water shadow pricing, is useful to make company-level exposure to water stress quantifiable in credit analysis. Taking part in the project has been a valuable learning experience, and having the opportunity to provide input at key stages has helped to make sure that the tool can be used in credit assessments, benchmarking, corporate bond valuations, engagement programmes and developing new investment strategies. The tool provides useful insight to evaluate companies on water risk against sector peers. We hope that we have helped to deliver a tool that is credible to the financial market. Its workings are transparent and it has the functionality and flexibility that are useful to integrate water as a factor into products and services offered by financial institutions.

It is a practical step towards developing a more systematic approach to understanding portfolio exposure to water risk. This will become increasingly important as variability in rainfall patterns, ecosystem degradation, population growth and growing demand from agricultural and industry contribute to growing competition for water resources.



Edith Siermann
CIO Fixed Income & Manager
Sustainability Investing, Robeco

Stuart Dalheim,
Vice-President, Shareholder Advocacy
Calvert Investment Management, Inc.

Gabriel Thoumi, Calvert
CFA, Senior Sustainability Analyst
Calvert Investment Management, Inc.

Claudio Paonessa
Assistant Vice-President Asset
Management Bonds & Absolute Return
Bank J. Safra Sarasin Ltd

Marcos Mancini
Director of Sustainable
Banking, Banorte

Kent G. Siefers
Senior High Yield Analyst
Pax World Management LLC

Liselotte Arni
Managing Director, Head Environmental and Social Risk
UBS AG, Group Risk Control

EXECUTIVE SUMMARY

Companies that depend on water and operate in locations where water withdrawals are high relative to available water supply are exposed to water risk. Their costs for obtaining the amount of water they need to sustain their operations might rise abruptly or gradually, impacting their profitability, competitiveness and finally their ability to repay their debt.

A new financial model to integrate water stress into corporate bond credit analysis has been developed through a partnership between the Natural Capital Declaration (NCD), GIZ, the German Association for Environmental Management and Sustainability in Financial Institutions (VfU) and seven financial institutions from Europe, the U.S. and Latin America. By combining data on the quantity of corporate water use per production location with cost based on site-specific water supply and demand conditions, the GIZ/NCD/VfU tool for integrating water stress into corporate bond credit risk analysis allows financial analysts to quantify corporate water risk and assess the potential impact of water stress on a company's credit ratios. Fixed income analysts and portfolio managers can use the Corporate Bonds Water Credit Risk Tool to benchmark companies and assets in water-intensive industries, such as mining, power and beverages industries on exposure to water stress.

How is water use relevant to credit risk?

For many companies, accessing sufficient quantities of water for operations is becoming increasingly costly, especially in water-stressed regions. On the supply side, continuous overuse of water sources, ecosystem degradation and changing climate patterns with more frequent and severe droughts are rendering water an increasingly scarce resource. On the demand side, population growth is contributing to rising demand from households and agriculture, and competition for water resources is growing within and between water-dependent economic sectors. As a result of these growing supply and demand pressures, we see water-related capital expenditure rising amongst companies that directly withdraw water in catchments with scarce or over-allocated resources. Water tariffs are increasing as utilities attempt to recover higher expenditure to secure supplies. Water shortages have prompted authorities in economies including the U.S. state of California and the Brazilian state of São Paulo to introduce demand management and restrictions, which can limit production. Increasingly uncertain water supply and rising water costs affect the financials of companies, e.g. in the mining, power and beverages sectors. Additional capital expenditures to secure water supply (e.g. through investment in desalination technology), higher operating expenditures due to increasing water prices, production losses resulting from restricted access to water or the loss of a company's social licence to operate as it competes for scarce water resources with the local community, can lead to lower than expected earnings, restrict growth, and affect financial ratios used in credit analysis.

What does the GIZ/NCD/VfU Corporate Bonds Water Credit Risk Tool do?

