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Understanding the impact of a low carbon transition on South Africa

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A CPI Energy Finance Report

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Descriptors

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About CPI

Climate Policy Initiative works to improve the most important energy and land use policies around the world, with a particular focus on finance. An independent organisation supported in part by foundation funding, CPI works in places that provide the most potential for policy impact including Brazil, China, Europe, India, Indonesia and the US. CPI's Energy Finance practice is a multidisciplinary team of economists, analysts and financial and energy industry professionals focused on developing innovative finance and market solutions that accelerate the energy transition.

Agence Française de Développement

The Agence Française de Développement (AFD) supported the launch of a reflection and the realization of studies by the Climate Policy Initiative on the financial implications of the low carbon transition, especially in South Africa, without contributing to this report. The AFD is not responsible for the accuracy of the information contained in the report, as well as the conclusions expressed by CPI. The conclusions of these studies are expressed and distributed under the sole responsibility of CPI.

Disclaimer

The analysis in the report was conducted by CPI Energy Finance using publicly available information on taxes, contracts, investments and company strategies, drawing particularly on the documents listed in the "References" section of the report. The analysis has been supplemented by a stakeholder engagement process, although none of the entities other than CPI were responsible for the provision of inputs. Unless explicitly stated, the findings do not represent an endorsement by any of the institutions mentioned in the report.

The quantitative analysis set out in the report was performed in relation to scenarios devised by CPI Energy Finance with inputs from institutions such as the International Energy Agency. The findings do not constitute a forecast of the future financial performance, or financial position or risks of any entity mentioned in this report.

Contents

List of Figures

List of Tables

Foreword

South Africa must navigate the risks and benefits of a global low-carbon transition

Patrick Dlamini
Chief Executive Officer and Managing Director
Development Bank of Southern Africa

In 2017, South Africa earned R61 billion ($4.2 billion) in revenues from exporting coal. Domestic coal resources provided 91% of South African electricity, as well as a major portion of transport fuel and chemical output. More than 100,000 people are employed in the mining, electricity generation, logistics, and synthetic fuel sectors related to the extraction, development and export of this natural resource.

In early 2018, Cape Town was in the midst of an extreme drought. The city was days away from running out of water, with 4 million Capetonians subjected to severe water restrictions. The severity of the drought made news headlines across the world and brought attention to a most unwelcome consequence of a warming world.

"If people around the world, specifically South Africa, ever thought that climate change is just a fable or a fiction, we in South Africa as regards Cape Town are now seeing the real effects of climate change," President Cyril Ramaphosa warned.

South Africa faces competing pressures. On one hand, the threat of climate change to its water supply, agriculture, coast lines, and infrastructure, and on the other, the threat to the country's economy of policies in other countries that reduce demand for South Africa's carbon heavy natural resources, such as coal. The country is not alone in facing these pressures, nor are the effects and choices faced by South Africa independent of what is happening elsewhere in the world.

Internationally, policy and technology are evolving quickly. South Africa is already taking the threat of climate change seriously. The country was among the 181 signatories to the 2015 Paris accord which required countries to submit carbon mitigation plans – its aim is to peak emissions by 2025 before plateauing for ten years and then declining after 2035.

Meanwhile, new policies such as the Integrated Resource Plan for the electricity sector will take account of the cost declines that continue to make electricity from low-carbon technologies less expensive than coal in many countries around the world, including South Africa.

But for as long as South Africa depends on coal and other commodities for a large part of its exports, the impact of climate change-driven transition on the country's economy may be more dependent on the actions of our international partners than our domestic policy.

How fast will major consumers of our coal, such as India, try to reduce their emissions? What opportunities will arise in new technologies for minerals mined in South Africa? Which industries should be prioritised as long-term, sustainable sources of jobs in a more prosperous South Africa? None of the choices that we face are without risk, which is why high-quality independent research and analysis as we find in this report is so valuable in helping government policymakers, investors and industry plan for South Africa's transition pathway.

For me, one of the most striking findings from this report is that South Africa faces "transition risk" approaching R1.8 trillion ($125 billion) in present value terms if the world achieves a path consistent with the Paris targets. With much of this risk apparently due to fall on the public balance sheet, such transition risk could strain the public finances, jeopardise the sovereign credit rating and the government's ability to pursue a progressive social agenda. It would be irresponsible of us not to investigate these risks more thoroughly.

For DBSA, this report is very timely as climate change mitigation and adaptation (and the energy transition) are increasingly becoming embedded in our core strategic objectives. As well as identifying specific risks to our balance sheet and those of other large corporates, the report also identifies a series of policies that government might adopt to reduce the impact of the risk to the whole country. As one of the major funders of municipalities and state-owned enterprises, DBSA will work with government to assess these findings.

At DBSA, we believe that the low carbon transition is a major opportunity for South Africa. That's why in October 2018, we announced the Climate Finance Facility (CFF) to catalyse financing from public and private sector sources for investment in sustainable development both in South Africa and across the rest of the African continent.

As is evident from this report, the transition is upon us and will cost us dearly. We need therefore to engage in the proactive pursuit of a path that seeks to contain the costs of the transition, one focused on alleviating the plight of the most vulnerable parts of society: workers and communities directly affected.

Preface

The transition to a low carbon economy should be a just transition, one that leaves no-one behind

Rémy Rioux
CEO of Agence Française de Développement (AFD)
Chair of the International Development Finance Club (IDFC)

Ever since the world's nations committed in December 2015 at the COP21 in Paris to limit global warming to well below 2°C and to pursue the efforts towards the 1.5°C goal, the energy transition has continued to gain momentum in many parts of the economy with the help of technological shifts, reduced renewable energy costs and ambitious public policies. The development finance community in particular is leading the way, with the majority of development institutions having committed in December 2017, at the One Planet summit in Paris, to align their financial flows with the Paris agreement.

These climate objectives require widespread and unprecedented efforts as highlighted by the recent IPCC Special Report on Global Warming of 1.5°C. But it is a scenario which governments and companies should factor into their planning and strategies. Indeed, such a transition will induce economy-wide transformations; some sectors will gain while others will inevitably bear financial, economic and social difficulties. Understanding, anticipating, and managing these difficulties is a responsibility naturally incumbent upon governments as they seek to maximize social welfare and economic stability. It is also an endeavour that the financial community has recently taken onboard, since the Financial Stability Board of the G20 issued in June 2017 a series of far reaching recommendations to analyse and communicate on climate-related financial risks.

Agence Française de Développement (AFD) is a development institution committed to being 100% compatible with the Paris Agreement. We provide financing, expertise and research to assess and manage transition risks. Financial stability is key for an orderly transition to a low carbon world, but more importantly still, inclusive policy debates are needed throughout the process. How to navigate through the low carbon transition is paramount to all actors, whether they are set to lose or to gain from it. Helping these particular companies, sectors, and countries navigate the difficult transition ahead is both an economic, environmental and social imperative. The transition to a low carbon economy is only possible if it is a just transition, one that leaves no-one behind and that leverages the many economic and job opportunities that a green transition offers.

We are all countries in transition towards sustainable development. This is the message of the Sustainable Development Goals adopted in 2015 at the United Nations. How to achieve them by 2030? The International Development Finance Club, of which both AFD and DBSA are members, offers a way forward. This network of 24 national and regional development banks share a similar vision of promoting low carbon and climate resilient futures, poverty reduction, an inclusive, fair and equitable design of the globalized economy. They are the largest provider of public development finance globally, totaling more than $4 trillion in assets, with commitments above $850 billion per year, of which $220 billion in green and climate finance.

Going forward, this in-depth country case study of South Africa, carried out by Climate Policy Initiative, and commissioned by AFD, and the Advisory Finance Group of the World Bank, is an important stepping stone in this collective effort. It is aimed to contribute to the on-going energy debate in the country and to the wider discussion around climate-related policy options.

South Africa is a country with huge potential in renewable energy as well as in low carbon transition-driven export sectors. It is also a country dependent on coal resources for a significant part of its energy needs and export activity. This low-cost energy resource has played an important role in South Africa's industrial and economic growth. This competitive advantage is not however without risks. As this report shows, fossil fuel exporting countries such as South Africa have a lot to gain by considering the consequences for their national budgets, companies and workers of the world moving away from coal, and planning ahead accordingly.

My hope is that this analytical work can contribute to the ongoing conversation among policymakers in the country on how best to manage these risks and opportunities. AFD stands ready to support the South African government and its many partners in the country in this endeavour.

Executive summary

Climate Policy Initiative (CPI), with the support of Agence Française de Développement and the Advisory Finance Group of the World Bank, have examined the risks to the economy of South Africa – and its government, municipalities, companies and financial institutions – from a global economic transition to a low-carbon economy.[1]

A global low-carbon transition could reduce the demand and price for assets including carbon-intensive fossil fuels such as coal and oil. Infrastructure that supports higher carbon activities including rail, power plants or ports built around fossil fuel industries, may have to be replaced or retired early. Companies, investors and workers could be hurt by lower prices and reduced demand for certain products. Governments may face reduced revenues, for example from lower tax receipts, while their expenditure increases for financial assistance to industries and workers in transition.

"Transition risk" is widely regarded as the risk that the value of assets and income are less than expected because of climate policy and market transformations, such as the switch away from coal-fired power. However, the analysis in this report not only quantifies the downside risk of South Africa's transition, ie the negative impact on assets and revenues, but it also attempts to forecast some of the potential benefits of a transition, such as the impact of a lower global oil price that is passed through to consumers.

Trade-offs associated with a low-carbon transition are particularly acute in South Africa, a country with high levels of unemployment[2] and inequality[3] and an ambitious development agenda.[4] South Africa's exposure to coal mining as a source of export revenues, as a fuel for domestic power generation and as a key employer in certain provinces presents significant transition risk that is mirrored in many other resource exporting countries.[5] Conversely, South Africa could gain via lower oil prices, through new markets for minerals used in low-carbon technologies (eg, platinum and manganese) or through the creation of new jobs in industries that are more resilient to, or would even benefit in, a low carbon world, compared to today.[6]

This report outlines the measures that South Africa and its partners can take to reduce climate transition risk, avoid potential economy-damaging risk concentrations and in so doing, reduce the costs associated with the decarbonisation of the South African economy. More generally, this analysis can serve as a template with which to identify and evaluate the financial risk of a low-carbon transition for a variety of countries. Well managed and less concentrated risk can facilitate the transition and lower its cost in countries across the world.

Several significant findings emerge from the evaluation of transition risk in South Africa, which are summarised here and are explored in depth throughout the report.

Finding 1: The cumulative impact on South Africa of a global low-carbon transition over the period of our analysis (between 2013[7] and 2035) could be more than $120 billion in present value terms

South Africa faces transition risk of more than $120 billion in present value terms between 2013 and 2035.[8] The analysis shows that these risks will accumulate slowly in the coming years before accelerating in the mid-2020s. Unless the government takes action to mitigate these risks, they could jeopardise South Africa's

1 For this study we define a 'low-carbon economy' as one that is consistent with a scenario that keeps temperature rises well below 2°C above pre-industrial levels (2DS), as agreed at the 2015 Paris climate convention. Other recent studies suggest that risks to South African coal exporters could be significant even in scenarios which fall short of Paris targets

2 According to Statistics SA, the formal unemployment rate has not dipped below 20% since the end of apartheid in 1994.

3 World Bank report, Republic of South Africa Country Diagnostic, An Incomplete Transition: Overcoming the Legacy of Exclusion in South Africa (2018), South Africa remains 'the world's most unequal country'

4 South Africa's National Development Plan aims to eliminate poverty and reduce inequality by 2030. Source: https://www.gov.za/issues/national-development-plan-2030

5 What does 'peak coal' mean for international coal exporters? (DIW Berlin, Climate Strategies and IDDRI, 2018). Source: https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Rapport/201809-GlobalModelingReport-Iddri-Coal_FINAL.pdf

6 Studies such as 'Green Jobs: an estimate of the direct employment potential of a greening South African economy' (IDC, DBSA and TIPS, 2011) have concluded that there is significant potential for job creation by decarbonising the South African economy. Experience in other countries indicates the potential for job creation in the wind and solar industries (https://www.seia.org/blog/solar-installer-fastest-growing-job-america)

7 We started our analysis from 2013, the year we had last analysed stranded assets in the coal sector to understand how global climate action had shifted business as usual between then and the start of the project. A more challenging question is how much key actors in South Africa have caught up with changes in policy and market conditions.

8 The figure represents downside risk from the sectors we have selected. The total is likely to be higher, given knock-on impacts of the risks on sectors that we have not studied (eg, the impact of lower employment in the coal sector on consumption in other sectors). Similarly, upside risks could also be higher, depending on the trajectory of global decarbonisation, for example, the use of platinum in hydrogen fuel cells could partially offset its declining use in diesel engines or more than offset it, depending on the relative market share of different electric vehicle technologies.

Table ES-1: Climate transition value at risk by sector

POTENTIAL TRANSITION IMPACT/RISK	DIFFERENCE IN NET PRESENT VALUE OF FUTURE CASH FLOWS BETWEEN BAU AND 2DS OVER 2018-2035 (USD BILLIONS)[9] NEGATIVE IMPACT	POSITIVE IMPACT	NET IMPACT (POSITIVE IN BRACKETS)	ISSUES
Potential impacts/risks arising from international trends outside of South African government control				
South African coal exports	83.7	-	83.7	Policy in countries such as China, India, Europe and the US, to reduce coal use to comply with a 2DS, will disproportionately affect internationally traded coal. As a result, both the volume of coal sold and its price will fall, impacting miners and export-oriented infrastructure
Global oil markets	8.3	45.5	(37.2)	Lower global oil demand will lead to lower oil prices. Provided that today's system of fuel price regulation persists, consumers will see most of the benefit, while some energy industry players – in particular, the producers of synthetic fuels – would lose out.
Global metals and minerals markets	0.5		0.5	Some risk to platinum market as demand for diesel vehicles reduces. Longer-term upside potential (not reflected) in fuel cell vehicles (platinum), batteries (manganese); potential longer-term downside from decarbonisation of the steel industry (iron ore).
Potential impacts/risks arising from domestic policy action to mitigate transition risk or contribute to global mitigation efforts				
Domestic power industry and its coal suppliers	Max 4.0bn negative impact but could be positive depending on performance of Medupi and Kusile stations		4.0	Government policy currently envisages coal generation capacity peaking in the early 2020s[10] but achieving a global 2DS could require that South Africa accelerate retirements of existing capacity and invest in cleaner sources.[11] Closure of plants before the end of their economic lives could result in a net cost to the country if the strategy is implemented in a way that negatively affects Eskom.
Domestic oil products and coal to liquids industries	27.4	-	27.4	Government is considering new fuel industry investments in upgrading existing refineries and new capacity, while there are no plans to shut the highly emitting coal-to-liquids production.[12] One of the world's largest single sources of CO2 emissions[13], Secunda would need to close in a global 2DS, although currently the cost of all replacement options would be higher than continuing to run the plant.
Other Impacts	A range of gains including adaptation ($1bn) and losses			Global efforts on carbon mitigation should reduce incremental physical climate risk and hence adaptation costs.[14] Government action to reduce national carbon emissions will impact other emissions intensive sectors, including steel and cement production, as well as other areas of the economy, including agriculture.
Total Impact	**123.9**	**46.5**	**77.4**	

9 The Rand equivalent figures, translated at the ZARUSD exchange rate of 14.47 as of the end of 2 January 2019 are South African Coal Exports: R1.2 trillion negative impact; Global Oil Markets: R120 billion negative impact and R660 billion positive impact (R540 billion); Global Metals and Minerals Markets: R7 billion; Domestic power industry and its coal suppliers: R58 billion; Domestic oil products and coal to liquids industries: R396 billion; Other: R14 billion.

10 Draft Integrated Resource Plan (Department of Energy, 2018). Downloaded from http://www.energy.gov.za/IRP/irp-update-draft-report-2018.html

11 World Energy Outlook [WEO] 2017 (International Energy Agency, 2017). Sustainable Development Scenario and impact on power sector (Annex A pg 683 for South Africa data)

12 South Africa's NDC (downloaded from https://www4.unfccc.int/sites/NDCStaging/Pages/Party.aspx?party=ZAF) includes a reference to CCS for Secunda. However, we assume that the modelling only requires this in the event of South Africa reaching the ambitious level of its targets. Sasol's recent investments in coal mining life extensions (https://www.sasol.com/media-centre/media-releases/sasol-opens-shondoni-colliery-part-r14-billion-investment-south-africa) suggests that it plans to operate the Secunda plant for at least the period covered in this study.

13 Source: https://www.iol.co.za/news/fall-in-line-on-climate-change-sasol-told-1176349

14 We estimated the benefit from higher global climate ambition (and therefore, reduced adaptation costs) in a 2DS at only $1 billion over 2018-2035. The benefit after that point rises sharply. We discuss the estimate of this potential benefit in chapter 5 of this report.

investment grade sovereign rating, which would cause further losses.

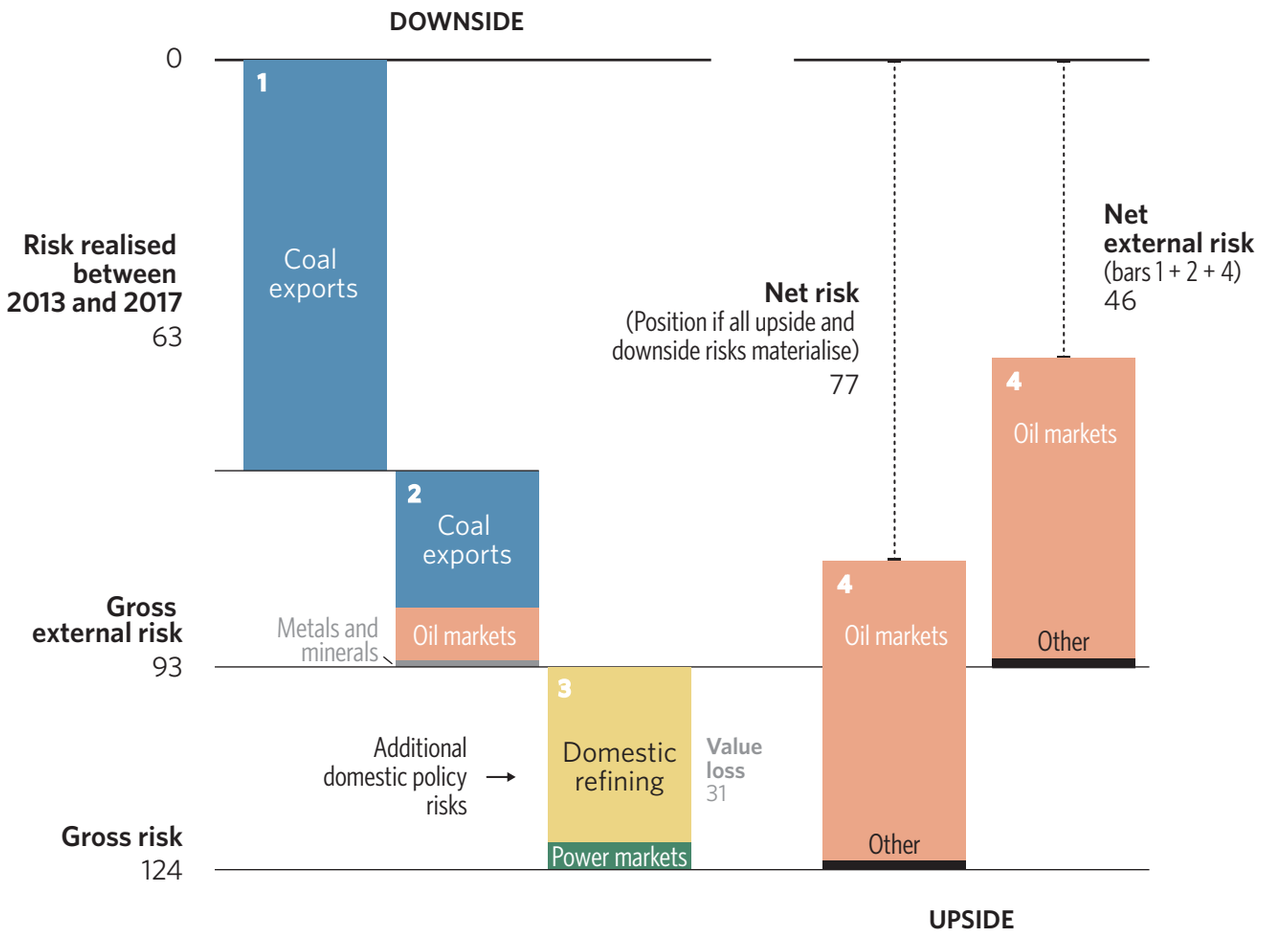
The largest share of risks come from factors that are beyond the control of South Africa itself, including changes to global coal and oil markets that will be driven by changes to global demand. Nevertheless, pro-active government responses to those risks beyond its control can help to mitigate the impact. As summarised in table ES-1, some transition risks have both potential negative and positive impacts on different parts of the economy, while other shifts in global demand could be positive for South Africa.

Finding 2: Much of the risk and potential impact (approximately 75%) is due to factors, policies, and events, beyond the control of the South African government, while nearly 50% has already been realised

Since CPI's last global coal analysis based on data from 2013 and the start of the work on this project in 2017, the world made significant progress in reducing green-house gas emissions, including commitments to the Paris accord. Meanwhile, the risk profile and valuation of fossil fuel energy assets have fluctuated, affected by

Figure ES-1: Sources of risk in a climate transition (2013-2035)

Billion USD (NPV to 2035)



factors including those related and unrelated to climate policy commitments. These factors include technological change (falls in the cost of wind and solar power generation and lithium ion batteries), new energy market regulation (new forms of market design which value energy system flexibility and support higher penetrations of renewables) and geopolitics – all factors beyond the control of South Africa or its government.

Future expectations for "business as usual" coal consumption, and by extension internationally traded coal volumes, have declined significantly as a result of these changes.

For South Africa, as illustrated in figure ES-1 on the previous page, the result is that by 2017 as much as $60 billion of the value that the country could have expected to earn from its coal resources based on 2013 business-as-usual (BAU) forecasts, had already been lost. That is, by 2017 nearly 60% of the transition value at risk was already factored into revised long-term forecasts for the development of the seaborne coal sector.[15] A further $29.4 billion of value (another 27% of the total) could be lost to South Africa if global coal exports and other markets adapt to a low-carbon transition consistent with keeping global temperature rises "well-below" 2C above pre-industrial levels.

Coal exports currently provide profits, royalties and tax receipts for South Africa when the revenue from selling the commodity exceeds production costs. Revenues from coal sales also pay back the sunk capital investment in mines and the rail and port infrastructure that is needed to get the coal to the market. If a global low-carbon transition prompts a fall in coal export revenues, not only might miner profits and government taxes be wiped out, there may not be sufficient cash to pay back original investments in mining and infrastructure. The debt defaults that might result could cascade through the economy.

Beyond the value at risk driven by international policy and markets, South Africa faces decisions about how it will meet its own emissions targets. While it has taken important recent steps to clarify the direction of its power sector[16], the future of oil refining and the synthetic production of fuel from coal and gas remains considerably more uncertain. Our analysis suggests that there is an additional $31.2 billion of value at risk in South Africa based upon the decisions to accelerate the retirement of these assets.[17] How these policies are financed and the level of support available from international partners will all shape the effect that South Africa's domestic low carbon transition will have on the economy and its citizens.

Finding 3: The public balance sheet in South Africa would explicitly face only 16% of the downside risk in South Africa with investors facing the rest. However, there are several channels through which business strategy, policy and financial distress may further distribute the share initially borne by investors – often as contingent liabilities to the national government

How risk is distributed through the South African economy is as important as the absolute level. Concentration of risk in one sector, industry or on one company could lead to a collapse that could send shock waves across the economy that magnify the overall impact. Alternatively, dilution of this risk among many groups, particularly foreign investors who have internationally diversified portfolios and investor bases, reduces the likelihood of sector or company collapse and broader economic contagion.

The direct or explicit distribution of risk is a function of ownership, contractual arrangements, historic and current policy, taxation and royalties, and business relationships. Companies and the national government have the greatest risk-bearing capacity. However, companies will seek to protect investors by passing risk onto the supply chain, consumers and workers.

The allocation of risk in South Africa may change once various parties react to the risk of loss in the value of their assets. Where the risk is not yet priced into listed securities, companies that are alert to climate transition risk may seek to sell them to those who are not yet considering this risk.[18] While coal mining companies will seek to recover the shortfall in export revenues by increasing sales to domestic customers such as Eskom,

15 The extent to which the impact on valuations of this shift (between 2013 and 2017 business-as-usual forecasts) have been 'priced in' or taken into account by equity investors, lenders, companies and governments varies. In practice, the extent of the incremental risk to financial assets and financial flows surveyed in this document will depend on the extent to which this shift is already incorporated.

16 Ibid. Department of Energy (2018)

17 This figure is calculated based on the costs associated with the early closure of certain power plants and the Secunda coal to liquids plant (eg, stranded asset, accelerated decommissioning costs) plus the incremental cost of replacing the products (electricity or fuels) produced by the existing assets with a "cleaner alternative". The details of this analysis are discussed in chapter 6.

18 Recent sales or planned sales by major international commodity houses (eg, Total, Anglo American and South32) to local players may reflect asymmetry of information / attention on the question of climate-related financial risks between those two groups.

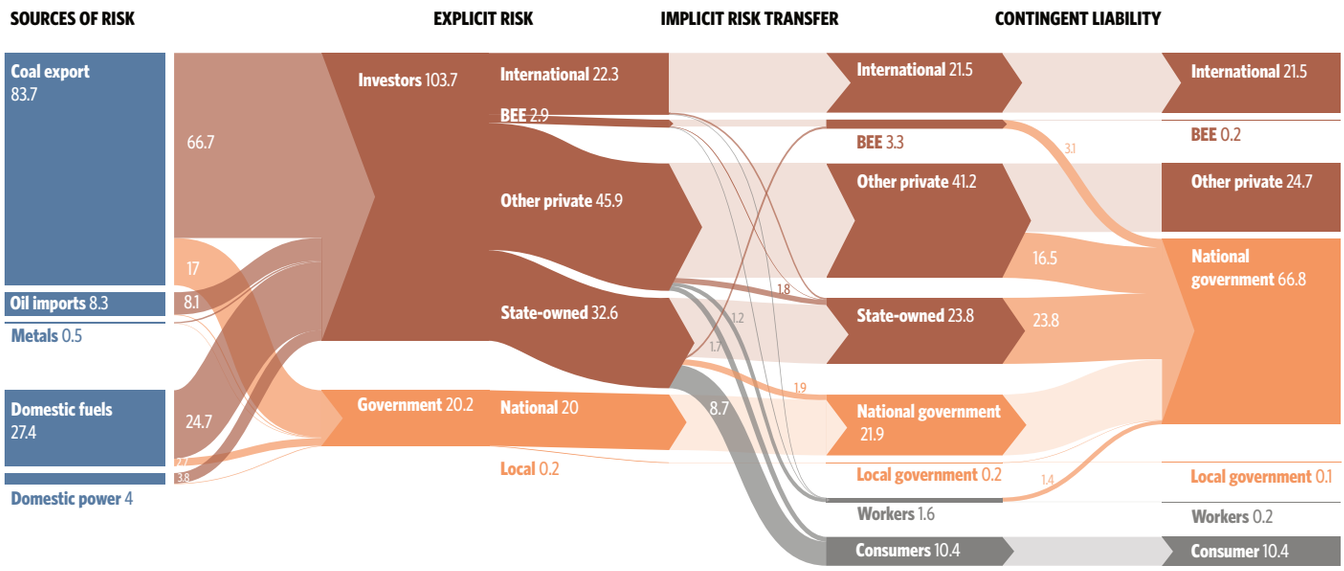
in practice, the ability to do so may be limited. Instead, workers and key counterparties such as Transnet Freight Rail will be forced to bear this risk, with investors bearing the remainder. Some mine owners may decide to close assets before the end of their economic lives. Mine closures will hit communities and workers through job losses, reduced economic activity and the loss of funding from companies for social infrastructure. Municipalities where assets are located may suffer the greatest impact, but the spread of transition risk will be broader. Lower national taxes will reduce transfers to municipalities, curtailing their ability to provide services and to pay their obligations.

As with municipalities, many companies will not have strong enough balance sheets and may appeal for government assistance. National government could find itself faced by sharply increased costs due to either bailouts or decommissioning costs following bankruptcy.

Government may find itself obliged or expected to absorb the impact of the transition in other ways. Government may support workers who lose their jobs or provide funding for unemployment benefits and retraining, or to provide finance and assistance to struggling municipalities to attract new job-creating investment. However, its capacity to provide this support could be constrained by lower tax revenues and an increase in non-performing loans and an erosion of the capital bases at state-owned financial institutions such as the Development Bank of Southern Africa (DBSA) and the Industrial Development Corporation of South Africa (IDC).

Our analysis, as summarised in figure ES-2 below, found that after these implicit transfers, the distribution of transition risk could become markedly more concentrated on national government, with the latter's share of the cumulative risk facing South Africa almost tripling from nearly 16% to more than half.

Figure ES-2: Implicit transfers of climate transition risk



Finding 4: The current South African system of incentives for new capital investment favour some existing industries that are exposed to transition risk, rather than new sectors that may create more sustainable sources of jobs and economic growth. Currently planned investment decisions could add more than $25 billion to the country's transition risk.

The South African government uses a range of incentives to attract investment in the country, including fiscal incentives, government or SOE-led procurement and access to debt and equity finance from state-owned financial institutions. However, new investments in assets such as mines, infrastructure and refineries could add to the transition risk faced by companies, investors and the government if lower future revenues under a 2DS are insufficient to cover the investment cost and losses and/or defaults ensue. Our analysis, supported by recent research from IDDRI, suggest that these investments could be avoided with limited impact on security of supply of coal[19], power or fuel.

New assets, mines and infrastructure could add to the transition risk faced by companies, investors and the government, if lower future revenues under a 2C scenario are insufficient to cover the investment cost. As shown in the table below, we identified further investments that would add more than $25bn to the risk that the South Africa could face in a global low-carbon transition.

If this sum was instead invested in industries or assets that are more resilient to transition risk, or benefit from a low carbon transition, it could spur a more sustainable source of jobs and economic growth.

Table ES-2: Future investments that could increase transition risk above the level in our analysis

ASSET	SIZE OF INVESTMENT (USD BILLION)	STAGE OF INVESTMENT
Rail lines – Expansion of Mpumulanga – Richards Bay line to 97.5 mtpa	0.6[20]	Planning
Rail lines – Waterberg expansion to 24 mtpa	0.1[21]	Planning
Rail lines – International links (Swazilink, Botswana link)	0.4[22]	Pre-feasibility studies
Coal IPPs (Thabametsi and Khanyisa)	2.8[23]	In financing discussions
Coal mines – Limpopo	1.4[24]	Range: from construction to feasibility
Coal mines – Mpumulanga	0.5[25]	Range: from construction to feasibility
New oil refinery	10.0[26]	Procurement being designed
EMSEZ industrial zone (Limpopo)	10.0[27]	Planning
Total potential investments	**25.8**	

Source: Transnet, University of Cape Town, Wood Mackenzie and CPI analysis

19 Ibid DIW Berlin et al (2018)

20 We have estimated this from Transnet disclosures on historic investment in exoanding the capacity of the line whose capacity currently stands at 81 mtpa. The actual figure could be higher or lower depending on the results of planning and feasibility studies

21 We estimated this figure based on disclosures on total project cost and percentage completion from Transnet's Annual Financial Statements 2017 (Annexure B to the Report of the Directors). Downloaded from: https://www.transnet.net/InvestorRelations/AR2017/Transnet%20AFS%202017.pdf

22 CPI estimates of Transnet's potential share of equity in Swazilink and the extension of the Waterberg line to Botswana, assuming the assets are mostly debt-funded.

23 Rand estimates taken from 'An assessment of new coal plants in South Africa's energy future: the cost, emissions and supply security implications of the coal IPP programme'. (Ireland G, Burton J, 2018)

24 Cost estimates taken from Wood Mackenzie database of coal assets and projects. CPI analysis suggests that new mining assets in Limpopo commissioned after 2023 (and therefore, with investment decisions taken in the next few years) would deliver a negative NPV in our 2DS.

25 Cost estimates taken from Wood Mackenzie database of coal assets and projects. CPI analysis suggests that new mining assets in Mpumulanga commissioned after 2023 (and therefore, with investment decisions taken in the next few years) would deliver a negative NPV in our 2DS

26 Source: https://www.reuters.com/article/us-safrica-refinery/south-africa-eyes-brics-partners-to-build-new-10-billion-refinery-idUSKBN1DL108

27 Source: https://www.thesouthafrican.com/china-south-africa-limpopo-coal-concern/

Finding 5: The South African government can still mitigate much of this risk, provided that it plans in advance to develop the fiscal, financial and policy tools required to shift transition risk away from parties without the capacity to bear it and to capture transition-related upside

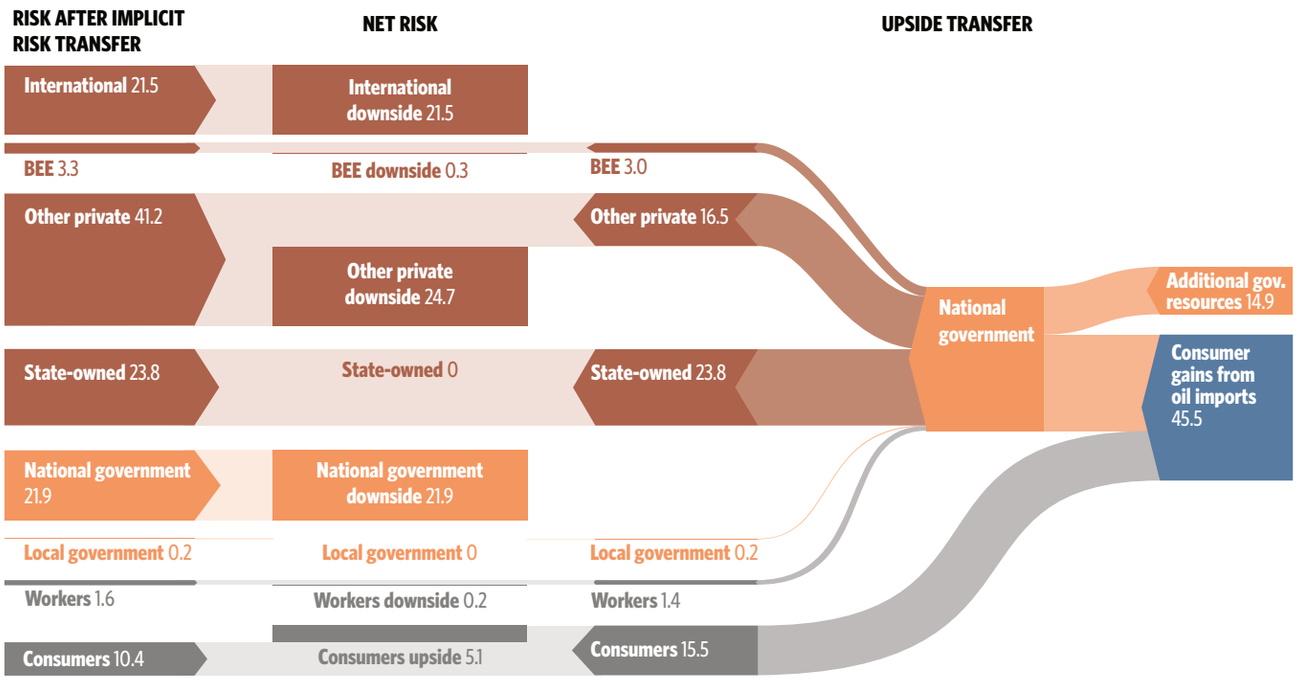
The timing of government action to mitigate transition risk will be critical, especially given the country's limited fiscal space after recent downgrades left the country close to losing its investment grade sovereign credit rating[28], the fast-deteriorating financial position of Eskom and resulting deterioration in the reliability of the electricity supply. Close power plants and fuel production assets too fast and the cost of generating or procuring replacement power and fuel could limit the government's ability to spend on social programmes and have a significantly negative impact on the workers and their communities. Act too slowly and continue to provide finance to new infrastructure predicated on a rise in future coal exports and the country could suffer a rise in debt downgrades and defaults when the expected export demand does not materialise.

By first incorporating transition risk assessment into the planning of government, state owned enterprises and state owned financial institutions, policymakers will be better informed when developing long-term emissions abatement strategies for key emitting sectors, such as coal mining, synthetic fuel production and cement making. They will also be better prepared to make the most of the benefits that a global low carbon transition could bring, particularly a net benefit of more than $40 billion from lower oil prices.

Lower oil prices could dampen the effect of falling coal exports on the balance of payments. A more proactive policy could use the benefit of lower oil prices to offset risks from other sectors. For example, national government might choose to increase taxes on oil products[29], diluting the benefit to consumers but reducing its own risk. Additional fuel tax revenues could be redistributed to parties struggling to bear the negative effects of the transition and/or retained to offset any pressure on the sovereign credit rating, as illustrated in figure ES-3 below.

