



POLICY NOTE 4

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Botswana's Coal: Dead in the Water or Economic Game Changer?

Ross Harvey¹

EXECUTIVE SUMMARY

Botswana possesses substantial coal deposits of 212 billion tonnes, the majority of which are low grade. Under favourable conditions, and until solar power becomes a feasible option for supplying baseload electricity, this coal could be either exported or used for local regional electricity production and consumption. Electricity shortages impose a considerable constraint on economic growth in sub-Saharan Africa. This strengthens the argument for local production of coal-fired electricity, especially if regional fossil fuel supplies are integrated in a technologically adept manner to ensure economies of scale. However, coal extraction for either export or local production is environmentally costly despite advances in technology.

The alternative is for Botswana to export its coal, which would attract immediate export revenue. This is unlikely to create sustainable economic diversification, though. Botswana is landlocked and lacks available transport infrastructure to facilitate exports of such a scale, weakening the argument for this option. Regional political difficulties impose a constraint on both options.

INTRODUCTION

This note aims to provide an overview of Botswana's economic options in the light of its substantial coal deposits, locating these possibilities in the broader global debates surrounding climate change. It begins with a brief assessment of the ecological economics literature. Second, it outlines Botswana's options for developing a coal export industry against a backdrop of considerable risks and uncertainty. Third, it examines Botswana's options for integrating regional fossil fuels for electricity production. It concludes by offering direction on a way forward that would best serve the country's and the region's long-term objectives of energy security and inclusive economic development.

ECOLOGICAL ECONOMICS

Concerns that environmental degradation poses a limit to future economic growth are not new. As far back as 1972, political economist Anthony Downs noted 'the immensity of the social and financial costs of cleaning up our air and water and of preserving and restoring open

spaces'.² These costs have only grown in the 42 years since. They must, however, be incurred if the next generation is to inherit a liveable planet.

Economists' faith in the ability of new technologies to solve seemingly intractable environmental problems should be viewed sceptically. Even the production of solar and wind power may carry hidden costs,³ in addition to being financially expensive and facing continued energy storage challenges despite rapid improvements in battery technology. Fossil fuel extraction and electricity generation, as damaging as it could be to the global commons, may provide the means for reducing indoor air pollution⁴ and generating capital for investment in new (cleaner) industries.

A 2013 book by historian Paul Sabin⁵ reflects on the 1970 clash between biologist Paul Ehrlich and economist Julian Simon. Sabin examines how the debates concerning economic growth and ecological preservation have unfolded since then. Simon challenged the view that the planet was necessarily headed for environmental catastrophe. Ehrlich challenged the view that free markets and technological innovation could prevent catastrophe and yield future prosperity. Simon refuted the notion that scarcity posed a limit to growth. He argued that scarcity would, in fact, drive technological innovation, which would allow humanity to escape the dire predictions of the impact of population growth. Ehrlich argued that the limits to growth were fixed and could not be altered; a Malthusian approach. Sabin concludes that, either way, the rate of current resource consumption cannot be sustained without deeply altering the planet.

Economist Daron Acemoglu and his co-authors confirm Simon's view that technology will endogenously respond to scarcity.⁶ They show that effective policy intervention (in the form of carbon taxes and subsidies for renewable energy research) need only be imposed for a discrete, finite period. There is a tipping point at which sufficiently advanced clean technologies (produced through subsidies) would attract privately funded research and deployment under ordinary market conditions (without taxes or subsidies). Furthermore, 'the use of an exhaustible resource in dirty input production helps the

switch to clean innovation under *laissez-faire*'.⁷ However, as Acemoglu and Robinson point out, the definition of *exhaustibility* is important: 'The real problem is not the world running out of oil, but the world frying itself with all sorts of fossil fuels, not just oil but also coal. And coal does not look like it will run out anytime soon.'⁸

Physician Alan Lockwood quantifies the negative environmental and social externalities of coal mining and coal-fired power generation.⁹ In terms of its impact on human health, he cites, among others, an article in *The Lancet*, which estimated that 24.5 deaths are expected for each terawatt hour of electricity generated by coal.¹⁰ An application of that data to the US' case alone indicates that 50 000 deaths a year may be attributable to burning coal. Lockwood's book provides weighty scientific evidence against the economic imperatives to mine and burn coal. However, politicians and policymakers often have limited incentives to impose policy measures that would limit these activities.