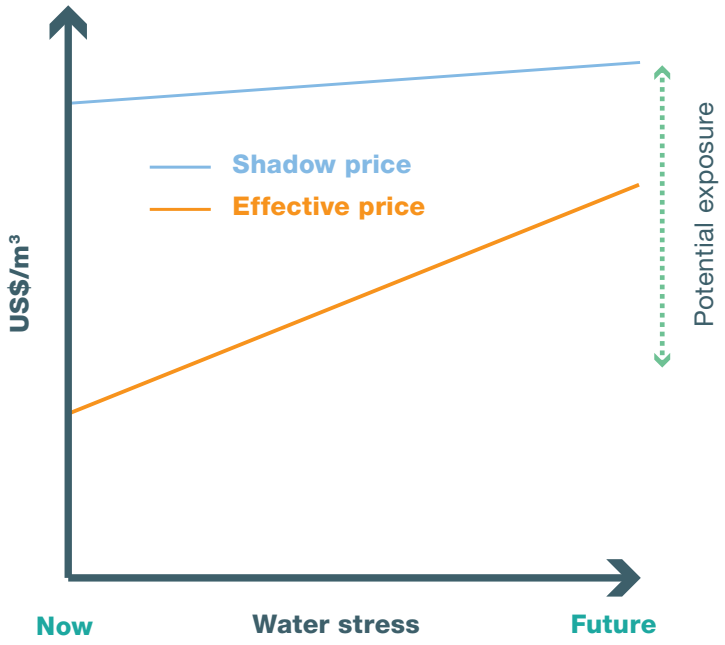
The tool incorporates newly available data from the World Resources Institute on water stress at any location globally into a traditional financial model. Thereby, it enables users to integrate a company's exposure to water stress into credit risk analysis. Users of the tool can benchmark companies on the potential impact of water stress on their credit ratios.

The model uses a shadow price for water as a proxy for exposure to potentially increasing costs for water resulting from water stress. Our analysis found no statistical correlation between urban water tariffs and water scarcity. In the absence of market prices that reflect resource constraints, shadow prices provide a proxy for the magnitude of exposure to water stress. The calculation of these shadow prices is based on a total economic value (TEV) framework – a concept taken from environmental economics. Shadow water prices

are calculated by considering the value of the alternative uses to which this water could be put, if it were not used by the companies analysed (opportunity costs). Where location-specific water use data are unavailable for a company, shadow water prices across a company's assets are weighted by production or assets in each location in order to derive a company-weighted water shadow price to reflect its overall risk profile. A higher company-specific shadow price indicates higher potential exposure to water stress across its operations. By using the shadow price to calculate a company's potential water use costs, water risk is introduced into the company's financial model via operating expenditures. This allows the user to measure the potential impact of increasing water costs on key financial ratios used in credit assessments.

The TEV framework is used to estimate the shadow price of water to provide an 'upper bound' with which the model is able to gauge the magnitude of direct potential exposure for a company, and test the company financials against this exposure. The market price of water might not reach the shadow price, however the costs of water constraints can be internalised through a variety of market and non-market mechanisms, including capital expenditure (capex), physical shortages leading to lower production, and asset stranding caused by loss of water rights.

Figure 1: Shadow price increases with water stress



DEPENDS ON

– Water usage
– Water cost
– 'Shadow price'

To illustrate the efficacy of the model, this paper also presents analysis undertaken on 24 companies, eight each from the mining, power and beverages sectors. We apply the new Excel-based model to investigate how these firms' credit ratios could be impacted by water stress, based on the potential costs associated with their water use under current and projected water supply conditions.

The model calculates company credit ratios before and after integrating the shadow price of the water used at their production locations. For some firms, the integration of the full value of water use that takes account of scarcity and population factors has the potential to have a significant impact on their credit ratios, which could lead to a rating downgrade and an adjustment in the value of their bonds.