These recommendations are set out in table ES-3 on the next page.

Figure ES-3: Taxing the gains from a lower oil price could halve transition risk to the public balance sheet



28 We explain the significance of the sovereign rating in box 2, chapter 3.3. In chapter 7 we discuss the potential impact of transition risk on that rating

29 This would likely require an alternative design to the current planned carbon tax, as discussed in chapter 5

Table ES-3: Key recommendations for the South African government

RECOMMENDATIONS	KEY ACTIONS
1. Take stock of the rapidly changing market for South African commodity exports and adapt development and financing plans accordingly.	Adopt a consistent approach to transition risk across South African government and public enterprises Develop fiscal and financial tools to manage risk Consider capturing oil price windfall to offset and manage risks Consider publishing government transition risk analysis
2. Avoid or delay new investments that could add to South African climate transition risk exposure, shift capital allocation to sectors more resilient to transition risk or benefiting from the transition.	Reconsider new investments that could add another $25.8 billion to transition Projects for reconsideration include planned IPPs, coal export rail and port infrastructure, and a new oil refinery Introduce climate transition risk assessments for access to public sector procurements and finance from state-owned banks Prioritise incentives for investment in sectors which are resilient to or benefit from the global transition (eg, renewable energy, EVs, batteries, fuel cells and related minerals, including platinum and manganese).
3. Make risk allocation explicit to reduce unmanaged risks and improve the efficiency of managing those risks.	Clarify responsibility for $38 billion of climate transition risk where the bearer of the risk is currently unclear or not explicit Develop and publish credible plans for managing these unallocated risks
4. Manage the timing and speed of climate mitigation actions and commitments to avoid compounding shocks to the economy.	Develop long term plans to manage the acceleration of transition risks in the early to mid-2020s Initiate scenario planning for early retirement of at-risk assets, including Eskom power plants and Transnet rail lines Develop R&D plans to create new technological options, for emissions abatement (eg, including CCS for Secunda, electric vehicles in the transport sector).
5. Plan for transitions to manage risk to vulnerable parts of the South African economy, such as workers and some investors.	Establish a transparent planning process for at-risk sectors, with earmarked transition funds and a gradual phase out Involve all interested groups in planning, including companies, trade unions, local governments, and the financial sector
6. Shift some risks from that national public balance sheet to other parties, possibly including sub-national governments, to increase risk bearing capacity.	Explore allocation of risks and revenues, particularly between different government levels, to maximise risk capacity Continue with proposed restructuring of Eskom with the aim of putting its finances on a more sustainable footing and hence manage material contingent liability to national government
7. Work with international development finance institutions and other international financiers to address items 4, 5, and 6 within the international context.	Work with international partners to balance global and South African risks and opportunities Seek assistance with financing solutions, underwriting, technical assistance, and potential carbon trades to leverage South African mitigation options

1. Introduction

Key messages:

1. Transitions and structural changes in industries and economies can result in permanent loss of value, usually shared between investors, workers and governments. Climate-change related transition risks could be particularly material in scope and scale.
2. Governments in most countries – whether explicitly, implicitly or both – are likely to face a significant amount of this risk, which will put pressure on public balance sheets
3. As an essential first step in managing and mitigating these risks, governments and development financial institutions should conduct regular detailed assessments of those risks, especially those which result from global policy or technological change.

For as long as markets have existed, businesses and industries have been disrupted by new technology. The analogue ("Kodak") camera, the bookshop and fixed-line telephony are all businesses once perceived as core parts of investment portfolios that have suffered permanent declines in value as their market share has been eroded by new industries and new business models. While the shape of decline has looked different in each industry, every structural change or "transition" has resulted in losses that have impacted investors, banks, workers and government.

Transitions associated with climate change pose much greater risks to established economic and socio-political paradigms. Their transformational impact means that getting the policy response wrong, or worse, not planning for the transition at all, will have a much more severe impact, and the spillover to the financial system and the real economy, will be much more difficult to contain. Companies at risk from the transition – large oil and gas companies, such as ExxonMobil and Royal Dutch Shell, mining companies, such as BHP Billiton and automobile companies, such as Volkswagen – have some of the largest valuations in global equity markets. Fossil fuels – in particular, oil – have also been at the centre of several of the largest geopolitical crises of the last century. A concerted shift away from the use of oil would also have serious implications for investors in debt and derivatives related to oil.

Central bankers and financial regulators, keen to avoid the mistakes made in the lead up to the 2007/8 crisis, are increasingly turning their attention to transition risk, ie the overvaluation of assets associated with fossil fuels.[30] A sharp repricing of these assets (ie, a sudden crystallisation of "climate transition risk") across sectors representing some of the largest on today's stock markets could prove destabilising to economies and financial systems that have yet to recover from the financial crisis.

The principal outcome of this drive to improve the identification, management and monitoring of climate change-related financial risk has been a focus on improving information. In theory, this approach allows investors to allocate capital differently and regulators and central bankers to understand the policy levers they may need or already have, to make economies more resilient to the consequences of a low-carbon transition.

Disclosure-focused initiatives such as the Taskforce on Climate-Related Financial Disclosure (TCFD),[31] investor-led trends such as "labelled" green or other sustainable investments and even those coming out of civil society such as the divestment movement have all served to raise awareness of climate-related financial risks. However, there has been less effort to understand the potential transmission pathways for those risks and their consequences beyond capital markets and outside of developed countries.

Over the last five years, CPI and others have begun the task of assessing financial risk relating to climate and other sustainability issues, with a focus on understanding which parties will be exposed to these risks and how

30 Source: https://www.carbontracker.org/bank-of-england-warns-stranded-assets-pose-threat-to-financial-stability/

31 Source: https://www.fsb-tcfd.org/wp-content/uploads/2018/09/Press-Release-TCFD-2018-Status-Report_092518_FINAL.pdf

they might be incorporated into financial asset prices see Annex B. CPI's analysis has consistently shown that despite wide-ranging ownership of fossil fuel-related assets by private companies, governments are likely to face more of the direct consequences of transition risk than private investors – through both **explicit** channels such as ownership, taxes, royalties and production sharing contracts and **implicit** channels including contingent liabilities, debt guarantees, inflexible spending commitments, and support for unemployed workers). An analysis of transition risks in their country-specific context is therefore critical, as it will help to identify potential economic, social and political barriers to national action on reducing carbon emissions.

Such an analysis should be useful not just for investors, bondholders and lenders, but also for international development financial institutions, the climate finance community, civil society organisations and the governments responsible for designing future policy.

Governments that do not adapt their domestic policies to global structural shifts will face increasing risk, first through changing global demand patterns, volatility in the balance of payments and then through the impact on domestic businesses. For some countries, the impacts could be so severe that they result in sovereign credit rating downgrades, that will increase debt service costs and reduce the ability to spend on infrastructure and social programmes at exactly the moment when the need for those programmes is increasing from workers and communities in declining industries. Poorly managed transitions can have serious lasting impacts on social cohesion.[32]

By contrast, a government which incorporates an assessment of transition risk into its policymaking can, by identifying at-risk investments, physical assets, companies, workers and communities will be able to design a more efficient transition path, which seeks to minimise knock-on economic, social and political costs. Such an assessment will also help government to identify the optimal strategies for decarbonising the economy, for investing in technologies enabled by the global transition and the optimal timing for both sets of investment. Finally, in contributing to global efforts to mitigate climate change, it may also be able to reduce its future exposure to the physical consequences of climate change (and therefore also the cost of investment in infrastructure to adapt to that risk).

Country-level transition risk analysis will also be helpful to participants in the international political debate on climate change, particularly the ongoing work on climate finance. If country-level transition risk analysis can help identify the economic and financial barriers to action on climate change in countries that are major emitters of carbon, government, DFIs and the climate finance community might be able to identify future investments which are more impactful in terms of the global climate change picture than those in wind and solar.

Table 1: Guide to discussions of risk allocation in this paper

<table>
<tr><th>TRANSITION IMPACT/RISK</th><th>NEGATIVE IMPACT / RISK</th><th>POSITIVE IMPACT / UPSIDE</th></tr>
<tr><td colspan="3">Potential transition impacts/risks arising from international trends outside of South African government control</td></tr>
<tr><td>South African coal exports</td><td rowspan="4">Chapter 4</td><td rowspan="4">Chapter 5</td></tr>
<tr><td>Global oil markets</td></tr>
<tr><td>Global metals and minerals markets</td></tr>
<tr><td>Adaptation costs</td></tr>
<tr><td colspan="3">Potential transition impacts/risks arising from domestic policy action to mitigate transition risk or contribute to global mitigation efforts</td></tr>
<tr><td>Domestic power industry and its coal suppliers</td><td rowspan="2">Chapter 6</td><td rowspan="2">-</td></tr>
<tr><td>Domestic oil products and coal to liquids industries</td></tr>
</table>

32 The 2001 study "Coalfields regeneration, dealing with the consequences of industrial decline" (Katy Bennett, Huw Beynon and Ray Hudson" considered the challenges with regenerating former coal mining regions nearly twenty years after many of the closures, focussing on the damage created by the speed of the closures and the adversarial approach of the government mandating the closures.

Overview of the analysis

This paper provides an economy-wide picture of the financial risks that South Africa could face as the world transitions to a lower carbon future compatible with a scenario that limits global temperature rises to well below 2°C above pre-industrial levels (a "2DS" world).

We started by considering which of South Africa's export and domestic sectors (and within them, which corporates) could be most exposed carbon transition risks. Then, we assessed how the current structure of the South African economy – including fiscal policy, regulation and the relations between state, corporate and financial sectors – distributes financial risk (**Chapter 2**).

Chapter 3 includes a summary of our findings, including an assessment of which sectors, companies and economic groups might face risk in a 2DS world, including downside risk and potential benefits arising from trends outside of the control of South Africa and risk arising from domestic policy action. Chapter 3 also sets out our understanding of the channels through which transition risk might be distributed through the economy. The differentiation between explicit and implicit risk allocation as well as the contingent liabilities that may ultimately fall to financial institutions and government provides the framework for much of the analysis set out in the following chapters.

As illustrated in ES-1 on page 16, **Chapters 4** to **6** tackle each source of (downside and upside) risk separately, quantifying the risk arising from each sector and identifying which parties are likely to face the ultimate impact. The chapters also include analysis of potential policies that the national government might implement in the near future – both those which could exacerbate the existing risk position and those which could help mitigate the risk.

Chapter 7 draws together the results from chapters 4-6 and considers the potential impact of transition risk on the sovereign credit rating. Here we also set out a series of actions that the government could take to improve the resilience of the sovereign rating to transition risk.

Finally, **chapter 8** sets out a potential plan of action for the South African government, outlining which actions (eg, avoiding investments that increase risk) are urgent in the short term and which need to be phased in (eg, a transition plan for workers in coal mining or a plan to abate emissions in the coal-to-liquids sector).

Several of the policy recommendations may require capital to implement them (eg, reworking the financing strategies for municipalities and state-owned enterprises) of a scale that is beyond the capacity of domestic capital markets and national development financial institutions. South Africa may be able to reduce the cost of climate transition risk mitigation actions by working with mission-driven international capital providers (eg, climate finance and national development financial institutions) to develop innovative new financial solutions.

2. Measuring transition risk in South Africa

Key messages:

1. Recent decline in the health of public finances and sovereign credit rating downgrades have made South Africa more vulnerable to risks arising from outside the country, such as those potentially posed by a global low carbon transition.
2. This paper outlines a framework for understanding the nature and magnitude of some of those risks in the South African context, how they are explicitly allocated in the current structure of the economy as well as where they may be implicitly transferred.
3. This approach includes sectoral and company models and focuses on identifying the gap between a "business as usual" scenario, which we assume is currently used for planning, and a 2DS and difference in value between the two scenarios (the climate transition value at risk).

In South Africa, government focus on the implications of physical climate risk has increased in recent years by events such as the 2018 drought in the Western Cape. However, interest in adaptation to physical risk does not yet appear to have been matched by attention on transition risk.

South Africa faces the global transition from a position of weakened financial flexibility. Having used the proceeds of a commodity price boom at the end of the last decade to fund spending on poverty reduction and other development objectives, since the financial crisis fortunes have reversed as low commodity prices and corruption allegations have led to rising budget deficits and a series of sovereign credit rating downgrades.[33]

The structure of the economy and the distribution of "government" or public risk across a range of levels of government state-owned enterprises and state-owned financial institutions may also present a barrier to change: especially to any consideration of the potential wind-down of industries, which are major sources of jobs.

The analysis laid out in this paper started by gaining an understanding of that structure, before applying our methodology for assessing transition risk.

The methodology: analysing transition risk in South Africa

The methodology of this work builds on previous CPI analyses of stranded assets in fossil fuel industries[34] and makes use of a series of in-house commodity market and financial models using data and some analysis from third party providers including Wood Mackenzie, Rystad Energy and the International Energy Agency.

Our approach followed four main steps:

1. Setting the **scope** for the analysis;
2. **Calculation of the value at risk** (economy-wide and to countries, sectors, groups of companies and other groups of economic actors) arising from trends external to South Africa and its transmission channels;
3. Analysing the **effectiveness of potential policy options** for mitigating external risks and understanding the winners and losers that they create;
4. Suggesting options (both policy and financial) for **reallocating risks** to parts of the economy best placed to manage them.

33 Moody's sovereign credit rating for South Africa fell from a high of A3 in July 2009 to Baa3 (the lowest level of investment grade) by June 2017. The historic rating trajectory is set out at https://www.moodys.com/credit-ratings/South-Africa-Government-of-credit-rating-686830

34 Government Assets: Risks and Opportunities in a Changing Climate Policy Landscape (Climate Policy Initiative, 2016).

2.1. Scoping

The scope of the analysis covers:

- **Sectors** in South Africa that are most exposed to transition risk;
- **South African companies and institutions** where transition will have a material impact;
- **Scenarios** that allow us to frame and measure the potential impact, and therefore the potential risk, of an energy transition driven by ambitious climate policy.

2.1.1 SECTORS

In South Africa many industries sell products at either export or export-parity prices or at prices affected by local policy and regulation. Government has much more control over the latter than the former.

Despite some efforts to diversify, over half of South Africa's **export revenues** continue to be derived from selling commodities and commodity-related goods. In 2016, nearly 40% of its exports were of precious metals (eg, gold, diamonds and platinum), with a further 30% in minerals, metals and chemicals. In 2016, the country's largest single import item was crude oil, while other key imports include electrical equipment, pharmaceutical goods and parts to serve the country's automobile assembly industry.

The Western Cape drought illustrates the potential impact that the country faces from the physical impacts of climate change, driving an estimated loss of 30,000 jobs in the agriculture and wine sectors over a 12-month period. However, the sectors exposed to transition risk are very different. We selected sectors for deep-dive analysis that were:

(a) material in the context of the economy;

(b) exposed to changes in behaviour driven by global climate policy and/or technological change and;

(c) where we felt the direction of the impact of those changes (ie, positive or negative) was certain enough to derive meaningful forecasts;

We considered in slightly less detail the sectors which might not meet the criteria above but could be put at risk in future if South Africa continues to extend its domestic decarbonisation ambition beyond the steps envisaged in this paper.

We conducted detailed quantitative analysis of **thermal coal** exports and **oil** imports, while undertaking detailed qualitative reviews of platinum, manganese, iron ore, automotive industries as well reviewing the literature on physical climate risk to try to understand the link between action to mitigate climate change (through a low carbon transition) and the future cost of adapting to that risk.

Some **domestic** sectors are implicitly exposed to changes in external markets as well as domestic policy. We focused our quantitative analysis on the most emissions-intensive sectors, which also have links to global markets. These include coal mining, power, rail, port, liquid fuels (including coal-to-liquids). Emissions-intensive sectors that are either not impacted by external transition risk (such as cement) or only in the longer term (such as steel and chemicals production), may only face a serious impact if the government incorporates a more concerted policy to reduce national carbon emissions due to international political pressure.

2.1.2 COMPANIES / ECONOMIC / SOCIAL GROUPS

Companies and governments will be the initial bearers of transition-risk driven reductions in price and volume and as such make the first steps to allocate risk through the economy. Our analytical approach, which assesses transition risk first on an asset-by-asset level, proceeds through an analysis of key companies, public bodies and the groups to which they transfer risk – including workers, consumers and the financial sector. Table 2 summarises the companies the analysis focused on.

2.1.3 SCENARIOS AND SENSITIVITIES

The analysis calculates transition risk as the difference in value between a "business-as-usual" (BAU) scenario and one where the world decarbonises in order to keep average global temperature rises well below two degrees above pre-industrial levels (2DS). To the extent that investors, companies and government currently rely on BAU forecasts for financial and strategic planning, the delta between BAU and 2DS represents value at risk in a climate transition.

We devised scenarios for the seaborne coal and oil markets, allowing us to build models which derive volumes and prices for coal exports and oil imports over a period of 2018-35. We chose the period as one with much longer time horizons than those used by rating agencies (because we needed to understand the impact of potential investments in long-life assets) and one broadly in line with the horizon of current government policy (the draft IRP sets out a plan for the power sector to 2030).

2.2. Calculating the external value at risk from trends outside South Africa

We used slightly different methodologies to estimate the size of transition risk, depending on sector and the nature of the risks.

2.2.1 METHODOLOGIES TO FIT THE RISK

For key sectors (coal exports and oil imports) where policy and/or customer behaviour (both external and internal to South Africa) are expected to drive price and volume changes, we conducted a detailed quantitative analysis, based on projections of future supply, demand

Table 2: Summary of key entities studied

ENTITY	SECTORS	SHARE OF BUSINESS IN SOUTH AFRICA	BACKGROUND
Sasol	Export coal, domestic liquid fuels	35% group EBITDA	Originally state-owned but privatised in 1979. Largest shareholders are PIC (14.3%) and IDC (8.5%).
Anglo American	Export coal, platinum group metals, iron ore, manganese	25% capital employed	4th largest mining company in the world by market cap; 25% of earnings in South Africa and diversified across commodities, including coal, PGMs, iron ore, manganese and diamonds.
Exxaro	Export coal, domestic coal	>90% earnings	Formed in 2007 following the demerger of Eyesizwe Resources, which also led to the creation of Kumba (now owned by Anglo). Largest investor in expanding SA coal capacity and major supplier to Eskom. IDC is a major investor in its BEE.
Transnet	Domestic rail, ports, liquid fuels	>90% earnings	Monopoly owner and operator of SA ports and pipelines and quasi-monopoly owner and operator of freight rail system.
Eskom	Domestic coal, power	>90% earnings	Monopoly owner and operator of transmission system and owns 84% of SA installed generation capacity, mainly coal-fired.
Industrial Development Corporation of South Africa (IDC)	Export coal, domestic coal, domestic liquid fuels	Mostly SA, growing footprint elsewhere in Southern Africa	National DFI with focus on private sector and equity investments. Second largest shareholder in Sasol.
Development Bank of Southern Africa (DBSA)	All	Mostly SA and Southern Africa, growing footprint elsewhere in the continent	National DFI with focus on public sector and infrastructure debt. One of largest lenders to Eskom and municipalities.
Public Investment Corporation (PIC)	All	Mostly SA	State-owned asset manager for government employee pension funds. Largest shareholder in Sasol, second largest shareholder in Anglo American, largest asset owner on the Johannesburg Stock Exchange, largest owner of Eskom and Transnet bonds.

Source: Company websites

and transport costs. We completed a similar, higher level analysis for platinum exports.

As set out in box 1 below, our analysis was driven from CPI's own global coal and oil models including asset-by-asset level cost data. CPI's domestic South African models linked export and domestic markets, deriving yearly mine-by-mine profitability and cash flow estimates which informed our assessment of which mines (and mining companies) might be put at risk in a 2DS.

The literature on adaptation costs is less well developed, but we have used recent analyses by the UNEP[35] and other agencies to estimate the positive impact on adaptation costs that would arise from greater progress on mitigation.

The study excludes analysis of the financial risk associated with physical damage that will be caused by "already locked-in" climate change arising from historical carbon emissions. Any adaptation efforts even in the short-term will impact the BAU operating profile of existing assets (eg, water risk for Limpopo power plants[36]) and more generally, the capacity of the South African economy to bear incremental risk.

BOX 1: CPI'S BAU AND 2DS SCENARIOS AND SENSITIVITIES

Coal

CPI's BAU analysis for coal uses supply and cost assumptions from research group Wood Mackenzie and demand assumptions from the International Energy Agency's (IEA) 2017 New Policies Scenario (NPS). Our 2°C scenario (2DS) takes the IEA's 2017 Sustainable Development Scenario (SDS) as a base. However, it adjusts most demand figures downwards based on our in-house research on transition efforts in major importers. The use of lower demand figures than in the SDS also reflects our concern that the IEA's scenario is overly optimistic on the ability to deploy a significant amount of carbon capture and sequestration (CCS) technology over the time horizon of the study. Further information on our modelling assumptions is set out in Annex C.

Oil

CPI's oil analysis uses supply and cost assumptions from independent researchers Rystad Energy as well as region-specific demand elasticity assumptions derived from previous CPI work. Base demand assumptions in BAU and 2DS scenarios are taken from the IEA's 2017 NPS and SDS scenarios.

Shipping costs

Both our BAU and 2DS cases for shipping costs incorporate our assumptions on the cost of compliance with the International Maritime Organisation's regulation on the sulphur content of marine fuel. We do not include assumptions on the impact of recent steps taken by the shipping industry to recognise the need to reduce carbon emissions, which are likely to increase costs in the longer-term. Therefore, the only difference in our shipping cost assumptions between BAU and 2DS is derived from our oil modelling.

Domestic decarbonisation required in a global 2°C scenario

We have not sought to devise a national 2DS for South Africa, rather we have used sensitivity analysis to test the impact of a series of potential policy options relative to a BAU scenario derived from our understanding of government policy. In the power sector, this means the draft IRP 2018 recommended plan for the period to 2030.

Nonetheless, while South Africa's current international commitments on emissions reductions may not commit the country to significant reductions, CPI's analysis of what would be possible in a global 2DS suggests that South Africa will likely face significant political pressure to increase the ambitions of its domestic plans. In particular, we considered the impact of: a) an accelerated shut-down of the country's coal-fired power fleet in line with the implications of the SDS 2017 for South African coal-fired power generation; and b) an early closure of the Secunda coal-to-liquids synthetic fuel refinery.

35 The United Nations Environment Programme's Adaptation Gap studies provide some of the most systematic attempts to estimate adaptation costs under various global warming scenarios but country-specific estimates are hard to come by. Africa's Adaptation Gap 2 (UNEP et al, 2013) is one of the best regional estimates.

36 The Centre for Environmental Rights has provided evidence on the water risks with Limpopo power plants https://cer.org.za/wp-content/uploads/2018/03/Annexure-

2.2.2 MECHANICS OF THE ANALYSES

For our sectoral analyses, we calculated transition risk based on the difference in the net present value of future cashflows (including operating and capital cashflows) arising from a given asset, company or sector between BAU and 2°C scenario.

We considered cashflows from both assets that are already in operation and those that we would expect to be built in a business-as-usual scenario.

With domestic businesses that do not sell at export or export-parity prices, we include revenues in our calculation as they are currently determined by existing regulations or policies. Such revenues are an artifact of a national government policy decision as to how to allocate risk in the economy, an allocation, which the government might decide to revisit in order to protect the country against the impact of transition risk.

As well as regulation which sets prices, we reviewed policy and commercial contracts / arrangements to understand how a given amount of value at risk in a sector might be further transmitted through the economy. As well as companies and national government, we assessed impact on workers, consumers, municipal government and the financial sector. An understanding of all the channels (eg, explicit, implicit and contingent liabilities) through which transition risk might impact the national government was also critical for an assessment of the impact on sovereign credit rating.

Our assessment of the potential contingent liabilities to the national government was driven by an analysis of key corporates, comparing the size of their climate transition risk exposure with the size of the company (where size was represented by market capitalisation, regulatory asset base or total assets). Where the scale of projected exposure was expected to be a very high percentage of a company's current size (or, in some cases, was larger than a company's current size), we projected that companies would default or go bankrupt, implicitly passing external transition risk back to national government. We made higher level assessments in relation to municipalities and workers.

2.3. Calculating the value at risk arising from government policy decisions

Where we reviewed transition risk arising from South African government policy rather than trends external to the country, we took a similar approach, albeit with some important distinguishing features.

For the two scenarios we tested – accelerated decommissioning of coal-fired power plants and the Secunda coal-to-liquids facility – we compared the BAU cost of operating the assets with a combined alternative cost, including stranded asset and accelerated decommissioning costs associated with assets being retired as well as the capital and operating costs of alternative technologies / means of supplying the same demand for electricity and liquid fuels.

2.4. Designing policies to mitigate transition risk and to reduce its impact

Public balance sheets have limited capacity to bear risk without affecting public service provision or other parts of the real economy. For South Africa, we sought to understand the potential implications of climate transition risk for the sovereign credit rating, which would in turn, influence future debt service costs and the ability of the country to meet its national development objectives.

After analysing the likely quantum of risk to the sovereign credit rating from the sources of climate transition risk discussed in sections 2.2 and 2.3 above, we devised potential policies, which would help the national government to a) mitigate transition risk or avoid adding to it (eg, through avoiding certain investments or selective early asset retirement; b) capture benefits from the transition so that they can be used to compensate at-risk parties; and c) to improve the resilience of the public balance sheet, to increase the likelihood that South Africa would be able to retain its sovereign credit rating.

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3. Transition risk in South Africa: a summary of our results

Key messages:

1. South Africa faces transition risk of over $120 billion between 2013 and 2035 in present value terms
2. Much of the risk and potential impact is due to factors, policies and events beyond the control of the South African government, while as much as 48% of this more than $120bn has already been realised as the long term prospects for the seaborne coal market have fallen
3. Much of the risk arises from a decline in coal exports, which outweighs the benefits from a lower oil price
4. Investors may initially bear nearly 84% of the value at risk (with government 16%) but, through a series of explicit (contractual) and implicit transfers (including contingent liabilities), the national government may in fact be exposed to more than 54% of the risk. If unmitigated, this could threaten the investment grade sovereign credit rating.

South Africa faces two general types of transition risk as the world moves towards a lower carbon economy:

- Risks that are **beyond the control** of the South African government, in both timing and magnitude, as they are driven primarily by global markets and international policy and trends. As explored later in this paper, the government still has a series of options to mitigate the impact of much of this risk;
- Risks that are mostly **within the control** of South Africa and its government, as they relate to domestic industrial and energy policies and how South Africa responds to international policy trends and agreements.

Within these two categories lie specific industries that will be most impacted if the global economy and South Africa each achieve carbon emissions reductions consistent with international objectives.

These are:

1. **Potential transition impacts/risks arising from international trends outside South African government control**
   - Declines in South African coal exports;
   - Lower prices in global oil markets;
   - Shifts in global metals and minerals demand and markets;
   - Other downside and upside risks, such as lower adaptation costs to the impacts of climate change.
2. **Potential transition impacts/risks arising from domestic policy action to mitigate transition risk or contribute to global mitigation efforts**
   - Developments in the domestic power industry and the impact on its coal suppliers;
   - Adaptation of the domestic oil products and coal to liquids industries;
   - Other domestic policy options.

We should note that impacts are not the same as risks, but rather that the risk or opportunity that South Africa faces can be measured, as we have done, as the expected financial and economic impact of a low-carbon global economy. Table 3 summarises the main source of impact on South Africa of each of these transitions and shows our estimate of the impact that these transitions would have – both positive and negative – on the South African economy.

This chapter summarises the analysis behind the numbers in the following table and figure 1, focusing first on the transition risk arising from outside the control of the South African government; second on the impact of domestic policy choices; and third, on how those risks are explicitly and implicitly allocated within the South African economy.

Table 3: Climate transition value at risk by sector

POTENTIAL TRANSITION IMPACT/RISK	DIFFERENCE IN NET PRESENT VALUE OF FUTURE CASH FLOWS BETWEEN BAU AND 2DS OVER 2018-2035 (USD BILLIONS)[37] NEGATIVE IMPACT	POSITIVE IMPACT	NET IMPACT (POSITIVE IN BRACKETS)	ISSUES
Potential impacts/risks arising from international trends outside of South African government control				
South African coal exports	83.7	-	83.7	Policy in countries such as China, India, Europe and the US, to reduce coal use to comply with 2DS, will disproportionately affect internationally traded coal. As a result, both the volume of coal sold and its price will fall, impacting miners and export-oriented infrastructure.
Global oil markets	8.3	45.5	(37.2)	Lower global oil demand will lead to lower oil prices. Provided that today's system of fuel price regulation persists, consumers will see most of the benefit, while some energy industry players – in particular, the producers of synthetic fuels – would lose out.
Global metals and minerals markets	0.5		0.5	Some risk to platinum market as demand for diesel vehicles reduces. Longer-term upside potential (not reflected) in fuel cell vehicles (platinum), batteries (manganese); potential longer-term downside from decarbonisation of the steel industry (iron ore).
Potential impacts/risks arising from domestic policy action to mitigate transition risk or contribute to global mitigation efforts				
Domestic power industry and its coal suppliers	Max 4.0bn negative impact but could be positive depending on performance of Medupi and Kusile stations		4.0	Government policy currently envisages coal generation capacity peaking in the early 2020s[10] but achieving a global 2DS could require that South Africa accelerate retirements of existing capacity and invest in cleaner sources.[11] Closure of plants before the end of their economic lives could result in a net cost to the country if the strategy is implemented in a way that negatively affects Eskom.
Domestic oil products and coal to liquids industries	27.4	-	27.4	Government is considering new fuel industry investments in upgrading existing refineries and new capacity, while there are no plans to shut the highly emitting coal-to-liquids production.[12] One of the world's largest single sources of CO2 emissions[13], Secunda would need to close in a global 2DS, although currently the cost of all replacement options would be higher than continuing to run the plant.
Other Impacts	A range of gains including adaptation ($1bn) and losses			Global efforts on carbon mitigation should reduce incremental physical climate risk and hence adaptation costs.[14] Government action to reduce national carbon emissions will impact other emissions intensive sectors, including steel and cement production, as well as other areas of the economy, including agriculture.
Total Impact	**123.9**	**46.5**	**77.4**	

37 The Rand equivalent figures, translated at the ZARUSD exchange rate as of the end of 2 January 2019 of 14.47 are South African Coal Exports: R1.2 trillion negative impact; Global Oil Markets: R120 billion negative impact and R660 billion positive impact (R540 billion); Global Metals and Minerals Markets: R7 billion; Domestic power industry and its coal suppliers: R58 billion; Domestic oil products and coal to liquids industries: R396 billion; Other: R14 billion.

The total downside impact from these main risks – in present value terms discounted to 2018 – would be slightly higher than $120 billion, which would be partially offset by over $45 billion in gains from lower global oil prices. While it is tempting to describe the net risk as "only" $77 billion, as we will describe later, transitions are not always complete and can follow different paths. It is entirely possible that the downside risks in coal and other sectors materialise, while the benefits of the global oil transition, ie lower prices for consumers, do not. In this case, South Africa's worst-case scenario could be slightly over $120 billion.

The timing of these risks is also an important consideration, particularly for the externally driven risks. As illustrated in figure 1 below, between 2013[38] and 2017, our BAU forecast for the value to be generated by South African coal exports between 2018 and 2035 fell by around $60 billion. That is, 48% of the transition risk was already realised via changes in BAU forecasts. As shown in figure 1 below, 60% of the total net risk arises from trends originating outside South Africa and two thirds of the gross downside arises in the coal sector.

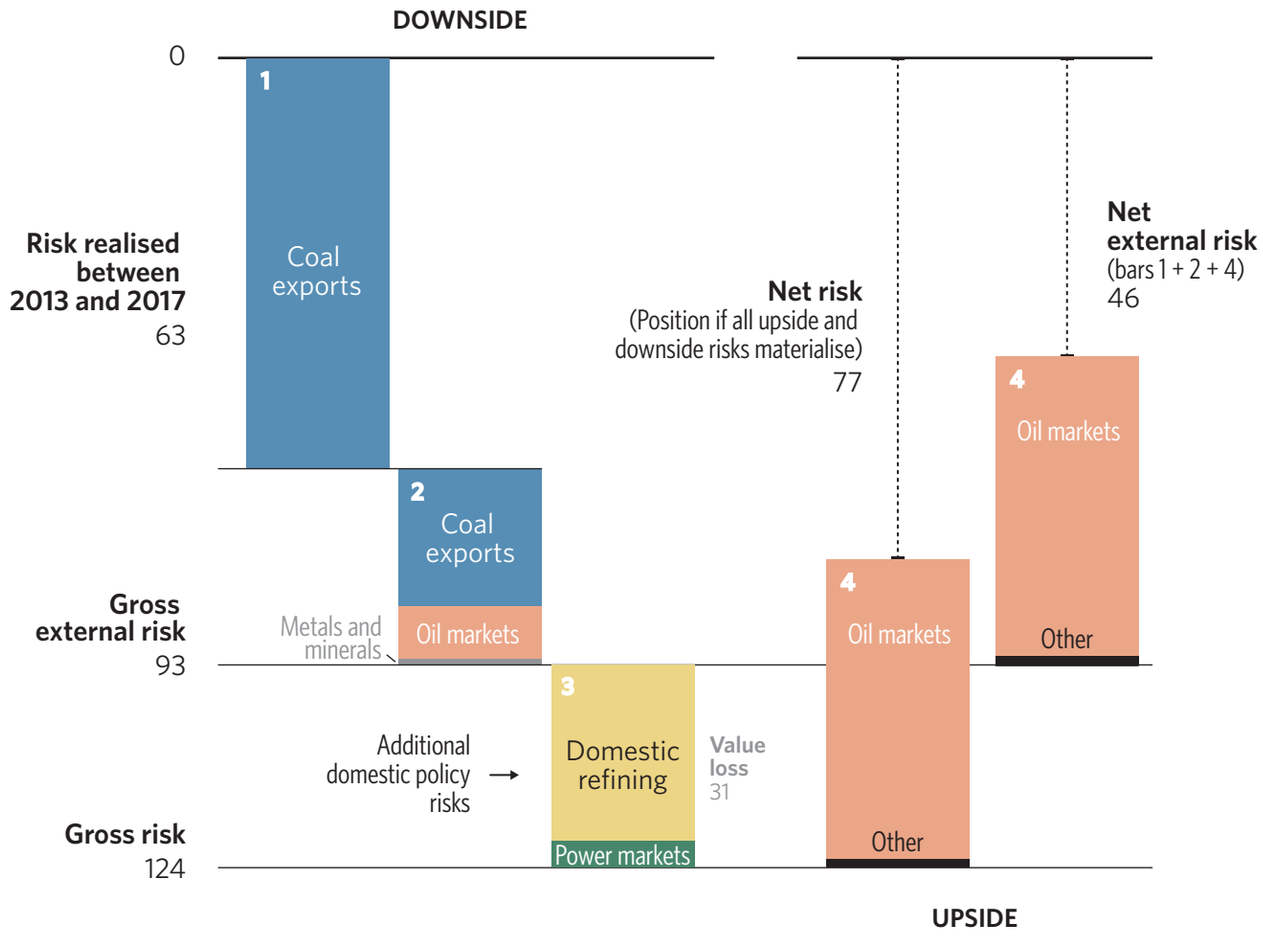
3.1. Transition risk from external trends arising outside South Africa's control

3.1.1 FALL IN SOUTH AFRICAN COAL EXPORTS

In 2017, Richards Bay port processed 77mt – a record amount – of South African coal for shipping to export markets while 2018 has seen a sharp rise in internationally traded coal prices, driven by increased demand from China and India. A strong conviction in the future sustainability and potential increase in demand for coal in power generation appears to lie behind ongoing and planned South African investments in new coal resources, rail and port infrastructure.

Figure 1: Climate transition value at risk by timeframe, sector and driver

Billion USD (NPV to 2035)



38 As noted in the Executive Summary, 2013 is point when CPI last performed this analysis, while 2017 represents the year the work on this project started.

In fact, recent price volatility[39] serves to emphasise how sensitive the seaborne market is to small changes in Chinese and Indian coal demand and coal production levels. A recent study[40] emphasised the vulnerability of South African exporters to an acceleration of decarbonisation in India, even if the global decarbonisation stays behind a Paris-compliant trajectory.