Even though technology endogenously responds to scarcity, 'provided there are other sources of dirty energy such as coal, this will not change the trajectory of fossil fuel consumption and climate change'.¹¹ This is due to the initial degree of productivity advantages (lower costs) involved in the fossil fuel sector and its relative lack of substitutability with cleaner technologies at this stage. Moreover, new discoveries of coal across the globe effectively shift it into the non-exhaustible category for short-run policy purposes. The question for Botswana is thus how to optimise the use of its coal resources – at minimal environmental cost to the global commons – over the next two decades.

BOTSWANA'S COAL: OPPORTUNITIES AND CONSTRAINTS

The map (Figure 1) identifies the geographic location of Botswana's economically recoverable coal reserves. Mmamabula possesses approximately 2.4 billion tonnes of thermal coal and is owned by the Indian company Jindal. Sese is a similar-sized deposit owned by African Energy Resources.

Figure 1: Botswana's coal deposits



Source: African Energy, 'Projects: Botswana; Sese, Coal & Power Project', Subiaco, WA: African Energy Resources ARBN, <http://www.africanenergyresources.com/display/index/sese-coal-power>, accessed 25 March 2014.

Estimates suggest that these and other smaller deposits could sustain a coal export industry of 36 million tonnes per annum (Mt/a) in the short run, growing to a possible 90 Mt/a (according to the government). The Botswana Institute for Development and Policy Analysis¹² offers a more conservative figure of 72 Mt/a at its peak in 2024. This would generate approximately \$2.15 billion (ZAR¹³ 23.65 billion) in export revenue by 2026, at an average \$1.27 billion (ZAR 3.97 billion)

a year between 2014 and 2026.¹⁴ Botswana is currently over-reliant on diamond revenues, raising the risk of economic underperformance and government revenue shortfalls beyond their current projected depletion in 2027. Coal exports therefore provide one possible means of economic diversification. Diversification is important because it is risky to rely on one exhaustible commodity for the bulk of gross domestic product and government revenue. Diamonds

have served Debswana¹⁵ well, but they are exhaustible. Neither is coal a panacea, as it too is both exhaustible and environmentally costly. The country's coal export ambitions are also subject to major uncertainties (enumerated below), which may render the effort difficult to justify.

A primary problem is that demand for Botswana's coal is not guaranteed. The International Energy Agency's (IEA) 'Annual Energy Outlook 2014' foresees a general shift away from carbon-intensive fuels for electricity generation, though that may largely be restricted to the Organisation for Economic Co-operation and Development (OECD) countries.¹⁶ A 2014 statistical review by British Petroleum,¹⁷ the global energy giant, shows that total world coal consumption in 2013 was the equivalent of 3 826 million tonnes of oil (Mtoe), up from 2 342 Mtoe at the turn of the century. Much of this growth is primarily generated by non-OECD countries. However, increasingly competing with coal and cohering with the IEA assessment, consumption of 'other renewables'¹⁸ was up to 279.3 Mtoe from only 51.8 Mtoe in 2000. In the absence of globally binding policies to mitigate climate change, though, the EIA still projects coal consumption to increase at an average rate of 1.8% per year through 2040 in non-OECD countries. Coal's share of fuel consumption for electricity will only decline from 43% in 2010 to 37% in 2040.¹⁹

China's share of global consumption increases from 47 percent in 2010 to 57 percent by 2025, followed by a decline to 55 percent in 2040. The sustained rapid expansion of coal use in India allows it to surpass the United States as the second-largest coal-consuming country after 2030.