When the model introduces water as a factor into the credit analysis of companies, the two parameters that determine estimates of how a firm's credit is impacted are the amount

of water the firm uses, and the shadow prices that the firm faces for water depending on the locations in which it produces. These factors, coupled with the financial strength and business risk profile of each company determine the extent to which firms are impacted by water stress in the model.

Shadow prices as a proxy for water risk

The TEV framework attempts to capture the benefits that water provides, in addition to the private benefit enjoyed directly by water consumers. We estimate the use value of four different "services" provided by water, namely water's value for agriculture, domestic supply, human health and environmental services. The model sums these four values to arrive at an overall shadow price. Water stress is one of the two independent variables in our calculation of shadow water prices. The second independent variable is population size within a 50 kilometre (km) radius. Areas that have high levels of water stress and are densely populated will have relatively high shadow water prices, reflecting expectations of increased costs to secure supplies and greater competition for resources. For a full explanation of shadow prices, see Appendix A.

Key findings

- Of the eight mining firms analysed, Barrick Gold and Vedanta are most exposed. Barrick Gold could see its Net Debt/EBITDA ratio rise by 20 per cent to 3.30x in 2017 if it were to fully internalise the costs of its water use. This could cause Barrick Gold's BBB rating to fall to High BB. However, this could be prevented by Barrick Gold's robust EBITDA/ Revenue margins.
- This scenario of full cost internalisation would see Vedanta's Net Debt/EBITDA ratio or leverage rise by 65 per cent to 3.85x in 2017. Although Vedanta's leverage rises quite sharply in our model, Vedanta is already rated Ba3/BB-, so its rating may not change.
- Of the power companies analysed, Eskom (Ba1/BB+Neg), the South African utility, already has extremely high leverage before water costs are added, with Net Debt/ EBITDA of 9.41x in 2017. Once Eskom faces the actual cost of its water use, its financial position deteriorates drastically, with its Net/Debt ratio almost tripling. But Eskom is unusual, being 100 per cent owned by the South African government (though its debts are not fully guaranteed by the government). Being financially stretched, Eskom is likely to be most exposed to water costs through physical constraints on its availability, which can challenge the reliability of existing operations and the viability of proposed projects, imposing additional costs for adaptive measures.
- Sempra, RWE and The Southern Company see their leverage rise quite sharply, when they internalise the full cost of their water use. Sempra Energy could see its High BBB rating fall to a non-investment grade rating: perhaps to High BB, because its leverage

Credit ratings explained

Ratings provide a simple way to communicate views on creditworthiness. Ratings used in this report are from the two largest rating agencies — Moody's Investors Service and Standard & Poor's (S&P). S&P uses 'AAA', 'BB', or 'CC' to communicate relative credit risk, with 'AAA' denoting the strongest creditworthiness and 'C' or 'D' denoting the weakest, or that a default has occurred. BBB- and above are considered "investment grade" – categories of issuers and issues with relatively higher levels of creditworthiness and credit quality. Similarly, Moody's ratings range from Aaa to C. Ratings of Baa3 and above are considered prime.

http://www.standardandpoors.com/aboutcreditratings/RatingsManual_PrintGuide.html
https://www.moodys.com/sites/products/AboutMoodysRatingsAttachments/MoodysRatingsSymbolsand%20Definitions.pdf

rises 97 per cent to 6.74x in 2017 when we estimate current shadow water costs. Power plants may face shut downs or operate at lower capacity in water-stressed areas.