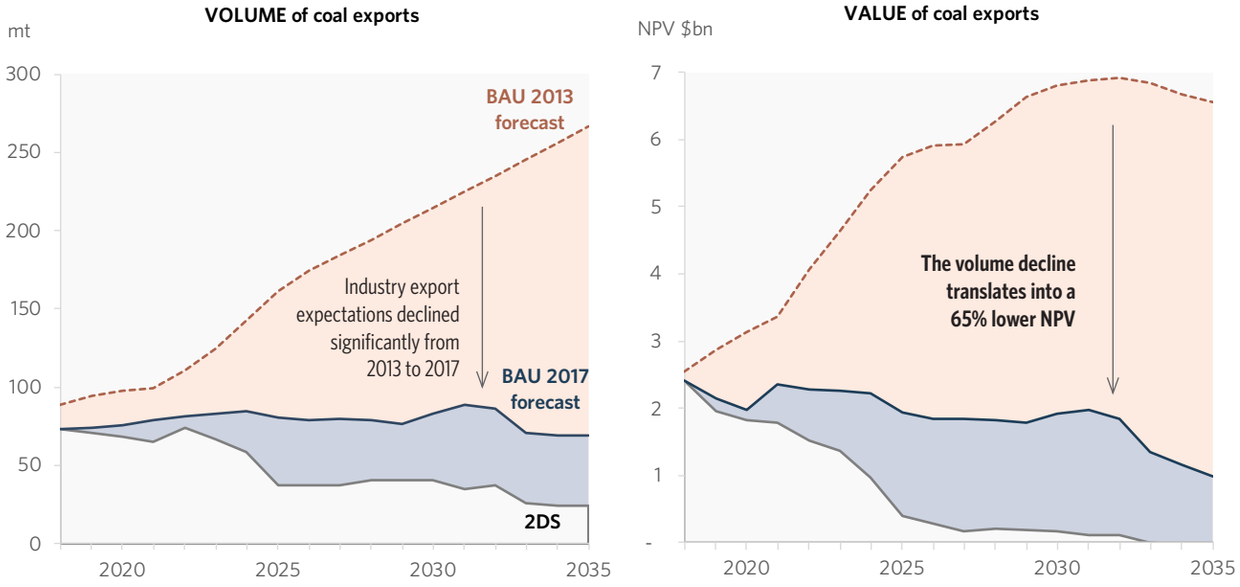
Our analysis shows that much of this investment would be stranded in a 2DS world. More significantly, much of the future value of existing assets has already vanished if we believe the changes to BAU scenarios, although not all of that lost value may yet be priced into investments, asset valuations, or planning decisions.

Our modelling shows that when we use the 2017 IEA forecasts compared with those from 2013,[41] coal demand halves between 2018 and 2035, with an expected value loss of 65% for South African exporters between the 2013 and 2017 scenarios.

In our 2DS the Richards Bay freight on board (FOB) price would be 26% lower in 2035 than in our BAU scenario and 55% lower than the 2013 BAU scenario, averaging around $77/tce nominal over 2018-35, compared with $109/tce and $153/tce in the two BAU scenarios.

If the world accelerates decarbonisation to a level in line with a 2DS, South African coal exports would drop sharply, starting in the early 2020s. As a result, any new coal mines whose investment cases include a significant amount of export revenues destroy value for their investors, provided that domestic demand for coal does not expand to absorb the excess supply.

Figure 2: More than half the value of South African coal exports was lost between 2013 and 2017



Source: International Energy Agency, CPI analysis

Source: CPI analysis

39 The Richards Bay coal price rose from $49/t at the start of 2016 before peaking at $106/t in July 2018 before falling below $90/t in early 2019. The rise was driven by a surge in domestic demand from China and India. In the case of India, the surge in demand is also partially due to near term logistical bottlenecks which curtail India's ability to use domestic production to satisfy demand. Source: https://uk.reuters.com/article/uk-india-coal-imports-analysis/train-shortage-power-demand-to-drive-resurgence-in-indias-coal-imports-idUKKCN1G61AB

40 According to ibid DIW Berlin et al (2018), even relatively small declines in Chinese and Indian demand of 5-10% could displace demand for imports entirely and would "first and foremost hit South African coal exports hardest".

41 We use the WEO 2017 New Policies Scenario as our 2017 BAU scenario, which reflects the expectations of the IEA for future coal demand based on all policies that had been implemented or announced by 2017. Our 2013 BAU scenario is an estimate of actual industry expectations during our previous analysis of international coal markets in 2014. We used the WEO 2013 which reflected industry expectations of future demand, based solely on policies which had already come into effect at that time before the Paris agreement in 2015

For state-owned rail and port operator Transnet, a collapse in export coal volumes could have serious consequences across its business.

In the ports sector, where its revenues are determined by an economic regulator (the Ports Regulator of South Africa), Transnet may be able to recover some lost revenues via an increase in tariffs on other goods, provided that port charges do not rise so high as to discourage trade via South Africa.

However, in its rail business, the fall in volumes transported from coalfields in Mpumulanga and Limpopo provinces would, by the second half of the 2020s, reduce margins from coal sales to the point where they would barely cover the costs of operating the main rail line carrying this coal. Soon thereafter, the losses on that rail line would exceed the potential profit from coal exports, leading to overall value destruction for South Africa. That would be a marked change from the current position where that line helps cross-subsidise tariffs on general freight lines.[42] A Transnet which has invested based on expectations of continued or increased coal export volumes could put its investment grade credit rating at risk, with implications for the government balance sheet if Transnet were – like many SOEs today – forced to seek government guarantees to enable cost-effective access to debt capital markets.

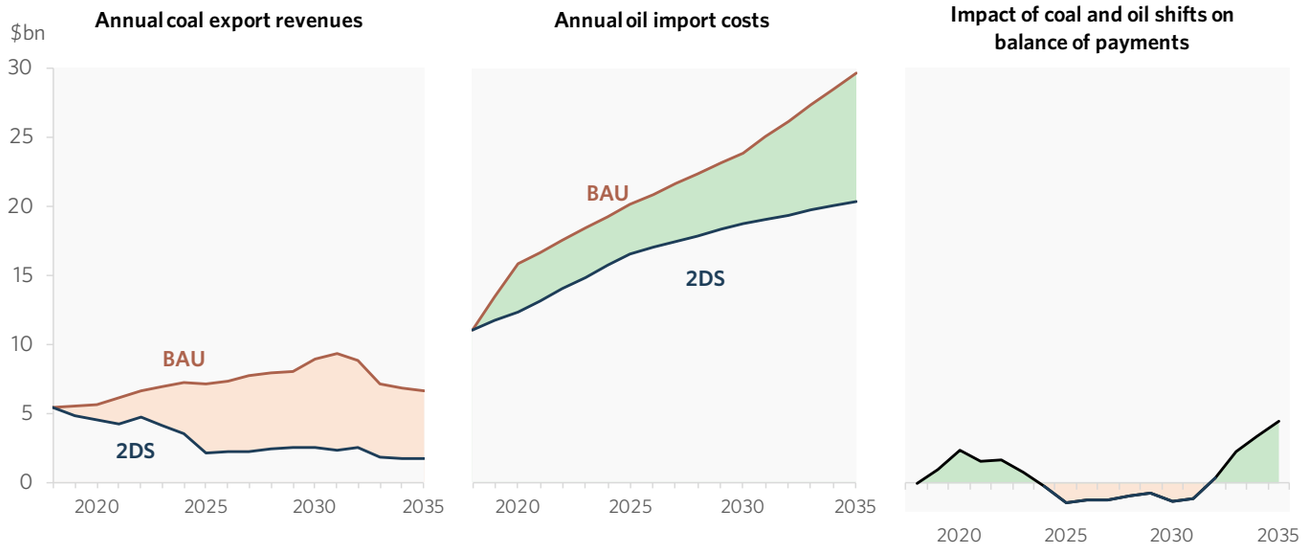
3.1.2 CHANGE IN GLOBAL OIL MARKETS

In our 2DS, the crude oil price would be 35% lower in 2035 than in our BAU scenario, averaging around $85 / barrel nominal across 2018-2035, compared with $112 / barrel in BAU. However, our analysis finds that, although South Africa spends twice as much on oil imports as it earns from exporting coal, the benefit of lower oil prices only partially offsets the risk in the coal sector.

Lower crude prices (feeding through to lower oil product prices) over this period could provide a material boost to the South African economy through a windfall for consumers. Although the magnitude ($45bn) also assumes that part of the benefit to the economy is offset by rising demand driven by lower prices. Investors – particularly in synthetic fuel production – would be negatively affected. Government would see a loss of nearly $4 billion (see figure 13), mainly the result of its ownership of PetroSA and its part-ownership of Sasol. Unless plans for a new refinery come to fruition, an increase in demand would need to be met from the import market.

Our analysis shows that if there were no significant EV penetration in South Africa, petrol and diesel imports increasing from 1.5mboe and 16mboe respectively in

Figure 3: How coal export revenue losses and lower oil import costs affect South Africa's total balance of payments



Source: International Energy Agency, CPI analysis

42 There are multiple sources suggesting that Transnet's coal and iron ore export lines are cross-subsidising general freight tariffs, including at http://documents.worldbank.org/curated/en/826871468000289228/pdf/WPS7532.pdf

2016 to 12mboe and 21mboe respectively in 2035.[43] Figure 3 in the previous page illustrates that the cumulative impact from the fall in the costs of crude oil imports, which would result in a $4.7bn benefit to South Africa's balance of payments.

Advocates for a new 400,000 barrel per day refinery in South Africa have used a putative benefit to the balance of payments as a means for advancing their case.[44] However, our analysis shows that even if demand were boosted by a lower oil price, the increase in product imports required to meet demand would not come close to justifying a refinery of that capacity. A decision to proceed with a new refinery would therefore need to consider a range of factors impacting its resilience to transition risk, including the size and shape of future export markets, the nature of the competition to supply to those markets, and domestic policy on fuel economy standards (Clean Fuels II). The implications of Total's discovery of gas condensate off the coast of South Africa will also influence this analysis. Enhanced ambition on reducing carbon emissions in the South African transport sector (eg, a sharp increase in the penetration of electric vehicles) may turn out to be a less risky option for the country, and could threaten returns on any potential oil sector capital investments.

3.1.3 CHANGING STRUCTURE OF GLOBAL METALS AND MINERALS MARKET

While there is much consensus (at least directionally) on the impact of a low carbon transition on coal and oil demand, the impact of the transition in the transport sector on some of the world's largest minerals/metals markets is less certain.

Our analysis shows one clear trend: an inexorable decline in the market share of diesel in light-duty vehicle (LDV) sales driven by the ramping up of European action to curb vehicle emissions that cause local air pollution and contribute to global warming.[45] This trend will hit demand for South African platinum as one of the primary components in catalytic converters, a key technology in reducing pollutants from internal combustion engines. However, the long-term prospects for diesel sales as implied by current markets are so weak that the value at risk for South Africa platinum would be relatively modest (at around $0.5 billion) although the extent to which South African policy makers have factored in the implications of this decline is uncertain. Despite the trend for diesel sales and significant recent job losses in South Africa (over 30,000 in the last decade),[46] the prognosis for the South African platinum sector is far from terminal but will depend to a large extent on the relative success of platinum-intensive technologies (eg, fuel-cell electric vehicles) used in low carbon transport and industrial applications.

Table 4: Potential impacts of the changing structure of the metals and minerals market

TREND	POTENTIAL IMPACT ON SOUTH AFRICA
Growth in demand for batteries (energy storage and electric vehicles)	Could be positive for manganese and vanadium demand depending on the relative market shares of different battery technologies
Growth in demand for electric vehicles	Could be positive for platinum if fuel cell vehicles gain significant market share. Uncertain impact on auto industry, which will be impacted by broader factors influencing the attractiveness of manufacturing investment.
Increasing utilisation of road vehicles (eg, ride-hailing, autonomous vehicles)	Long-term negative for auto industry, potential positive for large municipalities
Development of deep decarbonisation pathways for steel, cement and chemicals production	Long-term negative for materials supplying the steel industry, including iron ore, manganese, chromium and ferroalloys production
Policy development to incentivise greater resource efficiency ('circular economy')	As above

43 This analysis takes into account the forecasts for South African fuel demand from the International Energy Agency's 2017 Sustainable Development Scenario

44 Source: http://www.petrosa.co.za/building_futures/Pages/Project-Mthombo.aspx (downloaded 18 December 2018)

45 Source: https://www.independent.co.uk/news/world/politics/diesel-cars-europe-germany-poland-air-pollution-dieselgate-motoring-a8591641.html

46 Facts and Figures (Minerals Council of South Africa, 2017) Source: https://www.mineralscouncil.org.za/industry-news/publications/facts-and-figures

Table 5: Physical risk, adaptation cost and the link with climate mitigation action

PHYSICAL RISK	RESULTING FROM HISTORIC OR INCREMENTAL EMISSIONS	ESTIMATE OF TRANSITION RISK (2017 NPV)
Adaptation costs	Historic	Zero – the cost associated with the physical risk will be the same in both BAU and 2DS
Physical damage		Zero – the cost associated with the physical risk will be the same in both BAU and 2DS
Adaptation costs	Incremental	$0.5-$1 billion gain
Physical damage		Not estimated as part of this study

Under a 2DS, the South Africa mining industry could face several other major impacts – positive as well as negative – on sectors of material importance to the South African economy, as illustrated in table 4.

Although the timing, magnitude and even direction of some of these trends remains uncertain, South African policymakers should monitor them, especially when investing in or seeking to attract investment in new long-life assets (eg, mines, ports, rail lines). Proposals published in November 2018[47] by the Energy Transitions Commission, a consortium of some of the world's largest energy companies and energy-intensive users, technology and finance companies with which CPI works closely, demonstrated the uncertainty and risk around decarbonisation pathways for the steel industry. The ETC and its consultants found that, if the global steel sector shifted in line with its supply- and demand-side proposals, global primary steel production capacity could peak in the 2020s, significantly reducing future demand for iron ore.

3.1.4 CHANGING ADAPTATION COSTS

As well as the risk associated with changing demand for South African commodities, the country will face significant costs associated with the physical risk of climate change and the cost of adapting to that physical risk (eg, investment in infrastructure, such as flood defences or desalination plants), which will reduce the capacity of the economy to bear transition risks.

We considered the question of physical risk and adaptation cost even though an analysis of potential physical damage is outside of the scope of this study because we wanted to understand whether South Africa might gain material benefit from global action to decarbonise, even if it continued a BAU approach to domestic policy.

In 2015, UNEP estimated that adaptation costs from 2016-2050 for the continent of Africa would be $100 billion in a BAU world, but only $50bn under a 2DS, meaning a potential gain of $50 billion to the continent from accelerated global mitigation action. For the period of our analysis, the benefits are much smaller, but they widen significantly between 2035-2050.

We estimated the potential benefit to South Africa at between $0.5 billion and $1 billion.

3.1.5 TRANSITION RISK ARISING FROM SA GOVERNMENT POLICY ACTION

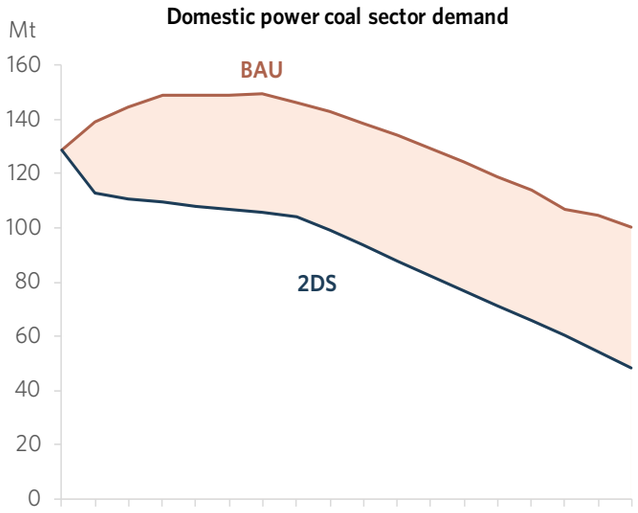
Between now and 2035, the phase-out of coal-fired power stations and coal-to-liquids fuel production are the two areas where South Africa has the most options to accelerate a transition. In power, the government's own analysis, as well as third-party scenarios, show that the least cost scenario to 2030 is cheaper than that preferred by current policy (the recommended scenario in the draft IRP 2018). By contrast, coal-to-liquids currently remains the least-cost method of liquid fuel production. We expect that international pressure to enhance South Africa's climate ambition, including the reduction of emissions from harder to abate sectors (eg, steel and cement production) will intensify starting by the 2030s at the latest if the world is to reach a "net zero" emissions position by 2050.

3.1.6 EVOLUTION OF THE DOMESTIC POWER INDUSTRY AND ITS COAL SUPPLIERS

South Africa's latest policy on the power sector (which we describe as BAU) is the recommended scenario in the draft IRP 2018 (currently under consultation at the time of publication). This foresees an increase in power sector coal consumption compared to today's levels, with new capacity driving it to peak around 150mt in the early 2020s, before falling by 2030 to a level similar to that being used today. The implication of that scenario, if it were to occur, would be to delay preparations for the transitions of mining workers and communities to new industries.

47 Mission Possible: reaching net-zero carbon emissions from harder-to-abate sectors by mid-century (Energy Transitions Commission, 2018).

Figure 4: South African power sector coal demand: IRP vs SDS



Source: Department of Energy, International Energy Agency

However, as is illustrated in figure 4 on the following page, the BAU trajectory in the IRP is at odds with that assumed by the IEA as necessary in its SDS scenario.

Accelerating the phase-out of coal in power generation so that it was in line with the IEA SDS scenario set out above could be achieved through a combination of closing power plants before the end of their economic lives, not completing plant under construction, such as Medupi and Kusile and/or reducing the market share of coal plants via the construction of plants with lower marginal costs or priority access to the grid. Any viable option would need to ensure that security of electricity supply was at least maintained if not significantly improved.[48]

We assessed the incremental cost of implementing one such strategy (which includes a combination of all three sources of emissions reduction mentioned above), relative to continuing to operate the plants in the profile assumed by the draft IRP.[49] Our alternative profile, with complete retirements of Komati, Grootvlei and Hendrina by 2020; non-completion of Medupi and Kusile and the replacement of generation with a mixture of wind and solar PV, could result in a relatively manageable net cost of up to $1 billion more than BAU.[50]

In fact, the scenario could even result in a net benefit to the country, depending on assumptions on the future performance of Medupi and Kusile, the cost of the capex required for existing plants to meet air quality regulations and the extent to which the cost of procuring wind and solar PV will have fallen since the last REIPPP bidding round.

A gradual, managed phase-out of the coal mining with proper funding for stranded workers and communities is likely to be much cheaper in terms of economic, social and political cost than one which starts later, which would have a sharper trajectory, which would therefore be more expensive and difficult to manage.

The economy-wide impact of the load shedding ongoing at the time of publication provides a potent reminder of the potential cost of risks left unmanaged.

3.1.7 ADAPTATION OF DOMESTIC LIQUID FUELS INDUSTRY

Unlike in the power sector, South Africa does not have a recently updated integrated national policy on carbon emissions in the transport / fuels sector. Sasol's recent investment in new mining resources demonstrates its intention to continue to operate its Secunda coal-to-liquids (CTL) synthetic fuel refinery for the foreseeable future.

However, as one of the largest single-site sources of CO_2 in the world, the opportunity to reduce emissions through its closure is very large. In fact, Secunda closure is likely to be a major target for meeting global emissions reduction targets, which may lead to both pressure and potential assistance to South Africa to do so. We assessed the impact of accelerating the reduction in emissions from the CTL, considering the potential cost of installing CCS as well as the stranded value associated with an early shut-down and the costs of replacement sources of product.

Our analysis shows that the total cost ($27.4 billion) to the country of shutting down the CTL early is significantly higher than the cost of accelerated

48 Eskom escalated to stage 4 load shedding in early February 2019

49 The cost is calculated as the difference between a) the replacement option (cost of building and operating replacement wind and solar generation plus accelerated decommissioning costs plus undepreciated regulated asset base / future earnings lost) and b) the cost of continuing to operate the stations, including an estimate of the cost of retrofitting the plants to be compliant with air pollution regulation. Further information is set out in Chapter 6

50 This scenario is inspired by the early retirement scenario set out by Meridian Economics and partners in 'Eskom's financial crisis and the viability of coal-fired power in South Africa' (2017). The number could be higher given that a termination payment would likely be payable in respect of non-completion of Medupi and Kusile. However, our estimate also uses conservative assumptions from the IRP for wind and solar learning rates, which push the total risk number up. The scenario also assumes the continuation of Eskom's regulatory framework and that the early shutdowns would not trigger a default on its debts.

decarbonisation in the power sector.[51] The high cost is due to a lack of cheap indigenous alternatives, especially for the chemicals produced by the facility. The recent discovery of gas condensate off the coast of South Africa could even reduce this estimate, depending on lifting costs at the field.

3.1.8 TRANSITION RISK IN THE SOUTH AFRICAN CONTEXT: EXPLICIT AND IMPLICIT RISK ALLOCATION

While South Africa faces potential transition losses of more than $120 billion, a further concern is how the risks are distributed and whether concentration of risk can lead to systemic failures that destabilise parts of the South African economy, leading to further losses.

To understand how concentration of risk might develop and flow, we must trace how the value at risk flows through pricing, ownership, taxation, and liability. Figure 7 shows how these risks flow and how the reactions of various actors, including companies and the government, could redefine the ultimate ownership of the risk.

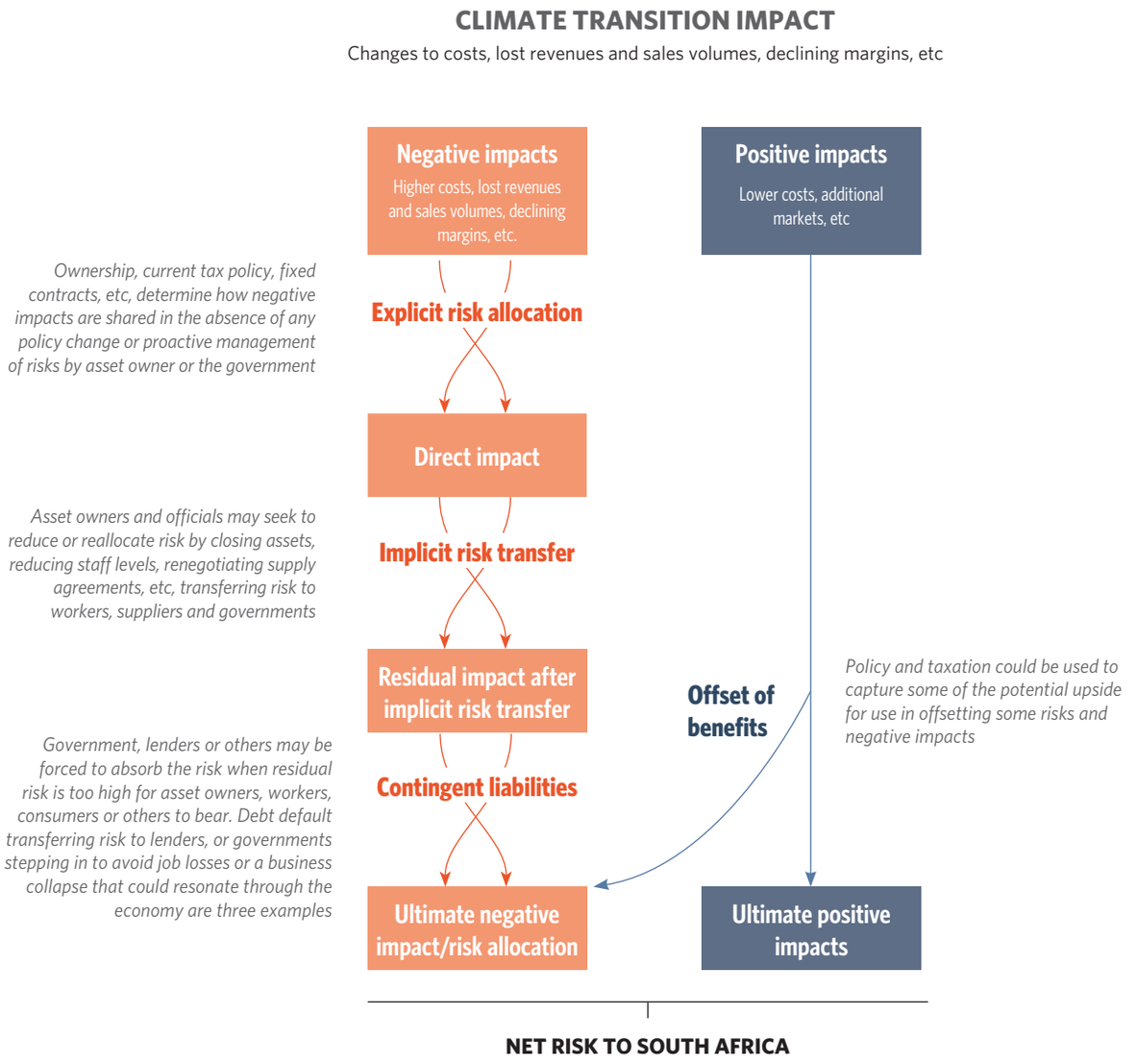
In figure 5 below, and in this paper, we define:

- **Explicit or direct risk** as the risk that each party would expect following the letter of the law and existing policy, regulation or taxes.
- **Residual risk or impact after implicit risk transfer** is how the risk is likely to be transferred as companies and the government react to market changes and take action to protect their interests, or those of the national economy (in the case of the government).
- **Contingent liabilities** lead to a final step of risk reallocation when residual risk is above the capacity of a company or actor to bear, leading to default, bankruptcy, or other event which passes the risk up the chain – through contingent liabilities – to investors, lenders, or the government. Contingent liabilities arise when all other options have been exhausted.

Each of the transition impacts have a series of risk transfers between government, investors, workers, consumers, and financial institutions. Discussion of these risk transfer mechanisms and their size for each industry is the main topic of Chapters 4, 5, and 6.

51 The cost is calculated as the difference between a) a replacement option (in this case, the highest cost / lowest risk option of closing the plant and replacing its entire output by importing product) and b) the cost of continuing to operate the stations. Further information is set out in Chapter 6

Figure 5: How climate transition risk is distributed within an economy: explicitly, implicitly and through contingent liabilities



Tables 6 and 7 summarise the mechanisms that reallocate risk for external and domestic factors, respectively.

Table 6: Potential transition impacts/risks arising from international trends outside of South African government control (key: blue is a gain; red is a loss)

TRANSITION IMPACT/RISK	DIRECT IMPACT/ EXPLICIT ALLOCATION	IMPLICIT RISK TRANSFER	CONTINGENT LIABILITIES AND POSSIBLE RESPONSE
South African coal exports	**Investors/Mine owners:** Profits and revenues fall Lower value of future sales and new mine development Negative asset values for some mines lead to write offs **Government:** Lower royalties and corporate tax revenues Lower value of state ownership of mines and companies **Suppliers, including the rail lines and ports:** Lower revenues due to lower cargo volume Decline in asset values due to excess capacity on rail and ports	**Investors/Mine owners:** Transfer risk to suppliers, municipalities Reduce work force as mines close/ production falls Additional revenues in domestic market **Government:** Increased costs to support displaced workers and communities **Suppliers, including the rail lines and ports:** Reduce work force Cancel supply agreements **Workers/Communities:** Job losses Knock-on effects to mining communities **Consumers:** Higher power prices	**Government:** Cost of potential bailout of bankrupt companies to support jobs and avoid economic contagion **Financial institutions:** Risk of debt default if companies unable to support debt at lower revenues
Global oil markets	**Investors/Refiners:** Lose sales/production margin due to falling oil prices **Government:** Lose taxes from refiners Benefit from lower energy costs **Consumers:** Benefit from lower oil prices	**Investors/Refiners:** Minor cost reductions	**Government:** May tax upside to offset risks from other parts of transition **Consumers:** May have reduced benefit if government taxes upside
Global metals and minerals markets	**Investors/Mine owners:** Lower revenues from metals used in internal combustion engines Potential upside from rare earths needed in electric transport **Government:** Lower royalties and taxes **Suppliers, including the rail lines and ports:** Minor impact	**Workers/Communities:** Job losses Knock on effects to mining communities	**Government:** Downside is unlikely to trigger default risks **Financial institutions:** Downside is unlikely to trigger default risks
Adaptation costs	**Government:** Slower/reduced climate change will reduce adaptation costs borne by national and local government		

Table 7: Potential transition impacts/risks arising from domestic policy action to mitigate transition risk or contribute to global mitigation efforts

TRANSITION IMPACT/RISK	DIRECT IMPACT/ EXPLICIT ALLOCATION	IMPLICIT RISK TRANSFER	CONTINGENT LIABILITIES AND POSSIBLE RESPONSE
Domestic power industry and its coal suppliers	**Consumers** Power price increases as consumers bear a share of any stranded asset cost **Investors/mine owners** Reduced value of new and existing mines if production falls or does not start **Government** Declining tax revenues, if higher costs reduce earnings for consumers	**Investors/Mine and powerplant owners** Lower long-term corporate growth opportunity for Eskom if replacement power is built by new entrants New entrant (independent producer) opportunity **Government** Support for workers and communities impacted by closure **Workers/Communities** Potential job losses and local economy impact Jobs created in different regions for replacement power	**Government** Heighted risk of Eskom debt default **Financial institutions** Heighted risk of Eskom debt default
Domestic oil products and coal to liquids industries	**Investors/Sasol/mine owners** Loss in earnings and value from coal to liquids New investment requirements for replacement Loss in market and volume for related coal resources **Government:** Loss of tax revenues Loss of value/dividend from Sasol stake Increase in balance of payments issues as oil imports increase	**Investors/Sasol/mine owners** Potential to pass some costs to non-regulated consumers[52] Potential to sell emissions reduction on global or bilateral markets[53] Potential staff reductions **Government** Support for workers and communities impacted by closure **Workers** Potential job losses at mines and CTL plant New jobs at replacement refineries	**Financial institutions** Reduced value of Sasol bonds if downgraded below investment grade.

52 Fuel prices (mainly relevant for petrol, diesel and LPG) are regulated only for retail customers.

53 This would be a different option to South Africa's carbon tax scheme, allowing South Africa's emissions budget to be considered not just on a national but an international scale.

3.2. The risk to corporations and their investors

Corporations and the decisions that they will take to protect their investors, both public and private, are at the heart of the process of risk transfer or distribution through the economy that is at the core of an analysis of the impact of a low carbon transition on South Africa. Furthermore, given the significant fiscal, financial and commercial linkages between private and public parties (as illustrated in figure 6 below), the fate of the public balance sheet may be closely interwoven with that of key private sector companies.

For some of the largest companies – Sasol, Anglo American, Exxaro, Transnet and Eskom – we used high-level financial models to consider the risk that any of these companies entered financial distress as a result of transition risk. A failure of one of these companies – of particular importance to the economy given their status as employers and taxpayers – could have knock-on effects on the financial sector and eventually on national government.

Figure 6: Significant linkages between private and public entities persist in South Africa today

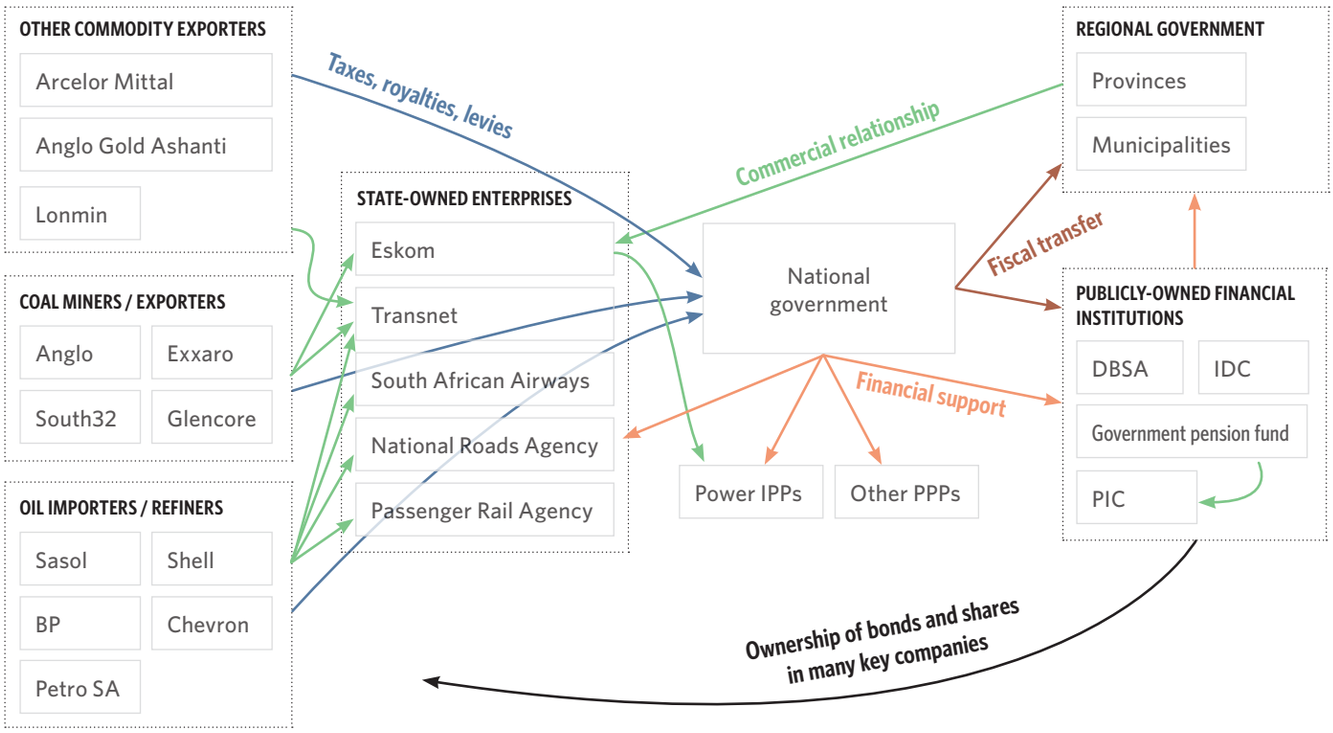
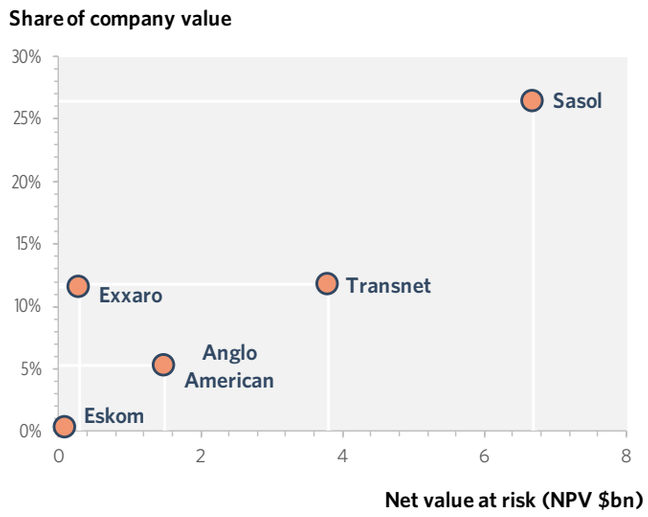


Figure 7 below illustrates that Transnet and Sasol would face the highest absolute amount of risk.[54] Exxaro would arguably be the most vulnerable: the risk it faces relative to the size of its balance sheet is similar compared with Transnet, but the former has a much weaker starting credit profile and fewer options for offsetting that risk.[55] Further details of the position of these companies is set out in the summaries in Annex A.

Figure 7: The companies we analysed face significant risk if they stick with their current strategies but have a range of mitigation options



The risks impacting Exxaro and Transnet could pose a broader risk to the economy. For Exxaro, whose principal credit facilities are due to be refinanced in the early 2020s, the company could face difficulties if it were to ramp up its investment pipeline in the Waterberg region. For Transnet, the risks could jeopardise the company's investment grade credit rating, causing it to increase reliance on government guarantees to access future funding.

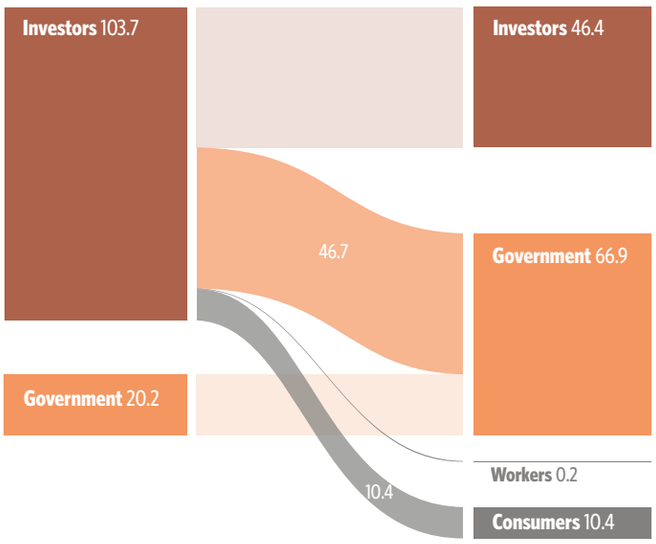
Beyond these companies, which are some of the largest employers in the affected sectors, the share of transition risk that is likely to be borne by smaller, South-Africa-focused and sometimes black economic empowerment (BEE) companies could be over $1 billion. These companies typically have little diversification and small balance sheets, meaning that any transition risk falling on these entities would likely be implicitly transferred to the state, including state-owned funders, such as the Industrial Development Corporation of South Africa (IDC).

Many of the companies we assessed – especially the largest and most diversified – will have strategic options to help them mitigate transition risk, including selling at-risk assets, diversifying their investments and taking out financial hedges. However, as yet there has been little public recognition by these companies of the broad range of transition risks covered in this study.