China's relative decline is important, as it effectively means that India is Botswana's primary target market. This is positive for Botswana in the sense that India's import market is driven by a genuine shortage of domestic supply, whereas China's import market is not. China has sufficient supply but imports for two main reasons. One, sourcing coal from its northern, remote regions is often more expensive than shipping it from

alternative sources. Two, the Chinese Communist Party is under increasing pressure to stop destroying the country's environment through water-polluting coal-mining activities.

The importance of the Indian market for Botswana is reflected in Jindal's purchase of CIC Energy in Botswana in September 2012.²⁰ Jindal is an Indian company and 'Botswana remains one of the few "greenfield" deposits in the world and there is every potential that Botswana will become a major supplier to India in the coming decade'.²¹

Compounding the above uncertainties is a geographic difficulty. Botswana is landlocked; it faces severe rail infrastructure constraints in transporting its coal to viable export terminals on the coast. The export volumes require that a new railway line be built with sufficient capacity to transport 72 Mt/a. Existing lines through South Africa or Mozambique are narrow Cape gauge lines, incapable of transporting such high volumes. Moreover, port handling fees and the political difficulties of going through Zimbabwe (en route to Mozambique) render the exercise largely unfeasible. However, Botswana's Chamber of Mines Chief Executive Officer, Charles Siwawa, suggested that an agreement with South Africa's Transnet would ensure initial, smaller volumes through the Richards Bay terminal until a new line was built through Namibia to Walvis Bay.²²

In late March 2014 the governments of Botswana and Namibia signed a Trans-Kalahari railway line bilateral development agreement.²³ This project would cost about \$10 billion (ZAR 110 billion) in capital and incur operating costs of \$27 billion (ZAR 297 billion) over 30 years.²⁴ However, if the total coal export revenue expected between now and 2026 is only \$16.48 billion (ZAR 181.28 billion), Botswana can expect a net loss of \$20.52 billion (ZAR 225.72 billion) on the railway project. This does not seem plausible, especially given the expected price volatility over the next decade. The line will take at least three years to complete and requires a bankable feasibility study to support the proposed public-private partnership necessary to develop it. There are five further disadvantages to the route, the costs of which must also be factored into the current equation: first, Walvis Bay is not

a natural deep-water port and would thus require constant dredging at extensive costs to facilitate large volumes of coal exports. Second, it would add roughly six days' worth of actual shipping transport costs en route to India (as opposed to going through the natural deep-water port of Techobanine in southern Mozambique). Third, Walvis Bay is an important fishing centre and coal shipping is likely to pose an environmental risk to fish stocks along that coastline, potentially undermining important Namibian livelihoods and export revenues. Fourth, beyond 2030, when solar technology seems likely to have advanced sufficiently to supply reliable baseload power, the line will become obsolete. Fifth, there are no foreseeable positive economic spillover effects from a single-purpose railway line traversing two deserts and combined country populations of less than 4 million people.

Botswana is water-scarce, and likely only to become drier as climate change advances. Intensive coal mining will exacerbate this constraint. Exports of 72 Mt/a would require 5 756 400 m³ of water a year, in addition to 216 MW of power each year.²⁵ One of the most intense uses of water, under current technologies, is to wash run-of-mine coal to separate it from ash to improve its thermal efficiency and reduce carbon dioxide emissions when burnt. The adoption of new technology²⁶ – DriJet™ – could eliminate the need for washing, but there is little indication that this is part of the current thinking. Water would have to be piped from the Zambezi River, as the sustainable abstraction of ground water is severely limited.²⁷ The government of Botswana has access to 495 000 000 m³ of water a year from the Zambezi, but the infrastructure costs of piping water to coal mines must also be factored into the equation. It is not clear whether Botswana is able to raise the necessary capital. Moreover, the opportunity cost of diverting water away from agricultural activities is likely high but as yet unquantified.