- Our approach may underestimate the risk posed by water scarcity to utilities such as EDF, GdF and RWE, which use a great deal of water for cooling purposes. Our model only analyses the consumptive use of water, and does not apply the shadow price to water used for cooling that is reverted to its source. However, where available, quantities of cooling water are included in the model so that users could adapt it to estimate exposure to this "non-consumptive" reliance on water. In addition, users can assume that utilities with assets identified as exposed to water stress under the model's assumptions will be exposed to additional risk through the dependence on cooling water.
- Introducing shadow water prices does not have a significant impact on the financials of most of the beverage firms analysed. The exception is Femsa (NR/A-), the Mexican bottling company. Femsa's Net Debt/EBITDA ratio more than triples from 0.61x to 2.27x at the end of 2017 when we include water costs. Femsa's relative EBITDA/Revenue margin is small compared to peers like Diageo and A-Busch. Adding water costs could see Femsa's rating fall one notch to High BBB. The concentration of its operations in Mexico increases its exposure to water stress, relative to other beverages firms with more geographically diversified operations.
- The model's approach to the beverages sector is likely to underestimate the risk that water scarcity poses to these companies as it does not consider water risk embedded upstream in value chains. Our analysis only accounts for direct water use in the operations of beverage companies and does not include indirect water consumption through their supply chains.

Potential applications of the model

The Corporate Bonds Water Credit Risk Tool presented in this report is of most immediate interest to credit analysts and portfolio managers working in the bond markets, both on the sell side for banks or on the buy side for asset managers or hedge funds.

Credit analysts can extend the use of the tool to cover other companies in the mining, power and beverages sectors, or to additional sectors that depend heavily on water resources and have bonds outstanding. Analysts can source corporate location-specific water data and conduct research by applying the tool to analyse specific companies, with the potential to extend or adjust the quantitative analysis.

Other bond professionals working in origination and syndication could use the tool to analyse the potential impact of water scarcity on their issuer, before they bring bonds to the market or even before they talk to companies about their issuance needs. Alternatively, rating agencies or companies themselves might use the tool to consider the potential impact of water stress on credit ratings. The model could also be useful for credit risk managers looking to analyse whole portfolios of bonds, rather than individual bonds.

Finally, Environmental, Social and Governance (ESG) analysts and service providers can use the tool to identify firms "at risk" from water stress, firms with whom they could engage, by encouraging stronger disclosure and management practices around water. Follow up activities could include further research into regulatory frameworks, water policies and infrastructure relevant to preparedness for water scarcity.

The shadow prices underlying the tool can be applied to similar models for different asset classes. For example, Bloomberg has included the shadow prices developed under this project in a tool to analyse water risk in mining equities. In addition to the Corporate Bonds Water Credit Risk Tool, a tool that provides only the shadow water price at each location and country is available for download. This tool may be used for a great number of applications where shadow water pricing is needed.

GUIDANCE ON USING THE TOOL

The Corporate Bonds Water Credit Risk Tool can be downloaded from http://www.naturalcapitaldeclaration.org bonds-water-scarcity/

How to use the Tool

The Corporate Bonds Water Credit Risk Tool takes the form of a single Excel file. It is prepopulated with the financial, locational and shadow price information for 24 companies grouped by sector: mining (8.0-15.0), power (16.0-23.0), then beverages (24.0-31.0); where each firm is analysed on a separate sheet. However, before one arrives at the company sheets, the user is presented with seven sheets (1.0 to 7.0) providing information on the tool and a results summary. The tool is designed so that new sheets can be added where new firms are analysed; see 'How to Add New Companies to the Model' below.

Figure 2: Description and purpose of sheets in corporate bonds water credit risk tool