3.3. Risk and risk transfer to the national government and implications for sovereign credit

Figure 8 shows that, at face value, national government bears only 16% of the negative consequences of climate transition risk, mainly through lower taxes, which are the result of lower company profits. Given regulatory, rather than market-based price setting, consumers could gain substantially all the windfall from lower oil prices.

Figure 8: Transfers of climate transition risk (a high-level summary) (NPV $bn)



However, as discussed above, both companies and governments have options to pass risk onto other parties.

54 The figures included here include only the transition risk between BAU 2017 and our 2DS and implicitly assume that the risk already realised between BAU 2013 and BAU 2017 has been fully priced into the market valuations of the three listed companies. In practice, given the uncertainty as to the global decarbonisation trajectory, it is unlikely that this risk has been fully priced in and it is likely that these numbers are understated. Including the 2013-2017 risk in these numbers would raise Transnet's net VAR from $3.8bn to $19.5bn; Sasol's from $7.0bn to $7.4bn; Exxaro's from $0.3bn to $2.3bn. It would reduce Anglo's from $1.5bn to $0.3bn. Eskom's would remain substantially the same as we assume that the company currently has de minimis capacity to bear incremental risk without resorting to government guarantees.

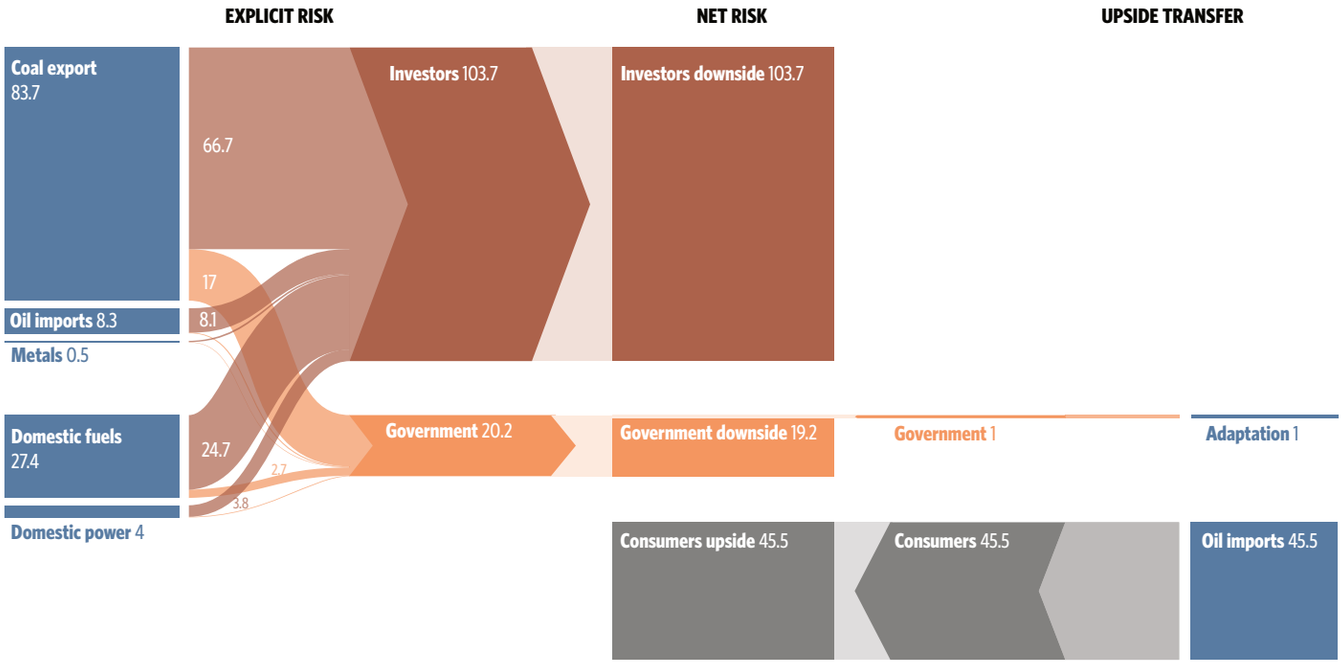
55 As investment grade corporates, Transnet and Sasol are likely to have a wider range of funding options than Exxaro and have a less concentrated debt maturity profile. The companies are also more diversified (Transnet across infrastructure businesses mainly within South Africa; Sasol more internationally). Figure 7 also assumes the current ownership structure of the South African mining sector.

Companies will seek to offset risks by cutting operating expenses, labour costs, cutting back on investment plans and, where possible, increasing revenues by raising prices. When they pass risk to parties that may be in a weaker negotiating position (eg, workers, commercial counterparties, some consumers), much of the risk that financially weaker parts of the economy have no capacity to bear could implicitly fall back on the national government. These unexpected, unbudgeted for additional costs represent contingent liabilities of a potentially material scale.

In practice, these costs would include unemployment benefit, worker retraining costs and additional transfers to municipalities where assets close to cover for the loss of funding for certain social infrastructure services currently provided by companies owning the assets. However, the implicit risks with the greatest potential for spillover to the real economy or the financial system are contingent liabilities resulting from bankruptcies of large private sector companies and sharp increases in borrowing costs of state-owned enterprises (which would most likely result from the loss of a given company's investment grade credit rating). Figure 9 below shows the result of such transfers – a net transfer of risk from private investors to the public balance sheet.

Absorbing this level of risk could have a significant impact on the government's ability to achieve its social and development objectives, particularly if the country loses its investment grade sovereign credit rating (as discussed further in box 2 on the next page). Current trends have already weakened South Africa's credit, to the extent that if incremental risk is not actively managed, South Africa could easily lose its investment grade status.

Figure 9: Explicit distribution of climate transition risk between economic actors



BOX 2: TRANSITION RISK AND SOUTH AFRICA'S SOVEREIGN CREDIT RATING

Sovereign ratings 101

The rating methodologies used by agencies such as Moody's, S&P and Fitch to assess sovereigns differ from those used for companies in important ways but still follow the same basic principles. Ratings are relative ranking tools, comparing companies or countries in relation to expected future probability of default on or expected loss over a given timeframe. Companies or countries that have strong / stable underlying conditions (for companies, 'business risk', for countries, economic fundamentals and institutional strength) can bear more financial risk at a given rating level than those that have weaker underlying conditions. Similarly, companies that are less reliant on foreign capital inflows would also be able to bear more financial risk.

South Africa's position today

South Africa's credit ratings have deteriorated over the last decade as its financial risk has risen (a sharp rise in government debt levels) as rating agencies have perceived a deterioration in its underlying conditions (weak economic growth and some erosion of key political institutions). The implication has been the loss of its investment grade (IG) rating with two agencies and an increase in debt service costs

The country's weakening financial position is in large part due to lower-than-expected tax receipts as well as a significant increase in explicit contingent liabilities as a result of guarantees to struggling SOEs, in particular, Eskom. At the same time, a period of prolonged depression in key commodity prices following the global financial crisis also regularly tipped the country's trade balance into deficit.

Transition risk and the South Africa sovereign rating

Our study finds that, if government policy continues a BAU course, it may face a continuation of the trends, which have led to a deterioration in the rating: lower-than-expected tax receipts, worse-than-expected balance of payments and the deteriorating financial position of large corporates. In addition, South Africa could face increased pressure on social spending in relation to workers and communities losing out from a transition.

4. External threats and how they are transmitted through the economy

Key messages:

1. External, ie international, trends are responsible for the majority of transition risk facing South Africa.
2. Declining demand for seaborne coal, driven by policy and technology changes as well as political pressure from the global climate change mitigation effort, is a major source of risk, while declining oil prices hold risk for South African energy companies.
3. The structure of the coal market and the regulation of retail liquid fuel prices pass these risks onto companies and their investors through lower revenues, and governments through lower tax revenues.
4. Companies will seek to transfer risk to consumers, workers, infrastructure providers, the financial sector, local and national government.

The international response to a climate change transition could cause up to $93 billion of reduced value in South African's coal, oil products and metals mining industries. The majority of this lost value is ultimately transferred back to the national government. Table 8 summarises the main factors leading to reallocation of this risk. This chapter provides background and analysis leading through each of the steps of risk allocation.

Table 8: Potential transition impacts/risks arising from international trends outside of South African government control

TRANSITION IMPACT/ RISK	DIRECT IMPACT/ EXPLICIT ALLOCATION	IMPLICIT RISK TRANSFER	CONTINGENT LIABILITIES AND POSSIBLE RESPONSE
South African coal exports	**Investors/Mine owners:** Profits and revenues fall Lower value of future sales and new mine development Negative asset values for some mines lead to write offs **Governments:** Lower royalties and corporate tax revenues Lower value of state ownership of mines and companies **Suppliers, including the rail lines and ports:** Lower revenues due to lower cargo volume Decline in asset values due to excess capacity on rail and ports	**Investors/Mine owners:** Transfer risk to suppliers Reduce work force as mines close/ production falls **Governments:** Increased costs to support displaced workers and communities **Suppliers, including the rail lines and ports:** Reduce work force Cancel supply agreements **Workers/Communities:** Job losses Knock on effects to communities dependent on mines	**Governments:** Cost of potential bailout of bankrupt companies to support jobs and avoid economic contagion **Financial institutions:** Risk of debt default if companies unable to support debt at lower revenues

TRANSITION IMPACT/ RISK	DIRECT IMPACT/ EXPLICIT ALLOCATION	IMPLICIT RISK TRANSFER	CONTINGENT LIABILITIES AND POSSIBLE RESPONSE
Global oil markets	**Investors/Refiners:** Lose sales/production margin due to falling oil prices **Government:** Lose taxes from refiners Benefit from lower energy costs **Consumers:** Benefit from lower oil prices	**Investors/Refiners:** Minor cost reductions	**Government:** May tax upside to offset risks from other parts of transition **Consumers:** May have reduced benefit if government taxes upside
Global metals and minerals markets	**Investors/Mine owners:** Lower revenues from metals used in internal combustion engines Potential upside from rare earths needed in electric transport **Government:** Lower royalties and taxes **Suppliers, including the rail lines and ports:** Minor impact	**Workers/Communities:** Job losses Knock on effects to mining communities	**Government:** Downside is unlikely to trigger default risks **Financial institutions:** Downside is unlikely to trigger default risks

4.1. Explicit risk allocation

In a world where regulation, policy, and contracts could not be changed, and where companies were allowed to fail with no wider impact on workers or the economy, most (80%) of the internationally driven climate transition risk would lie with companies and their investors, as in Figure 10.

4.1.1 DIRECT IMPACT/RISK OF A DECLINE IN SOUTH AFRICAN COAL EXPORTS

The recovery of the price of South African coal over the last three years has boosted profits for the country's coal exporters. While greater-than-expected Chinese and Indian imports may have driven prices to over $100 / tonne from below $50 / tonne at the end of 2015, most longer-term forecasts suggest a definitive decline in the seaborne market.

In 2013, business as usual scenarios forecast that South Africa miners could expect to sell 3,118 million tonnes of coal between 2018 and 2035. By 2017, models of global demand and supply suggested that expectations had fallen by 55% to 1,408 million tonnes. In a low-carbon transition, exports would fall a further 39%, to 854 million tonnes, or 73% lower than in BAU 2013. Additionally, our models suggest that lower export demand will also soften prices. We forecast that under a 2DS, the price of Richards Bay FOB coal in 2025 would be $68 / tonne compared with $106 in our BAU scenario and $141 in BAU 2013.

4.1.2 COMPANIES AND THEIR INVESTORS INITIALLY BEAR MOST OF THE RISK

Companies and their investors bear nearly 80% of the explicit risk from the coal transition, with the rest being borne by government. This risk would materialise through lower profits and lower profit margins per tonne sold as certain fixed costs, such as rail take-or-pay commitments, would not fall with production.

Figure 11 overleaf shows that of the miners, a third of the investor value at risk from the coal transition is currently concentrated in internationally diversified, investment grade majors. A further 30% accrues to the public balance sheet via SOEs such as Transnet and state-owned financial institution stakes in certain international majors and other private companies. BEE companies bear 4%.

Figure 10: Investors face most of the explicit allocation of external transition risk

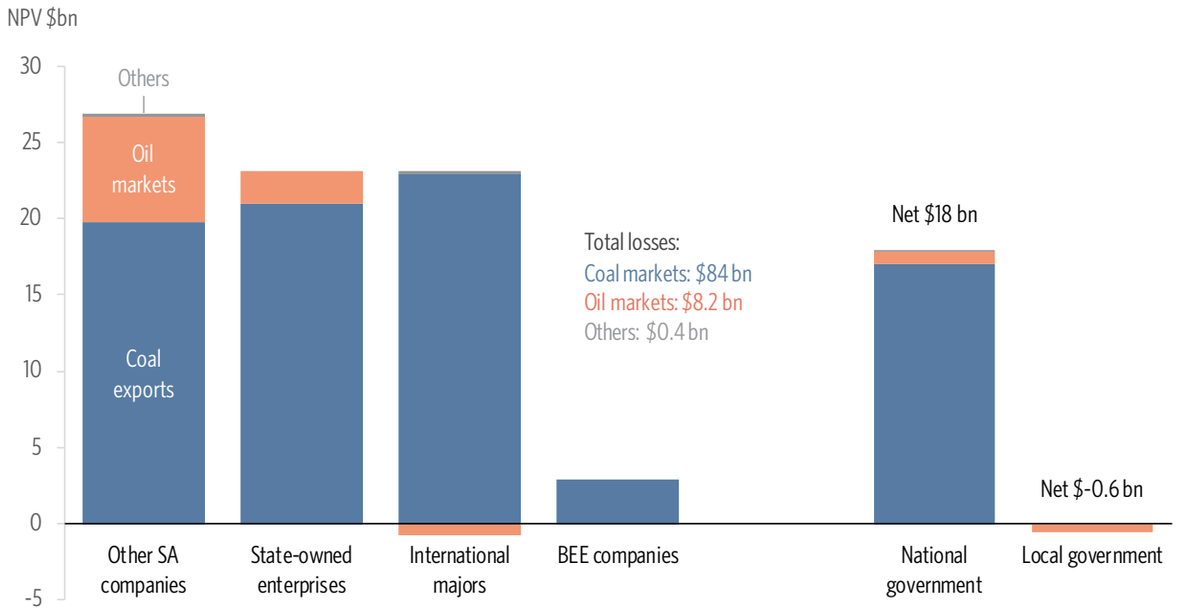
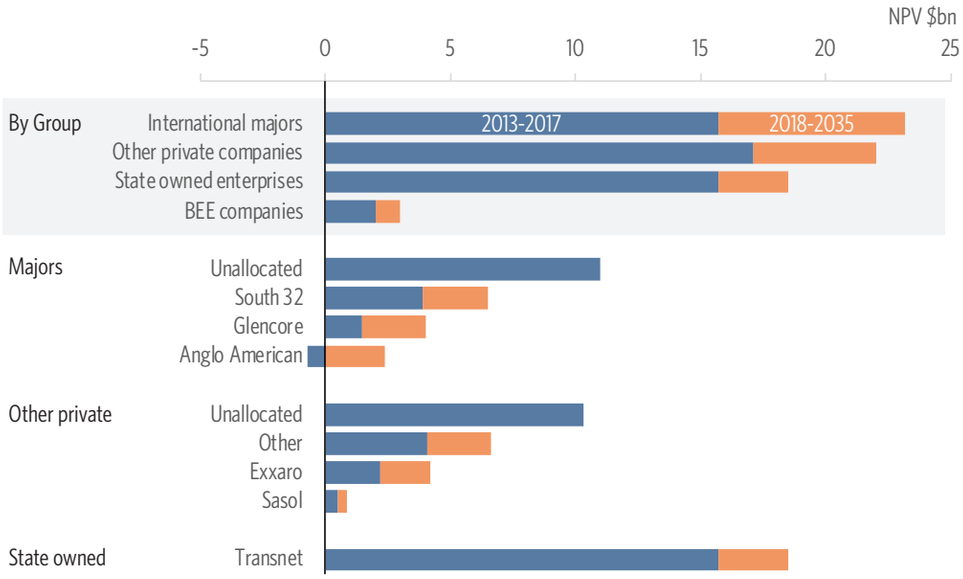


Figure 11: More than a third of the explicit risk is borne by internationally diversified majors



Transnet is protected from the risk of falling export volumes under the terms of its take-or-pay contracts until the middle of the 2020s.[56] After those contracts expire, we expect that it would be fully exposed to that risk as it would be unlikely to be able to recontract on a similar basis. Transnet will be in a weak negotiating position as annual export volumes of 32mt in 2026 would be much lower than the annual capacity of the rail line (currently 81mt). The financial impact ($15.7 billion already realised[57], $2.8 billion future) would be material for Transnet in the context of a balance sheet sized at just over $30 billion.

As illustrated in table 9, the impact on future export volumes falls mainly on the development of new South African coal resources. In the BAU 2017 scenario, new production represents 22% of total exports compared to 80% in the BAU 2013 scenario. By contrast, in the 2DS scenario, existing mines are sufficient to cover almost all projected exports.

Table 9: Projected 2018-2035 coal exports in mt

	BAU 2013	BAU 2017	2DS
Assets currently operating	957	1,098	813
New assets	2,161	310	41
Total	**3,118**	**1,408**	**854**

If the South African mining industry were to continue to invest in new assets based on forecasts of future exports or encouraged by recent high prices, it would face additional transition risk in relation to capital expenditure on developing new assets / resources which would not earn a return in a future depressed seaborne market.

4.1.3 CHANGE IN GLOBAL OIL MARKETS

Chapter 3 showed that a low carbon global economy is also likely to be one where crude oil prices are lower than they otherwise would have been in a BAU scenario. A trajectory of crude oil prices under our 2DS, which are as much as 35% lower under a 2DS than BAU through 2035, translates into a net benefit of $37 billion for South Africa as a whole. Consumers benefit by $45 billion, but companies in the South African oil industries would face risk of $8.3 billion. For fuel producers, end-user price regulation would limit the ability to protect profits against the impact of lower oil prices. If no efforts are made to constrain the increase in demand driven by more affordable fuel, government would see only slightly lower overall tax revenues ($0.2 billion)

56 Moody's has viewed Transnet's take-or-pay contracts on coal and iron ore lines as a key credit positive. In "Transnet SOC Ltd: Prudent Response to Capital Spending is Key in Low Commodity Price Environment" (2016), the analyst describes how the coal contracts run to the mid-2020s.

57 Risk "already realised" relates to the difference in the NPV of 2018-2035 cash flows between BAU 2013 and BAU 2017 cases, where as "future" risk relates to the difference in the NPV of 2018-2035 cash flows between BAU 2017 and our 2DS case.

as lower corporate taxes would be largely offset by an increase in fuel duties driven by higher consumption.

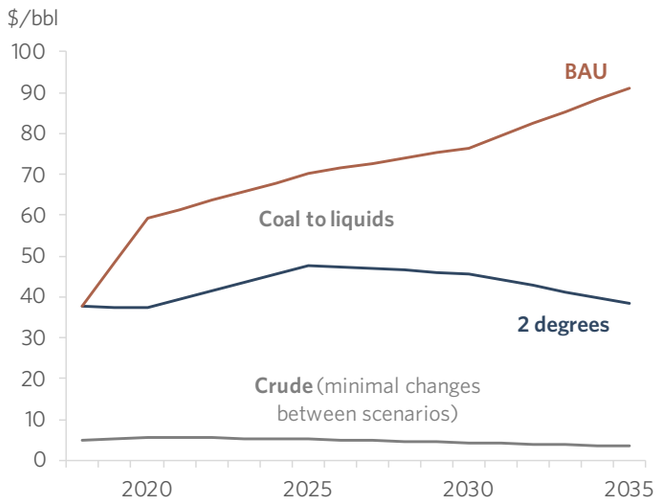
a. Synthetic fuel production hit while other parts of the value chain protected

In many countries, vertically integrated oil companies can offset the negative impact of lower oil prices on their exploration and production divisions by recording higher profits in refining and marketing operations, keeping end-user prices steady while input (crude) costs fall. In South Africa, oil companies do not have the power to set fuel prices to retail customers. Instead, the maximum price is set by the National Energy Regulator (NERSA).[58]

NERSA's regulation protects South African consumers against rising crude prices and volatility, leaving more oil price risk with oil companies than in markets without end-user price regulation. The regulation is also designed to protect the South African oil industry – in particular, refineries – against competition from cheaper imports that could undermine South African energy security and balance of payments. To meet these objectives, a regulatory pricing formula sets a "basic fuel price" that includes a regulated markup to global crude oil prices, in effect exposing South African refiners to lower crude oil prices while protecting their refining margins from external competition.

Since oil refineries can pass through lower or higher crude oil costs through the formula, they are largely unaffected by declining oil prices, benefitting in our scenario by a net $0.3 billion. Synthetic fuel producers have input costs that are less directly linked to oil prices – including coal at Sasol's Secunda plant and gas at PetroSA's Mossel Bay. Without the offsetting movements in input prices, these producers are strongly affected by lower product prices linked to lower crude oil prices losing $8.9 billion of value as a result. Secunda faces the majority of this risk but Sasol are likely to be able to mitigate some of this risk by increasing the share of natural gas feedstock, increasing the sensitivity of input costs to oil prices. Distribution businesses would gain by a $0.5 billion in total, mainly as a result of higher volumes, if no action is taken on constraining consumption.

Figure 12: The CTL would remain more profitable than crude refineries even in a 2DS



Source: Financial statements of oil refining companies, Sasol, CPI analysis

Our analysis shows that South African refineries remain competitive against imports in a 2DS. However, other potential costs, mostly unrelated to global crude prices, are likely to have larger impacts on future profitability. These costs include the carbon tax if it rises significantly, the cost of compliance with fuel economy regulation (eg, Clean Fuels II)[59] and the costs associated with expanding domestic refining capacity.

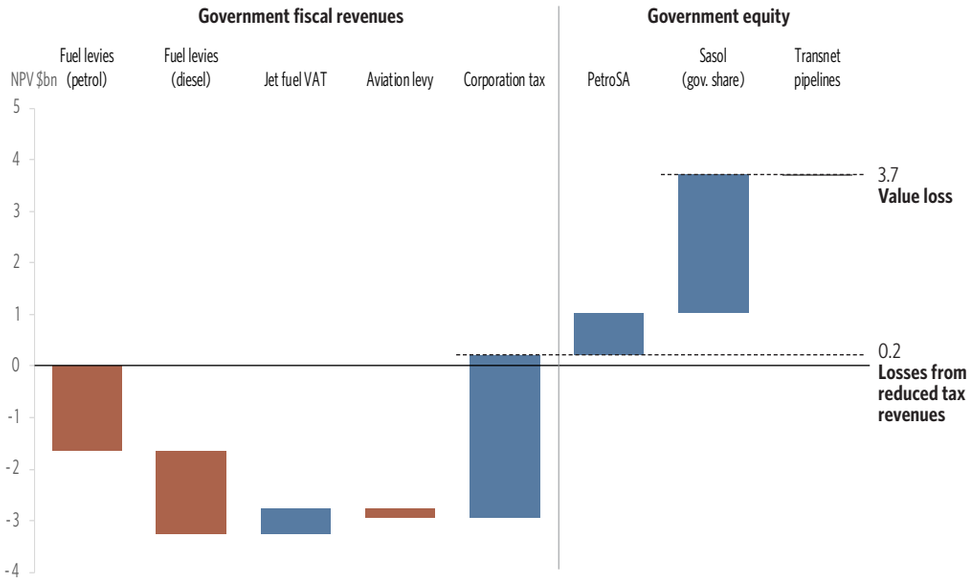
b. Government fiscal gains eroded by ownership of CTL and GTL production

As well intervening in the market to protect domestic workers and consumers, the South African state has a significant financial stake in the performance of its refining industry through its ownership of PetroSA and through the Industrial Development Corporation of South Africa (IDC) and the Public Investment Corporation (PIC), which together own 23% of Sasol. As illustrated in figure 13 overleaf, the value at risk that the public balance sheet bears through these stakes is far larger than the $0.2 billion net risk from lower taxes.

58 Source: http://www.energy.gov.za/files/esources/petroleum/December2018/Petrol-Regulation.pdf

59 Source: https://www.hydrocarbonprocessing.com/magazine/2017/april-2017/columns/refining-uncertainty-grips-south-africa-s-clean-fuels-program

Figure 13: Government net losses on tax are outweighed by losses on investments



4.1.4 SPLITTING TAX REVENUES BETWEEN NATIONAL AND LOCAL GOVERNMENT

Between the oil transition ($0.2 billion), the metals transition ($0.1 billion) and the coal transition ($17 billion), the national government would be set to lose $17.3 billion in tax revenues. However, although the national government collects the revenue, under the existing constitutional settlement, responsibility for public service provision is split between national, provincial and municipal governments, requiring a split in tax revenues. Just as government shares tax revenues with provincial and municipal governments, we would also expect it to share the risk of lower tax revenues with them.

South African local governments ("municipalities") have constitutional responsibilities for delivering a wide range of services, from providing electricity, water, sewage and waste services to basic social infrastructure. While they can raise some revenues directly from taxpayers via user charges for some services, they are reliant on government transfers of revenue raised centrally.[60]

There are two principal types of transfer – "conditional" transfers relate to specific projects such as grants to extend rural electrification or provide free basic services, "unconditional" transfers effectively represent budgetary support. The "equitable share" is an unconditional transfer set by legislation which allocates centrally raised revenue to provinces and municipalities on the basis of a set formula.[61] For a number of years, the national government has also tended to share a proportion of fuel duties and levies with metropolitan municipalities.[62]

The net impact on municipalities of a lower equitable share and higher fuel duties would be a nominal $0.2 billion decline in total revenue, leaving $17.1 billion of revenue losses with national and provincial government. This decline is composed of $0.8 billion lower equitable share transfers (assuming local government's current 9% share of nationally raised revenues) and $0.6 billion higher fuel levy transfers (assuming that metro municipalities continue to receive around one sixth of the total revenue raised).

The resulting distribution of risk would benefit metropolitan cities while district and local governments would lose out, as set out in table 10 below.

Table 10: Risk transfer to local government ($bn)

TYPE OF TRANSFER	METROPOLITAN CITIES	DISTRICT AND LOCAL GOVERNMENT	TOTAL
Equitable share	0.2	0.6	0.8
Fuel levy sharing	-0.6	-	-0.6
Total risk (gains in negative)	**-0.4**	**0.6**	**0.2**

60 From our analysis of the most recent (mainly year to 2017) financial statements of all South African municipalities, we found that government transfers were a material source of revenue for all, especially district and local municipalities

61 Source: https://www.researchgate.net/publication/241752363_South_Africa's_Provincial_Equitable_Share_An_Assessment_of_Issues_and_Proposals_for_Reform

62 Towards an alternative financing model for metropolitan cities in South Africa (South African Cities Network in partnership with City of Tshwane, 2017).

4.2. Implicit risk transfers

Although companies and their investors explicitly bear 80% of transition risk, our analysis suggests that they would seek to transfer as much risk as possible to other parties. We call these second order effects "implicit risk transfers". Table 11 sets out four principal strategies for companies seeking to offset their transition risk.

Table 11: Risk allocation strategies

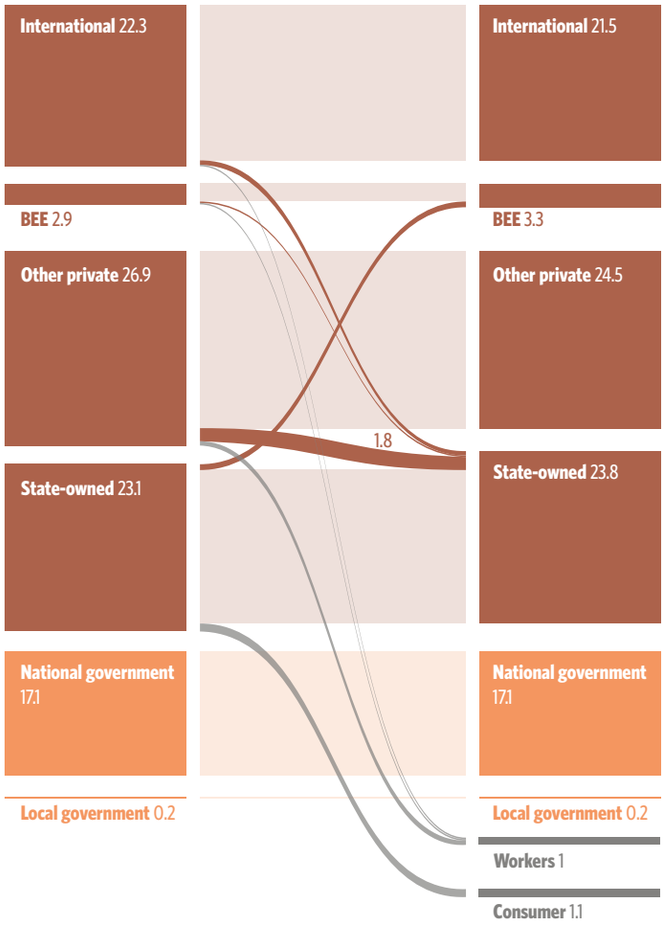
COMPANY RISK ALLOCATION OPTION	WHO IS AFFECTED?
1. Reduce controllable costs	Workers
2. Earn additional revenues in other markets	Eskom (state-owned banks and SOEs)
3. Close loss-making assets	Workers, local government, national government, Transnet (state-owned banks and SOEs)
4. Viability of other assets	Transnet

Parties on the receiving end of this transfer of risk may not have the capacity to bear the risk. Most workers and smaller municipalities will have limited ability to offset a loss in earnings and may need to fall back on the support of the state through unemployment insurance payments or additional fiscal transfers.

For many companies the level of residual risk after transfers may still be too high for them to bear. The result could be an increase in bankruptcies, pushing losses onto the financial sector and/or pressure on government to provide financial support (ie, "bailout" money) or otherwise risk job losses. These potential additional costs to government are contingent liabilities.

Figure 14 below illustrates these two sets of risk transfers – the implicit risk transfers and the contingent liabilities to government. The net result across the matrix is a major transfer of risk from companies and investors to national government.

Figure 14: Implicit risk transfers of external risk



4.2.1 COMPANY RISK TRANSFER STRATEGIES

a. Reduce controllable costs

As set out in table 12 below, companies will have some limited opportunity to manage transition risk by reducing controllable costs. We estimate this would be at least $0.5 billion.

Table 12: Reduce controllable costs – a reconciliation of risk transfers ($bn)

TYPE OF COMPANY	INVESTOR RISK BEFORE THIS STEP	RISK TRANSFERS	INVESTOR RISK REMAINING
International majors	22.3	0.0	22.3
BEE companies	2.9	0.1	2.8
Other private companies	23.9	0.4	23.5
SOEs	26.4	0.0	26.4
Total investors	**75.5**	**0.5**	**75.0**

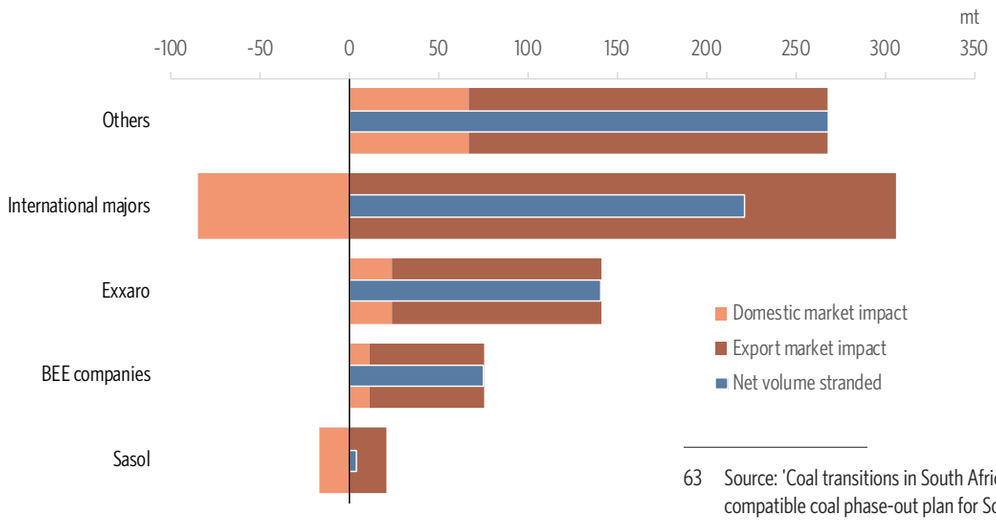
Most of the $0.5 billion of controllable costs come from labour, for instance reducing maintenance or operating staff as volumes decrease. These numbers reflect a greater opportunity to reduce costs at opencast mines, as underground mines tend to be more mechanised, but the variability of labour cost with production in coal mining is typically low compared to other mining sectors, such as platinum. The ability to reduce wages (if not headcount) may be higher in smaller mines, where according to a recent study[63], the proportion of contracted, rather than permanently employed staff is much higher than at larger sites.

Our modelling shows between 5,000 and 10,000 incremental jobs put at risk in the South African coal mining sector as a result of the collapse of the export mining sector, relative to business as usual. This would happen through a mix of redundancies at operating asset and mine closures (see section c below).

b. Earn additional revenues in other markets

Some coal mining companies will be able to shift a further $1.9 billion by selling coal in the domestic market that would otherwise have been sold to export markets.[64] But as domestic coal demand over the long term is fixed or declining, redirecting coal from exports to domestic markets will reduce production from other mines. Only where new mine investment can be avoided, or where the cost of producing the redirected coal is lower than the coal it replaces, will this redirection lead to lower overall risk, rather than just a transfer of risk between two companies.

Figure 15: How much volume from existing asset base is recovered in the domestic market (by company)



63 Source: 'Coal transitions in South Africa: Understanding the implication of a 2C compatible coal phase-out plan for South Africa' (Burton J, Caetano T, McCall B, 2018)

64 Our modelling assumes that this production might be available to Eskom at first on a short-term or "spot" basis. We estimate the size of the "spot" requirement for each power station in each year by taking into account Eskom's existing contracts, which we assume are re-contracted at expiry and run until the end of our period of analysis, the life of the mine or the operating period of the power plant, whichever comes sooner

Table 13: Earn additional revenues in other markets – a reconciliation of risk transfers ($bn)

TYPE OF COMPANY	INVESTOR RISK BEFORE THIS STEP	RISK TRANSFERS	INVESTOR RISK REMAINING
International majors	22.3	0.3	22.0
BEE companies	2.8	-0.6	3.4
Other private companies	23.5	1.4	22.1
SOEs	26.4	0.0	26.4
Total mining sector impact		1.9	
Total trucking sector impact		-0.8	
Total	**75.0**	**1.1**	**73.9**

In practice, the "domestic market" refers to Eskom as the principal buyer of coal for use in power generation. Other major consumers either have their own coal supply, as in the case of Sasol, or require different types of coal, as in the case of the steel industry.

Eskom currently buys coal under a range of long-term contracts, supplemented by shorter-term markets.[65] The size of potential Eskom demand that could be serviced by export coal therefore depends on the amount of generation expected in each year and the roll-off profile of the long-term contracts. Based on the current profile of generation included in the draft Integrated Resource Plan, our analysis suggests that total power sector coal consumption would peak at 150 mt per annum in the early 2020s although the amount sourced in the non-contracted market (ie, the size of the "spot" market") would continue to rise before peaking in 2027, unless Eskom changes its coal procurement strategy to increase the proportion of longer term contracts.

As illustrated in figure 15 on the previous page, our analysis indicates that international majors would be better positioned to sell additional volume to Eskom if exports declined, while the smaller players could see their own domestic market share displaced. This shift in the structure of the domestic market by itself could jeopardise the viability of smaller domestic players, including those who do not have access to export markets and thus are not explicitly impacted by the external transition. Eskom's coal trucking costs would also fall in this scenario (by $0.8 billion) as it would be able to source coal from larger mines closer to its power plants.

65 Our understanding of Eskom's outstanding contracts was taken from Report in respect of the investigation into the status of the business and challenges faced by Eskom, instituted by the board of Eskom Holdings (SOC) Ltd in terms of a resolution passed on 11 March 2015. (Dentons, 2015)

The changing dynamics in the domestic market would result in increased coal costs for Eskom[66], raising the combined cost of coal procurement over the period by $1.1 billion (or 3% over BAU). Although Eskom's regulatory framework allows it to efficiently pass through coal costs to power consumers, an incremental increase in power prices driven by higher coal costs is unlikely to be neutral for Eskom's financial position. In fact, it could further compound the increase in bad debts resulting from a weakening of municipality credit profiles after a reduction in fiscal transfers.[67]

Unless the planned restructuring of Eskom is successful in improving the company's credit profile, any additional transition downside impact on Eskom would likely need to be borne implicitly through government, via an increase in government-guaranteed debt.

c. Close loss-making assets

If after implementing all the above measures, companies still expect certain assets to be loss-making, they may decide to close them before the scheduled end of their lives. Selective closure of assets would reduce companies' exposure to transition risk at the expense of Transnet, workers, national and local government. Based on our assessment of the assets that would become unviable in a 2DS, mining companies could offset their total risk a further $1.1 billion by closing them early.

Table 14: Close loss-making assets – a reconciliation of risk transfers ($bn)

TYPE OF COMPANY	INVESTOR RISK BEFORE THIS STEP	RISK TRANSFERS	INVESTOR RISK REMAINING
International majors	22.0	0.4	21.6
BEE companies	3.4	0.1	3.3
Other private companies	22.1	0.6	21.5
Risk mitigation from early closures		1.1	
SOEs	26.4	-0.7	27.1
Total	**73.9**	**0.4**	**73.5**

66 Our analysis showed differing impacts for power plants in Mpumalanga vs. Limpopo. In Limpopo, due to a less competitive market with a limited number of suppliers, fixed costs associated with stranded export coal (such as take or pay rail contracts with Transnet) are passed on to the domestic market increasing the average cost of coal to Eskom. In Mpumalanga the excess supply and the competitive nature of the market offsets this impact and causes a slight fall in the average cost of coal for the province.

67 Eskom's municipal bad debt has increased over the course of 2018 despite threats of power disruption to non-payers, debts stood at R17bn at the end of September 2018. Source: https://www.businesslive.co.za/bd/companies/energy/2018-11-14-municipal-debt-to-eskom-balloons-to-r17bn/

Table 15: Impact of closing mines on workers, municipalities and Transnet ($bn)

RECEIVER OF RISK	AMOUNT TRANSFERRED ON MINE CLOSURE	IMPACT/ISSUES
Workers	$0.5 bn	Early closures in a 2DS scenario could accelerate the loss of around 2,000 coal-related jobs. Highly skilled workers (~10% according to IDDRI/UCT-ERC estimates[68]) are likely to find new work without government support. Low and medium skilled workers may need support and social costs of up to $500m. This $500m is in addition to the $500m of risk that will come from reduction of controllable costs in mines that continue to operate.
Metropolitan Municipalities	0 (larger munis are not home to potential early closure mines)	Munis with early closures could lose up to $100m of CSI contributions. Assets at risk of closure are located in a small number of municipalities. The country's coal mines and coal-fired power stations are concentrated in 29 local and district municipalities (10% of the total number of municipalities), which represented about 5% of total municipal revenues in 2017 or 12% of total district and local municipal revenues. Some of these are already under financial stress. In 2017, the 29 municipalities in question had slightly more than R250 million of financial debt (only 0.4% of total municipal debt). Some, such as Emalahleni in Mpumulanga also had significant debts to Eskom for bulk power that they have not been able to pay for. Municipality debts to Eskom have risen by 6x over the last 5 years. District and local municipalities overall are already more dependent on fiscal transfers than metropolitan municipalities and bear much more explicit risk. These may therefore be much more likely to default than their larger counterparts.
District and local municipalities	$0.1m	
Transnet	$0.7bn	Loss of transport volumes from closed mines would impose losses on Transnet if it were unable to recover revenues associated with terminated take-or-pay rail contracts. Losses of $0.7 billion would not, by themselves, be significant in the context of a company with total assets of over $30 billion. Given the nearly $20 billion in explicit risk that the company could face, Transnet's financial profile could deteriorate sharply in the mid-2020s, depending on which scenario it has used for planning its investment in capacity expansions.
Total	**$1.3**	

Under a 2DS, our model showed that several of the most expensive mines in operation today would be unviable and generate a negative return between 2018 and 2035. Closing these mines would remove 1.6 mtpa of production in KwaZulu-Natal and 6.8mtpa of production in Mpumulanga immediately, followed by a further 15.2 mtpa of production in Mpumulanga in the mid-2020s. Today's Limpopo mines, which are much more focused on the domestic market, remain profitable in even under our 2DS, provided that Medupi is fully commissioned in line with the assumptions in the draft IRP.

Closing mines early would avoid company losses associated with keeping the assets open, although it would accelerate the requirement to fund decommissioning. However, the closures would result in lower royalties to the national government and could mean lost earnings for mine workers and mining company contributions to municipalities for social infrastructure ("corporate social investment" or CSI)[69], as well as lost revenues or higher costs to workers, municipalities and Transnet, as in table 15.

d. Viability of other assets

Our analysis suggests that after 2025, Transnet's coal rail line would only just break-even before becoming loss-making after 2030. Given that profits from the coal line are currently used to subsidise tariffs in the general freight business, the swing from a strongly profit-making to a loss-making asset, combined with the boost to the competitiveness of road freight provided by lower

68 Coal transitions in South Africa: Understanding the implication of a 2 degrees C compatible coal phase-out plan for South Africa (University of Cape Town Energy Research Centre, 2018)

69 Ibid. Minerals Council of South Africa (2017) suggested that the mining industry targets CSI of at least 1% of net profit after tax

70 Ibid. Burton et al (2018)

liquid fuel prices could damage the general freight business. Transnet could consider the possibility of shutting the rail line when it becomes loss-making, even if there is still demand for South African coal on the export market.

For Transnet's shareholder, the national government, the case for the early closure of such a strategic asset may be less straightforward. Shutting the rail line would pull South Africa out of the global seaborne market and would physically strand any coal that would otherwise be profitably exported – even in a 2DS. An accelerated shut-down of South Africa's export coal would also likely result in the shut-down of the privately-owned Richards Bay Coal Terminal, although the Richards Bay port itself appears diversified enough to withstand such a change. There would also be a negative impact on the balance of payments.

Provided that the economy could bear such short-term losses, our analysis showed that even after taking into account the value that would be lost from curtailing exports, shutting the rail line in the late-2020s could be neutral or even net positive for the country's economy, as illustrated in table 16 below.

Table 16: Assessment of potential rail closure decision ($bn)

FACTOR INFLUENCING DECISION TO CLOSE	VALUE
Export coal profits lost	-0.9
Richards Bay Coal Terminal profits lost[70]	-0.1
Government royalties lost	-0.1
Job losses (Richards Bay Coal Terminal)[71]	-0.3
Subtotal value lost	-1.4
Rail losses avoided	0.2
Lower power station coal costs [72]	1.5
Subtotal value gained	1.7
Total net value gained by an early closure of the rail line	**0.3**

Table 17: Summary: key groups after implicit risk transfers ($bn)

ECONOMIC ACTOR	EXPOSURE AFTER IMPLICIT RISK TRANSFER	IMPLICATIONS FOR SOUTH AFRICAN FINANCIAL SYSTEM
Companies (international majors)	21.6	Limited. Investment grade ratings and high financial flexibility. Limited dependence on South African financial institutions
Companies (BEE)	3.3	Heightened risk of default / value loss but small size of individual exposures means limited impact on balance sheet of lending institutions
Companies (other private)	21.5	Range of impact, from heightened risk of default to moderate decline in creditworthiness of coal loan book.
SOEs (Eskom)	-	Limited given almost all SA private sector exposure to Eskom is government-guaranteed.
SOEs (Transnet)	27.1	Weaker creditworthiness could require SA banks ($1 billion exposure) to hold more capital against Transnet loans and a downgrade below investment grade could force institutional investors ($0.3 billion) to sell.
Total investors	**73.5**	
Local government	1.4	Increased risk of default. The Development Bank of Southern Africa (DBSA) bears most of this risk as the largest lender to South African municipalities.

71 While Richards Bay port is owned by Transnet, Richards Bay Coal Terminal is privately owned by the mining companies

72 Our analysis did not attempt to quantify the potential value of a refurbished Richards Bay Coal Terminal. We assumed that the port itself would remain open.

73 Our domestic coal mining modelling showed that coal previously destined for export, but physically stranded by closure of the rail line would be cheaper to Eskom than the coal it would otherwise have needed to procure

4.2.2 IMPLICATIONS FOR THE FINANCIAL SECTOR

Together, these implicit risk transfers, would result in risk mitigation for companies of nearly $3.5 billion, including $2.3 billion of transfers to workers ($1 billion) and Eskom's power customers ($1.1 billion). However, they would be still left with over $70 billion of risk to bear on their balance sheets. As set out in table 17 on the previous page, if the coal mining industry continues to be financed as it is today, the South African financial system would see an increase in default risk, although not of a magnitude that would destabilise the system.

4.2.3 FINANCIAL SECTOR

a. Private sector banks

South Africa's private financial system is dominated by four major banks: Absa, First Rand, NedBank and Standard Bank. As of June 2018, these banks had total assets of R5.3 trillion or $370 billion.[74]

The banks do not provide public information on their exposure to the sectors that we identify in this report as at risk from a low-carbon transition. However, there have been reports of bank lending to coal mining projects in a range of structures, including project finance and working capital. A report published by the Heinrich Boll Foundation / Kigoda Consulting[75] provides the most up-to-date summary of these issues.

The loans identified in the report have a range of tenors – from working capital facilities, which we assume to be short-term, to seven-year loan facilities. For loans of a shorter-tenor, provided the companies or mines they relate to are still cash-generative by the maturity of the loan, they may be able to protect themselves against transition risk (which we expect to accelerate in the mid-2020s) although given the narrowing band of banks willing to lend to the sector even now, a refusal to refinance could in itself accelerate the insolvency of smaller mining companies. For those banks who have extended funds for a longer tenor, loans on their current book may become non-performing, in which case the amount of risk they ultimately bear could depend on the structure and security of the loans.

b. Industrial Development Corporation of South Africa

IDC's role as a national development finance institution has in recent years appeared to act as (equity and debt) capital provider of last resort to South Africa. As a development finance institution, the bank tends to take on risks (both on creditworthiness and tenor) that the private financial sector would not take and hence we expect that it would be the most exposed entity in the South African financial sector to a decline in the prospects of the coal mining and refining sectors.

As set out in table 18 below, the level of transition risk in IDC's existing portfolio could be material at over 10% of the value of its total loans and investments as at June 2018.

Table 18: IDC transition risk summary

TYPE OF INVESTMENT	EXPOSURE / RISK (USD BILLION)
Total loans and investments	6.2
Equity – Sasol	0.6[75]
Equity – Coal Mining Companies	0.01
Debt – Coal Mining Companies	0.05
Total transition value at risk	**0.7**
Transition value at risk / investment book	**11.2%**

A deterioration in IDC's balance sheet would increase its non-performing loan ratio (in 2017 this was nearly 25%, more than 10 times higher than the highest ratio among other large banks[77]) and erode its capital base, which in turn could impact on its ability to play a full role in financing new industries emerging from a low carbon transition

Putting any un(der)priced transition risk to one side, IDC has a material single name concentration on Sasol with the value of its investment at slightly more than $2 billion or 36% of total loans and investments and 55% of the group's equity portfolio. Concentrated risks are typically regarded by rating agencies as credit negative[78] and they may reduce the incentive for IDC to invest in technologies / sectors (for example in low carbon transport) whose businesses might undermine Sasol's market position.

74 Total assets according to the 30 June 2018 interim results were R1.2 tr for Absa, R1.5tr for First Rand, R1bn for Nedbank and R1.6 tr for Standard Bank

75 Financing Investments in the Energy Sector. Kigoda Consulting (2017)

76 This is calculated by multiplying Sasol's transition value at risk by IDC's ownership share in the company (see Annex A for more details)

77 Source: South Africa – Major banks analysis" (PWC, March 2018): https://www.pwc.co.za/en/assets/pdf/2h17-major-banking-analysis-march-18.pdf

78 Based on rating methodologies for major rating agencies. Moody's (August 2018): https://www.moodys.com/researchdocumentcontentpage.aspx?docid=PBC_1128883

c. Development Bank of Southern Africa

Like IDC, DBSA has a large single name concentration risk. However, in DBSA's case, this is Eskom, where, even though the facility does not benefit from a government guarantee, DBSA might expect the South African government to support the company's credit profile.[79] The principal exposure to transition risk in its current portfolio is in its lending to South African municipalities.[80] DBSA is the largest debt funder of the municipalities, providing more than half of the total non-bond debt.[81]

As set out in table 19 below, DBSA's exposure to district and local government municipalities is a relatively small part of its current portfolio risk. Even if all the loans were all to default in a transition – something which we consider very unlikely given what the implications would be for service provision – its exposure would be lower than that of IDC.

Table 19: DBSA transition risk summary

TYPE OF INVESTMENT	EXPOSURE / RISK (USD BILLION)
Total loans and investments	5.8
Maximum transition risk: all loans to district and local municipalities	0.4
Maximum transition risk / investment book	7.7%
Loans to municipalities where coal mines and coal power plants are located	0.1
Coal exposure / investment book	2.2%

d. Public Investment Corporation

The Public Investment Corporation is the government's asset manager and has a much larger and more diversified book than the state-owned financial institutions. While it does provide private equity and debt finance to coal mining firms and projects through its asset allocation to private markets, it principally invests in publicly traded securities.

In theory, this means that it should have more options for hedging its embedded transition risk. In practice, as owner of more than 50% of Eskom and more than 60% of rand-denominated Transnet bonds, its debt portfolio is likely to be relatively illiquid. In the event that Transnet lost its investment grade rating, PIC may be pressured into taking more transition risk, acting as buyer of bonds from institutions who are no longer able to hold the notes once they fall below investment grade.

Table 20: PIC transition risk summary

TYPE OF INVESTMENT	EXPOSURE / RISK (USD BILLION)
Total AuM	91.8
Equity – Anglo American	0.2
Equity – Sasol	1.0
Equity – Exxaro	0.4
Value at risk in equities	1.6
Transition value at risk / investment book	1.7%
Bonds – Eskom	5.5
Bonds – Transnet	1.8
Bonds – IDC	0.1
Bonds – DBSA	0.9
Debt exposure to companies facing transition risk	8.3

4.2.4 NEW INVESTMENTS COULD INCREASE TRANSITION RISK

South African financial institutions have varying abilities to hedge transition risk in their existing portfolios, but they need a careful incorporation of transition risk analysis into investment processes to avoid new investments which could increase their transition risk.

The actions of state-owned DFIs is particularly important, in many cases acting as capital-providers of last resort. The participation of IDC, PIC and DBSA may sometimes make the difference between a deal going ahead and not. At a time when President Cyril Ramaphosa is seeking to attract $100 billion in new investment over the next five years, there may be a temptation to invest in "tried-and-tested" sectors, conserving jobs in the short-term, but increasing the concentration of risk exposure in a small number of sectors. Higher concentration in these sectors is likely to increase transition risk in the country, raising the likelihood of a future sovereign downgrade, while

79 Moody's assumes a 'strong level of government support...underpinned by Eskom's strategic importance in the government's social and economic policy' (https://www.moodys.com/research/Moodys-downgrades-Eskoms-ratings-to-B2B3Ba2za-NSR-negative-outlook--PR_381305)

80 The impact on South Africa of global and low carbon transitions will also have ripple effects for key trading partners in the SADC region and potentially for DBSA's exposures in those countries.

81 Based on an analysis of the most recent municipality financial statements (mostly 16/17, some 15/16) available at the time of analysis. The analysis covered all metropolitan, district and local municipalities, with information sourced from https://municipaldata.treasury.gov.za

undermining the ability to diversify the economy away from volatile commodity exports.

We identified the following potential investments as – set out in table 21 below – that could proceed with state or DFI support over the next 1-3 years. Some would increase South African transition risk (eg, rail lines) whereas for other large investments (eg, refineries), the picture is more uncertain.

Table 21: Future investments that could increase transition risk above the level in our analysis

ASSET	SIZE OF INVESTMENT (USD BILLION)	STAGE OF INVESTMENT
Rail lines – Expansion of Mpumulanga – Richards Bay line to 97.5 mtpa	0.6	Planning
Rail lines – Waterberg expansion to 24 mtpa	0.1	Planning
Rail lines – International links (Swazilink, Botswana link)	0.4	Pre-feasibility studies
Coal IPPs (Thabametsi and Khanyisa)	2.8	In financing discussions
Coal mines – Limpopo	1.4	Range: from construction to feasibility
Coal mines – Mpumulanga	0.5	Range: from construction to feasibility
New oil refinery	10.0	Procurement being designed
EMSEZ industrial zone (Limpopo)	10.0	Planning
Total potential investments	**25.8**	

a. Rail lines (total identified potential investment: $1.1 billion)

Our analysis identified $1.1 billion of potential investment in expanding the capacity of rail lines designed to transport cargo to ports and either explicitly dedicated to coal or where we expect the investment case would be dependent on transporting coal. Transnet has financed recent rail capacity extensions on balance sheet, but is increasingly looking at alternative funding models, including PPPs, which would enable it to spread its risk. This could enable the participation in a project financing of state-owned DFIs, such as DBSA.

For Transnet and any co-investors and lenders, the decision to proceed with the projects would likely depend on a) their view of the likely development of the export market; b) the risk allocation in the contracts that miners and other users of the line would be willing to sign; and c) the potential to convert the line to transport cargo that was not originally envisaged in case the original investment case underperformed.

The investment would follow a recent programme to extend the capacity of the Mpumulanga – Richards Bay line from 75 mtpa to 81 mtpa. The first two phases of the extension line to Waterberg are complete, enabling 6mtpa of coal from Limpopo to be transported to Richards Bay. In a BAU scenario, we expect that these investments would pay off, but there would be little scope for further capacity expansion with South African coal exports set to peak at closer to 85 mtpa. In a 2DS, the already-implemented capacity increase would not be required, let alone the long-term plan to expand capacity on the line to 97.5 mtpa. Any further capacity increases on this line would not earn a return for Transnet and compound the risks to its credit profile.[82]

It is unclear whether the proposed Waterberg extension could be repurposed to allow excess mining capacity in Mpumulanga to be transported to Limpopo power stations and whether earlier-stage projects, such as the Swazilink (in financing discussions) or a Waterberg-Botswana extension could, if built, be repurposed to carry other cargo[83]. However, investments which would not be viable based on alternative uses to transporting coal for export could also deliver negative returns.

b. Power plants: Thabametsi and Khanyisa IPPs (total identified potential investment: $2.8 billion)

The South African electricity sector is currently waiting for a final decision in respect of $2.8 billion of potential investment in 1GW new coal-fired power plant capacity to be built by independent consortia. As of publication, the capacity remains in government's future plans despite the apparent withdrawal from the deals of private sector funders Nedbank and Standard Bank.

Funders may be hesitating because of the medium-term risk that the South African government might intervene to force the early shut-down of the stations as part of a policy to accelerate carbon emission reductions. Concern over costs could become cause for an early shutdown as the two assets are already 80%

82 The total investment could add more than 10% to 2018 net debt and represent 3% of total assets

83 Public information about the likely cargo of the Swazilink line, in particular, is inconclusive about the amount of coal planned to be transported on the line

more expensive than new generation (such as wind and solar) from alternative sources, such as wind and solar.[84] The disparity is only likely to grow. A recent University of Cape Town Energy Research Centre paper[85] estimated that the decision to invest in them, rather than a least-cost-plan, could cost the country R20 billion (or just over $1 billion) over 2015-2052.

However, equity investors (such as Marubeni, KEPCO and ACWA Power) may decide to proceed if they can convince lenders that long-term take-or-pay contracts with Eskom, government guarantees, and other contractual provisions are sufficient to offset the political risk.

Unlike the rail investment, the profitability of the Thabametsi and Khanyisa IPPs would not directly be impacted by the decline of the export coal market. However, the solvency of their coal suppliers might be, depending on their current exposure to the export market and the investments that they make in new assets.

- For Anglo American, earmarked to supply Khanyisa from the discard pile of its Khwezela mine, we have learned that its exposure to transition risk would likely be manageable given its diversified global portfolio and that it does not plan significant new investment anywhere in the world in thermal coal (see Anglo American summary in Annex A).
- For Exxaro, which would supply the Thabametsi power plant from its namesake mine, the risks to its balance sheet from its planned development of the Waterberg region could be significant, potentially resulting in financial distress.

If the coal supplier to one of these projects went bankrupt or reneged on the contract, the projects would have to source alternative coal, which would most likely come at an increased cost, reducing the return of the equity investors. Potential lenders who factor in transition risk at the outset might seek contractual protection against this risk via collateral or letters of credit or risk a default further down the line.

Beyond the political risk that IPP investors will face and transition risks related to their coal supply contracts, potential lenders to the IPPs with exposure to Eskom may consider not lending to the IPPs given the negative indirect impact that it would have on Eskom. Avoiding the IPPs would result in lower costs to the consumer and hence lower Eskom bad debts as well as lower coal procurement costs for the Eskom fleet (totalling $1.1 billion) as capacity from the Thabametsi mine is freed up to supply Eskom's Medupi rather than the latter having to bring in coal at greater expense from Mpumulanga.

c. Coal mines (total identified potential investment: $1.9 billion)

There are at least $1.9 billion of potential investments in South African coal assets and developments, with most concentrated in the Waterberg region in Limpopo.[86] With the draft IRP including no coal IPPs beyond Thabametsi and Limpopo, this potential new capacity would have to rely either on outcompeting existing mines or on accessing the export market.

Table 22: Costs and benefits of moratorium on new mine development

POLICY / STRATEGY	AVOIDED NPV-NEGATIVE INVESTMENTS FOR MINERS (USD BILLION)	ADDITIONAL COAL COSTS RELATIVE TO 2DS	NET BENEFIT OF NOT BUILDING COAL MINES (BENEFIT IN POSITIVE)
No new coal mines commission after 2020 (country-wide)	7.8	8.0	-0.2
No new Mpumulanga coal mines after 2020	2.4	1.2	1.2
No new Limpopo coal mines after 2020	5.4	7.1	-1.7

84 'An assessment of new coal plants in South Africa's energy future: the cost, emissions and supply security implications of the coal IPP programme' (Ireland G, Burton J, 2018)

85 Ibid. Ireland G et al (2018)

86 This refers to projects which would commence after 2023 including the second phases of the Thabametsi and Boikarabelo mine developments as well as the general Waterberg development. All three of these are in Limpopo and are not tied to any approved new IPP or Eskom power capacity additions.

Table 23: Key unanswered questions which could affect the viability of a new oil refinery investment

KEY QUESTIONS TO BE ANSWERED BEFORE CONFIRMING INVESTMENT IN A NEW OIL REFINERY
1. Would the new refinery be designed in part to serve export markets? If so, what would South Africa's competitive advantage be?
2. If it is planned primarily to serve the domestic market, would a new refinery investment be resilient (or an obstacle) to a future set of policies designed to reduce carbon emissions in the South African transport sector?
3. Would the new refinery be designed to provide South Africa's domestic low-sulphur (Clean Fuels II-compliant) demand? If so, what is the plan for the existing refineries?
4. Are Clean Fuels II investments (for all or part of the refining industry) and a new refinery mutually exclusive?
5. How have balance of payment considerations been taken into account when considering the option of a new refinery, relative to other policies?
6. Would the current system of fuel price regulation need to be adjusted to allow the new refinery to earn a return on capital?

In our BAU case, much of this capacity would be built and would be profitable. However, very little of it would be competitive in a 2DS scenario where export demand is much lower and Limpopo-based power stations would be unlikely to be competitive given the high cost of transporting coal to Richards Bay.

Our analysis shows that South Africa could supply all its power plants and industry with coal until the 2030s without developing any new mines or resorting to imports. Furthermore, we found that even though not building new mines would prevent job creation in the sector in the short-term, it would be positive for mining jobs in the medium-term. If miners focused on generating cash from existing mines, rather than investing in new developments, this would likely result in stronger balance sheets and less risk of bankruptcy of entire companies.

However, the economic case for not building new coal mines on a countrywide level is not simple. A "no new mines scenario" would reduce competition in the domestic coal market and could therefore push up costs to Eskom, with a knock-on impact on power prices. We modelled the impact of three scenarios, accounting for the mine-specific cost estimates, the location of each mine relative to each power plant, and the demand of each power plant for coal over and above the amount secured via long-term contracts.

As table 22 on the previous page illustrates, our analysis showed that not building new mines in Limpopo could result in an increase in power sector coal costs that outweighed the benefit avoiding NPV-negative investments in the mining sector. In Mpumulanga, the opposite was the case. The dynamics are different because of the tighter starting supply/demand balance in Limpopo and the likely excess of production in Mpumulanga.

In fact, avoiding new coal mine investments and instead investing in Mpumulanga/Limpopo rail capacity would likely be a cheaper way of utilising excess Mpumulanga production stranded in a 2DS scenario.

d. New crude refinery and EMSEZ Industrial Zone (Limpopo) (total identified potential investment: c. $20 billion)

Beyond the coal and power sector investments which have an obvious transition risk exposure are two larger projects that could attract significant foreign investment but for which the commercial models and risk profile do not appear to be defined. Investing in these projects without a clear understanding of the medium- and long-term risks could increase transition risk exposure to the South African economy.

The government has been considering building a new oil refinery for close to ten years, with recent estimates for the cost of a unit with a throughput of 400,000 barrels-per-day at around $10 billion. However, current uncertainty around policy on the future of oil, gas and transport in South Africa means it is not possible to say if the refinery would increase or decrease transition risk in South Africa. Such a judgement would require answers – at a minimum – to the questions in table 23.

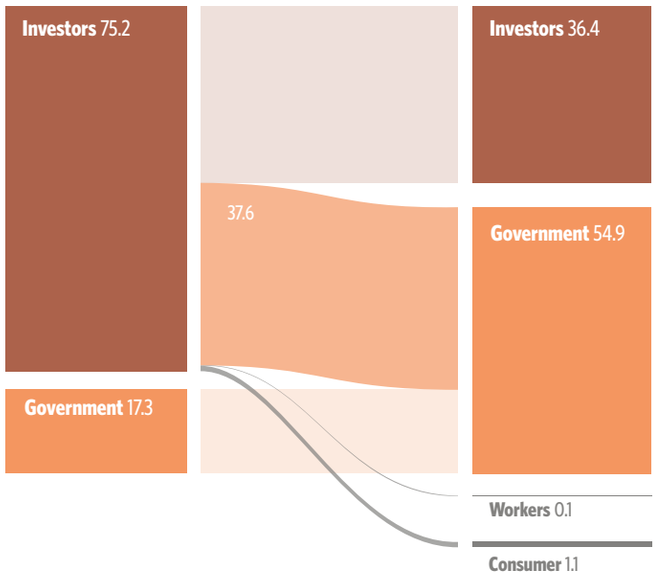
Similar questions will need to be asked about the EMSEZ Industrial Zone project signed with a Chinese consortium early in 2018 and about which few details have yet been released.[87]

87 There is little public information about this project and the power plant included in the plan does not feature in the draft IRP. Source: https://www.thesouthafrican.com/china-south-africa-limpopo-coal-concern

4.3. Summary

Under a 2DS, the magnitude of the transition downside would result in up to $38 billion of transition risk that could implicitly fall on parties, such as small companies, workers and municipalities, who are unable to bear the risks as summarised in figure 16 below.

Figure 16: Impact of implicit risk transfers and contingent liabilities (NPV $bn)



Unless it is made clear who will bear these risks, they may well fall back to the national government in an uncoordinated way. This and other factors not quantified here could lead to increased contingent liabilities which could lead to further pressure on the sovereign credit rating.

This $38 billion estimate may be conservative because it assumes the continuation of the existing ownership patterns within the coal and oil industries. However, the pattern of involvement of large international companies in the oil and coal sectors has been changing in recent years, and in ways that may increase contingent liabilities to the government.

An uncertain investment environment could be driving this trend, but strategic decisions to reduce exposure to the thermal coal sector may be a factor. Table 24 below highlights some of the major divestments over the last four years – although there is a divergent trend in buyers between the coal and oil sector.

The recent bidding process for Chevron's oil assets saw Glencore outcompete Chinese Sinopec and a series of other international players, highlighting the strategic importance of South Africa in the oil market as a trading hub, as a market in itself and as a means of access to other markets in Sub-Saharan Africa. By contrast, in the coal sector, there has been a clear trend for international majors to sell down to local players with weaker balance sheets.

With few international mining companies still active in thermal coal mining, we expect that the remaining majors may follow the lead of Total and South32 and seek to sell their assets while transition risk is not fully priced in. Increasing ownership of South Africa coal resources by South African companies could reduce the capacity of the industry to absorb transition risk, making them more likely to consider radical measures such as asset closures, and ultimately – defaults and bailouts.

4.3.1 TIMING OF EXTERNAL RISKS

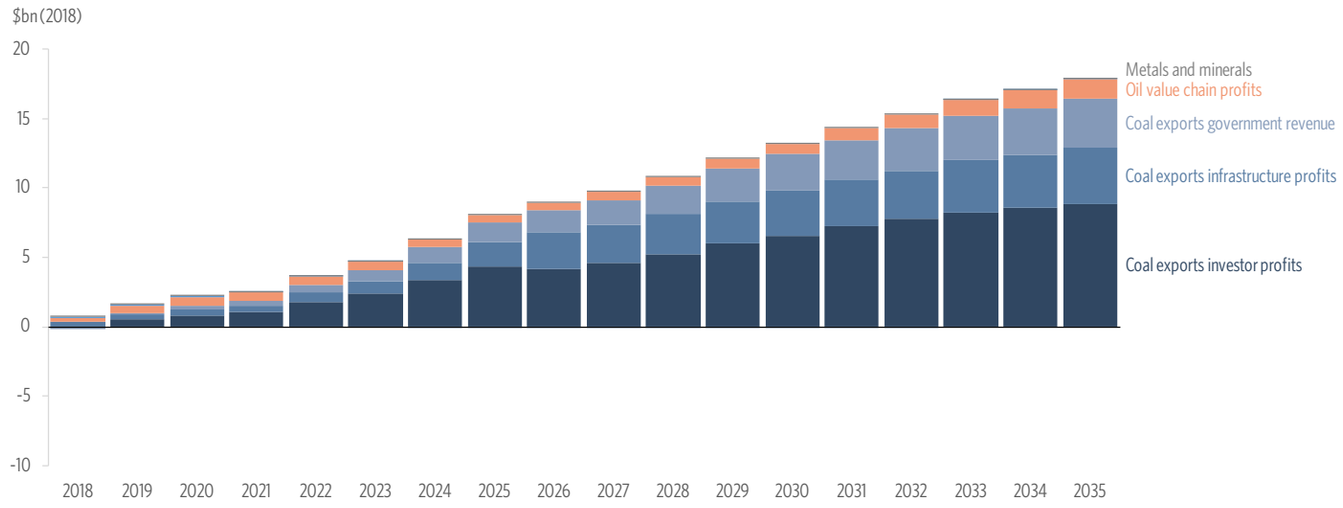
In our analysis, risks to investors, infrastructure owners and government are spread over the next 17 years, reaching over $16 billion per year (in real 2018$) by 2035. Although we have not looked beyond 2035, our analysis suggests that these risks would accumulate for a few years after, before declining. The risk here represents the difference in revenues less incremental costs that would occur each year of our time horizon.

Once markets and investors begin to take declining revenues into account, both private and public borrowing will become more difficult and expensive as cashflows against which to borrow will be lower. Equity values

Table 24: Summary of recent South African M&A transactions – sales by international majors

COMPANY	ACTION	TIMING
Total	Sale of all South Africa coal assets to Exxaro	H2 2014
Glencore	Restructures investment coal JV with Africa Rainbow Minerals	H2 2017
Anglo American	Sale of domestic-focused mines to Seriti Resources	H2 2017
South32	Spin-off / sale of South Africa coal assets announced	February 2018
Chevron	Sale of South Africa oil assets including Chevref refinery to Glencore	H2 2018

Figure 17: Timing for gross annual external risk (2018-2035)



will decline by the present value of the cashflows that the market believes have been lost. The likelihood is that the impact will be gradual, as the market may take some time to realise the full lost value. We believe that some or most of the value lost by changes to scenarios between 2013 and 2017 has yet to be incorporated into 2018 valuations.

Our figure for total risk represents the present value of all these future value losses. Implicitly we assume that the market places zero value on cashflows after 2035. In this report, we distinguish between changes that have already occurred due to changes to BAU forecasts, and those further declines that would occur under a global 2DS.

Finally, we should note that as these value losses increase steeply throughout the 2020s. If markets delay recognition of the risk, and then the risk occurs suddenly, the impact in present value terms will be much higher, as higher losses in earlier years will become more significant with less of a discount for time. By 2022, the discounted value of these cashflows could increase by 36%.

5. Capturing the benefits of the global low carbon transition

Key messages:

1. The global low-carbon economic transition could bring benefits to South Africa as well as costs
2. Many of the benefits are either unknowable or difficult to quantify, as they will often be driven by innovation or new business and industry models
3. Two such benefits to South Africa may be lower long-term oil prices driven by lower global demand, and lower and delayed adaptation costs as slower climate change could delay the need to reinforce or build new infrastructure to cope with a changing climate
4. The upside risks and benefits do not directly offset the downside risks, particularly since the benefits are likely to flow to different parties, the timing of the benefits and costs do not match perfectly, and the probability and drivers of the benefits are distinct from those of the downside risks

Mass adoption of the internal combustion engine in the 20th century transformed the way we trade and live. It mechanised industries and improved productivity, leading to mass manufacturing and more efficient agriculture. As the motor car caught on, the oil and refinery industries boomed, roads were built to carry goods and people from factories to retailers, from high streets to homes.

At the beginning of the 20th century it was much easier to see that the role of horses in daily life would be dramatically reduced than it was to envision most of the changes that the internal combustion engine would bring. Likewise, the low-carbon economy is likely to bring a host of changes and business opportunities that are nearly impossible to imagine today. We can imagine opportunities in renewable energy, battery development, or even electric transport, but even these give only a hint of what opportunities and business models might develop.

While we can assume that benefits of the new economy will balance out many of the risks, we cannot quantify or rely on these offsets because they are so uncertain.

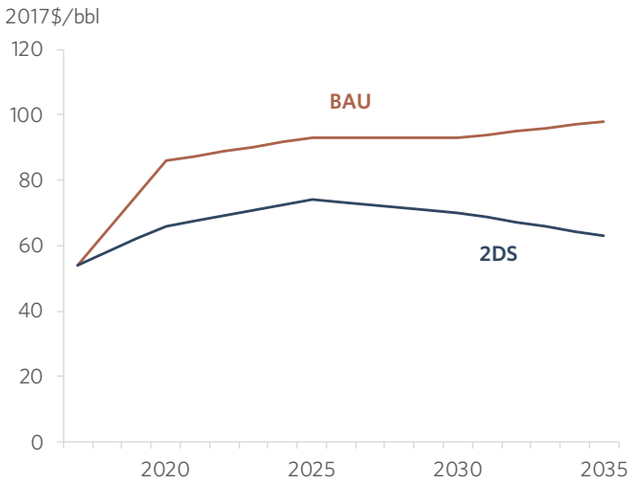
Further, the likelihood is that the distribution of benefits will accrue unevenly. For example, the opportunity to build renewable energy businesses are unlikely to accrue to large oil companies because the product, required skills, business models and financing structures are very different from upstream oil exploration and production. On an economywide basis, benefits and risks may balance, but individual actors may still have concentrated downside risk. The timing of benefits is also likely to be misaligned. Many of the largest benefits such as lower adaptation costs or new, as yet undefined businesses, are likely to be further in the future than some of the costs.

Of all the potential benefits from a global energy transition there are two that are slightly easier to imagine and quantify: the impact of lower global oil prices in a low-carbon world, and the impact of lower and delayed infrastructure adaptation costs. We describe these two examples in this chapter to outline the potential and issues regarding balancing upside versus downside.

5.1. Sources and potential benefits of an oil price windfall

As CPI has described in earlier work[88] as well as chapters 3 and 4, a low-carbon world is likely to have much lower global oil prices than a business as usual world. A low-carbon world will include measures to improve energy efficiency, use alternative fuels, and even replace oil with electricity as is the case in our 2DS and nearly every other low carbon scenario available. Lower demand reduces the need to incentivise development of more expensive and complex new resources, while it increases competition for sales among existing resources. Figure 18 below shows how the lower demand in a 2DS scenario affects the oil price forecasts in our models.

Figure 18: CPI crude oil price projections in BAU and 2DS



Source: International Energy Agency, CPI analysis

Lower oil prices reduce profits and margins for the oil industry, as discussed in chapter 4, but they can also benefit consumers if they are passed through. Lower energy costs also have a marked positive impact on economic growth, but that value is not included in this analysis. How the benefit is divided among different consumer groups will depend upon consumption levels and how regulation and markets translate crude oil prices into final product prices. For South Africa, the allocation of the cost reduction under current taxes and regulation is clear-cut in the case of road transport and those fuels under price regulation. For fuels sold to industry in a competitive market, some of the benefit could conceivably be retained by the refiners. As illustrated in table 25, road transport consumers could expect to earn around two thirds of that windfall.

88 Moving to a Low-Carbon Economy: The Impact of Policy Pathways on Fossil Fuel Asset Values and Government Assets: Risks and Opportunities in a Changing Climate Policy Landscape (CPI, 2016).

Table 25: CPI estimate of the split of oil transition gains between major consumer groups

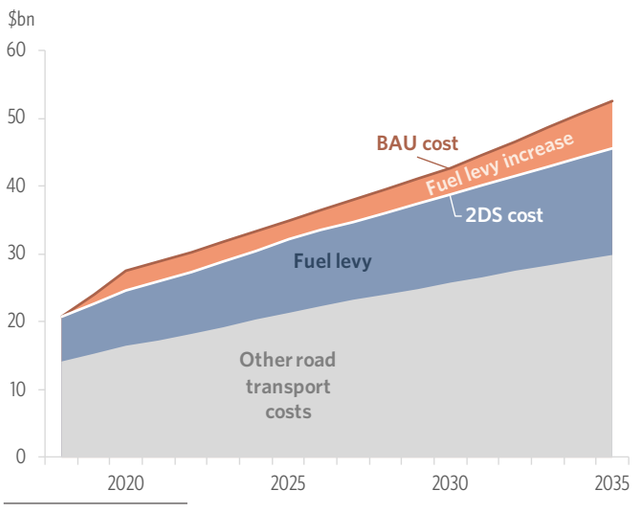
CONSUMER SECTOR	SHARE OF OIL TRANSITION GAINS (USD BILLION)
Road transport	30.0
Airlines	4.2
Buildings	1.8
Chemicals (feedstock)	2.9
Bunker	0.3
Rest of industry	2.2
Other	4.1
Total	**45.5**

With the exception of chemicals, none of these sectors are likely to be among those most hit by the international climate transition risk to coal and mining revenues. Even in the case of chemicals, the refiners who would benefit because they use oil as a feedstock, do not share the risk felt by Sasol's Secunda plant, which uses coal as a feedstock and therefore does not benefit.

5.2. Reallocating the windfall to offset transition risks

According to our analysis, if the government sought to levy taxes to capture the windfall, for example, from road transport users, it would need to add an average $0.16 of fuel duties per litre of petrol across 2018-2035. By 2035, the share of taxes and levies in the price of a litre of petrol would rise from 32% today to 43%, as illustrated in figure 19 below.[89]

Figure 19: Increasing the fuel levy in a 2DS could shift part of the windfall away from road transport consumers



89 NB this excludes an estimate of the impact of the South African carbon tax as the design of its future, more impactful phases currently remains uncertain.

The size of the potential road transport gain represents 55% of the total $55 billion downside risk facing the public balance sheet but would be almost sufficient to cover the $38 billion of that total, which represents risk to workers, municipalities and companies who are not capable of bearing it. Figure 20 below illustrates how such a compensation mechanism could reduce the level of net risk, and hence contingent liability to the public balance sheet.

Increasing the fuel duty by a significant amount could be politically challenging, depending on which parties would receive the funds. However, the timing of the implication of the policy (as discussed further in section 5.5) is also critical given that risk in the coal sector and gains in the oil sector do not materialise along the same timelines. As illustrated in figure 21, we expect coal-related losses to begin slowly and accelerate sharply in the mid-2020s while much of the oil-related benefit could occur after this point.

5.3. The benefits of lower adaptation costs

The 2018 Cape Town drought, and the costs of building the infrastructure necessary to prepare for more frequent and deeper droughts in future, indicates the financial challenges ahead for South Africa in adapting to a significantly altered climate. Droughts, rising sea levels and increased storms, will all require additional infrastructure to protect South Africa and its economy. However, the issue is not how much South Africa may have to spend on adaptation, but rather how much lower these adaptation costs will be if we slow the onset of climate change. As we discussed in section 3, very little analysis has been carried out on adaptation costs for South Africa – this perspective is also outside of the scope of this study. However, drawing from Africa-wide studies we can estimate the savings to be approximately $1 billion through 2035, representing a reduction of 16% over that period. While this number is small compared with South Africa's overall transition risk, potential cost savings after 2035 – which are outside of the scope of this study on both the transition and adaptation costs – accelerate rapidly, even as transition costs will fall towards zero, as the transition will be nearing completion.

Figure 20: Illustration of how the government could use revenues from an oil windfall to compensate parts of economy most hit by the transition

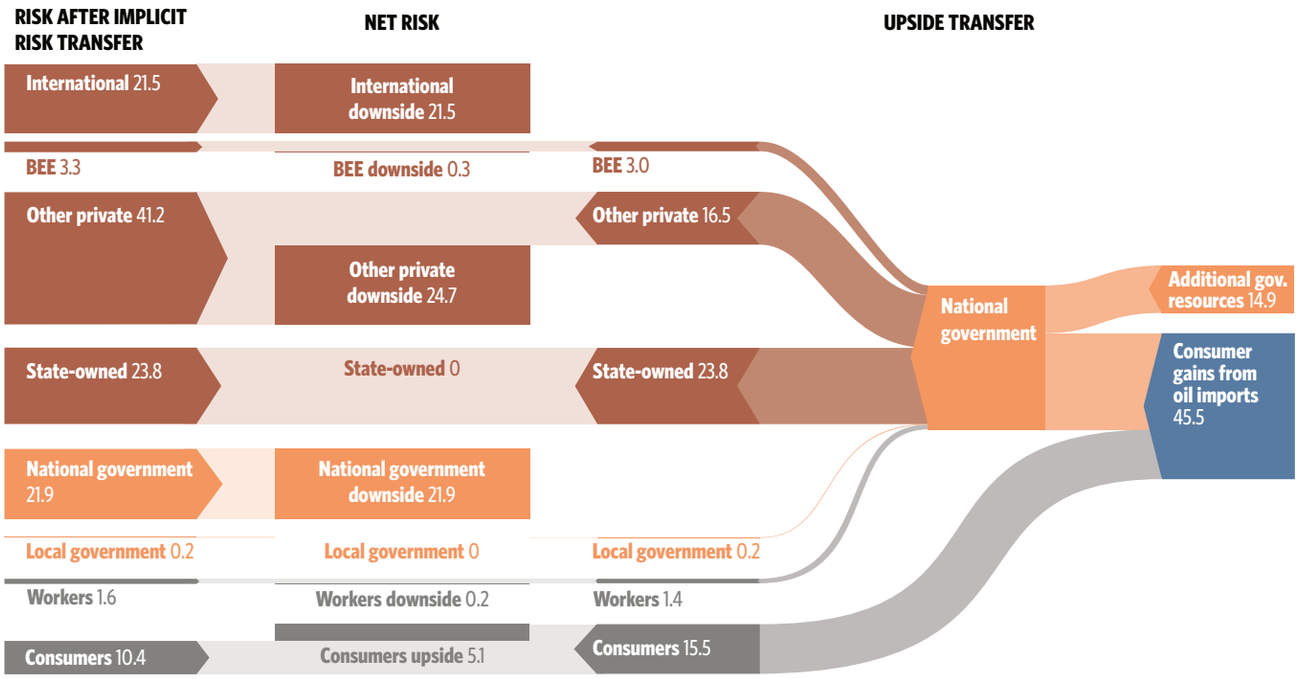
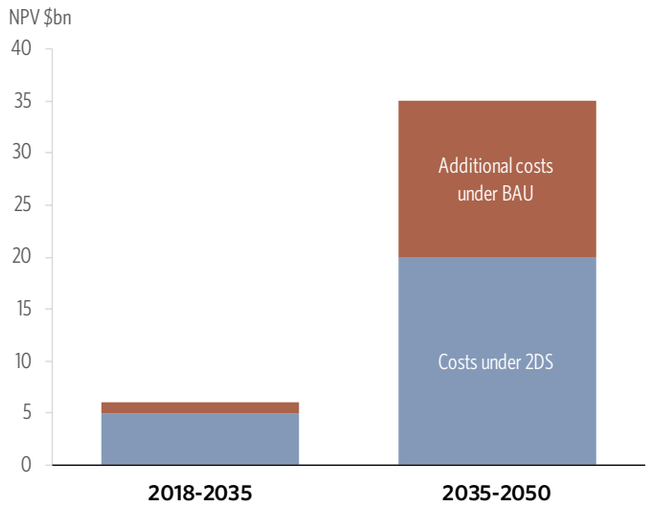


Figure 21: Possible adaptation costs under BAU and 2DS scenarios



Source: UNEP, CPI analysis

Unfortunately, this timing misalignment leaves us with debates over the cost of capital and how future costs should be accounted for. More importantly for this study, the mismatch makes it very difficult to use these longer-term savings to offset near-term risk, especially if realisation of the downside risk were to cause permanent systemic damage to the economy before the long-term was realised.

5.4. Implicit transfer of benefits and matching flows of upside benefits and downside risks or costs

Falling oil prices create a tempting opportunity for government to balance risks from the energy transition. Under a principle that consumers should not be worse off under the transition, government could justify taxing oil for the entire $45 billion to offset its risks from other parts of the transition. Government could even redistribute the oil price benefit to make the related oil industry whole and still have $37 billion available to offset losses in other parts of the economic transition.

Three potential problems arise:

- Consumers are unlikely to agree even if they are no worse off after the tax, since under a low carbon scenario, consumers will never directly experience the higher prices of a "business as usual" world. As a result, consumers would likely feel hurt economically.
- It is possible that risks will be realised, but not the benefits, or vice versa. International policy, particularly that which achieves only part of the full 2C low-carbon transition objectives, could result in lower global coal demand, even as oil demand remained high and the benefits of lower adaptation costs were minimised. (See box 3 on the next page)
- The timing of costs and benefits may create mismatches, for example with costs occurring well before the compensating benefits.

BOX 3: PLANNING FOR UNCERTAINTY IN THE TRAJECTORY OF A CLIMATE CHANGE TRANSITION

The analysis in chapters 3 and 4 of this report suggests that South Africa faces close to $125 billion of downside risk through the impacts of a global energy transition on global and domestic coal markets, metals markets, oil markets, and follow on impacts on South African infrastructure. Meanwhile, the analysis also suggests that South Africa will benefit by more than $40 billion from lower oil prices that would result from falling global oil demand in a low-carbon energy transition.

While our analysis suggests using potential windfalls from lower oil prices as a way of reducing the size and concentration of risk facing South Africa, the country cannot just rely on the oil offset to limit value lost for at least two reasons:

There may be many policy, technology and economic paths that the world could follow to reach its objective of limiting global temperature rises to well below 2C. Some paths may have far greater or lower risk for South Africa.

The greatest financial risk is likely to be, that the world follows a transition path that falls short in some, but not all, of the key transition elements.

Different global energy transition paths hold different sets of risks for South Africa

As set out in chapter 2, our analysis draws mostly on demand figures taken from the IEA's new policies scenario (NPS) and sustainable development scenario (SDS), with supply side information taken from other sector-specialist sources. These scenarios assume a balance in emissions reduction and technology development that is shared between energy efficiency, industry, transport, buildings, coal markets, oil markets, and natural gas markets. These scenarios also assume a significant amount of carbon capture and storage (CCS) which, by capturing the CO2 from burning coal or gas in power or industry, increases the amount of fossil fuels that can be burned in the coming decades without exceeding the well below 2C (WB2C) threshold.

While the scenario designers attempt to balance costs and impact, technological, political and economic forces are likely to change the mix of emissions reductions over time. For example, if CCS proves economically or politically infeasible, then global oil, coal and gas demand would have to peak and decline precipitously as much as two decades earlier than the base WB2C scenarios.

The risk of partial energy transitions

Of even greater concern to South Africa would be a policy environment, which currently seems very possible, that includes some elements of a required global energy transition but falls short in others. It is conceivable that global policy leads to sharp declines in demand for coal imported from South Africa, even as global oil demand continues to increase. Such a world could fall short of the 2C objective, even while net transition risks to South Africa would be higher. In this case South Africa could experience the loss in coal export value, while experiencing little of the benefits of lower global oil prices.

Risk management policy needs to consider multiple paths and be flexible to adapt to changing conditions

A robust set of climate risk management strategies thus requires evaluation of multiple scenarios, identifying sets of outcomes that could pose the most risk to a country. While preparing flexibly, with measures and options that can address different eventualities, countries will also need to monitor international policy, technology and economics to update policies as circumstances and transition paths evolve.

5.5. The timing of costs and benefits

Gains from lower oil prices and adaptation costs could be used to help South Africa offset risks, fund adaptation, or develop new transition options. Unfortunately, the benefits are often difficult to observe and are likely to occur later than the potential offset or investment needs.

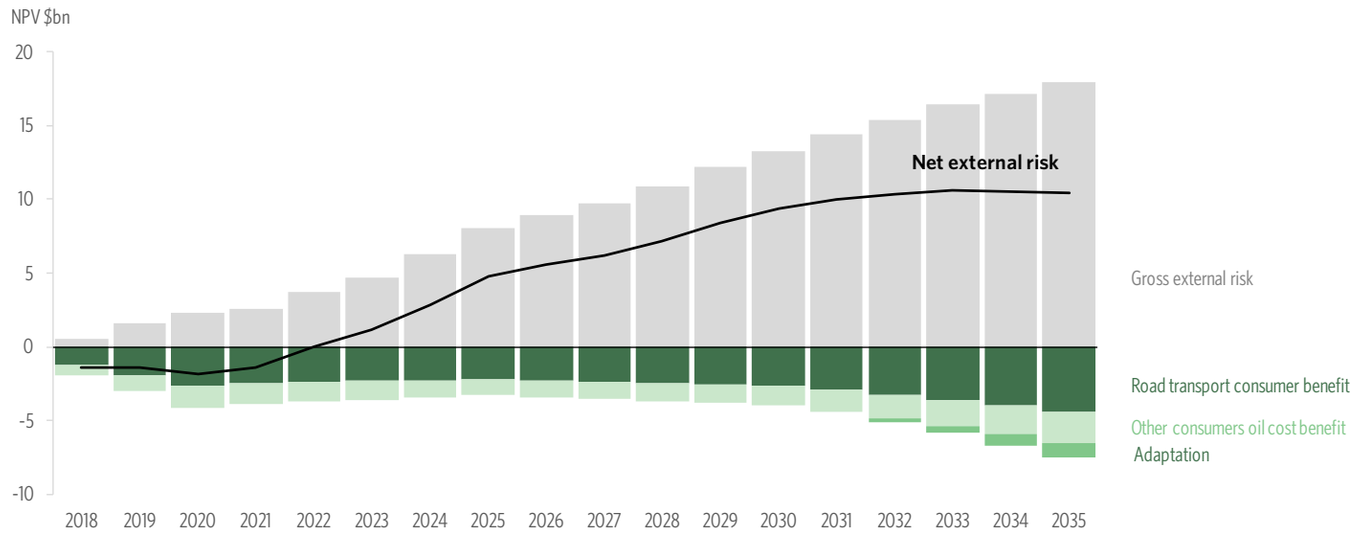
Figure 22 shows how from 2030, the benefits of the transition begin to grow faster than the costs. Beyond 2035 we would expect this trend to accelerate as the adaptation benefit and the oil price benefit would continue to grow, while the coal export loss would tail off. A critical question is how to manage this transition and how to balance future benefits versus nearer term costs.

One option would be for the government to pre-fund these gains. National and international DFIs have expressed interest in supporting a low carbon transition with a "transition" or "stabilisation" fund. A fund could borrow against future tax revenues or it could securitise future dedicated tax revenues. Furthermore, these tax revenues could be set to leave prices to consumers at levels that could have been expected under a BAU scenario, thus creating an automatic risk adjustment for the 2DS scenario.

There would be a variety of ways in which such a fund could be structured (eg, mixture of debt and equity) and durations. As explained in box 4 below, there is precedent from European and US electricity markets across the last three decades of using securitisation to refinance up-front funds provided to compensate workers and companies for stranded assets.

A securitisation could be used in the South African context to refinance a transition fund, but for this to be successful, government would need to protect the tax from the political weather of the day, perhaps by giving it some legal protection.

Figure 22: Timing for net annual external risk (2018-2035)



BOX 4: SECURITISATION AS A FUNDING MECHANISM TO SUPPORT STRUCTURAL CHANGE

In the 1990s, a number of European countries and US states implemented significant changes to the structure of their electricity systems, which aimed to reduce costs over the long run. In many places, competitive wholesale markets with bilateral trading replaced markets where generators were explicitly able to recover investment costs through regulatory mechanisms. Many power plants built under the old system would become uneconomic in competitive markets, potentially resulting in billions of dollars of stranded costs for utilities.

In order to ensure that market restructuring did not result in the bankruptcy of utilities, regulators in a range of markets – from California to Spain – sought to protect the companies. In California, the Public Utility Commission tried two mechanisms to help utilities recover otherwise stranded costs over time – competition transition charges (CTCs) and securitisation (in the form of rate reduction bonds or RRBs). Both mechanisms provided for utilities to be repaid via a surcharge on consumer bills, with the latter (named the Fixed Transition Amount or FTA) being set by the Public Utility Commission. The fact that that the FTA was set by the public regulator and was subject to restrictions on future changes meant that it was seen to be a revenue stream that was secure enough to be securitised. Ownership of future FTAs was transferred to a securitisation special purpose vehicle (SPV), with the sale financed by the issuance of RRBs. The proceeds allowed utilities to recover stranded costs upfront, repairing potential damage to their balance sheets, while consumers saw only a small increase in consumer bills.

Securitisation as a solution for accelerating recovery of stranded costs has recently started attracting more interest in the context of a low carbon transition. In several US states, CPI provided analytical support to utilities, regulators and advocates making the case for extending the securitisation concept to the early retirement of coal power plants. Such a solution could be of interest in South Africa as the government designs transition funding instruments.

6. The costs and benefits of extending South Africa's climate ambition

Key messages:

1. South Africa has several options that would accelerate its own internal transition and contribute to the global low-carbon transition, but many of these choices could have a cost to the South African economy
2. Accelerating the power transition would be relatively cheap while dealing with the coal-to-liquids plant would be relatively more expensive
3. The risk and financial capacity of South Africa to pursue these options, and the most appropriate timing to do so, depends on the pace and impact of the global transition on South Africa
4. International support and negotiations can help balance the impact of the external factors with potential international costs and benefits of the internal transitions

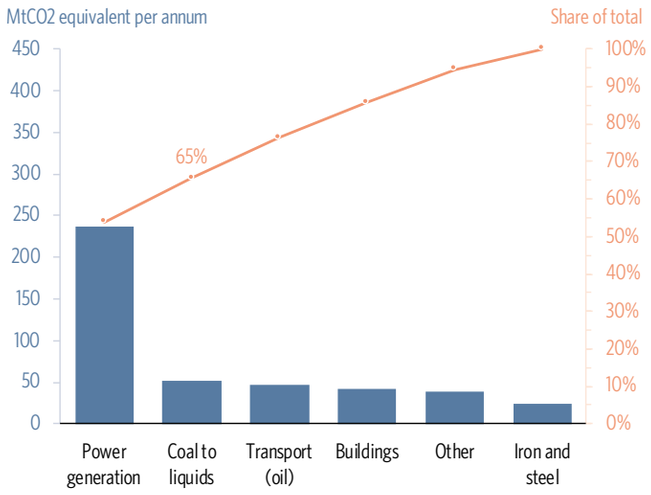
In Chapters 4 and 5 we saw how South Africa faces potential risks and benefits from a global transition that could have profound impacts on the South African economy and even its sovereign credit rating. At the same time, South Africa is a signatory to the global Paris accord on limiting greenhouse gas emissions. South Africa's commitment to the Paris accord includes a peak-plateau-decline (PPD) trajectory with emissions peaking between 2020-2025, plateauing for around a decade and then declining after the end of the period covered in this study.[90]

The financial capacity to meet – or go beyond – its commitments under the Paris accord will partly depend upon the financial impact of the global transition. With little control over the loss of coal exports to international markets or the transition driven fluctuations of the oil price, the areas where South Africa has the most control to balance risk and smooth the impact are on the internal transitions, and the investments and retirements South Africa can make or avoid.

The greenhouse gas reduction target in its Nationally Determined Contribution (398 to 614 MTCO2e over 2025-2030) for the Paris agreement is broad enough to allow for a wide range of national policy actions. Furthermore, while the current global intended Paris contributions are impressive, in aggregate they fall short of the overall target for the agreement.[91] It is likely, therefore, that additional contributions will be needed as part of future negotiations. Thus, South Africa has an opportunity to manage its transition risk, meet its current commitments, and provide a platform for future negotiations.

There are many potential options to reduce South African greenhouse gas emissions, but as figure 23 demonstrates, in 2010, over 65% of South African emissions came from either power generation or coal-to-liquids.[92] Thus, these sectors provide an obvious choice to look at for balancing internal and external transition risks.

Figure 23: In 2010, over 65% of South African emissions came from power and coal-to-liquids



Source: Department of Environmental Affairs, CPI analysis

90 South Africa's NDC (https://www4.unfccc.int/sites/NDCStaging/Pages/Party.aspx?party=ZAF)

91 Source: https://www.aljazeera.com/news/2018/10/ipcc-climate-change-report-paris-climate-accord-181009134051255.html

92 Historic emissions data taken from the Department of Environmental Affairs. Source: https://www.environment.gov.za/sites/default/files/docs/greenhousegas_invetorysouthafrica.pdf

Our scenarios assume South Africa's draft integrated resource plan (IRP) for the power sector is is part of South Africa's intended contributions, which are designed to comply with the upper end of its NDC commitments and allow continued operation of the Secunda CTL until at least 2030.

Beyond this scenario, we have no basis for discerning alternative scenarios for South Africa which might result from future increased global commitments. However, the 2018 IPCC report, on 1.5C warming, the increasing frequency of large-scale natural disasters linked to climate change (eg, Cape Town drought and California wildfires) and the revival of interest in European policy circles in carbon border adjustments raise the possibility that South Africa will face political pressure to accelerate its national emissions reduction trajectory.

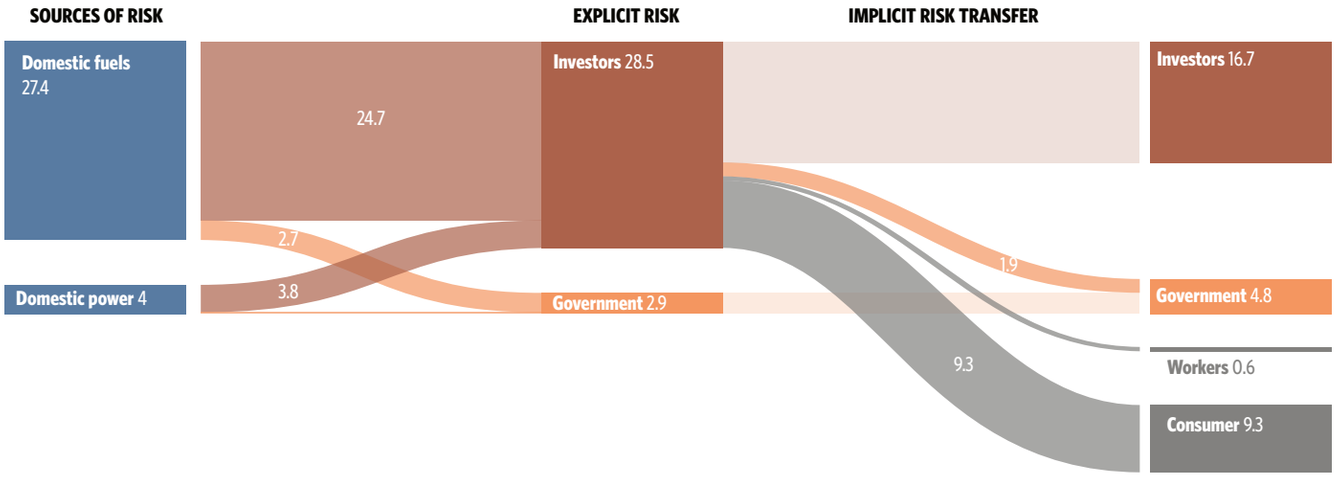
Thus, to evaluate the interrelationship between the international transition and South African domestic transition policy, we have focused on

1. The potential cost of an accelerated phase-out of the coal-fired power fleet, starting with the cancellation of investments in new capacity and including early decommissioning of some plants from the early 2020s;

Table 26: Potential transition impacts/risks arising from domestic policy action to mitigate transition risk or contribute to global mitigation efforts

TRANSITION IMPACT/RISK	DIRECT IMPACT/ EXPLICIT ALLOCATION	IMPLICIT RISK TRANSFER	CONTINGENT LIABILITIES AND POSSIBLE RESPONSE
Domestic power industry and its coal suppliers	**Consumers:** Power price increases as consumers bear a share of stranded asset cost **Investors/mine owners:** Reduced value of new and existing mines if production falls or does not start **Government:** Declining tax revenues, if higher costs reduce earnings for consumers	**Investors/Mine and powerplant owners:** Lower long-term corporate growth opportunity for Eskom if replacement power is built by new entrants New entrant (independent producer) opportunity **Government:** Support for workers and communities impacted by closure **Workers/Communities:** Potential job losses and local economy impact Jobs created in different regions for replacement power	**Government:** Heighted risk of Eskom debt default **Financial institutions:** Heighted risk of Eskom debt default
Domestic oil products and coal to liquids industries	**Investors/Sasol/mine owners:** Loss in earnings and value from coal to liquids New investment requirements for replacement Loss in market and volume for related coal resources **Government:** Loss of tax revenues Loss of value/dividend from Sasol stake Increase in balance of payments issues as oil imports increase	**Investors/Sasol/mine owners:** Potential to pass some costs to non-regulated consumers Potential to sell emissions reduction on global or bilateral markets Potential staff reductions **Government:** Support for workers and communities impacted by closure **Workers:** Potential job losses at mines and CTL plant New jobs at replacement refineries	**Financial institutions:** Reduced value of Sasol bonds if downgraded below investment grade.

Figure 24: Risk allocation from domestic policy



2. Early shut-down of the Secunda coal-to-liquids plant in the mid-2020s could cost $27.4 billion, although this figure could fall if the closures were implemented later or if the cost of alternative sources of power and fuel had declined.

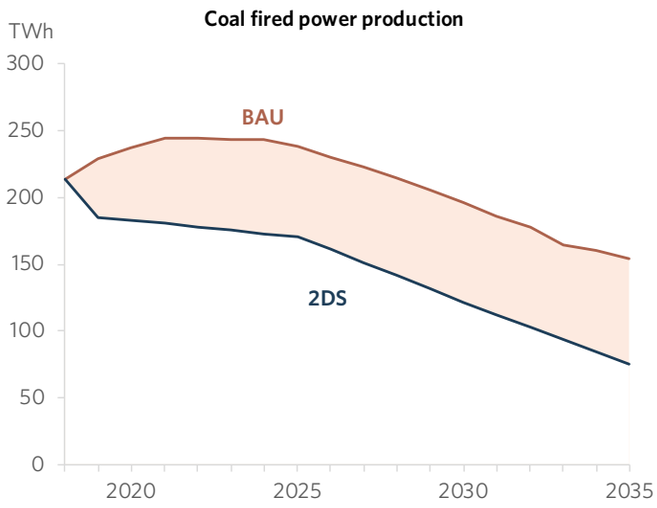
Table 26 suggests the preliminary view of how these risks might be allocated, if South Africa were to move further with these actions.

As set out in figure 24, we would expect most of this risk explicitly to be borne by investors, who will seek to transfer it to power and chemicals customers via increased prices. Given that recent Eskom price rises have led to a significant increase in bad debts, we expect that government would likely share in this risk to protect consumers from the full impact of the transition risk.

6.1. Power station closures

The draft IRP assumes total net power generation from coal stations peaks in the early 2020s at around 238TWh in 2025 as Medupi and Kusile are fully commissioned and the Thabametsi and Khanyisa IPPs are built, before starting to decline as older stations are decommissioned after reaching their 50-year design lives.[93] One option would be a faster decommissioning trajectory in which, coal-fired power generation begins to decline immediately, as illustrated in figure 25.

Figure 25: Decommissioning in line with the IEA SDS would mean starting to reduce coal fired power generation from 2019



Source: International Energy Agency, CPI analysis

This alternate 2DS for South African coal-fired power generators uses projections for South African coal-fired power generation taken from the IEA's SDS. Our model derives the SDS generation profile by adjusting the IRP profile for the following:

- Early closure of Grootvlei, Hendrina and Komati stations (as proposed by the recent Meridian Economics / UCT ERC study[94]) from 2020;
- Non-completion of Medupi and Kusile;

93 Ibid. Department of Energy (2018)

94 Ibid. Meridian Economics et al (2017)

- The reduction in load factors across the rest of the fleet to achieve the desired generation reduction;
- Replacement of the generation with new wind and solar PV capacity (split 50:50 between the two technologies).

Six stations – Majuba, Tutuka, Duvha, Matla, Kriel and Grootvlei – are not currently compliant with air quality legislation introduced in 2004, and may need significant investment in the near term, which could provide other options for accelerated decarbonisation, but closure of these is not included in this analysis.

The principal financial costs (or benefits) of early closure beyond issues relating to air pollution or water use are:

- The cost of building and operating alternative generation sources (eg, wind, solar PV or potentially gas) relative to the incremental cost of continuing to operate the coal stations.
- Costs associated with closing the stations, including any stranded value and decommissioning costs.

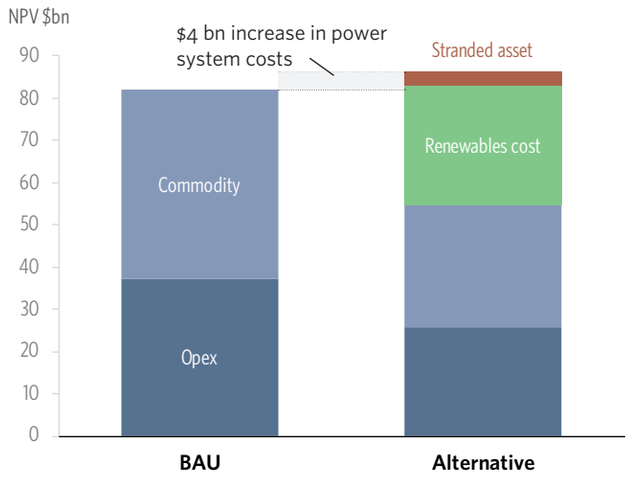
Given the lack of public information, we have not attempted to analyse a third important factor, which would influence the decision, namely the value of the additional services that coal stations provide to the grid (eg, ancillary services, such as spinning reserve, frequency response and black start) and the cost of providing alternative sources of grid services.[95]

We estimated the incremental cost of replacing coal generation with wind and solar PV (prior to the stranded asset cost) at $1.1 billion over 2018-2035.[96] We assumed that the generation would be replaced by these clean sources at levelised costs declining at 0.3-0.6% per annum (extrapolated from the draft IRP). The cost of coal generation included our plant-specific estimates of coal costs.

A separate modelling scenario, with less coal generation being replaced (because of weaker than expected performance at Medupi and Kusile) and less conservative renewables costs suggested that the country could, instead of a net cost, reap a benefit.

A larger sum would be required to fund early decommissioning and the recovery of undepreciated regulatory asset value/base (RAV/RAB) associated with each station, which would otherwise be stranded. While there is no public information on the station-by-station make-up of Eskom's R550 billion ($39 billion) generation RAB,[97] we made a conservative (high) estimate of the value associated with Grootvlei, Hendrina and Komati at between 30 and 40 billion rand (or $2-3 billion).[98] Even with conservative assumptions, the combined additional cost of decommissioning coal stations in this earlier profile would be manageable at $4 billion.

Figure 26: Power sector early shut-down cost (2018-2035)



There are a variety of precedents around the world for the treatment of undepreciated RAB balances when assets are closed early, with a variety of risk allocations ranging from leaving it all with the company (ie, the RAB is removed causing lower future earnings, but the company receives no compensation) to fully compensating the company and transferring the risk to consumers (see box 4, page 76). Given Eskom's weak financial position, we think it unlikely that government would force the company to bear significant risk. However, given the recent increase in the numbers of people unable to pay Eskom's bills at current prices, we expect that government would have to take on some of the risk, perhaps via an equity injection.

95 Flexibility: the path to low-carbon low-cost electricity grids (CPI 2017)

96 We assume that network connection costs are included in wind and solar capex estimates. Higher penetrations of variable renewable energy can increase network integration costs, but we do not include any in these estimates as renewable penetrations remain low for the forseeable future.

97 Estimated regulated asset base figure for the generation segment taken from http://www.nersa.org.za/Admin/Document/Editor/file/Consultations/Electricity/Presentations/Eskom14-11-2017.pdf.

98 We first estimated the generation RAB associated with new or under-construction stations (Medupi, Kusile, Ingula and Sere) to derive an estimate for the older stations and then derived a high level estimate the RAB associated with the above 3 stations, taking into account the age of the assets in the fleet

6.2. Secunda coal-to-liquids closure

Coal use in the South African power sector has been a key aspect of the consultation period for the draft IRP. Conversely, interviews in with stakeholders in South Africa revealed limited discussion or consideration of closing coal-to-liquids (CTL) operations at Secunda; in part because the plant produces valuable low-sulphur fuels, a wide variety of chemicals, and employs around 15,000 or so people in the mines that produce the coal used as feedstock.

However, Secunda is the largest single-source site of CO_2 emissions in the world and, producing more than 50mt of CO_2 equivalent per annum, more than 10% of the country's total emissions. Closure of the plant is not required to meet GHG reductions in its NDC. However, if the country did face political pressure to accelerate domestic emissions reduction, it would need to consider options for abating emissions at this plant or even closing it.

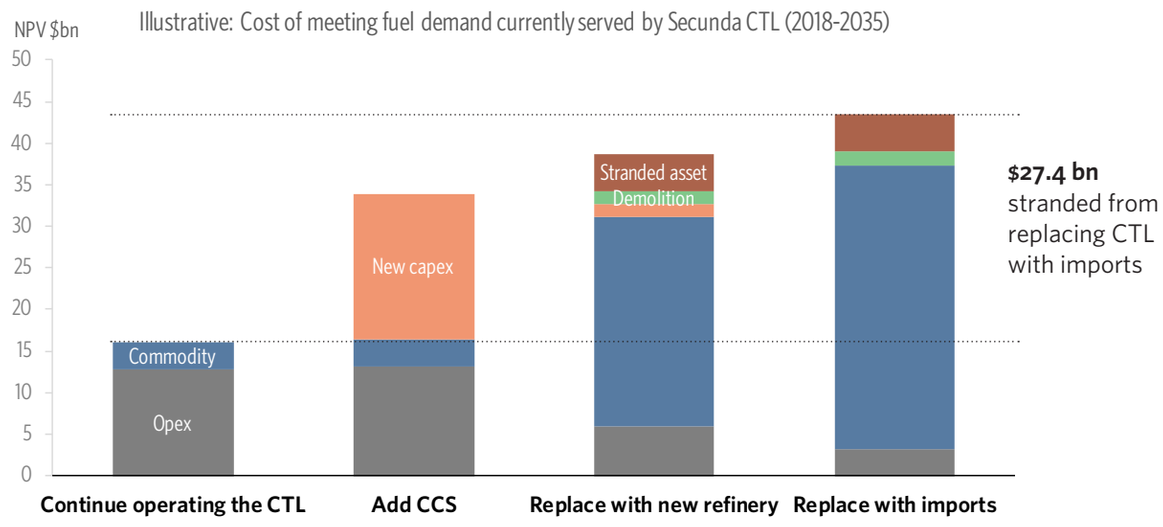
Figure 27 shows that adding carbon capture and sequestration (CCS) could be the lowest cost option to reduce emissions at Secunda. CCS could be relatively low cost at a CTL plant like Secunda because the CTL process inherently separates out the CO_2 during production.[99] Given the size and relative ease of capture, Secunda could be a significant option to explore in the development of global CCS capabilities.

However, this option would add significant transition risk for South Africa. First, the technology is not yet completely proven and the costs of CO_2 transport and storage are not fully understood. Furthermore, while the CCS plant could remove up to 80-90% of the carbon emissions from the production phase of fuels from the CTL[100], the process is very carbon intensive to begin with, so the remaining production emissions are still as high as in refineries. Meanwhile, half of the CTL full cycle emissions, or approximately 90% of the refinery derived full cycle emissions, come from consuming the fuel itself, where emissions are the same from refinery, import, or CTL derived fuels. Technology or policy changes that lead to lower fuel use could reduce the market and value of the CTL or of a refinery.

Thus, by adding capital to carbon intensive processes, South Africa could risk further future transition risks if the CTL or new refinery were to be closed before the end of its useful life. Furthermore, for the CTL plant, fixing the costs of fuel production to the price of coal could reduce the benefit that South Africa could enjoy from transition driven lower oil prices. In other words, the CTL could reduce one of the offsetting risk factors.

All told, the lowest risk (although the highest cost) alternative available today would be to close the refinery and rely on product imports. While South Africa would suffer early closure costs, it would avoid future transition risks from added capital expenditure and increase its positive exposure to lower oil prices. This

Figure 27: Replacement of the Secunda CTL plant could cost as much as $27.4 billion



Source: CPI estimates and analysis

99 Impacts of Carbon Capture and Storage (CCS) on South African National Priorities other than Climate Change. SLR Consulting and Prime Africa Consultants (2013)

100 Ibid. SLR Consulting and Prime Africa Consultants (2013)

Table 27: CCS could be the cheapest alternative but the least technologically proven

CTL REPLACEMENT OPTION	NET COST OF REPLACEMENT (USD BILLION)	PRACTICAL CHALLENGES
Carbon capture and sequestration	17.9	High purity of CO2 stream would could make CCS cost-effective relative to other sites. But the technology is not widely proven at scale and there is significant execution risk around storage. Adds risk of future stranding of CCS capital in a future where fuel demand falls.
Demolish and build new refinery	22.7	Cost likely to be higher than this as refinery producing with a throughput of only 160,000 barrels a day (the equivalent of Secunda) would struggle to compete against imports unless explicitly protected by regulation. Government plans for a 400,000 barrel per day refinery suggest that this cost could be even higher.
Demolish and replace with product imports	27.4	The lowest-risk scenario but would have a significant negative impact on the balance of payments. Could be combined easily with a drive to reduce oil use, perhaps through the uptake of electric vehicles.

alternative has an additional cost (assuming a shut-down in 2025) of at least $27.4 billion (as is illustrated in figure 27 below) and likely more, given that we assume that the chemicals output of the plant would not be easily replaceable at equivalent cost.

Unlike in the power sector, where the replacement of coal with wind and solar is now commonplace around the world, there are no tried-and-tested options for replacing to coal-to-liquids operations. We assessed three options, which all have important practical challenges, as set out in table 27.

As with the coal-fired power closures discussed above, we expect that the explicit cost of closure would fall on Sasol investors unless government agreed compensation at time of mandating the closure.

Unlike with Eskom, which is an SOE, it would be more complicated with a private listed company such as Sasol for government to mandate the early shut down of the asset. We assume that government would seek to share the risk between Sasol's investors[101], consumers (via higher prices) and the public balance sheet. In practice, the amount of compensation that government might choose to pay would also have to factor in the losses of the Public Investment Corporation (PIC) and the Industrial Development Corporation of South Africa (IDC) who own 23% of the company and the impact on the rest of South African business and the jobs it supports.

6.3. The timing of all risks – external and internal – in South Africa

Unlike with the external elements of the transition, South Africa has options for the internal transition in terms of timing, which options to choose, finance, and even possibly international assistance. Figure 28 summarises how these different options might affect the timing of risk.

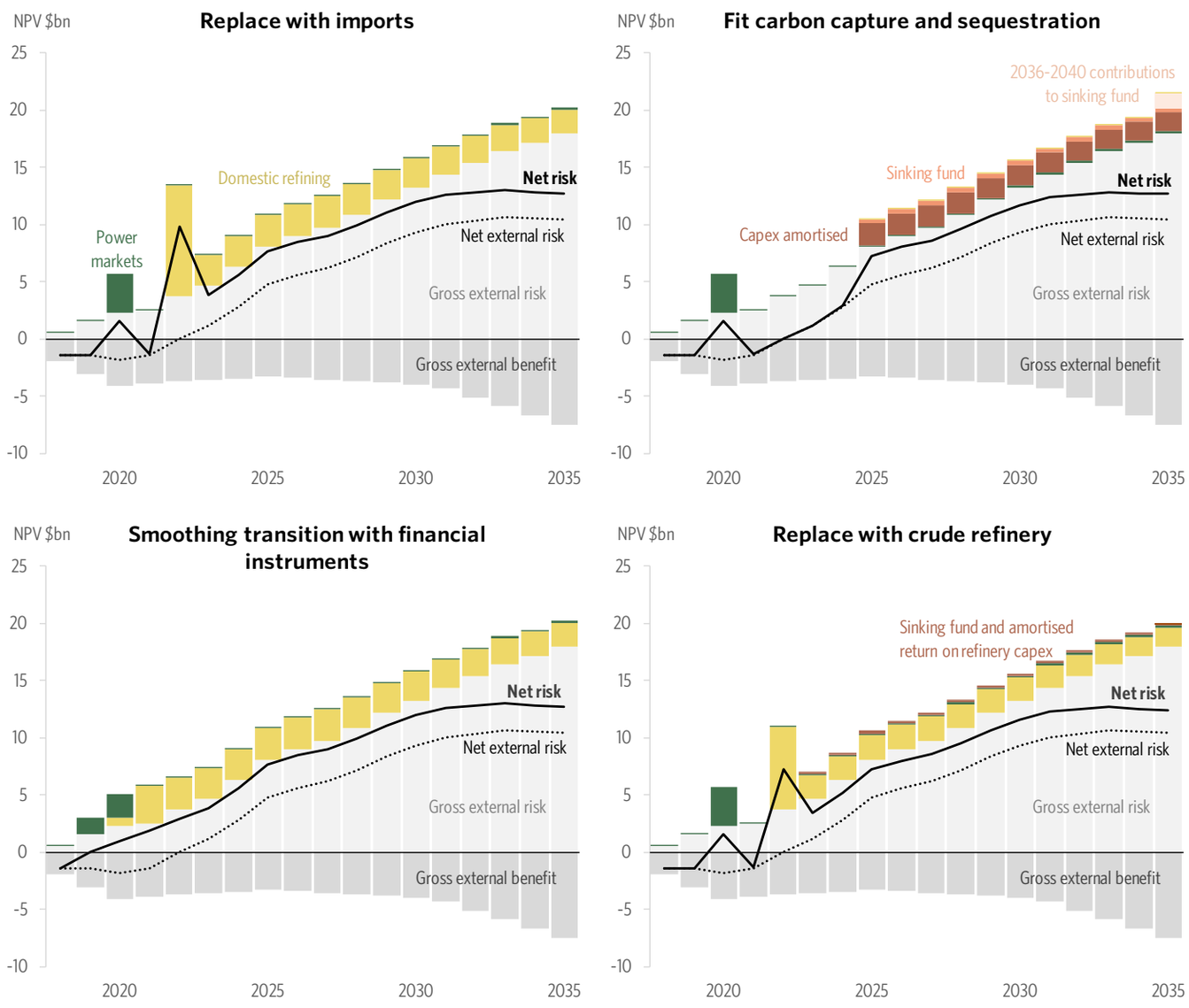
- **Replace CTL with imports.** The lowest risk solution (upper left in the figure), replacing the CTL with imports, nevertheless leads to significant volatility in annual risk and impact. In the early years of the transition, South Africa would be hit by crystalised value losses, first from write-offs of assets in the power sector, followed by a write-off of the CTL when it is closed. After closure, South Africa will then experience the incremental cost of product imports compared to the expected cost of the same products from the CTL. South Africa will also see a deterioration in its balance of payments as foreign currency will be needed to purchase the imported fuel.
- **Fit CTL to CCS.** If South Africa instead chooses to add CCS to the CTL plant (upper right), it can avoid writing off the CTL plant, but will need to finance the capital cost of the CCS equipment and pay for additional operating expenses. Relative to most CCS schemes proposed globally, the investment required for CCS at the CTL plant is low, due to the high purity of the CO2 stream produced by the CTL, which reduces the size and amount of capture equipment required. These investment costs, which produce value through lower oil product

101 Our modelling assumption is that half of the risk remains with Sasol's investors, with most of the rest being transferred to consumers. In practice, the amount of risk left with Sasol's investors (or the amount of compensation paid by government) would be devised as part of a series of economic, financial and political deliberations. This split is therefore for illustration only.

costs compared to imports, will be amortised over each year of production, and so appear as a series of annual risks rather than a lump sum investment.

- However, even after fitting the CCS, the full cycle emissions, including combustion of diesel used in transport, is similar to either imports or the new refinery option. Therefore, South Africa still runs the risk that a fully-fledged energy transition, for instance by more rapid progress on electric transport than currently envisioned, will lead to reduced demand for the fuels the CTL produces. While this risk is present for any of the options, in the instance of replacement by imports that risk has been transferred from South African to international refiners, while adding CCS and the capital investment involved, increases the risk to South Africa. For illustration purposes, we have added a sinking fund to reflect a CTL that would be retired in 2040, after 15 years of operation of the CCS equipment, rather than after 30 years of operation. Our 2035 figures include the remaining element of that sinking fund to be recovered.
- **Replace CTL with a crude refinery.** The third option would be to replace the CTL with a new refinery (bottom right). This option combines some of the characteristics of both the import scenario and the CTL scenario. First, there will be a crystallised risk when the CTL is closed early, which will then be followed by the amortised cost of the refinery, the higher cost of imported crude compared to domestic

Figure 28: Timing of all risks with different CTL replacement options (2018-2035)



coal as feedstock, and a sinking fund in case of early closure. In practice, the costs associated with this option could be even higher as a new refinery sized only to replace the products produced by the CTL would be relatively small and might be vulnerable to import substitution.

- **Using financial instruments to smooth the transition.** Finally, any of the three options could be made more palatable for South Africa, its companies and taxpayers by smoothing the impact, potentially with the help of international financial institutions (see section 6.5). Financial support, including securitisation of the write-offs so that the stranded value can be recovered over a period of future years, can reduce the lumpiness of risk and impact that could create financial shocks to the South African economy. As discussed in Section 5, securitisation is a mechanism that has been employed in several energy related structural transitions in Europe and the US.

The analysis does not suggest which of these paths, if any, are best for South Africa. Rather, it demonstrates how the international context and different domestic mitigation options are interrelated from both a risk and timing perspective. In other words, planning for the international transition and the domestic options need to be considered jointly, and possibly in conjunction with international plans for technology research, a global transition plan, and support from international financial institutions for South Africa's transition.

6.4. Research alternatives and develop potential funding plans / transition plans for the closure of carbon-intensive assets

For Secunda, and perhaps, even more for other carbon-intensive sectors such as steel and cement, the cost associated with reducing emissions could be significant based on the structure of the economy and the technologies available today. While the country may not yet face political pressure to decarbonise those sectors, in prioritising research and development funding into alternative low-carbon technologies today, it will be well prepared to act quickly as the cost of alternative technologies falls and it could uncover opportunities to develop new industries with export potential.

The low carbon transition offers South Africa an opportunity to change its economy, reducing the exposure of its public finances and currency to commodity prices and attracting new industries, which could help to reduce a stubbornly high unemployment rate, which has remained above 20% for the last two decades.[102]

South Africa has many natural advantages, including its well-established manufacturing capability, strategic location for global trade and as an entry point for investment in the African continent and the abundance of its commodities. Economic studies have regularly shown that the potential job creation arising from the decarbonisation of the power sector outweighs the jobs that would be put at risk from the phase-out of coal[103]. Less attention has been focused on the potential for using the opportunity of a domestic low carbon transition to put municipality financing, currently very dependent on revenues derived from resource consumption, on a more sustainable footing. Clearer statements of policy intent around low carbon technologies, such as fuel cells and hydrogen could spur investment in the manufacturing facilities needed to drive new, growing sources of export revenue.

A clearer understanding of risks and opportunities could enable the government to be more targeted in terms of the incentives it offers for investment in new industries, including fiscal treatment and access to finance from state-owned financial institutions. A more confident approach to national priorities could also lead to the government rejecting more offers of investment that do not accord with its national development priorities.

6.5. Work with international development financial institutions and other financiers to address these issues

Where government is considering additional climate action that is not absolutely required by international political pressure, it may balk at the additional costs identified above as they would require spending reductions in other areas. However, there may be options for South Africa to benefit from new sources of funding being developed by international mission-driven capital (including development financial institutions), which might enable it to reduce the cost of an accelerated transition.

102 Ibid. SLR Consulting and Prime Africa Consultants (2013)

103 See ibid. IDC, DBSA and TIPS, 2011 for estimates of job creation. There is increasing work ongoing to understand the potential mapping of coal miner skills to "green jobs" and the extent to which retraining might be possible. Burton J et al (2018) seeks to segment the coal miner workforce between different skill levels.

As the scale of global climate change mitigation increases, climate leaders, for example, Germany, Sweden and France, will likely find that the marginal cost of incremental national emissions reductions starts to rise (as relatively "low-hanging fruit" such as the power and transport sectors become largely decarbonised). At the same time, increasing awareness of the physical consequences of climate change may provoke and increase in the urgency within global climate negotiations. With the consequences of failing to act fast enough on climate change becoming ever starker, developed world countries may be willing to offer additional financing to developing countries to allow them to make deeper emissions cuts.

Several initiatives, within a range of developed country development financial institutions, are looking to expand the climate change impact of lending operations, going beyond lending to renewable energy assets to focus on transitions. For South Africa, there may be opportunities for South African development financial institutions to work with their developed country counterparts to attract additional mission-driven funds to the country, which might help to pay for a range of transition costs from including assistance to workers and communities in areas where assets have closed as well as potential payments to compensate owners of emissions-intensive assets for early closure. International support may enable the country to undertake a faster switch, which would also enable it to channel more local DFI funds into developing new low carbon industries.

7. Managing the impact on the sovereign rating

Key messages:

1. South Africa's investment grade sovereign credit rating allows it to borrow cheaply to fund investments, social spending and to manage volatility in its trade balance. Losing that rating would have a negative impact on the country's economy.
2. A downgrade would most likely result from higher-than-expected public debt. This could result from a combination of lower-than-expected tax revenues and higher contingent liabilities, in particular relating to SOEs and municipalities
3. Unless the South African government manages transition risk effectively, it could face nearly $40 billion in unbudgeted risk, jeopardising the country's investment grade status.
4. Cliff edge risks, such as a deepening of Eskom's financial crisis or Transnet's potential loss of its investment grade credit rating, would be particularly difficult for the public balance sheet to bear.

In March 2018, Moody's Investors Service concluded its review of South Africa's sovereign credit rating following the accession of President Cyril Ramaphosa and kept the country at the investment grade rating of Baa3. Having already lost its investment grade ratings from Fitch in April 2017 and Standard & Poor's in November 2017, retaining a Moody's rating of Baa3 prevented a forced sell-off of South African sovereign bonds by investors whose mandates prevent them from holding sub-investment grade securities. This country was spared the spike in sovereign yields and inflation that could have followed such a sell-off. A classical monetary policy response – raising interest rates in order to stabilise the currency – would have knock-on impacts for business activity in the country.

In stabilising the rating outlook, Moody's pointed to the halt of the decline in South Africa's institutions, which occurred under the previous administration, an improved outlook for growth and action through a mixture of tax rises and reduced public spending designed to keep public debt at around 55% of GDP to the end of the decade[104]. If all goes to plan, the South African government could face the start of a decline in the seaborne coal market from a position of fiscal stability.

If the government has incorporated an understanding of transition risk into its budgetary planning, it may enter the early 2020s with increased fiscal headroom and a strategy for the phase-out of coal in domestic power generation, which includes funding for worker retraining and support for municipalities. If it has ignored transition risks, then it could face a series of shocks, including an increase in corporate defaults and municipality financial distress (see chapter 4), which pushed it into a shorter, sharper and therefore, costlier, wind-down of emissions-intensive industries. It would also likely lose out on opportunities to develop new sources of jobs and economic growth arising from a low-carbon transition as well as missing out on one of the most cost-effective ways of mitigating transition risk – taxing fuel to capture the benefit of lower oil prices (see chapter 5).

7.1. Potential causes of a sovereign rating downgrade

South Africa's recent sovereign credit rating reductions arose through a combination of a perceived decline in the strength of the country's institutions under the previous President and a significant increase in the public debt to GDP ratio.

Upheaval to global coal and oil markets will have an undetermined impact on South African institutions. Nevertheless, our analysis suggests that even in the case of a better than expected balance of payments due to the impact of a lower oil price offsetting the loss of coal exports), transition risk absorbed by the public balance sheet would likely cause an increase in public debt.

104 Source: http://www.treasury.gov.za/documents/national%20budget/2018/review/FullBR.pdf

Table 28: Channels through which transition risk could impact the sovereign credit rating

FACTOR LEADING TO INCREASED PUBLIC DEBT	MECHANISM LEADING TO LOWER PUBLIC WEALTH / HIGHER PUBLIC NET DEBT
Lower-than-expected tax revenues	Higher fiscal deficits needing to be financed by debt capital markets (probably through a combination of domestic and international bonds)
Declining credit profile of SOEs	SOEs earn lower-than-expected profits, leading to higher-than-expected debts, credit rating downgrades and increased reliance on government guarantees to access debt capital markets. Rating downgrades also reduce the value of bonds already in issue, resulting in capital losses for the Public Investment Corporation (PIC).
Declining credit profile of private companies	Lower private corporate profits result in lower economic growth. Equity losses and rising non-performing loans (NPLs) at the Industrial Development Corporation of South Africa (IDC). Bankrupt mining and industrial companies implicitly leave the tab to government to pay for decommissioning of assets and other environmental obligations.
Declining credit profile of municipalities	Lower local investment, lower fiscal transfers and higher bulk power costs stretch the financial capacity of local and district municipalities. This could also lead to a rise in NPLs at the Development Bank of Southern Africa (DBSA).

As illustrated in table 28 above, the crystallisation of transition risk could cause public debt to rise via at least four channels.

In each of these cases, a gradual deterioration in the public finances would be easier to adjust to in "real-time" (via changes in tax or spending) than if the impact is concentrated in particular years or in specific large companies.

7.2. Potential causes of an unexpected, sharp rise in sovereign debt

Assuming tax revenues and public spending in line with 2018 budget publications[105], South Africa would enter the mid-2020s with gross public debt of more than R3.5 trillion (or $250 billion), compared with the current position of slightly more than R2.5 trillion (or $175 billion).

7.2.1 CONCENTRATION OF RISK IN A SHORT TIMEFRAME

In a worst-case scenario where all the $55 billion[106] of national government risk identified in chapter 4 had not been budgeted for and crystallised in the same year, it would add 30% to today's public debt or 22% to projected debt in the mid-2020s.

In the context of today's level of public debt to GDP of around 55%, this could add 15 percentage points to the total today or 12 points in the mid-2020s. Given that a rise in public debt had previously one of the key drivers of South African sovereign downgrades over the last decade (its Moody's rating has fallen from Baa1 with positive outlook and public debt to GDP of 26% in 2009 to a level on the cusp of sub-investment grade in 2018), we would expect a further sharp increase in debt / GDP of more than 10 points would cause the country to lose its investment grade rating. Large middle-income countries with solid institutional strength and sub-investment grade ratings, such as Brazil (Ba2 stable), tend to have public debt to GDP levels between 60-70%.

Of course, as we have shown in figures 17 (in chapter 4), 22 (in chapter 5) and 28 (in chapter 6), we would not, in practice, expect all this risk to materialise at one time (eg, $18 billion relates to a shortfall in expected tax revenues, with the impact spread over our period of study). More likely would be that much of the $38 billion of potential contingent liabilities could crystallise over a period of 2-3 years in the mid-2020s with a sharp decline in coal exports driving lower profits or a sudden withdrawal of the banking sector from funding coal (as has happened in Europe over the last few years) causing a liquidity crisis / inability to refinance.

This addition of a still significant amount of incremental debt (of a quantum of 8 percentage points of mid-2020s GDP) would still put pressure on the sovereign rating, especially if the government has not implemented offsetting policies, such as the additional taxes on liquid fuel referenced in chapter 5.

105 Source: http://www.treasury.gov.za/documents/national%20budget/2018/review/FullBR.pdf

106 The figure of $55 billion (as in figure 16) includes all the risk identified in this paper including risk already realised by the decline in business as usual forecasts between 2013 and 2017. If the South African National Treasury has already incorporated some of the 2013-2017 risk into its forecasting, then the incremental risk would be lower than $55 billion. The minimum (ie, if it had incorporated all the 2013-2017 risk) would be closer to $20 billion.

7.2.2 DETERIORATION OF ESKOM'S CREDIT PROFILE

While government may face $38 billion of incremental contingent risk as set out above, if a transition were to cause a debt default of any countries with already-significant government guarantees, a cross-default that crystallised existing contingent risk could put further pressure on the sovereign credit rating. As at March 2018, government had over R400 billion or nearly $30 billion of guarantees in issue to SOEs, independent power producer (IPP) and public private partnership (PPP) investors. Of these, more than half relate to Eskom.

Eskom is critically important to the government as the largest SOE, the monopoly owner of the electricity grid and of more than 80% of the country's power generation assets. However, its deteriorating financial position over the last five years (as growth in debt has far surpassed that of earnings) has increased the likelihood that its government guarantees will need to be called upon, causing rating agency analysts to single out the company out as a source of risk to the sovereign rating[107]. As illustrated in table 29 below, state or public exposure to Eskom's debt may be close to double the amount guaranteed by government.

Table 29: Public exposure to Eskom debt (March 2018)

EXPOSURE OF THE PUBLIC BALANCE SHEET TO ESKOM DEBT AS AT MARCH 2018 (USD BILLION)	VALUE
Government guarantees to Eskom	16
Government guarantees to IPPs in respect of Eskom's payment obligations	8
DBSA unguaranteed loan to Eskom	1
PIC share of Eskom's unguaranteed bonds	6
Total exposure	**31**

As discussed in chapters 4 and 5, Eskom may face $1.1 billion of transition risk from increased coal costs and a further $4 billion or more in stranded assets if government forces it to close some of its coal-fired power stations early. While in theory, it might be allowed by the regulator NERSA to recover this cost via increased consumer prices, in practice, recent exchanges between Eskom and NERSA suggest that this might not be possible. Even if it were possible, the evidence of sharp price rises over the past five years suggests that the ability of Eskom to raise prices may be a double-edged sword, if it results in increased grid defection (by heavy industry and potentially by large cities) and an increase in bad debts (particularly from municipalities)[108].

With Eskom's standalone position currently rated as close to default, any transition risk that it is not able to bear would likely need to be covered by government (through increased government guaranteed debt) or else bring the company closer to default, increasing the risk of crystallisation of all the public exposure. Either way, Eskom would be a channel through which further risk would be imposed on the sovereign rating.

A restructuring of the company, as proposed by the Eskom task force in January 2019 will only be successful if it can steady the company's financial position and reposition at least some of the unbundled divisions so they are capable of financing themselves without recourse to government.

7.2.3 DETERIORATION OF TRANSNET'S CREDIT PROFILE

Unlike Eskom, Transnet currently has a solid investment grade credit profile and as at March 2018 had only R4 billion (or $270 million) of outstanding government guarantees. However, as set out in chapter 4 and appendix 1, Transnet faces much more significant transition risk approaching $20 billion. If this crystallised (as discussed in box 5), the resulting shock to Transnet's balance sheet would likely result in a loss of the latter's investment grade rating, which in turn could curtail or increase the cost of its access to capital market without incremental government guarantees. This could therefore provide a further drag on the sovereign rating.

7.2.4 IMPACT ON WORKERS

Our analysis shows 25,000-35,000 job losses in the coal mining sector between 2018-2035 in both our BAU and 2DS scenarios driven by declines in coal exports and power sector consumption in line with the draft IRP. Redundancies occur earlier in the 2DS scenario but total jobs in the sector at around 50,000 in 2035.

Mining job numbers are driven more by production (ie, volume) than by profits. The decision on whether to decommission power plants or the Secunda CTL (which we estimate supports around 15,000 mining jobs by itself) early may be more material for job numbers than the decline in the global export market.

107 Moody's considers as one of the key downgrade risks for the sovereign "the potential for SOE sector risks crystallising in a manner which raised the government debt burden and put it on a higher trajectory"

108 The statistics in Eskom's most recent annual report demonstrate how sales to industrials have started to drop off over the last five years. Source: http://www.eskom.co.za/IR2018/Documents/Eskom2018IntegratedReport.pdf

This profile more or less follows the findings of recent studies on this subject, which suggest that the coal labour transition is already underway. According to a recent study by the University of Cape Town Energy Research Centre[109], employment in the coal mining sector peaked in 1981 before beginning of general decline driven by increasing mechanization of the production process.

A total of 30,000 job losses over nearly two decades would be material for the workers and communities involved but would represent a slowing of the recent trend and a shallower decline than in the platinum sector where 30,000 jobs have been lost in the decade alone.

109 Ibid. Burton J et al (2018).

7.3. Summary

Beside lower-than-expected tax revenues and a potential decline in the credit profiles of Eskom and Transnet, the national government could also be forced to bear certain other costs – such as support to municipalities, funding for worker retraining and, potentially costs to decommission assets facing early closure – which for the public balance sheet might only be implicit responsibilities but necessary to maintain social cohesion or to prevent pollution of land and watercourses.

Despite these risks, a sovereign credit downgrade in a low-carbon transition is far from an inevitability. By implementing the recommendations set out in chapter 8, South Africa can mitigate much of the negative impact from the global transition, gain from the benefit of lower oil prices (as discussed in chapter 5) and benefit from the opportunities that a local low-carbon transition will present for new industries and jobs.

BOX 5: TRANSNET – EXTERNALLY DRIVEN POLICY CHANGES CAUSING POTENTIAL, BUT AVOIDABLE, FINANCIAL DISTRESS FOR STATE OWNED ENTERPRISES (SOES)

A rating downgrade for Transnet would be most likely to materialise in the event of a significant increase in what rating agencies call its "business risk profile" or the riskiness of its operating cashflows.

An increase in risk profile could occur gradually as its rail business is disrupted:

If international majors continue to sell assets to South African companies with weaker balance sheets, the value to debtholders of the secure cashflows that the coal rail take-or-pay contracts would provide would diminish as counterparty risk increased (ie, the risk that Transnet would not get paid under those contracts would increase);

As miners start to bear transition risk, as discussed in this chapter, their financial positions may deteriorate, intensifying counterparty risk;

At the expiry of its remaining contracts in the mid-2020s, unless Transnet were able to recontract on similar terms (ie, with export volume risk borne by miners), then the riskiness of its operating cashflows would increase. Our analysis suggests that miners would not be willing to recontract on similar terms as annual demand for South African coal on the seaborne market would be significantly below the capacity of the rail line.

Transnet could very quickly be facing lower revenues and increased riskiness of operating cashflows.

Companies see changes in business risk profile all the time and yet are often able to maintain a steady credit rating by making an offsetting impact to its financial risk profile. For rating agencies, companies with riskier cashflows can support lower financial leverage at a given rating level. A deterioration in business risk could therefore be offset by a decision to reduce financial leverage, most likely either by reducing investments or an equity injection.

If Transnet factors this transition risk into its investment plans between now and the mid-2020s, diversifying away from coal and reducing financial leverage, it may be able to offset the impact of a sharp decline in coal exports. If continues to invest (and take on debt) in existing based on the assumption of a growing export market for coal, it would not have the financial flexibility to offset the impact of riskier operating cashflows and would likely require a government equity injection (or "bailout") to stave off a rating downgrade.

8. Conclusion: a plan of action for South Africa's policymakers

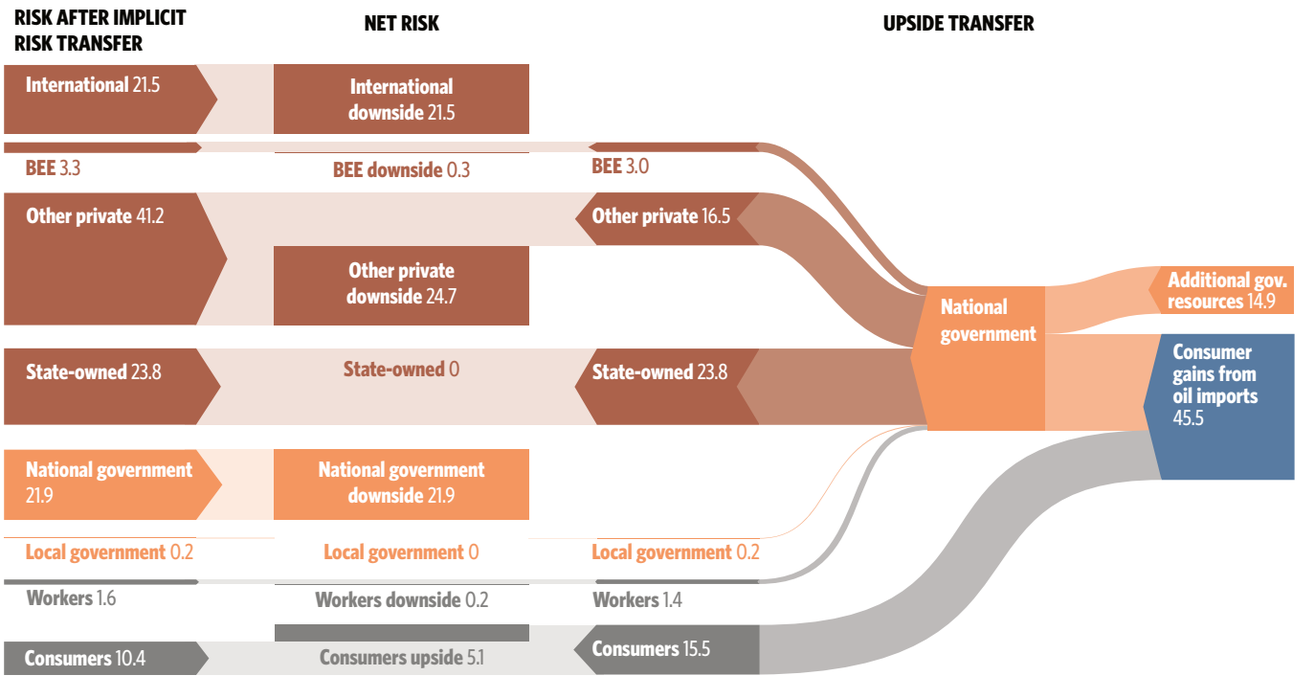
Throughout the many discussions we held with stakeholders in South Africa in producing this report, South African and international stakeholders often conflated the global risks associated with climate change and the difficulty in taking action on climate mitigation in the country. While the two are related, this report shows clearly that climate migitation action in South Africa is not the major cause of risks to its economy and finances. Furthermore, managing the timing and financing of action in South Africa is one of several tools South Africa can use to manage and reduce its climate transition risk. The analysis in this report demonstrates that the risk to South Africa – its companies, workers and public finances – of continuing with business as usual is higher than the costs of managing those risks through proactive management of risks to the economy.

We estimated the downside risk associated with a low-carbon transition at $123.9 billion in present value terms between 2018-2035 and the potential benefits of at least $46.5 billion. Both numbers are likely to be underestimated given the necessary limitation of the scope of the analysis to a small number of sectors. If the government does not plan actively for a low-carbon transition – paying particular attention to risks arising outside of the country that are out of its control – it could face the downside without capturing the upside risk. It could also lose its investment grade sovereign credit rating. By contrast, implementation of the recommendations set out here may provide the country with an excellent opportunity to mitigate downside and expand the benefits of a low-carbon transition.

Recommendation 1: Take stock of the rapidly changing market for South African commodity exports and adapt development and financing plans accordingly

The most effective government response to transition risk would require coordination across all areas of the public sector, from national government departments, supervisory bodies such as the South African Reserve Bank, to publicly owned entities operating at arms-length from the national government, including

Figure 29: Mitigation scenario: oil benefits used to compensate some of those at risk from coal-related downside



state-owned enterprises, such as Eskom and Transnet and state-owned financial institutions, such as DBSA, IDC and PIC.

The analysis set out in this report provides an example of the tools that the national government could use to monitor and respond to the changing nature of global coal and oil markets, as well as future shifts in global markets driven by responses to climate change. These tools could help South Africa develop new fiscal and financing methods (see recommendations 6 and 7 below) to capture the benefits from a transition and use them to compensate weaker parts of the economy that are not financially strong enough to bear transition risk. Figure 29 demonstrates how the potential upside from lower oil prices could be used to manage risks to government finances and the contingent liabilities it faces due to the potential risk and failure of South African companies.

A mechanism to capture the potential lower oil price windfall could be based upon expected business as usual oil prices. An additional tax could be set at a rate such that consumers would be left at least as well off as they would have been under a business as usual scenario. Meanwhile the amount of revenue gained by the government would be a function of the degree to which oil prices would be lower, which should partly reflect progress of the global transition.

Another potential complementary approach would be to publish the results of national government analysis. This transparency could have benefits as South Africa seeks to stabilise its profile with international rating agencies and foreign investors. Incorporating transition risk into economic forecasting could itself be positive for rating agencies as it should reduce the likelihood of sharper policy changes further down the line and of serious divergence from expectation of major economic performance indicators.

Recommendation 2: Avoid or delay new investments that could add to South African climate transition risk, until the market for the related product is certain

With more than $25 billion of new investment over the next five years that would destroy economic value to the country in a concerted, global low carbon transition, South Africa needs to be certain that it can – and wants to – bear these risks. For each of these investments, South Africa needs to understand thoroughly the consequences and likelihood of the transition and related risks as well as determining whether these investments continue to make sense within South African's development ambitions.

Introducing climate transition risk assessments as a standard condition of application for public sector procurements, financial assistance such as guarantees to finance on preferential terms from state-owned financial institutions or other fiscal incentives, could help avoid investments where the risks outweigh potential or likely benefits.

These assessments would likely lead to ending further investment coal-fired power stations and coal-related rail infrastructure from today and no new coal mines after 2020. On the other hand, the case for a new oil refinery is less clear and will depend on government decisions on policy around fuel economy standards, carbon tax and the future life of existing crude and synthetic fuel refineries.

Whether investments in developing recently discovered gas fields will increase or decrease risk is also currently uncertain and will depend to a large extent on the life of the resource and the lifting cost.

Recommendation 3: Make risk allocation explicit to reduce unmanaged risks and improve the efficiency of managing those risks

In chapter 4, we identified $38 billion of downside climate transition risk that could ultimately end up with parties without the financial strength to manage them. These include local companies with weak balance sheets (including many Black Economic Empowerment companies) investing in coal mines, district and local municipalities, and workers facing job losses. This risk could end up falling back on national government via the pressure to provide financial assistance to companies, additional fiscal transfers or financial relief payments for municipalities, and unemployment benefits or funds for training for workers.

These risks and risk transfers may arise because companies or municipalities have themselves not planned for or managed the potential risks, often because they assume that the national government will manage it for them. If the government on its side has not planned for these risks, then their materialisation could come as a complete shock to the government and the economy. Whether or not the government ultimately wishes to retain the risk or leave parts of it with companies, municipalities, and workers, it should be clear and explicit where and how the risk will land.

If, for example, government made transition risk allocation explicit by requiring funded decommissioning plans as a requirement for accessing state-backed funding from coal mining acquisition finance, companies, municipalities and workers may be more likely to act early to protect themselves against climate transition risk. Publishing analysis on forecast transition risk and how it will affect different industries will also encourage all parties to balance risks before making business decisions. Making the risk and its eventual allocation explicit may also reduce the incentive for local entrepreneurs to compete to buy emissions-intensive assets from international mining majors, leaving more transition risk with investment grade balance sheets who are strong enough to absorb it. Such a step would also make it easier for government to budget for the effect on the public finances.

Recommendation 4: Manage the timing and speed of climate mitigation actions and commitments to avoid compounding shocks to the economy

Transition risk analysis (as in recommendation 1) will also help public policymakers understand to the costs trade-offs and distribution impacts of potential South Africa climate mitigation strategies which go above and beyond the power plant retirements included in the draft Integrated Resource Plan for the power sector.

While much of the external risk arises in the mid-2020s, government and companies should start scenario-planning now for the potential early retirement of carbon-intensive assets which might become uncompetitive or face sharp drop-offs in demand. These include coal mines with relatively high cash costs; Eskom's coal-fired power stations starting with the oldest and least efficient; and Transnet's coal freight rail line from Mpumulanga to Richards Bay. As well as planning for the effects on workers and municipalities, actions such as rationalising maintenance capex and avoiding new long-term obligations including coal supply contracts could reduce the amount of value stranded.

For other assets, such as the coal-to-liquids plant at Secunda, while there does not appear to be a cost-effective replacement option today, but where CO_2 emissions are so high any global low-carbon scenario will eventually require its closure or emissions abatement. For Secunda, and other carbon-intensive technologies, such as steel plants, cement plants and smelters, government should prioritise funding for research into the use of low-carbon alternatives, more efficient use and re-use of resources (eg, circular economy principles) and alternative methods of carbon abatement, such as Carbon Capture and Storage.

Recommendation 5: Plan for transitions to manage risk to vulnerable parts of the South African economy, such as workers

For the sectors and assets which face transition risk, a transparent planning process, with identified transitional funding mechanisms and a gradual phase-out timetable is essential. Plans should cut across sectors. For example, as a majority of the coal mining workforce is supported by demand from domestic sources (eg, mines supplying just Secunda's coal-to-liquids facility provide nearly a quarter of all jobs in the sector), the phase-out timetable for the mining sector needs to be developed in parallel with plans for the power and fuels sectors.

To ensure that all groups' views are fairly represented (and increase the chance of social acceptance of the policies), these processes should include input from all key stakeholders, including companies, trade unions, local governments and the financial sector. As well as drawing on South African experience of mine closures in the diamond, gold and more recently, platinum industries, policymakers should learn lessons from countries who have recently been planning for the wind-down of their domestic coal industries (eg, Germany, Spain and parts of the USA).

For the most vulnerable parties involved – in particular, workers, communities and local governments – early transition planning will enable government to design supportive policy and financial interventions. These could include retraining programmes for workers, which will require comprehensive skills mapping of the at-risk workforce to that the programmes are effective. It will also be important to undergo early consultation with municipalities to understand what funds they stand to lose if miners close assets and withdraw their corporate social investment in the local areas. Obtaining this information early will assist in the development of transition funding instruments. DBSA, as the largest lender to municipalities, could help to enable this, providing technical assistance, direct financing and credit enhancement/structuring support to enable more municipalities (perhaps by grouping together) to access debt capital markets.

Recommendation 6: Shift some risks from the national public balance sheet to other parties, possibly including sub-national government, to increase risk-bearing capacity

Closures of assets and falling fiscal transfers may cause many of the smaller district and local municipalities to face failing finances as they are often more dependent on fiscal transfers than the larger metropolitan municipalities. Metropolitan cities may benefit from increased fuel levies, which should provide a short-term boost to their credit profiles.

Although a metro funding model which is dependent on resource consumption is unlikely to be sustainable in a future low-carbon South Africa, the government could use the short-term increase in metro financial flexibility to introduce reforms which allow cities greater autonomy to raise and retain revenues (eg, land value taxes), attract private sector co-investment in infrastructure (eg, PPPs) and to cut costs, perhaps through allowing cities to build or act as offtaker to new renewable energy projects and benefit from prices for new assets that are 30% lower than the average cost of grid-connected electricity.

This adjustment could enable metro municipalities to make more use of the maximum debt levels allowed by legislation, which we estimate at an incremental R48 billion (or $3.3 billion) relative to the position in March 2018. If municipalities were able to utilise this capacity, it could free up a similar amount of headroom for the national balance sheet. Similarly, restructuring Eskom (as set out in box 6 below) to reduce its dependence on government guarantees, could reduce pressure on the sovereign rating. Both actions could reduce the pressure on the sovereign credit rating, increasing the risk-bearing capacity of the public balance sheet.

Recommendation 7: Work with international development finance institutions and other international financiers to address items 4, 5 and 6 within the international context

Chapters 4 and 5 showed how South Africa is far from alone in either needing to adapt to climate change or in taking actions to mitigate it. Reaching the world's well below 2C targets will require further action from nearly every country across the world, including South Africa, but recommending which additional actions should be taken, in which countries, and who should pay the cost of these actions, is well beyond the scope of this paper.

Nevertheless, there are mitigation actions in South Africa that are likely to be less costly to undertake than many actions in other economies, where countries might work with South Africa to put forward lower cost joint contributions. There are also actions that require financial support or technical assistance, and development projects that could benefit from access to, and the support of, international financial markets and the assistance of international development financial institutions.

This paper has highlighted at least five areas for international consideration:

1. International financial institutions (IFI) could help develop and underwrite financial mechanisms and programmes to smooth South Africa's climate transition risk.
2. International technical assistance with Carbon Capture and Storage on Secunda could both lower medium-term emissions, as well as provide valuable international experience in the development and scale up of CCS.
3. If development of CCS does go forward, IFIs could help finance an early retirement fund to ensure that the new CCS plant is retired on time and does not, itself, become a victim of transition risk and become a stranded asset (as illustrated in figure 30 below).
4. IFIs could provide finance to smooth and de-risk domestic South African transitions for either or both coal fired power and the oil products industry.
5. Finally, there could be an opportunity for bi-lateral or multilateral carbon trades, either directly following existing carbon markets, or putting forward agreements outside of existing carbon markets.

BOX 6: ESKOM: A RESTRUCTURED AND REFINANCED CAPITAL STRUCTURE COULD REDUCE THE PRESSURE ON THE SOVEREIGN CREDIT RATING

For the South African government - shareholder and guarantor of much of Eskom's debt – the company's recent financial distress has started to weigh on the sovereign credit rating. Despite injecting equity into Eskom in 2015 and further public funds in early 2018, the company has suffered declining financial results with time and cost overruns at Medupi and Kusile power stations (as well as poor availability at commissioned units) increasing debt levels and increasing coal and other costs driving power prices up to levels which are too low to allow Eskom to rebuild its reserves but too high as to be sustainable for Eskom's customers, prompting increasing grid defection and bad debts.

The government now faces a quandary. However, in the State of the National Address in February 2019, the President announced his intention to implement the initial recommendations of the task force he appointed in December 2018 to review strategic options for the company. This includes creating an independent transmission and system operator and splitting Eskom into three parts: generation, transmission and distribution. A successful strategic review and financial restructuring would be one which restored security of supply (following increased loadshedding in late 2018). As yet, there has been little indication of concrete plans, which would stem the company's losses and deliver a sustainable path to reduced reliance on government guarantees to access funding from capital markets. If the task force is successful in devising such a plan, this would in turn relieve some of the pressure on the sovereign credit rating, leaving the public balance sheet more resilient to deal with other risks, including those discussed in this paper.

Such a restructuring will not be easy to achieve. First and foremost, it would need to avoid triggering a default assessment by lenders or rating agencies, as that would crystallise government guarantees and could prompt a sovereign downgrade. Second, a restructuring which split the business into multiple parts would need to allocate the existing debt in a way which was both amenable to creditors and ensured that each part of any "new Eskom" were financeable. Recent pressures in the generation (cost overruns and low plant availability) and distribution businesses (rising bad debts) may limit the appetite of traditional lenders for such businesses while a cash-generative transmission segment may stand a greater chance of regaining a standalone investment grade rating, depending on how much legacy Eskom debt it would take on.

Development finance institutions may be critical to the refinancing of generation and distribution segments, providing a level of concessionality (on risk appetite and/or pricing) in return for greater restrictions on the segments' operations. In particular, there could be a role for mission-driven international capital if there were a commitment by Eskom to accelerate emissions reduction.

Annex A

Company summaries

SASOL

KEY FINDINGS

Total explicit transition VAR 2018-2035: **$7.0 billion** (Total 2013-2035: $7.4 billion)

Total implicit transition VAR: **$-0.3 billion**

Total transition VAR: **$6.7 billion** ($7.1 billion)

Total transition VAR / market cap: **26.5%** (28.1%)

Key risk from potential government policy

A shut-down of the CTL without compensation would seriously affect Sasol's financial standing. It would lose equity value of close of more than $6 billion, bringing transition VAR / market cap up to **51%**

Strategic options: Invest in lower-carbon options, flexible electricity generation and in broadening the use of gas in the South African economy. Increasing the share of natural gas feedstock in the CTL could reduce the sensitivity of profits to movements in the global oil price.

Other issues: A lower global crude price would hit Sasol's non-SA assets, reducing its capacity to deal with SA risks

KEY FACTS

Employees in South Africa: **17,517**

Government ownership of equity: **PIC (14.3%), IDC (8.5%)**

Government ownership of debt: **Zero**

SA share of group: **35% of group EBITDA**

Earnings by segment: **Mining (13%), E&P (4%), Performance Chemicals (24%), Base Chemicals (18%), Energy (38%), Other (3%)**

Market capitalisation: **$25.3 billion**

Net long-term debt: **$8.8 billion**

Net debt / LTM EBITDA: **1.9x**

Credit rating (standalone): **Baa3 stable (Moody's)**

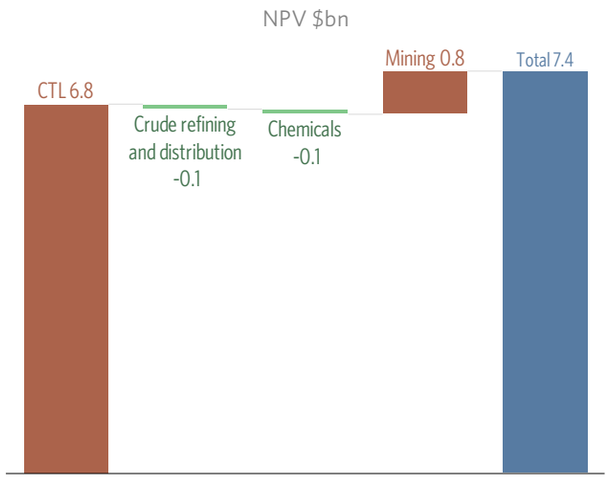
Explicit value at risk from the external transition

Total explicit VAR: $7.0 billion explicit future transition VAR in SA business. Non-SA impacts could be larger. "Historic" / already realised VAR of $0.4 billion.

Coal: Volume of coal exports would fall by 50% and value by 76%, relative to BAU.

Fuel distribution: Marginal $0.1bn increase over wholesale and retail segments driven by higher volumes of fuel sold.

Crude refining: In the Natref crude refinery (Sasol 64% share), input commodity costs would fall slightly further than the refinery sales price, marginally increasing the margin per barrel on petrol and diesel.



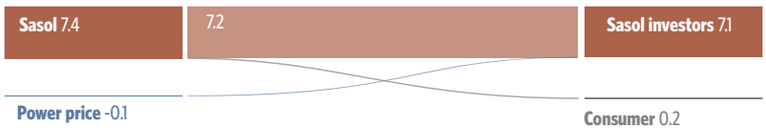
Coal-to-liquids: As the CTL uses coal, rather than oil, as primary feedstock, its input costs would not fall in-line with the oil-price driven fall in sales prices, resulting in lower margins per barrel of liquid fuel in 2DS, and value at risk of $6.8bn.

Chemicals: Although our quantitative analysis did not assess this, we would expect part of this to be offset by higher profits from the chemicals produced at Secunda, on the assumption that Sasol's market power in South Africa is such as to be able to maintain prices even as oil prices fell.

Implicit value at risk from external transition

Total implicit VAR: Could gain $0.3 billion in the SA business after implicit risk allocation.

Coal: Could recover 80% of lost export volume and 50% of lost export value ($0.2 billion) through sales on the domestic market.



Power price: As a consumer of electricity, could gain $0.1 billion as a result of lower prices.

Risks from domestic mitigation policy

POLICY	POLICY IMPACT (GAINS IN NEGATIVE)
No more coal mines	0.2
No coal IPPs	-0.1
Shut-down coal export line early	0.1
Shut-down coal power plants early	0.2
Shut-down coal-to-liquids early	6.1

ANGLO AMERICAN

KEY FINDINGS

Total explicit transition VAR 2018-2035: **$2.3 billion** (Total 2013-2035: $1.1 billion)

Total implicit transition VAR: **-$0.8 billion**

Total transition VAR: **$1.5 billion** ($0.3 billion)

Total transition VAR / market cap: **5%** (1%)

Key risks from potential government policy

An early shut-down of the coal rail line with Richards Bay would strand $0.2 billion of value from Anglo's relatively competitive export assets

Strategic options: Partial or complete sell-down to local players before transition risk is fully priced in.

Other issues: Potential upside risk in platinum and manganese (not factored in) from growth in energy storage and fuel cell technologies.

KEY FACTS

Employees in South Africa: **61,000**

Government ownership of equity: **PIC (13.3%)**

Government ownership of debt: **Zero**

SA share of group: **25% of group capital employed**

Earnings by segment: **Coal (27%), Diamonds (22%), Iron Ore & Manganese (22%), PGM (19%), Copper (16%), Nickel (2%), Other (-8%)**

Market capitalisation: **$28.4 billion**

Net long-term debt: **$8.3 billion**

Net debt / LTM EBITDA: **1.1x**

Credit rating (standalone): **Baa3 positive (Moody's)**

Explicit value at risk from the external transition

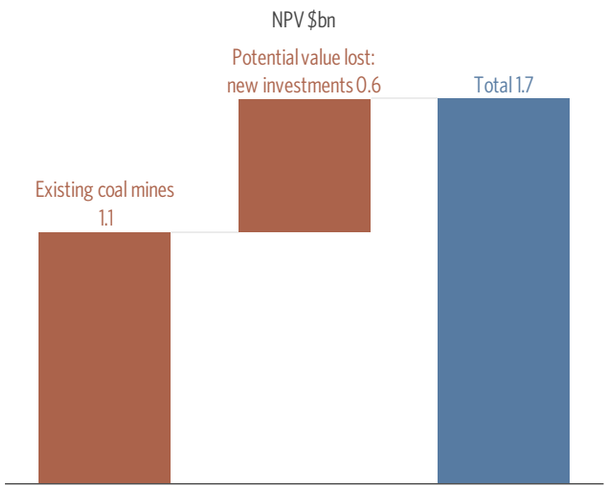
Total explicit VAR: $2.3 billion explicit transition VAR in SA business. "Historic" / already realised VAR of -$1.2 billion.

Export coal summary: Volume of coal exports would fall by 39% and value would fall by 58%.

Export coal detail: Assets remain relatively competitive vs. peers: opencast (Mafube); large-scale (Zibulo), Mpumulanga-based (lower rail costs).

Coal investments: Already sold almost all development assets. Remaining Elders project does not generate value over the period of our study, even in our BAU case.

Other metals: Potential short-term boost to Kumba iron ore and Samancor manganese assets. Mogalakwena platinum asset is low on global cost curve and hence would be relatively protected against declines in demand

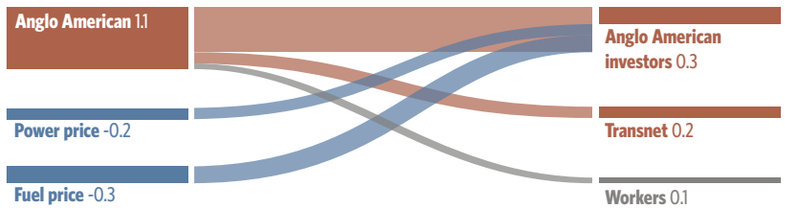


Strategic options to mitigate risk: Sold operating domestic-focused coal mines and recently commissioned New Largo to local investors in 2017. May consider selling further stakes / assets while transition risk not fully priced in.

Implicit value at risk from external transition

Total implicit VAR: Could gain $0.8 billion in the SA business after implicit risk allocation.

Coal: Could recover 30% of lost export volume but little value through increased sales in the domestic market



Fuel price: As a consumer of diesel and other liquid fuels, Anglo could **gain $0.3 billion as a result of lower prices**, assuming it continues current levels of consumption.

Risks from domestic mitigation policy

POLICY	POLICY IMPACT (GAINS IN NEGATIVE)
No more coal mines	0.1
No coal IPPs	0.3
Shut-down coal export line early	0.2
Shut-down coal power plants early	0.5
Shut-down coal-to-liquids early	0.0

EXXARO

KEY FINDINGS

Total explicit transition VAR 2018-2035: **$2.0 billion** (Total 2013-2035: $4.0 billion)

Total implicit transition VAR: **-$1.7 billion**

Total transition VAR: **$0.3 billion** ($2.3bn)

Total transition VAR / market cap: **12%** (88%)

Key risk from government policy

Accelerated shut-down of domestic coal-fired power plants could hit Exxaro could result in lost value of nearly $1bn.

Strategic options

Curtail investments in new coal mines, conserve cash and develop more diversified future strategy ahead of major refinancing in early 2020s

KEY FACTS

Employees in South Africa: **6,648**

Government ownership of equity: **PIC (10.2%)**

Government ownership of debt: **Zero**

SA share of group: **Close to 100% earnings**

Earnings by segment: **Coal (99%), Iron Ore (1%)**

Market capitalisation: **$2.6 billion**

Net long-term debt: **$0.3 billion**

Net debt / EBITDA: **0.0x**

Credit rating (standalone): **zaB stable (S&P)**

Explicit value at risk from the external transition

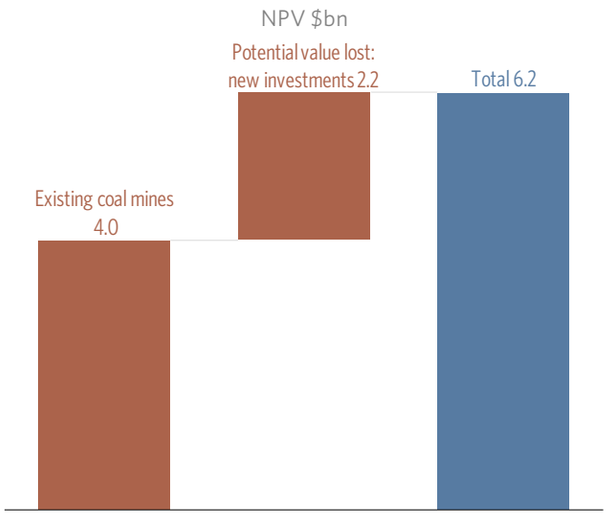
Total explicit VAR: $2.0 billion explicit future transition VAR."Historic" / already realised VAR of $2.0 billion.

Export coal summary: Volume and value of coal exports would fall by 86% and 95% respectively, relative to BAU.

Export coal detail: Assets less competitive vs. peers: small-scale (Leeuwpan), Limpopo-based / higher rail costs (Grootegeluk).

Domestic coal summary: Fixed price domestic contracts (15 mtpa) and sales to industrial users such as cement and steel plants (4 mtpa) would be resilient in the short term.

Coal investments: Exxaro has major future plans to lead the development of the Waterberg coal basin. On our analysis, the viability of all Waterberg investments requires a flat or expanding export market, which would not exist in our 2DS. Investments in new mines beyond those already in construction could add up to $2.2 billion in transition risk.

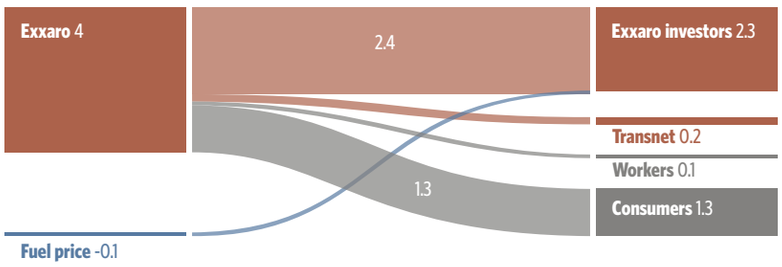


Risks from financial sector: Declining appetite of finance sector for coal could lead to refinancing risk in early 2020s.

Implicit value at risk from external transition

Total implicit VAR: Could gain $1.7 billion in the SA business after implicit risk allocation.

Coal: Could recover 17% of lost export volume and 59% of lost export value ($1.3 billion) through increased sales on the domestic market. We expect this to flow to consumers via lower power prices.



Fuel price: As a consumer of diesel and other liquid fuels, Exxaro could **gain $0.1 billion as a result of lower diesel prices**, assuming it continues current levels of consumption.

Risks from domestic mitigation policy

POLICY	POLICY IMPACT (GAINS IN NEGATIVE)
No more coal mines	-4.1
No coal IPPs	1.4
Shut-down coal export line early	0.9
Shut-down coal power plants early	3.3
Shut-down coal-to-liquids early	0.0

TRANSNET

KEY FINDINGS

Total explicit transition VAR 2018-2035: **$2.9 billion** (total 2013-2035: $18.6bn)

Total implicit transition VAR: **$0.9 billion**

Total transition VAR: **$3.8 billion** ($19.5bn)

Total transition VAR / total assets: **12%** (60%)

Key risk from government policy

Government decides to protect mining companies in a declining industry by passing risk onto Transnet rail (ie, forced renegotiation of take-or-pay contracts)

Strategic options: Incorporate view of global low carbon transition into strategic planning. Reduce investment to lower leverage, where new business lines may have an uncertain or higher risk profile than the coal freight rail line.

KEY FACTS

Employees in South Africa: **53,648**

Government ownership of equity: **100%**

Government ownership of debt: **62% (PIC)**

SA share of group: **Close to 100% of earnings**

Earnings by segment: **Freight Rail (59%), Port Terminals (17%), Port Authority (14%), Pipelines (6%), Engineering (3%)**

Total assets: **$32.4 billion**

Net long-term debt: **$7.9 billion**

Net debt / EBITDA: **3.3x**

Credit rating (standalone): **Baa3 stable**

Explicit value at risk from the external transition

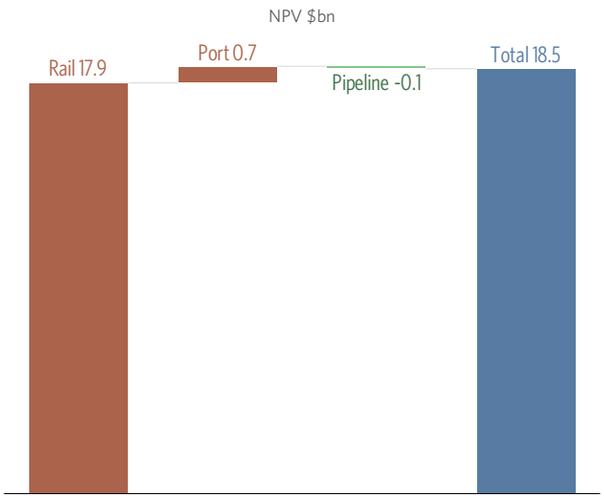
Total explicit VAR: $2.9 billion explicit transition VAR. "Historic" / already realised VAR of $15.7 billion.

Summary: Risk mostly concentrated in freight rail ($3.9bn) with a small negative in the National Ports Authority ($0.2bn) offset by a slight positive in Pipelines ($0.1bn)

Freight rail: Take-or-pay rail contracts taking coal to Richards' Bay protect Transnet against most export volume risk to early 2020s. But expiry of contracts and drop-off in export volume would mean the line was loss-making from the mid-2020s.

Ports: RAB-based regulation protects port assets against most volume risk.

Pipelines: Increase in volumes transported by the pipelines sector would partially offset this risk (increase in NPV of $0.1bn).

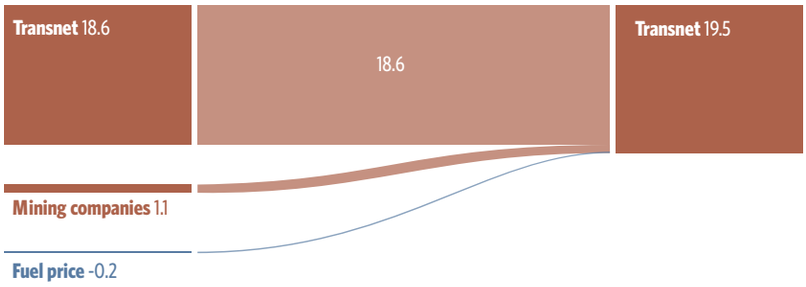


Investments: Company is exploring expansions of capacity of the coal rail line to Richards Bay (81 mtpa to 97 mtpa) increased capacity to Waterberg and spurs to Botswana and Mozambique which could cost over $1 billion. In a 2DS scenario, these would deliver a negative return and weigh on Transnet's credit profile.

Implicit value at risk from external transition

Total implicit VAR: $0.9 billion implicit transition VAR.

Coal: This would mainly arise from companies deciding or not being able to pay take-or-pay rail commitments – effectively passing some volume risk onto Transnet even during the period of the contracts. **Our analysis shows this could be as much as $1.1 billion.**



Coal: The likelihood of this happening will be linked to the creditworthiness of the counterparty base (which could likely decline as international companies sell to local ones).

Fuel price: Transnet would gain **$0.2 billion from lower diesel prices**, assuming it continues current levels of consumption.

Risks from domestic mitigation policy

POLICY	POLICY TYPE	POLICY IMPACT (NPV 2017)
No more coal mines	Avoid investments adding risk	0.0
No new coal power plants	Avoid investments adding risk	0.0
Shut-down coal export line early	Early asset closures	2.7
Shut-down coal power plants early	Early asset closures	0.0
Shut-down coal-to-liquids early	Early asset closures	0.0

ESKOM

KEY FINDINGS

Total explicit transition VAR: **$0.0 billion**

Total implicit transition VAR: **$0.1 billion**

Total transition VAR: **$0.1 billion**

Total transition VAR / market cap: **0.1%**

Risk from government policy:

Risk that regulator does not allow full passthrough of higher coal costs. In practice, downside risk is limited as Eskom has been close to default for some time, but the government is unlikely to let that happen as it would crystallise sovereign guarantees,

Secondary impacts: Eskom is currently devising its medium-term strategy to restore it to financial sustainability. A restructure and recapitalisation could relieve some pressure on liquidity and increase the risk-bearing capacity of a separate grid company.

KEY FACTS

Employees in South Africa: **48,628**

Government ownership of equity: **100%**

Government ownership of debt: **65% explicitly guaranteed, 56% PIC**

SA share of group: **95% of revenue**

Earnings by segment: **Generation (62%), Transmission (11%), Distribution (16%), Pipelines (6%), Sales & Trading (2%), Other (3%)**

Regulated asset base: **$50.1 billion**

Net long-term debt: **$30.2 billion**

Net debt / LTM EBITDA: **8.9x**

Credit rating (standalone): **caa2 (Moody's)**

Explicit value at risk from the external transition

Total explicit VAR: Eskom is not explicitly affected by the external transition, other than the pressure to decarbonise, which results from falling global costs of alternatives to Eskom's unreliable coal-fired power generation fleet.

Implicit value at risk from external transition

Total implicit VAR: Limited implicit transition VAR in SA business, depending on the ability to pass through risk to consumers and levels of bad debt.

Coal costs: Eskom would face an increase in coal costs totalling $1.1 billion as mining companies seek to offset the impact of the external transition. In theory, its price regulation would allow it to pass the increased cost through to consumers...

Bad debts: ...however, it would likely suffer an increase in bad debts from municipalities, whose credit quality would fall as fiscal transfers from government fall in the face of lower central tax revenue collection. Eskom's very weak credit profile would likely mean that the impact of any bad debts would in practice, be shared with government

Fuel price: In our 2DS scenario, Eskom would gain **$0.2 billion as a result of lower** diesel prices, assuming it continues current levels of consumption.

Risks from domestic mitigation policy

POLICY	POLICY IMPACT (NPV 2017)
No more coal mines	8.0
No coal IPPs	-1.1
Shut-down coal export line early	-1.4
Shut-down coal power plants early	Depends on compensation mechanism
Shut-down coal-to-liquids early	0.0

Annex B

Sustainability risks and their impact on financial stability

Economists, bankers, and planners have long observed that risks embedded in the economy and the financial system can disrupt financial stability if those risks are not properly monitored and addressed. The mortgage lending driven crisis of 2007/8, the stock market crash of 1929 that drove the great depression, the Asian financial crisis of the mid 1990s and even the tulip crisis of the 17th century all began with asset mispricing and financial bubbles that led to dramatic repricing of assets, followed by major economic downturns.

Through the Advisory Finance Group (AFG) of central bankers, development bankers and financial regulators, CPI has been asked whether sustainability risks, shocks, or bubbles could have similar potential impacts on financial stability and the economy. We have also been asked what steps a country, its regulators, and the international community could or should take to mitigate the impact of these sustainability shocks on national and global financial stability.

The first step to answering these questions is to define what is a "sustainability shock." Four our definition we draw on economics:

A sustainability shock *to a financial system occurs when a previously unpriced or underpriced externality is priced into an economy and related financial markets.*

An unpriced externality is a cost that one party imposes on society at large through their actions, but without the obligation to pay for those costs. For example, a driver on a free motorway causes wear and tear on the road and will add to congestion on the road. Taxpayers usually pay for road maintenance, while increased congestion will cost other drivers and businesses time, and may cost businesses sales, if the congestion discourages shoppers. Pricing of the externality would force the driver to pay the costs of maintaining the road and the cost of congestion. But if that externality were repriced overnight, the impact on the economy could be severe and destabilizing. For instance, the value of exurban houses whose owners relied on inexpensive access to roads would fall, just as they did when gas prices peaked. Automobile sales would decline. Some stores and businesses would benefit, others might fail. Some workers might no longer be able to afford to get to work, while others would move, but to smaller, more expensive properties.

For any "sustainability shock", the level of impact and the range of people and businesses affected will depend on specifics of the externality. The impact is entirely dependent upon how and how fast an externality is repriced. A slow and gradual repricing of an externality will give the economy and those affected more time to develop plans and adjust to the new economic realities. A gradual repricing may not always be an option, or may be difficult to achieve, due to the various mechanisms that may lead to repricing. We have identified three general categories of repricing:

- **Event Driven**: A driver causes an accident, a dam breaks causing a flood, climate change leads to stronger hurricanes; many externalities are probability driven rather than absolute. By using the road, the driver slightly increases the chance of an accident happening, but when an accident happens, costs of that potential accident become real. The driver probably had insurance, which reflected the probability of an accident, and the insurance company now bears most of the cost of the accident happening. The damage caused by the dam breaking may or may not have been completely insured, but even if it was insured, the event itself is likely to lead to enquiries that could eventually lead to policy changes that have a wider effect on the economy. Large hurricanes, to the extent that they can be tied to climate change, could trigger climate change mitigation policy. Event driven repricing may often be sharp and difficult to control, if not managed in advance
- **Internal policy driven**: A country, province or municipality can set its own policy to reprice externalities that exist within its own borders. This repricing happens frequently, often through either taxes or regulation. Fuel duties

attempt to charge motorists for their impact on road maintenance, regulation might prohibit dumping of toxic waste, while other regulation might force the polluter to pay for its clean up. Carbon taxes are another example of attempts to price in externalities. For these in-country externalities governments can think ahead and stage or smooth the repricing to avoid the destabilizing impacts of sudden, unplanned for changes.

- **External policy driven**: In an interconnected world, policy often reaches across borders. One country's decision to price in the cost of carbon and thus reduce coal imports, will reduce another country's exports. The country whose exports fall is often in a position where it can only react. These changes can be either sharp or smooth, but may be difficult for a government or regulator to respond to and control.

While the AFG has been grappling with how to address the potential financial destabilization of sustainability shocks, the Agence Francaise des Developpement (AFD) has been grappling with the question of how it can ensure that its technical assistance, development side, and lending will be consistent with global climate change objectives and will remain robust and financially sound under strong climate change action. The two issues, it turns out, are completely interrelated, as climate change, and the related energy transition that would be needed to address it, is possibly the most significant potential sustainability shock facing the global economy.

Annex C

Further information on CPI global modelling assumptions

The analysis described in this report is underpinned by modelling of the global seaborne coal market and the global oil market. This annex builds on the descriptions of the modelling set out in the body of the report in Box 1 (section 2.2.1) and section 3.1.

Global coal modelling

Our model for the seaborne coal trade is an equilibrium model, which uses linear programming to identify, for each year, the unique series of global trade flows, which optimises the total system cost. This enabled us to understand not only which assets were exporting, but the FOB prices at each major exporter and the CFR prices at each major importer.

We ran this model for various climate policy scenarios where the key variable changed between scenarios was demand for coal from the seaborne market for each major import node. The three scenarios referred to in this report are:

1) BAU2017 based on the New Policies Scenario of the International Energy Agency's World Energy Outlook 2017 or WEO 2017 (red lines);

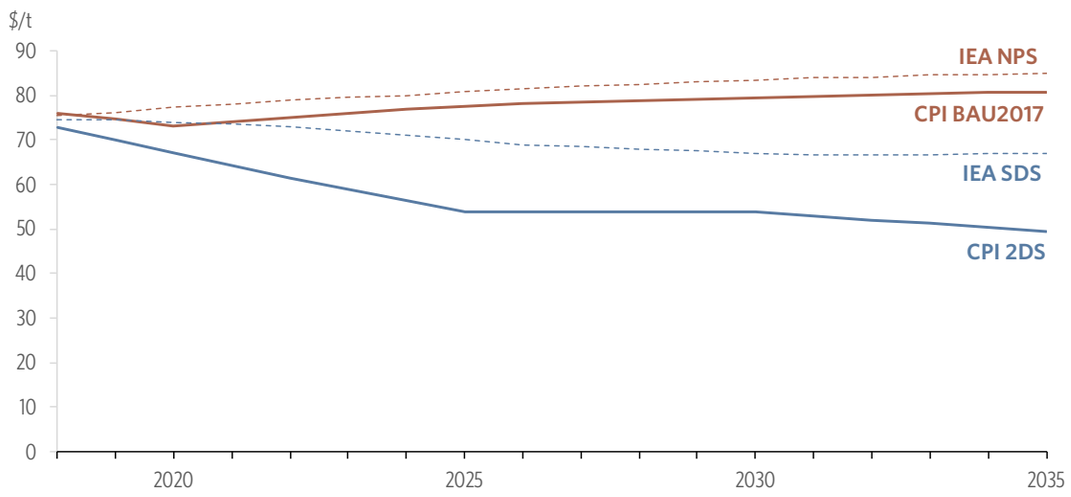
2) 2DS based on the Sustainable Development Scenario from the WEO 2017 with CPI adjustments (blue lines below), and

3) BAU2013 based on the Current Policies Scenario from the WEO 2013 with CPI adjustments (not shown).

Coal supply assumptions are CPI's own, derived from information from the Wood Mackenzie thermal seaborne cost curve database.

The chart below compares the outputs of CPI's scenarios vs the IEA's forecasts for OECD coal import prices taken from the WEO 2017. The CPI 2DS price is materially lower than the IEA SDS price, primarily as a result of our adjustment to reduce the amount of import demand from China and India. Our assumption of lower demand from those regions derives from a less bullish view on the likely deployment of CCS and a more optimistic view on Indian domestic coal production.

Figure AC1: OECD coal import prices (real)



Assumptions for global coal modelling

A few key assumptions are common to each scenario: a) asset-by-asset forecasts of total production and production available to be sold on the seaborne market for each major exporting country/region (South Africa, Indonesia, Colombia, Russia and the United States); b) export infrastructure constraints for each region; c) cash costs per mine; d) tax and royalty regimes; e) greenfield and brownfield capex costs; f) the average calorific value of coal exported by each major exporting region, and g) shipping regulation.

Sources for these fixed variables are set out in table AC1 and key variables that change by scenario are set out in table AC2.

Table AC1: Summary of coal modelling assumptions common to both scenarios

VARIABLE	SOURCE	OTHER COMMENTS
Coal production and supply	Wood Mackenzie	South African assumptions compared vs. CPI domestic analysis of South African coal market
Export infrastructure constraints	Wood Mackenzie	South African assumptions compared vs. CPI domestic analysis of South African coal market
Cash costs per mine	Wood Mackenzie	Costs split between mining, coal preparation, rail, port and overhead costs
Tax and royalty regimes	Wood Mackenzie	South African assumptions compared vs. CPI domestic analysis of South African coal market
Capex costs	IEA World Energy Investment Outlook 2014 (latest available report)	Estimates greenfield and brownfield capex per costs per region
Average calorific value of coal (ie, mt to mtce calculation)	IEA and Wood Mackenzie	IEA tce figures adjusted for Wood Mackenzie expectations of average calorific value of South African exports
Shipping regulation	International Maritime Organisation	We assume that MARPOL restrictions on sulphur content of marine fuel apply in both scenarios. Our scenarios do not attempt to estimate the impact on marine fuel prices of the shipping industry's nascent attempts to combat climate change

Table AC2: Summary of coal modelling assumptions that vary between the scenarios

VARIABLE	SOURCE	OTHER COMMENTS
Coal demand	IEA WEO 2017 and IEA WEO 2017 adjusted for CPI analysis	8 major demand hubs modelled: Europe, China, Japan/Korea/ Taiwan, South Asia (mainly India), South East Asia (ex-Indonesia), Africa (ex-South Africa), North America (ex-US), South America (ex-Colombia)
Price of shipping fuel	Coal Spot, Sea Rates, adjusted for CPI oil analysis	Estimated based on published rates and distances between ports

Oil modelling

Our oil model balances the global supply curve for crude oil with international oil demand on a yearly basis to produce forecasted price and production time series.

We ran this model for various climate policy scenarios, where the variable changed between scenarios was demand for oil on a global level. The two scenarios referred to in this report are

1) **BAU** (based on the New Policies Scenario from the WEO 2017) and
2) **2DS** (based on the Sustainable Development Scenario from the WEO 2017).

Oil supply assumptions are derived from Rystad Energy's database of breakeven prices for oil producing countries, sourced variously on a sub-national basis (eg, the US and Russia are split between regions); a national basis (eg, Nigeria) or a regional basis (e.g. Central Asia other), depending on the importance of the given area for the global oil trade.

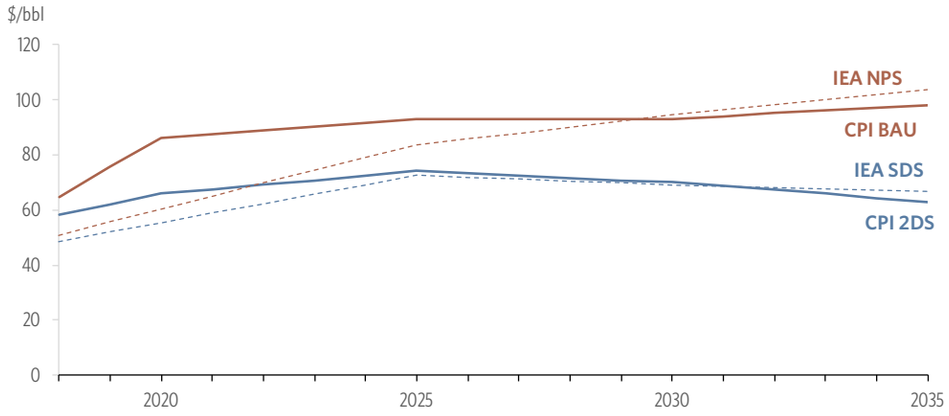
The chart below compares the outputs of CPI's key scenarios vs. the IEA's forecasts for global oil import prices taken from the WEO 2017. The CPI BAU and IEA NPS scenario both reach similar long run price equilibria, however, the CPI BAU forecast (using different supply data) shows a sharper price rise in the short term. Short-run oil prices can be subject to significant volatility driven by a range of factors, including geopolitics.

Assumptions for oil modelling

A few key assumptions are common to each scenario: a) forecasts of total production available to be sold for each major producing area/country/region; b) the costs, including cash costs and capex, for each supplier which build up to form the breakeven price. We obtained both of these from Rystad Energy.

The major variable that changes between scenarios is oil demand – with BAU demand taken from the NPS in the WEO 2017 and 2DS demand taken from the SDS.

Figure AC2: Crude import prices (real)



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