Even though the EIA projects coal consumption to continue rising until 2035 and only decline thereafter, the pressure on individual countries to reduce greenhouse gas emissions will likely grow. In the light of these constraints, and an export

revenue equation that appears to be economically unfeasible, what should Botswana do?

REGIONAL OPTIONS

Southern Africa is in the midst of a power crisis. Few Southern African Development Community countries have sufficient supply to meet local demand. Any efforts at improving intra-regional trade and promoting industrialisation in the region are therefore subject to this significant constraint. The paradox is that regional coal and natural gas deposits could provide sufficient power for the region if they were harnessed in a more efficient and co-ordinated manner. However, doing so requires a level of political co-operation that appears difficult to attain.

South Africa is in the process of building three large coal-fired power stations. Eskom, the state-owned entity responsible for power generation, in partnership with the national Department of Public Enterprises, promised that the first of these, Medupi, would go live by the end of 2012. Mid-way through 2014, it was still not producing power. In an effort to compensate for the foreseen supply shortage after the 2008 blackout crisis, Eskom embarked on a programme of procuring power from independent power producers. In 2009 the Department of Energy changed the regulations governing the programme and made itself the purchaser of power (rather than Eskom). In 2011 'South Africa's second integrated resource plan (IRP 2010) was completed and unfortunately did not provide any opportunity for [Mmamabule Energy Project] MEP to supply power to South Africa prior to 2019, and then only in smaller amounts than [the planned] 1200 MW'.²⁸ The Integrated Resource Plan was updated in 2013 and still contains no purchasing agreement with MEP.

The reasons for South Africa's lack of co-operation on the Mmamabule project remain unknown. In hindsight, it would have lost nothing either politically or economically. Political and economic 'losers' would normally attempt to block the advance of new initiatives and technologies to protect their own rent streams,²⁹ but in this case the mutual benefit

from co-operation seems obvious. Meanwhile, the South African government is finalising plans to procure 9 000 MW of nuclear power, which is patently unwarranted in the light of the country's capital borrowing constraints and the time lag of 10 years before any of the six proposed stations come into operation.³⁰ The purchase of 1 200 MW from MEP would provide revenue for Botswana and sufficient electricity supply in the short run for both countries, especially when considered alongside the existing 600 MW generated by Morupule B Power Station.

Even in the absence of South Africa's co-operation, coal-to-liquid³¹ and gas-to-liquid technologies could potentially be harnessed regionally to provide energy security for Namibia, Botswana and Mozambique. More urgent research is required into how this could work and where the stations could be positioned optimally. Coal bed methane in Botswana, and natural gas from Mozambique and Namibia, along with coal in Mozambique and Botswana, could power at least these three countries into the foreseeable future.

CONCLUSION

Climate change and its attendant mitigation and adaptation policies pose a serious risk to any new coal-mining or coal-fired power investments. However, electrifying Southern Africa through coal by harnessing new technologies is arguably less environmentally and socially costly than the current costs of indoor air pollution from burning wood and other fuels. This only holds until solar baseload becomes a reliable and cost-competitive source of power. Botswana is endowed with abundant coal resources, with potential exports of around 72 Mt/a and the ability to generate at least 1 200 MW of extra power through MEP. However, its options in terms of exporting the resource are limited and costly. This note argues that new thinking is necessary, and calls for research to ascertain how to optimally harness the region's coal and gas to secure reliable power generation. Without power, sustainable economic growth will remain a pipedream. Protecting the environment in the process also remains a significant challenge.

ENDNOTES

- 1 Ross Harvey is a senior researcher with the Governance of Africa's Resources Programme (GARP). His field of interest is the political economy of mining and development.
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 - 14 Grynberg R, *op. cit.*, p. 15.
 - 15 The 50/50 joint venture between the Botswana government and the diamond company De Beers.
 - 16 IEA (International Energy Agency), 'World Energy Outlook 2014', http://www.iea.org/publications/freepublications/publication/WEO_2014_ES_English_WEB.pdf, accessed 20 November 2014.
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