Sheet No.	Purpose
1.0 Guidance	Lists and explains the purpose of different sheets.
2.0 Companies	Lists the 24 companies analysed in the model. Information on each firm is presented, including its company's headquarters, market capitalisation, Bloomberg equity ticker, and credit rating with Moody's and S&P.
3.0 Sum Ratios	Summarises EBITDA/Revenue and Net debt/EBITDA ratios for the 24 firms. On the left-hand side of the sheet, static credit ratios are presented, assuming that companies do not face water shadow prices. On the right hand side ratios are drawn from the individual company sheets; as the analyst adjusts the assumptions made on any or all of the company sheets, so the resulting ratios are shown. The analyst can compare ratios generated when firms face no shadow water costs [Left-hand side of the sheet] with the ratios faced under the water risk assumptions [Right -hand side].
4.0 Graph Ratios	Analysts can graph data from any of the firms in the model. The model allows analysts to see how elements of a firm's operation change over time.
5.0 Graph Financials	Shows the effect of 2010 shadow prices on company financials. Using the dropdown menu "select company sheet", analysts can select a firm included in the tool and then use the dropdown menu "select graph item" to choose a financial indicator.
6.0 New Company	Where analysts enter a new company. Data on locations and longitude/latitude is automatically included in the "New Co Location Data" tab [33.0] where water stress data is sourced from the WRI's Aqueduct Water Risk Atlas and shadow prices are calculated.
7.0 Blank	For analysts' own workings.
8.0 to 31.0	Pre-populated sheets with analysis of 24 companies.
32.0 Location data	Data for the 24 companies analysed by the model are held on the sheet. Data are pulled in from the World Resources Institute onto this sheet, using a macro.
33.0 New Co Location Data	New location data: this links to the "New Company" tab [6.0]; a macro pulls in water stress data at a catchment level from WRI's Aqueduct Water Risk Atlas for each location. It includes a formula to calculate the shadow price for each of these locations, which is then displayed on the "New Location" tab alongside the locational information at the bottom.
34. Country data	This sheet calculated 2010, 2020, 2030 and 2040 shadow prices for countries, as opposed to for specific locations. This was necessary as we use country-level shadow prices for the beverages sector.

Usage of the Corporate Bonds Water Credit Risk Tool and methodology

The project developers would appreciate information on whether and how financial institutions and service providers are using the Corporate Bonds Water Credit Risk Tool, and any outcomes of its application. To share this information, provide feedback or if you have any difficulties in using the tool, please contact secretariat@naturalcapitaldeclaration.org

How the Model Evaluates Corporate Exposure to Water Credit Risk; Sheets 8.0 to 31.0

The upper part of each sheet contains a conventional credit model

All of the individual 24 sheets that model the 24 firms have the same layout as one another. The top half of each Excel sheet is a standard credit analyst company model. The top half of the model contains profit and loss (P&L), cash flow and balance sheet information for each company, for the years 2013 to 2017. While there are some differences in the way P&L information is presented, the formats of the cash flow and balance sheet is consistent for all firms.

These three statements are interlinked. The profit and loss account is connected to the cash flow statement, because the firms' EBIT figure is taken from the P&L and entered onto the firm's cash flow. The cash flow statement is connected to the balance sheet statement in that the free cash flow after dividend figure for 2013 is added to the end 2013 cash and short-term securities figure, so impacting the end 2013 net debt figure.

These three statements generate five credit ratios displayed on rows 30 through to 34: gross debt/EBITDA, net debt/EBITDA, FFO/net debt, FFO/gross debt and EBITDA/revenue.

Financial jargon

EBITDA: Earnings before Interest, Tax, Depreciation and Amortisation.
FFO: Funds from Operations. FFO is essentially EBITDA minus cash interest and cash tax (interest and tax items from the firm's cash flow).

The lower part of each sheet contains data on water consumption and locational shadow water prices

The lower part of each company sheet is the novel feature of this model. Here we introduce location-specific information about the firms' operations and water use, and calculate the company-specific shadow water costs to link water use and water stress data. From rows 43 to 46, information is presented on the amount of water that a company used in 2013, in terms of thousand cubic metres. We enter the aggregate water used in 2013 for each company. We gather this data largely from Bloomberg, which gathered this information from companies' annual or corporate responsibility reports. The water use figure is calculated differently for different sectors. Below we set out the Bloomberg mnemonics used to calculate water use by firms in different sectors.

Figure 3: Different Bloomberg water use devices by sector

Sector	Bloomberg devices to calculate water use, by sector
Power companies	Subtract the COOLING WATER OUTFLOW figure from the COOLING WATER INFLOW figure, to arrive at a Water Use figure
Mining companies	Subtract TOTAL WATER RECYCLED from TOTAL WATER USE, to calculate Total Water Withdrawn
Beverage firms	Add SURFACE WATER WITHDRAWALS, GROUND WATER WITHDRAWALS and MUNICIPAL WATER USE to calculate Total Water Withdrawn

For each location around the world, the model pulls in data on current and projected water stress held by the World Resources Institute (WRI) and uses this to calculate shadow water prices for the years 2010, 2020, 2030 and 2040. The blended current shadow water price for each company is presented on row 48. From rows 63 and below, information is presented on the main locations at which the firm operates. We present the name of these locations in column A, and the latitude and longitude, to two decimal places, in columns B and C. We also calculate the amount of water used at these locations.

Most firms only provide data for their overall aggregate water use per annum: most do not break down water use by location. So for most companies, we make assumptions about how much water they use by location, per annum, in the following way: For **mining companies**, we divide up their annual water use, in proportion to the size of the firm's mining reserves at each location. So if mine A has 60 per cent of a company's reserves and

mine B 40 per cent, we assume that 60 per cent of the water is used at mine A and 40 per cent at mine B.

For **power companies**, we divide up their annual water use, in proportion to the size of the power generation installed capacity in megawatts (MWs) at each site. So if a firm has two sites with 400 MW of generation capacity at each, then we assume each site uses 50 per cent of the firm's annual water usage.

For **beverage companies**, we look at the number of factories each firm has in each country. Because many beverage firms have so many factories, we look at country level rather than locational water TEVs. We work out what percentage of a beverage firm's factories are in each country, and then calculate the firm's blended water costs in terms of national shadow water prices, based on national baseline water stress scores provided by the World Resources Institute (WRI).

The model uses a slightly different methodology for beverage companies, largely because they operate so many production sites, bottling plants, distilleries and breweries around the world. So rather than trying to identify the exact location of all of these operations, their blended shadow water price is calculated at a country-level. Analysts assess the proportion of their operations in different countries, and then assign a country specific shadow price (as opposed to a locational price to the site). This approach reflects the time constraints that analysts are likely to face, but the model could be adjusted to create a more granular, site-specific evaluation in countries with significant production sites and areas of water stress.[2]

How then do we get the appropriate average shadow water price for each beverage firm? We assign a weighting to the country shadow water price according to one of the following criteria. Essentially we look at the following hierarchy of information provision.

- How much product, in terms of hectolitres, produced per country, does the company produce? If disclosed, this information is used to assign weightings to the different country shadow prices.
- If the above information is not available, the model includes the number of factories, bottling plants or distilleries or breweries they operate per country to develop a weighting for the shadow price.
- If neither piece of information is provided, the breakdown of the company's annual revenues by country is used.

Of the eight beverages companies that we analyse in this report, only A-Busch and Heineken specify the amount of product they produce by country in terms of hectolitres. Nestlé specifies the number of production sites it operates in each country. The remaining five firms break down their sales by country.

Having divided up the water use of the company in any year between its operational plants, we then allocate the estimated shadow price of water to each site in the mining and power sectors. For the beverage companies, the model applies a blended water cost that is based on the overall water scarcity of the countries in which the companies operate.[2]

The model calculates shadow prices for water as US$/m^3, for every land-based location around the world. A blended shadow price is calculated for each company by considering the amount of water used at each location to weight the shadow prices at each site. So for the mining company that used 60 per cent of its water at mine A (where the shadow price was US$10.00/m^3) and 40 per cent of its water at mine B (where the shadow price is US$2.00/m^3), the company's blended shadow price would be (US$10 x 0.6) + (US$2 x 0.4) = US$6.80.

The blended shadow price that the company faces is multiplied by the amount of water that the company uses in a year. This sum is integrated into the financials as a new water opex line on the company profit and loss account. Entering this sum has a negative impact on the company's credit ratios. Users may use the analytical results to consider whether the estimated ratios deteriorate sufficiently for the company to be at risk from a credit rating downgrade.

2. WRI provided country-level water scarcity data for 2010. The NCD commissioned WRI to estimate country-level baseline water stress values for the years 2020, 2030 and 2040.

Analysts are able to alter four different assumptions of the model

1. In column B row 37, they enter their assumption of the annual revenue growth, in percentage terms.
2. In B 38 they enter their assumption about the annual rate of growth of cost of goods sold, in percentage terms.
3. In B 39 they enter their assumption about the annual rate of growth in water use.
4. In B 40 they enter their assumption about the average rate of growth of the price of water.

How to Add New Companies to the Model

Users can add information on new companies to analyse in the tool.

To enter new companies to analyse in the tool:

1. Select the "6.0 New Company" sheet. Copy the 6.0 New Company sheet, and save as a new tab; with the name of the company being entered.
2. Enter financial data for the new company on the top half of this new sheet.
3. Enter latitude and longitude data for the company's main locations on the lower half of this sheet. Analysts can find the latitude and longitude of these main locations, by entering the location's name and country into the appropriate box on the first page of the NASA web site: http://mynasadata.larc.nasa.gov/latitudelongitude-finder/. A hyper link to this website address is included at the top left of the 33.0 New Co Location Data [and at the top left of the 32.0 Location Data sheet]. The user can access the NASA website on that page or by typing the website address in any browser. This website provides the latitude and longitude of an address, and a satellite picture of the site.
4. Once the analyst has entered the key locations and their latitudes and longitudes, he or she should press the "PROCESS COMPANY DATA" button found on the 6.0 New Company sheet. Pressing this button will pull in the appropriate water stress data from the WRI Aqueduct Water Risk Atlas, and calculate the shadow water prices (2010, 2020, 2030 and 2040) relevant to water stress levels at these locations.
5. The user needs to enter information on water use by location or on reserves/installed capacity/production/sales/number of factories by location in order to weight the shadow price values by the relevant factor.
6. The weighted shadow prices should show in the section "Water pricing and consumption", where total company-wide water usage can be entered to apply the relevant blended shadow price for the specific company.
7. "Additional water opex" will appear in row 7 so that the potential impact on financial ratios can be assessed.
8. Analysts can add modelling of additional water capex costs in row 21, and adjust assumptions about revenue growth, COGS, water use growth and water price growth per annum in rows 37-40.

For more information, contact:

UNEP Finance Initiative
15, Chemin des Anemones
CH-1219 Chatelaine, Geneva
Switzerland
Tel: +41 (0) 22 917 8178
Fax: +41 (0) 22 796 9240
E-mail: fi@unep.ch
www.unepfi.org

Global Canopy Programme
23 Park End Street, Oxford
OX1 1HU
United Kingdom
Tel: +44 (0) 1865 724333
www.globalcanopy.org

Verein für Umweltmanagement und Nachhaltigkeit in Finanzinstituten e.V. (VfU)
Ravenspurger Strasse 41,
86150 Augsburg
Tel: +49 (0)821 41903686
E-mail: info@vfu.de
www.vfu.de

GIZ GmbH
65760 Eschborn, Germany
Tel: + 49 (0)6196 79 1967
www.giz.de

Natural Capital Declaration (NCD), GIZ and the German Association for Environmental Management and Sustainability in Financial Instimtions (VfU) have developed a Corporate Bonds Water Credit Risk Tool to enable portfolio managers and analysts to evaluate corporate bond exposure to water stress. The tool has been developed and tested with seven banks and fund managers across Europe, the U.S. and Latin America. This summary report includes key findings from applying the tool across 24 mining, power and beverages companies, along with guidance on using the tool. The project was commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ).