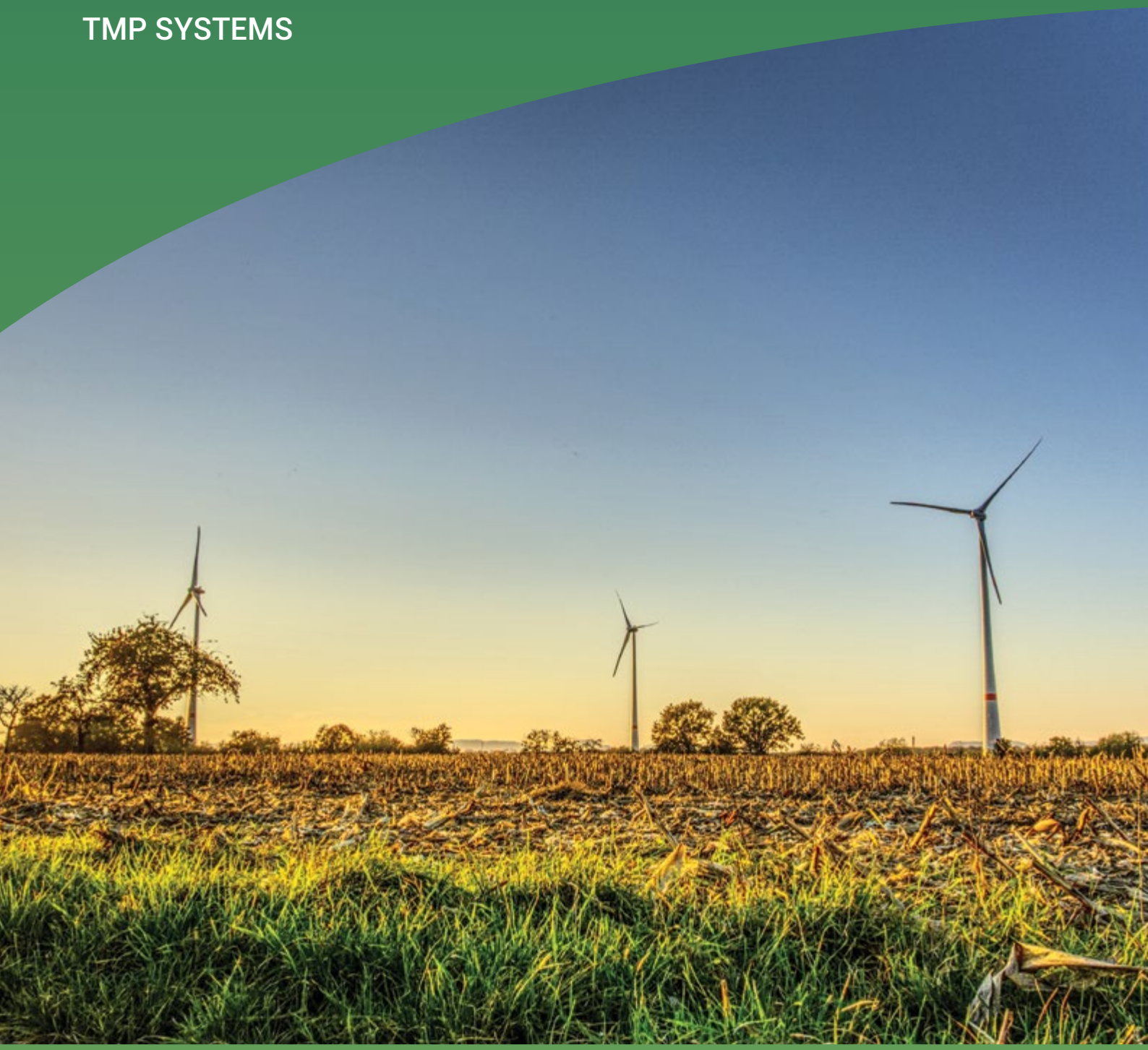
INGA 3: Too High a Cost

A Study of the Socio-Economic Costs of the Inga 3 dam for South Africa

TMP SYSTEMS



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About the Authors

TMP Systems

TMP Systems is a network that solves complex environmental and social problems, working through cooperative agreements among three specialised organizations. Their expertise is in finance, technology and political economy and their work spans developed and developing countries on six continents. For more than a decade, TMP Systems' mission has been to measure, analyze and manage the risks (or opportunities) created by Social and environmental changes that are reshaping our world at an unprecedented pace.

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This report assesses the socio-economic impact of the Inga 3 dam with a particular focus on South African citizens and on women. It looks at the commercial case for the dam, comparing it with alternatives on price, before weighing positive and negative social and environmental impacts against each other. Our report suggests that Inga 3 will deliver poor outcomes for South Africans at a very high price. At a time of high debt and unemployment, alternatives appear to offer a more prudent energy strategy with more substantial social benefits.

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1. Glossary

Term	Description
Buffer	In the Riverscope analysis, we use an area around the specific location of analysis to ensure we capture all the impacts that are experienced.
Capacity Factor	Capacity factor is the ratio of actual generation and the rated capacity of a power plant.
Dam	Refers to the construction of the dam wall, immediate connecting infrastructure and the impacts of the resulting inundated area.
DCM	Discounted Cashflow Model is a cashflow model of the investment over the expected lifetime of the project and where the net cash flow is discounted in order to calculate the Net Present Value. (See below for the definition of Net Present Value.)
Discount Rate	Discount Rate can be considered as the cost of capital for the project shown as a percentage. This is similar to an interest rate, so a discount rate of 10% means that the borrower will need to pay the lender 10% more than the principal (the amount of the original loan).
ESG	Environmental, Social and Governance are three commonly used factors in measuring impact in terms of investments and are used to determine future financial viability.
IRP	South Africa's Integrated Resource Plan (IRP) is an electricity infrastructure development plan until 2030, based on the least-cost electricity supply and demand balance, taking into account security of supply and the environment by minimising negative emissions and water use.
KBA	Key Biodiversity Areas are the most important places in the world for species and their habitats.
LCOE	Levelised Cost of Energy is the average cost per unit of electricity produced and connected to the grid, presented in current terms. This is useful to compare different energy generation technologies on a consistent basis.
NPV	Net Present Value is the net value of a project's cash outflows and inflows presented in current terms. This value is used to determine whether the investment will be profitable or not. The metric is commonly used by investors assessing projects.
PA	Protected areas – national parks, wilderness areas, community conserved areas, nature reserves and so on – are a mainstay of biodiversity conservation, while also contributing to people's livelihoods, particularly at the local level.
Sediment Flow	Sediment flow refers to the conglomerate of materials, organic and inorganic, that can be carried away by water to provide key nutrients and minerals for downstream ecosystems.

2. Executive Summary

Inga 3 offers the promise of an enormous injection of energy capacity for South Africa. But when will South Africans get this energy and at what cost? This report investigates these questions using geospatial assessment (via the Riverscope process developed with International Rivers) and through expert analysis. This assessment, which is detailed throughout this paper, suggests that the socio-economic case for Inga 3 is weak and that there are strong arguments for investment in alternatives, such as solar and wind.

The South African energy sector is currently in transition, with numerous coal-fired power plants planned for decommissioning in the coming years.[1] This will inevitably create supply gaps for South Africa to fill through new energy generation although the precise amount needed is disputed. However, South Africa's national utility, Eskom, is heavily indebted to the tune of R488bn[2], which is a chronic problem and the result of long-standing structural challenges.[3] These conditions already threaten any hopes for improving electricity access and availability, so how South Africa chooses to procure new energy generation will have a direct impact on the country's future energy security and economy, particularly on the estimated 5 million[4] people without access to electricity.

Our investigation assesses the plans for Inga 3 on a series of bases:

1. Financial assessment: We want to know whether the energy that Inga produces will be competitive for South Africa. To establish this, we develop realistic projections of the timelines and challenges involved. We have also considered which of these expenses will be borne by the South African government and/or public.
2. Social impact evaluation: We want to know what kind of social impact the Inga 3 project will have in South Africa. Here we pay particular attention to impacts on poor and vulnerable women. To do this, we consider the immediate impacts of the construction process, which would require construction of the world's longest transmission line. We then consider the impacts of increased access to energy and jobs, relative to possible alternatives like solar and wind, for South Africans.
3. Environmental impact evaluation: We want to establish what negative impacts the project will have on the local environment for South Africans. Since climate change is such a significant threat for South Africa, we also consider the extent to which Inga 3 might contribute to climate change.

Much of the analysis of Inga 3 to date has focused on the DRC and on impacts around the dam site (see Background section below). While we recognise these issues, the primary focus of this study is South Africa, which is currently the principal offtaker of the planned energy.

This report uses a range of analytical techniques (see Methodology section below) to produce important estimates, such as the ultimate cost of electricity produced by Inga 3 and how many people will be negatively impacted. We find that hundreds of thousands of people within and outside South Africa will be left worse off if Inga 3 goes ahead. They will be exposed to forced displacement, curtailed livelihoods, conflict and human rights abuses.

We find that hundreds of thousands of people within and outside South Africa will be left worse off if Inga 3 goes ahead.

1. Creamer, T. "Eskom moves to finalise just energy transition framework as shutdown of Grootvlei, Komati and Hendrina draws near" (17th November 2020): https://www.engineeringnews.co.za/article/eskom-moves-to-finalise-just-energy-transition-framework-as-shutdown-of-grootvlei-komati-and-hendrina-draws-near-2020-11-17
2. IOL. "Eskom debt increases to R488bn" (3rd September 2020): https://www.iol.co.za/news/politics/eskom-debt-increases-to-r488bn-4de6103f-7609-42ab-8925-5240492d06a7
3. Mailovich, C. & Quintal, G. "Former Eskom executives to appear in court over alleged Kusile corruption" (19th December 2019): https://www.businesslive.co.za/bd/national/2019-12-19-former-eskom-executives-to-appear-in-court-on-corruption-charges/
4. Figure derived from The World Bank "Access to electricity (% of population) - South Africa" (no date): https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=ZA ; Statistics South Africa "Mid-year population estimates 2018" (23rd July 2018): http://www.statssa.gov.za/?p=11341

Clearly, energy is urgently needed in South Africa so this paper also looks at the question of how it could be delivered. We consider the expense, social and environmental impact of alternatives like solar and wind, so that these impacts can be compared with Inga 3. This demonstrates that alternative plans can deliver energy more rapidly, at a lower cost and with more significant social benefits.

> Alternative plans can deliver energy more rapidly, at a lower cost and with significant social benefits.

Energy sources such as solar and wind are not necessarily without challenges – including their high spatial needs - but they can avoid major negative impacts associated with importing power from Inga 3 while providing interesting opportunities for sustainable development.

Inga 3 has little to no chance of attracting private finance and will therefore likely be funded exclusively through public finance. This means that the public sector will also carry the burden of debt (or a significant portion of it) and should Eskom default, the National Treasury, which guarantees some R330bn of Eskom's R488bn debt,[5] will be held liable. This is concerning given South Africa's existing sovereign debt, which has been downgraded by key rating agencies.[6] This paper evaluates the case for using public funds on Inga 3, recognising that this capital might be put to better use elsewhere, e.g. in the development of domestic renewable energy.

Should construction delays continue into 2023, which seems very likely at this point, South Africa and the DRC will need to review their agreement.[7] This would create a window of opportunity for South Africa to adjust its energy plans. We want to ensure that decision-makers and the wider public have the full set of facts in front of them as they move towards this important juncture. We hope this paper will be helpful in this informative process.

Background

South Africa is facing an energy crisis. Rolling blackouts are coupled with an increasing debt burden held by the national utility, Eskom, that has only been worsened by new, albeit delayed and costly, large coal-fired power stations. Such reliance on fossil fuels, with considerable climate change impacts and alarmingly poor air quality, is further accompanied by extremely high levels of unemployment, borne disproportionately by women, and one of the worst rates of income inequality in the world.

There are still millions of poor and working class South African women in need of energy access and with electricity prices up 177% in the past 10 years[8]; even those with access struggle to afford it.[9] South Africa therefore requires the rapid expansion of clean energy as well as aggressive energy efficiency improvements[10] to meet its socio-economic challenges.

In 2013, South Africa agreed to purchase 2,500 MW from the proposed 4,800 MW Inga 3 dam and to finance the costs of transmission from the DRC. However, the exact design and capacity of Inga 3 is highly uncertain, in part due to an overall lack of transparency around the project.[11]

5. Khumalo, S. "Lawmakers quiz Eskom on R488-billion debt - and who they owe" (25th November 2020): https://www.news24.com/fin24/economy/eskom/lawmakers-quiz-eskom-on-r488-billion-debt-and-who-they-owe-20201125
6. Business Tech "What the latest rating downgrades mean for the average South African" (22 November 2020): https://businesstech.co.za/news/finance/450475/what-the-latest-rating-downgrades-mean-for-the-average-south-african/
7. Du Plessis, C. "Flipping the switch on Inga 3?" (23rd April 2020): https://www.businesslive.co.za/fm/features/africa/2020-04-23-flipping-the-switch-on-inga-3/
8. Business Insider South Africa "Electricity is now 177% more expensive than 10 years ago – but water is up far more than that" (19th October 2020): https://www.businessinsider.co.za/water-prices-have-increased-massively-in-south-africa-over-the-last-decade-the-reserve-bank-says-2020-10
9. WoMin "We are the victims of pollution and victims of energy poverty: Coal affected women in Phola-Ogies speak out!" (October 2020): https://womin.africa/community-activists-resources/women-activists-confront-energy-inequality/
10. Eskom "Energy efficiency in the global & South African context" (no date): https://www.eskom.co.za/OurCompany/SustainableDevelopment/ClimateChangeCOP17/Documents/Energy_efficiency_in_the_global_and_South_African_context.pdf
11. Designs for Inga 3 range from 4,800MW to 11,000MW. President Tshisekedi intends to start with an initial 4,800MW phase and increase capacity to 7,500 MW and 11,000 MW over time. However, these time frames and details are unclear. Nevertheless, South Africa's 2,500MW offtake is expected from the 4,800MW design. See Engineering News " DRC reverts to 4 800 MW plan for Inga" (16th December 2019): https://www.engineeringnews.co.za/article/drc-reverts-to-4-800-mw-plan-for-inga-2019-12-16 ; "Treaty on the Grand Inga Hydropower Project Between the Republic of South Africa and the Democratic Republic of the Congo" (29th October 2013): https://static.pmg.org.za/141104treaty.pdf

Inga 3 has also already faced multiple development challenges, including the withdrawal of support from the World Bank and key developers, as well as an overall eight-year delay. Indeed, large hydropower projects repeatedly face such delays that are frequently associated with significant environmental and social impacts, together with large cost overruns. It is therefore unsurprising that Inga 3 is often criticised as a 'pipe dream'.

To date, previous research and analysis of Inga 3 has addressed its potential impacts on the DRC, the environment[12] and on local communities.[13]

Other analyses have looked at the economic costs,[14] alternatives[15] and political dynamics[16] of Inga 3; however, these have been primarily focused on the DRC.

There are currently no comprehensive analyses into the socio-economic impacts of Inga 3 for South Africa, nor has a feasibility study of importing power from Inga been carried out. This report therefore aims to address this gap by providing a combined quantitative and qualitative analysis into the socio-economic costs of Inga 3, and the associated transmission line from the DRC, for South Africa.

Photo courtesy of WoMin

12. Showers, K. "Congo River's Grand Inga hydroelectricity scheme: linking environmental history, policy and impact" (2009): https://link.springer.com/article/10.1007/s12685-009-0001-8
13. Amisi, B.B. "Civil Society, Dams and Underdevelopment of the Democratic Republic of Congo: A Study of Communities Affected by the Inga Hydropower Projects" (2015): https://researchspace.ukzn.ac.za/bitstream/handle/10413/14542/Amisi%20Baruti%20B_2015.pdf?sequence=1&isAllowed=y ; Krüger, R. "Watering down justice: Energy justice in the Inga dams case in the DRC (2017): http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8914763&fileOId=8914839
14. Jones, T. "In debt and in the dark: Unpacking the economics of DRC's proposed Inga 3 dam" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/in_debt_and_in_the_dark.pdf
15. Deshmukh, R., Mileva, A. & Wu, G.C. "Renewable riches: How wind and solar could power DRC and South Africa" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/ir_inga_re_report_2017_fa_v2_email_1.pdf ; Deshmukh, R., Mileva, A. & Wu, G.C. "Renewable energy alternatives to mega hydropower: a case study of Inga 3 for Southern Africa" (2018): https://iopscience.iop.org/article/10.1088/1748-9326/aabf60
16. Congo Research Group & Resource Matters "Inga III: Kept in the dark: How the world's largest hydropower site is being negotiated behind closed doors" (2019): http://congoresearchgroup.org/wp-content/uploads/2019/10/GEC_Resource-Matters_Inga-III_EN_final-2.pdf ; Congo Research Group & Phuzumoya Consulting "I need you, I don't need you: South Africa and Inga III" (2020): https://cic.nyu.edu/sites/default/files/south-africa-inga-3-report-web.pdf

Methodology

Our analysis of Inga 3 was based in part on the Riverscope Analysis Process which combines a rapid quantitative geospatial assessment (Rapid Assessment (RA)) with a qualitative, desk-based review into critical project issues (see Riverscope Risk Model in Appendix I).

For the RA, we compared the geospatial profiles of 92 dams that are known to have significant Environmental, Social and Governance (ESG) problems with 190 dams that have not experienced reported problems.[17] By comparing these two groups, we identified 17 social and environmental indicators that showed statistically significant correlations with the dams that have experienced problems associated with dispute and conflict (see Appendix III for full Methodology). These indicators relate to a diverse range of ESG conditions and were applied at three levels of analysis, namely the Dam, River and District.[18] This analysis was used to identify potential social and environmental risks associated with Inga 3.

To quantify this risk financially, the scores were input into a Discounted Cashflow Model (DCM) to provide an assessment of Inga 3's Net Present Value (NPV) and the likely Levelised Cost of Electricity (LCOE) that it will deliver. This allowed us to compare the LCOE of Inga 3 to South Africa with the LCOE of solar and wind, based on the best available local data.

Our analysis of the Transmission line routes (see Transmission Line Risk Model in Appendix II) was based on the Landscope[19] analysis tool that we developed. Landscope was funded by the UK government and developed over four years with an 18-month intensive testing process involving nine development finance institutions as well as hundreds of private investors and companies. Landscope data is also available as a layer on the Bloomberg Terminal.

Landscope similarly provides an ESG or tenure risk score for a given infrastructure project's location by carrying out a comparative statistical analysis between the given location and other infrastructure project locations that have experienced project delays. The resultant similarity score, or ESG risk score, based on numerous ESG indicators allowed us to determine whether the project is likely to experience delays. These scores are provided as Social and Environmental Risk Scores, and cumulatively as an Overall Risk Score. This was based on an Expected Delays Model developed by TMP and the ODI, which reflects an exponential relationship between ESG risk and delays.

The transmission line analysis was split into two segments, including an analysis of five routes from the DRC to SA (external) and a separate analysis of three routes within SA (internal). The internal and external analyses were based on subnational level data and all but one external route (straight line from Inga 3 to SA) was based on existing transmission routes.

> All quantitative analyses were backed by an expert qualitative review process of the best publicly available information.

All quantitative analyses were backed by an expert qualitative review process of the best publicly available information. This qualitative investigation accounted for any weaknesses in the quantitative models, including more complex and/or recent issues that are not well or fully captured by currently available geospatial data.

17. Some of the dams in our control group may have experienced problems that have not been reported
18. Dam area of analysis considers 20km radius from the dam wall; River area of analysis considers 100km downstream from the dam wall and 10km on either side of the river; District/Regional area of analysis considers the GADM L2 district that the dam is situated in
19. For more details see: https://landscope.info/

Results

Our assessment of Inga 3 suggests that it will be an expensive project with very limited benefits and quite considerable negative impacts. Many of these costs and negative impacts will affect South African citizens, particularly women, while the meagre employment benefits are largely concentrated in the DRC, around the dam site. Our analysis found that:

- Inga 3 is likely to be heavily delayed, which undermines the value of the project and pushes up the cost of the electricity it produces. We estimate that the dam's ESG factors will lead to a three-year delay, with the most likely start for operation in 2032. Further delays around transmission infrastructure due to both ESG risks and general technical transmission delays are also possible.
- By the time Inga delivers electricity, it is likely to cost $0.121/kWh (R1.80/kWh),[20] while solar and wind could cost just $0.064/kWh (R0.96/kWh) and $0.044/kWh (R0.66/kWh), respectively. This reflects a respective 89% and 175% difference and is almost 36% more expensive than the average cost of electricity expected for South Africa in 2021/2022, at $0.089/kWh (R1.33/kWh).[21] Average South African households already spend between R450 – R600 (~$30 - $40) per month and poor, often women-led, households particularly struggle to keep up with annual electricity increases.[22] Even once grid and storage complications are considered, solar and wind are likely to be much cheaper options that also deliver greater energy security.
- Inga's electricity cost, regardless of the transmission route selected or delay experienced, will require South African citizens to foot the bill of an additional $0.027 - $0.04/kWh (R0.40 – R0.59/kWh). This could equate to between $414m - $610m (~R6.19bn – R9.12bn) per year.
- The project will have significant negative social impacts, particularly via the way that it will drive displacement and possible conflict.

  The transmission lines in South Africa would run through areas with high social risks where people are particularly vulnerable to the sort of disruption caused by major infrastructure construction work. Our estimates suggest that between 211,920 and 333,423 people within South Africa could be disturbed or in some cases displaced by this work. This potential conflict could cause additional delays and so further increase costs.
- Inga 3 will create very few jobs in South Africa. In comparison, investments in wind and solar could create approximately 8,096 full time jobs for South Africans. Based on the gender impact numbers we have from the Independent Power Producer Procurement Programme (REIPPPP), this would mean 739 jobs for women. But these technologies can do a lot better on gender impact: on average, The International Renewable Energy Agency (IRENA) finds that 32% of the global workforce for renewable energy is female. In general, renewable energy projects that are developed at site for communities will provide jobs and other benefits for local women. While still not enough, if alternatives in South Africa follow this path, we would be looking at over 2,500 jobs for women. Improvements on South Africa's renewable energy programmes are needed to deliver real social impact for women.
- Transmission lines also run through some environmentally sensitive parts of South Africa. Our research shows that areas with low environmental risk and high renewable energy potential are abundant, offering a route to better environmental impact in energy planning.

Our report indicates that the Government of South Africa should reconsider its support for Inga 3 and must, at the least, conduct a full and transparent feasibility assessment. We are quite confident that this assessment would be unfavorable, based on currently available information.

20. All US Dollar to Rand conversions in this report use an exchange rate of $1/R14.95 from 11 March 2021, based on X-Rates at: https://www.x-rates.com/table/?from=ZAR&amount=1
21. Steyn, L. "Court order will raise electricity prices by another 15%" (16th February, 2021): https://www.timeslive.co.za/news/south-africa/2021-02-16-court-order-will-raise-electricity-prices-by-another-15/
22. WoMin "We are the victims of pollution and victims of energy poverty: Coal affected women in Phola-Ogies speak out!" (October 2020): https://womin.africa/community-activists-resources/women-activists-confront-energy-inequality/

3. Financial Assessment

This section looks at the financial costs for Inga 3, investigating these important questions:

1. How much will the electricity produced by Inga 3 cost once likely delays are factored in?
2. How do these costs compare with domestic renewable energy options such as solar and wind?
3. Which costs will be borne by the South African government or public?

The majority of dams are delayed and start operations late, often by years and with severe budget overruns (typically 33% in emerging markets).[23] We have calculated the impact on electricity prices if Inga 3 follows this pattern. This calculation shows that the overall cost of Inga 3 is likely to be high. We show that the Net Present Value (NPV) of the project is severely impacted by delays.

We also show that the Levelised Cost of Electricity (LCOE) produced by Inga 3 is likely to be uncompetitive with solar and wind at the time that Inga 3 eventually starts to operate. This is a result of higher costs for Inga 3 as well as rapidly falling costs for alternatives. This assessment of overall cost and competitiveness is particularly important for two reasons: first, South Africa has not conducted its own feasibility assessment of the project, which means that it cannot be compared with solar and wind under the Integrated Resource Plan (IRP).[24] We are providing these data-driven estimates in the absence of official figures, which we would argue are still urgently needed.

Second, there is also a lack of clarity over what the South African government will pay for. The treaty signed between South Africa and the DRC indicates that South Africa is responsible for the construction of transmission lines from the DRC-Zambia border.[25] This would mean that they would pay for thousands of kilometers of the longest transmission line in the world, but not for the dam itself. As such we have focused on the cost of transmission lines, as well as the cost of purchasing the electricity produced.

But there is also considerable uncertainty over the cost of transmission lines, with estimates ranging from $3 - 4.3 billion.[26] Recently, an Eskom official suggested “we simply do not have that kind of money”.[27] This fits with statements indicating the utility is about $30.3 billion (R463.7 billion) in debt,[28] in a context where electricity prices have increased by 177% in the past decade[29] (with further increases expected), where electricity can already cost up to $0.25/kWh(R3.74/kWh) depending on the time of use,[30] and where “load-shedding”, which is expected to continue for at least the next 5 years,[31] just reached its worst year yet in 2020.[32] In such circumstances, and where the government has yet to produce figures, the financial assessment of Inga 3 is particularly important.

23. Braeckman, J.P., Disslhoff, T. & Kirchherr, J. “Cost and schedule overruns in large hydropower dams: an assessment of projects completed since 2000” (2020): https://www.tandfonline.com/doi/full/10.1080/07900627.2019.1568232
24. The Integrated Resource Plan (IRP) is South Africa's electricity infrastructure development plan until 2030. It is based on the least-cost electricity supply and demand balance, taking into account security of supply and the environment. The IRP plans for 28,730MW of renewable energy (~37% of total installed energy capacity) by 2030, from a 2018 baseline of 3,754MW. This ~37% includes solar, wind and Concentrated Solar Power (CSP) but excludes storage.
25. “Treaty on the Grand Inga Hydropower Project Between the Republic of South Africa and the Democratic Republic of the Congo” (29th October 2013): https://static.pmg.org.za/141104treaty.pdf
26. The World Bank “International Development Association project appraisal document on a proposed grant in the amount of SDR 47.7 million (US$ 73.1 million equivalent) to the Democratic Republic of Congo for an Inga 3 basse chute and mid-size hydropower development technical assistance project” (2014): http://documents1.worldbank.org/curated/en/817971468245430631/pdf/774200REPLACEM0140Box382121B00OUO90.pdf ; ADPI-RDC “Inga 3 Hydropower Project“ (2018): https://aid.nepad.org/m_assets/uploads/document/15330269121716599182.pdf
27. Congo Research Group & Phuzumoya Consulting “I need you, I don’t need you: South Africa and Inga III” (2020): https://cic.nyu.edu/sites/default/files/south-africa-inga-3-report-web.pdf
28. Eskom “Integrated Report” (2020): https://www.eskom.co.za/IR2020/Interim/Documents/InterimAFS2020spreads.pdf
29. Business Insider South Africa “Electricity is now 177% more expensive than 10 years ago – but water is up far more than that” (19th October 2020): https://www.businessinsider.co.za/water-prices-have-increased-massively-in-south-africa-over-the-last-decade-the-reserve-bank-says-2020-10
30. This excludes accessor demand charges, as in: Eskom “Retail tariff restructuring plan: Fact sheet” (2020): https://www.eskom.co.za/CustomerCare/TariffsAndCharges/Documents/3888%20ESKOM%20-%20TARIFF%20RESTRUCTURING%20FACT%20SHEET%20Final%20HR%20NC.pdf
31. Business Tech “Expect 5 more years of load shedding for South Africa – these charts show why” (16th March 2021): https://businesstech.co.za/news/energy/475990/expect-5-more-years-of-load-shedding-for-south-africa-these-charts-show-why/
32. Cape Talk “2020 has been the worst year of load shedding to date, claims CSIR” (14th August 2020): https://www.capetalk.co.za/articles/393029/2020-has-been-the-worst-year-of-load-shedding-to-date-claims-csir

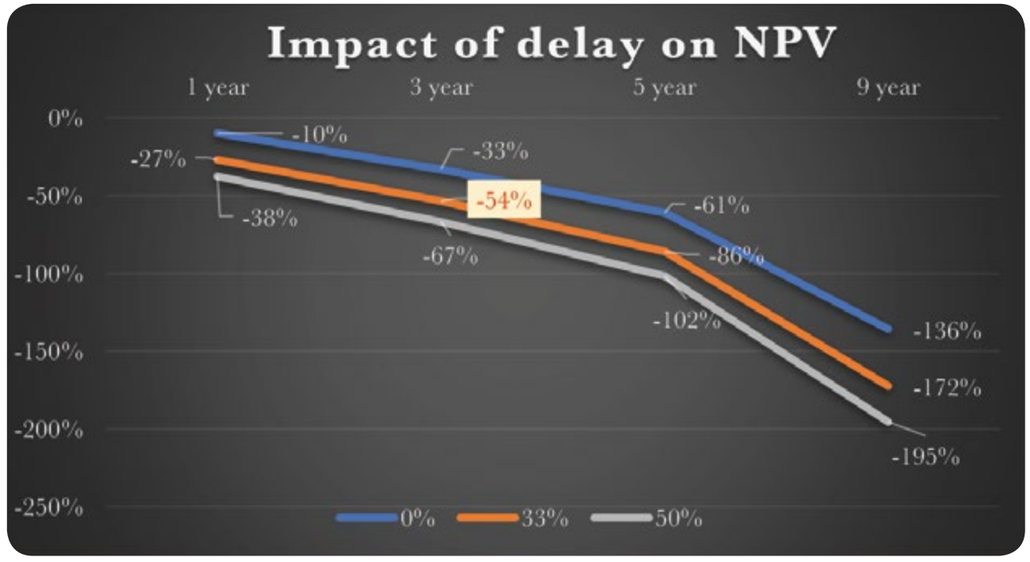
Inga 3: Delays, NPV and LCOE

Hydropower projects are particularly exposed to delays, in part because they have large and irreversible social and environmental impacts[33] that invite opposition, create controversy and stall progress.

Inga 3 has been delayed by about eight years[34] and has been in the pipeline for decades. Although the project was meant to start operation in 2020/2021, this was then delayed to 2024/2025.[35] While recent reports suggest construction could start at the end of 2021,[36] the project's status, including financing, is all highly uncertain which means in actuality it could be on hold indefinitely.

According to our assessment,[37] the most likely start date of operation, if it is not cancelled, would be 2032.[38]

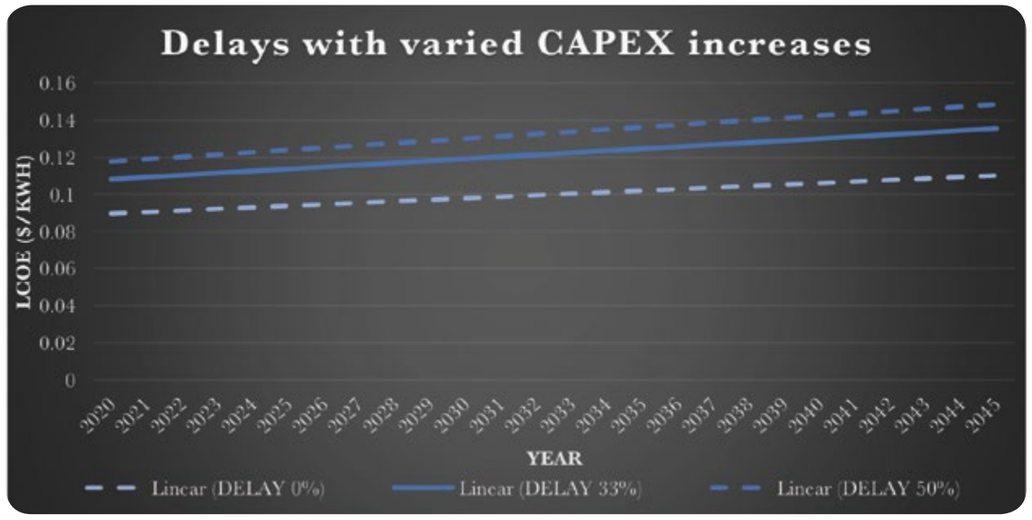
Typically, these long delays go hand-in-hand with budget overruns. The average large dam experiences budget overruns of 33%.[39] But, in some cases, delays can reach into decades and budget overruns into the hundreds of percent. The graph below shows how delays and CAPEX increases could impact Inga 3's NPV.



33. Hydropower projects can be delayed by numerous factors, including technical issues related to engineering and commercial problems, as well as non-technical issues related to environmental, social and governance factors. This latter category can include resettlement issues, cultural and environmental concerns, corruption, and a general lack of social license to operate due to the aforementioned issues and others.
34. Engineering News “Construction on Inga 3 hydropower project could start by year end, ambassador says” (17th February 2021): https://www.engineeringnews.co.za/article/construction-on-inga-3-hydropower-project-could-start-by-year-end-ambassador-says-2021-02-17
35. CNBC Africa “DRC delays Inga 3 hydro project to 2024/25” (4th July 2017): https://www.cnbcafrica.com/news/2017/07/04/drc-delays-inga-3-hydro-project-202425/
36. Engineering News “Construction on Inga 3 hydropower project could start by year end, ambassador says” (17th February 2021): https://www.engineeringnews.co.za/article/construction-on-inga-3-hydropower-project-could-start-by-year-end-ambassador-says-2021-02-17
37. This looked at the 4,800MW Inga 3 scenario with all transmission lines at a total CAPEX of $14bn
38. This assumes Inga will start construction in 2022, with a 3 year delay and 7 years of construction
39. Braeckman, J.P., Disslhoff, T. & Kirchherr, J. “Cost and schedule overruns in large hydropower dams: an assessment of projects completed since 2000” (2020): https://www.tandfonline.com/doi/full/10.1080/07900627.2019.1568232

According to our model, the most likely outcome would see Inga 3 with an NPV of negative 54% (picked out in the graph above). Backers normally walk away from projects before projections reach this stage, but the figures show that delays could have a catastrophic impact on the financial case for Inga 3. In this context, it is worth noting that hydropower is also highly exposed to COVID-related delays, which may inject further uncertainty.[40]

Delays to the dam or transmission line will, effectively, increase the price of electricity being delivered by Inga 3. This is evident on the graph below, which shows delays with different cost increases (0%, 33% and 50%). If Inga 3 were to start operating, as planned, in 2023[41] with a CAPEX overrun of 33%, its electricity might cost $0.11/kWh. But if operation is delayed until 2032, it could cost more than $0.121/kWh.



40. These projects have large workforces, a portion of which must be flown in, that are concentrated in areas near vulnerable groups like indigenous people.
41. This is highly unlikely given that the project has not started and would likely require a 7 year construction period
42. Eskom "Condensed Group Interim Financial Statements" (2020): https://www.eskom.co.za/IR2020/Interim/Documents/InterimAFS2020spreads.pdf
43. See full list of financial assumptions in the methodology document.

Inga 3 vs alternatives: Price competitiveness

South Africa urgently needs energy, so it is important to locate Inga 3's LCOE in a comparative context. This sub-section indicates that Inga 3 is more expensive than solar and wind, which can likely be rolled out more cheaply, as well as more quickly. Given Eskom's indebtedness,[42] the competitiveness of solar and wind provides strong rationale to reconsider commitment to Inga 3.

For this comparison with solar or wind to be meaningful, we need to compare actual values for Inga 3 dam with representative local values for alternatives.[43] We have employed the IPP LCOE figures reported by the Department of Energy that use actual prices based on local conditions. Due to many uncertainties, particularly for Inga 3, we have had to rely on the best available information, as outlined in the table below.

Assumption Description	Value
Total Capital Expenditure	$14bn[44]
Discount Rate	6.4%[45]
Loan Duration	18 years[46]
PPA cost per kWh	$0.07/kWh[47]
Inflation	4.3%
Solar LCOE 2020	$0.085/kWh[48]
Solar LCOE price decrease per year	2.28%[49]
Wind LCOE 2020	$0.071/kWh[50]
Wind LCOE price decrease per year	3.8%[51]

44. This figure refers to the 4,800MW option of Inga 3 and includes transmission and financial costs, as estimated by the World Bank in "International Development Association project appraisal document on a proposed grant in the amount of SDR 47.7 million (US$ 73.1 million equivalent) to the Democratic Republic of Congo for an Inga 3 basse chute and mid-size hydropower development technical assistance project" (2014): http://documents1.worldbank.org/curated/en/817971468245430631/pdf/774200REPLACEM0140Box382121B00OUO90.pdf
45. Congo Research Group & Resource Matters "Inga III: Kept in the dark: How the world's largest hydropower site is being negotiated behind closed doors" (2019): http://congoresearchgroup.org/wp-content/uploads/2019/10/GEC_Resource-Matters_Inga-III_EN_final-2.pdf
46. Congo Research Group & Resource Matters "Inga III: Kept in the dark: How the world's largest hydropower site is being negotiated behind closed doors" (2019): http://congoresearchgroup.org/wp-content/uploads/2019/10/GEC_Resource-Matters_Inga-III_EN_final-2.pdf
47. INGA 3 has not secured a PPA, so this is indicative, as in: The World Bank "International Development Association project appraisal document on a proposed grant in the amount of SDR 47.7 million (US$ 73.1 million equivalent) to the Democratic Republic of Congo for an Inga 3 basse chute and mid-size hydropower development technical assistance project" (2014): http://documents1.worldbank.org/curated/en/817971468245430631/pdf/774200REPLACEM0140Box382121B00OUO90.pdf
48. Sklar-Chik, M.D. "System Cost of Energy Generation Scenarios for South Africa: Understanding the real cost of integrating energy generation technologies" (2017): https://www.crses.sun.ac.za/files/research/completed-research/eppei/MSklarchik.pdf
49. Global reduction in Solar LCOE calculated from historic and projected LCOE data as published by IRENA "Future of solar photovoltaic: Deployment, investment, technology, grid integration and socio-economic aspects" (2019): https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Nov/IRENA_Future_of_Solar_PV_2019.pdf
50. Sklar-Chik, M.D. "System Cost of Energy Generation Scenarios for South Africa: Understanding the real cost of integrating energy generation technologies" (2017): https://www.crses.sun.ac.za/files/research/completed-research/eppei/MSklarchik.pdf
51. Global reduction in Wind LCOE calculated from historic and projected LCOE data as published by IRENA "Renewable Power Generation Costs in 2019" (2019): https://www.irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019

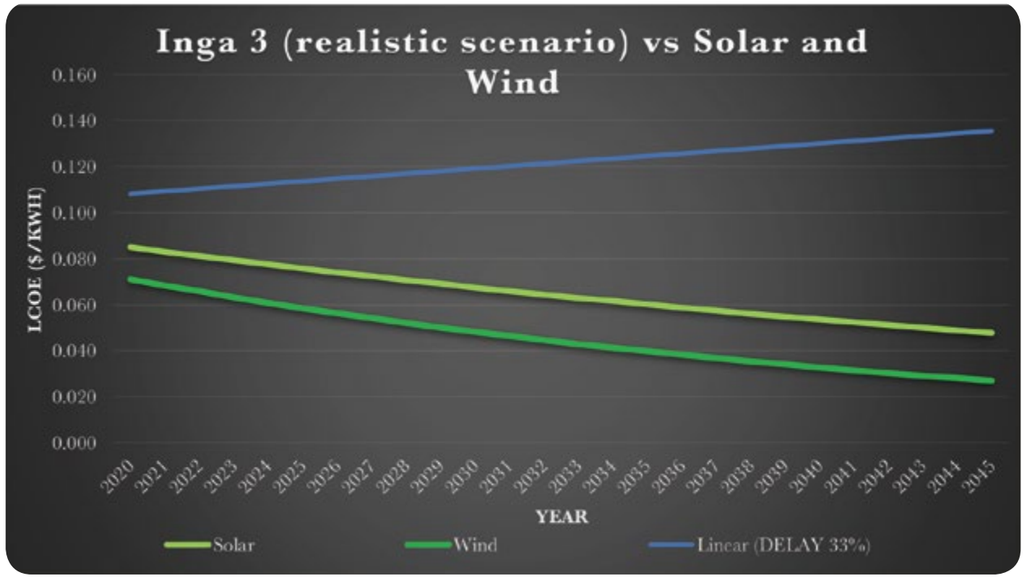
Using these representative figures, we compare the climbing price of Inga 3 (blue lines) with the falling price of alternatives (green lines). We are being conservative here, assigning Inga 3 a much lower discount rate (6.4%), or costs of capital, than solar and wind (10%).

This graph shows that Inga 3 is already uncompetitive with wind. If it were to start operation after 2024, which is unavoidable should Inga 3 be built, it will be more expensive than solar. At the most likely operation date (2032), the LCOE of Inga 3 at $0.121/kWh (R1.8/kWh) would be around 175% more expensive than the cheapest alternative, wind, at $0.044/kWh (R0.66/kWh).

These costs need to be considered within a context of already unstable electricity prices, exacerbated by the variable demand in time of use. We recognise that variable renewables such as wind and solar may pose some challenges and that some studies suggest sources like gas may be needed for stable grid management and growth.[52]

But this picture is also changing fast. Battery energy storage has already seen significant cost reductions, as the first quarter of this year reflected US$150/MWh for battery storage with four hours' discharge duration, representing a fall greater than 76% since 2012.[53] This baseload potential is crucial for meeting time of use demands.

Later sections of this report look at the social and environmental impacts of 4.3Inga 3, comparing them to solar and wind, which appear to offer greater benefits with much smaller risks. As analysts, we were surprised to find that solar and wind also appear to be cheaper in pure financial terms, potentially significantly so.



52. Deshmukh, R., Mileva, A. & Wu, G.C. "Renewable energy alternatives to mega hydropower: a case study of Inga 3 for Southern Africa" (2018): https://iopscience.iop.org/article/10.1088/1748-9326/aabf60
53. Colthorpe, A. "Behind the numbers: The rapidly falling LCOE of battery storage" (6th May 2020): https://www.energy-storage.news/blogs/behind-the-numbers-the-rapidly-falling-lcoe-of-battery-storage

Financial cost for South Africa

South Africa is supposed to be the primary offtaker of the Inga 3 dam, agreeing to 2,500 MW of the 4,800 MW currently planned. But with no Power Purchase Agreement (PPA) signed, the agreement between SA and the DRC may lapse in 2023 should the project continue to experience construction delays.[54] Since these delays seem likely, we want to consider what deal would be on the table for the South African government.

So far, this section has used total figures for Inga 3 because liabilities are very unclear. But it is not plausible to expect South Africa to foot the entire bill. Instead, we deduce that South Africa will pay for the transmission line from the DRC-Zambia border to South Africa, as indicated in the treaty between South Africa and DRC,[55] but not for the dam or other transmission infrastructure within DRC. As noted, these transmission lines could be the longest in the world with cost estimates ranging from $3 - 4.3 billion.[56] Our calculations suggest a figure between at least $1.4bn - $2.7bn,[57] while the World Bank estimated $2bn alone from the DRC-Zambia border to South Africa.[58] However, these figures are shrouded in uncertainty, and our estimates are highly conservative.

Importantly, based on these estimates, South Africa could alternatively invest this same $2bn to build approximately 920 MW[59] of solar or wind entirely, which could then be operated and distributed very cheaply.

But, like the dam itself, transmission lines may be exposed to significant delays and cost increases. Moreover, South Africa's existing transmission infrastructure is old and alternatives can heighten grid instability, especially if regulations allow for aggressive wheeling.[60] Yet these challenges can be overcome through further upgrades, maintenance, and careful grid planning,[61] which would enable the integration of solar and wind while reducing transmission losses.

This comparison between the dam and alternatives above does not factor in transmission losses: in wealthy economies, electricity transmission losses range between 4% and 9%. But in developing countries, this rate of loss tends to be significantly higher.[62] The International Energy Agency has shown that the DRC loses 20% of its electricity through transmission. In South Africa total losses are 12%.[63]

54. Du Plessis, C. "Flipping the switch on Inga 3?" (23rd April 2020): https://www.businesslive.co.za/fm/features/africa/2020-04-23-flipping-the-switch-on-inga-3/
55. "Treaty on the Grand Inga Hydropower Project Between the Republic of South Africa and the Democratic Republic of the Congo" (29th October 2013): https://static.pmg.org.za/141104treaty.pdf (pg. 19)
56. The World Bank "International Development Association project appraisal document on a proposed grant in the amount of SDR 47.7 million (US$ 73.1 million equivalent) to the Democratic Republic of Congo for an Inga 3 basse chute and mid-size hydropower development technical assistance project" (2014): http://documents1.worldbank.org/curated/en/817971468245430631/pdf/774200REPLACEM0140Box382121B00OUO90.pdf ; ADPI-RDC "Inga 3 Hydropower Project" (2018): https://aid.nepad.org/m_assets/uploads/document/15330269121716599182.pdf
57. Our calculations are based on the shortest and longest realistic transmission routes that follow the route DRC (Inga)-Angola-Namibia-SA (Route 3) and DRC (Inga)-Zambia-Zimbabwe-SA (Route 1), respectively, at R7 million [$0.48 million] per kilometer as mentioned in: Congo Research Group & Phuzumoya Consulting "I need you, I don't need you: South Africa and Inga III" (2020): https://cic.nyu.edu/sites/default/files/south-africa-inga-3-report-web.pdf. These are very conservative figures.
58. This estimate is from 2014 and is likely conservative, from: The World Bank "International Development Association project appraisal document on a proposed grant in the amount of SDR 47.7 million (US$ 73.1 million equivalent) to the Democratic Republic of Congo for an Inga 3 basse chute and mid-size hydropower development technical assistance project" (2014): http://documents1.worldbank.org/curated/en/817971468245430631/pdf/774200REPLACEM0140Box382121B00OUO90.pdf
59. Our calculations were based on the World Bank's estimated $2bn cost of transmission from the DRC border to SA found here: The World Bank "International Development Association project appraisal document on a proposed grant in the amount of SDR 47.7 million (US$ 73.1 million equivalent) to the Democratic Republic of Congo for an Inga 3 basse chute and mid-size hydropower development technical assistance project" (2014): http://documents1.worldbank.org/curated/en/817971468245430631/pdf/774200REPLACEM0140Box382121B00OUO90.pdf and calculated renewable energy values found here: USAID "South Africa Power Africa Transactions" (2019): https://www.usaid.gov/powerafrica/south-africa-power-africa-transactions
60. Sustainable Energy Africa (SEA) "Sustainable energy solutions for South African local government: a practical guide" (2017): https://www.sustainable.org.za/userfiles/green%20power%20purchase(1).pdf
61. Eskom plan to spend $16.7bn on upgrading existing lines and a further $78.8bn on transmission expansion projects between 2020 and 2029, as indicated here: Eskom "Transmission Development Plan 2020-2029" (2019): https://www.eskom.co.za/Whatweredoing/TransmissionDevelopmentPlan/Documents/TDP%20Report%202019-2029_Final.pdf
62. Jones, T. "In debt and in the dark: Unpacking the economics of DRC's proposed Inga 3 dam" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/in_debt_and_in_the_dark.pdf
63. Jones, T. "In debt and in the dark: Unpacking the economics of DRC's proposed Inga 3 dam" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/in_debt_and_in_the_dark.pdf

Together such transmission losses would be between 10%[64]-20%[65] of Inga 3's generation. That's as much as 500 MW.

Given these uncertainties around transmission costs and losses, we carried out an analysis to understand how these uncertainties affect the cost of electricity delivered to South African consumers. Here we analysed the cost of Inga 3 and transmission lines separately, accounting for varied transmission costs and potential transmission losses.

Based on our assessment, we found that the actual LCOE for the dam and potential transmission line costs could be between $0.11/kWh[66] – $0.122/kWh[67]. This LCOE for the dam and transmission line is significantly higher than for solar and wind, which at the likely point of operation in 2032 will be $0.064 for solar and $0.045 for wind. Importantly, the cost is also higher than the average cost of electricity in South Africa for generating coal, at $0.084/kWh.[68]

To put this in perspective, we have calculated the revenue that Eskom is expected to receive from Inga 3 on a per kilowatt basis. This amounts to $0.082/kWh when considering the varying costs and usage of businesses and households.[69] It is therefore clear that Inga's electricity cost, regardless of the transmission line selected or delay experienced, will require South African citizens to foot a bill for the additional $0.027 - $0.04/kWh, equating to between $414m - $610m (~R6.19bn – R9.12bn) per year, whether through increased tariffs or government subsidies paid by the taxpayer. This will ultimately impact South Africa's most vulnerable as it affects the bottom line of businesses and increases the household costs of low-income groups.

A further key consideration in this picture are the uncertainties around the costs of capital used for Inga 3, which have a significant impact on a comparison with solar and wind and also on the level of debt accrued to Eskom. Using the total cost of Inga 3 ($14bn) and a varied cost of capital, Inga 3 could produce electricity costing between $0.092 - $0.153/kWh[70] by 2032, which is 54% - 155% more expensive than solar and 134% - 286% more expensive than wind per kWh. This opportunity cost will be borne by Eskom and so contribute to its already significant debt burden.

Finally, IRPs over the past 10-20 years have consistently overestimated future energy demand.[71] COVID-19 has also worsened this situation and arguably set South Africa's demand back by several years. This creates a situation in which the electricity from a long-delayed Inga 3 may not be needed by the market at all. South Africa could instead consider a more incremental approach to energy development with shorter lead times and higher involvement from private sources of capital. This would significantly reduce liability for South Africa relative to known plans for Inga 3.

South Africa could instead consider a more incremental approach to energy development with shorter lead times and higher involvement from private sources of capital.

64. Deshmukh, R., Mileva, A. & Wu, G.C. "Renewable riches: How wind and solar could power DRC and South Africa" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/ir_inga_re_report_2017_fa_v2_email_1.pdf
65. Wernick, A. "Congo pushes for a mega-dam project, with no environmental impact studies" (3rd July 2016): https://www.pri.org/stories/2016-07-03/congo-pushes-mega-dam-project-no-environmental-impact-studies
66. Assuming a transmission cost of $2bn and a 3 year delay, with a discount rate of 10% and a transmission loss of 10%
67. Assuming a transmission cost of $4.3bn and a 3 year delay, with a discount rate of 10% and a transmission loss of 10%
68. Yelland, C. "Cost of new power generation in South Africa" (17th October 2016): https://www.ee.co.za/article/cost-new-power-generation-south-africa.html
69. Households consume approximately 20% of electricity in SA while businesses consume roughly 80% (see: Deloitte Consulting "An overview of electricity consumption and pricing in South Africa: An analysis of the historical trends and policies, key issues and outlook in 2017" (2017): https://www.eskom.co.za/Documents/EcoOverviewElectricitySA-2017.pdf) while household and business tariff also vary by over $0.072/KWH (see: Global Petrol Prices "South Africa electricity prices" (2020): https://www.globalpetrolprices.com/South-Africa/electricity_prices/)
70. These are based on a total CAPEX of $14bn, with a 3-year delay and 33% CAPEX increase (average), with costs of capital at 3% and 9%, respectively, using rounded values from: RSA Retail Savings Bond (2021): https://secure.rsaretailbonds.gov.za/ViewHistory.aspx & World Government Bond " South Africa Government Bonds - Yields Curve" (2021): http://www.worldgovernmentbonds.com/country/south-africa/
71. Department of Mineral Resources and Energy "Integrated Resource Plan 2019" (2019): http://www.energy.gov.za/IRP/2019/IRP-2019.pdf

Financial Assessment Summary

A financial assessment of Inga 3 shows that the project makes little commercial sense and is likely to expose backers to significant losses. Our analysis shows that Inga 3 will likely be delayed by three years, if it is not cancelled altogether. In all plausible scenarios the dam has significant negative NPV, which should deter private investors. Offtakers and regulators should be aware that the electricity produced by Inga 3 is very likely to be more expensive than alternatives.

For South Africa, our assessment shows that Inga 3's cost per kilowatt will be detrimental to Eskom, the economy, and ultimately South African consumers. Footing the bill of the transmission line from the DRC-Zambian border to South Africa will cost the country billions of rands, even excluding delays, which according to our environmental and social evaluation, are very likely. This at a time when South Africa already faces a debt crisis coupled with economic downturn from the COVID-19 pandemic.

Our assessment finds that the cost of electricity from Inga 3, including the potential cost of the transmission lines, is likely to be between $0.11/kWh – $0.122/kWh. This is significantly higher than the current price of electricity in South Africa and could lead to additional costs to Eskom of between $414m - $610m (~R6.19bn – R9.12bn) per year, which will ultimately be paid by South African consumers and taxpayers.

By contrast, alternatives like solar and wind are more commercially competitive. Our assessment shows that these technologies can respectively provide electricity priced 89% and 175% lower than Inga 3, by our expected operation date of 2032, which could ultimately affect the cost of electricity for South Africans. Moreover, these alternatives are modular, allowing for smaller and lower risk investments that can yield higher returns over shorter periods. These are crucial comparisons for South Africa given that the exorbitant cost of electricity already limits energy access, which is key to addressing some of the country's most pressing socio-economic challenges.

Photo courtesy of WoMin

4. Social Impact Evaluation

Cheap and sustainable energy can deliver huge social benefits. In fact, it is often a precondition for rapid and equitable socio-economic development. But energy assets can also do serious social harm, particularly at a local level during their construction. Hydropower projects are associated with problems like forced displacement; deprivation of food and water; and conflict, to name a few. Many of these negative impacts are carried disproportionately by vulnerable groups and women.

This section looks at the social costs and benefits that might be associated with the Inga 3 dam to help determine whether the project is in the interests of the South African public. We first look at the negative impacts of the dam and compare them to those associated with solar and wind technologies. Our quantitative assessment analyses the risk that Inga 3, and its transmission lines, may drive displacement, social conflict and human rights issues, in the DRC and especially in South Africa. This is supported by qualitative evaluations of negative social impacts and their distribution by gender.

We then pivot to compare the positive social impacts that may be associated with Inga 3 or with alternatives. Any such investment will create jobs and economic opportunities at some considerable scale. However, we want to investigate whether Inga 3 provides a good return on public investment, considering factors like the number and quality of jobs directly and indirectly created. Again, we pay particular attention to how these benefits are distributed, paying close attention to gendered impacts.

In summary, we have found that Inga 3 will have large negative impacts and has the potential to drive conflict at scale. Entrenched opposition to the plan will likely contribute to further delays for a project that has been on the slate for decades. In terms of positive impacts, plans for Inga 3 are inefficient in terms of job creation and income improvement. This is especially so for South Africa, which will see very limited employment benefits. The project may erode public trust in energy planning in the process. The socio-economic case for Inga 3 therefore appears to have significant problems.

Photo courtesy of WoMin

Negative impacts: conflict and displacement

Our investigation of negative impacts is split into an evaluation of the area around the dam, an assessment of the transmission lines and a relatively brief consideration of end use (a topic picked up again in the positive impact section). We pay particular attention to the impacts of the transmission lines since these will be the most directly relevant to South Africa.

Impacts around the dam

The table below presents the results of a quantitative assessment process of the area around the planned Inga 3 dam, based on previous analysis of 282 dams to identify social indicators that correlate with risk of dispute and conflict. This process is further described in the Methodology in Appendix III. Any score over 45 indicates that risk of dispute and conflict is above average, while any score above 60 indicates a very high risk of such (as reflected in our basic color coding).

These high scores suggest that Inga 3 will have large negative impacts on surrounding vulnerable populations and they also indicate that these impacts could be connected to dispute and conflict. Inga 3 is planned in a remote area inhabited by people with little experience of large-scale economic development. What experience there is has been largely negative, with displaced communities from the Inga 1 and 2 dams still without compensation and basic services decades after construction was completed.[72]

Indicator	Score			Description of Indicator Score
	Dam	River	District	
% poor and deprived: Improved Sanitation	61	56	59	This score is quite high, suggesting that large portions of the population lack access to basic services.
% poor and deprived: Drinking Water	93	90		This score is very high which indicates that access to drinking water in the immediate area and downstream is limited.
% poor and deprived: Schooling	78	76		This score is high, suggesting that the project will need to conduct an extremely thorough and extensive prior consultation process in order to ensure they have consent, otherwise they risk local opposition to the project.
Multidimensional Poverty Index	91			These very high levels of local deprivation are linked to increased risks of social dispute and conflict over investment projects.
Population vulnerable to poverty	76			This high score reflects the reliance of locals on essential resources.
Population density		75		These high scores are counter-intuitive, suggesting low population densities in the area. This reinforces a picture of a remote area that has little experience of development. These areas may *seem* attractive for hydro but are in fact risky.
Night Lights		63		
Conflict			10	The low conflict score suggests that there have been little to no events of conflict in the area. This is likely a problem with the dataset which is not well reported within the DRC.

72. International Rivers "The Women of Inga: A Portrait of Resilience" (4th July 2017): https://www.internationalrivers.org/news/the-women-of-inga-a-portrait-of-resilience/

The most serious social problems for the area around the dam are connected to the likely relocation of at least 10,000 people living in and around the Bundi Valley.[73] Our investigation suggests 75,786 people could be economically affected in the area of analysis around the dam and up to 144,945 people downstream.[74] This is likely to include local populations like the Basangela people, who inhabit the Bundi Valley that would be flooded, as well as communities displaced decades ago by Inga 1 and Inga 2.[75] Similarly, women and young people are likely to be disproportionately affected.

Free, prior and informed consent should at least be obtained from relocated communities and planning should be done jointly with affected parties. However, internationally there are numerous case studies that show scant or no regard for information dissemination and consultation prior to the implementation of mega projects like Inga 3, let alone the acknowledgement of women and their right to dissent over the loss of land.[76]

Impacts around transmission lines

The transmission lines for Inga 3 have their own set of social and political challenges, both within South Africa and in the countries that they pass through. A key driver of these negative impacts is displacement and curtailed access to resources for local people. Partly as a result, these transmission corridors will be exposed to sabotage,[77] public opposition and related land acquisition issues,[78] amongst other challenges. These risks may delay transmission line development and so energy delivery, while also increasing the financial cost for South Africa.

External transmission assessment

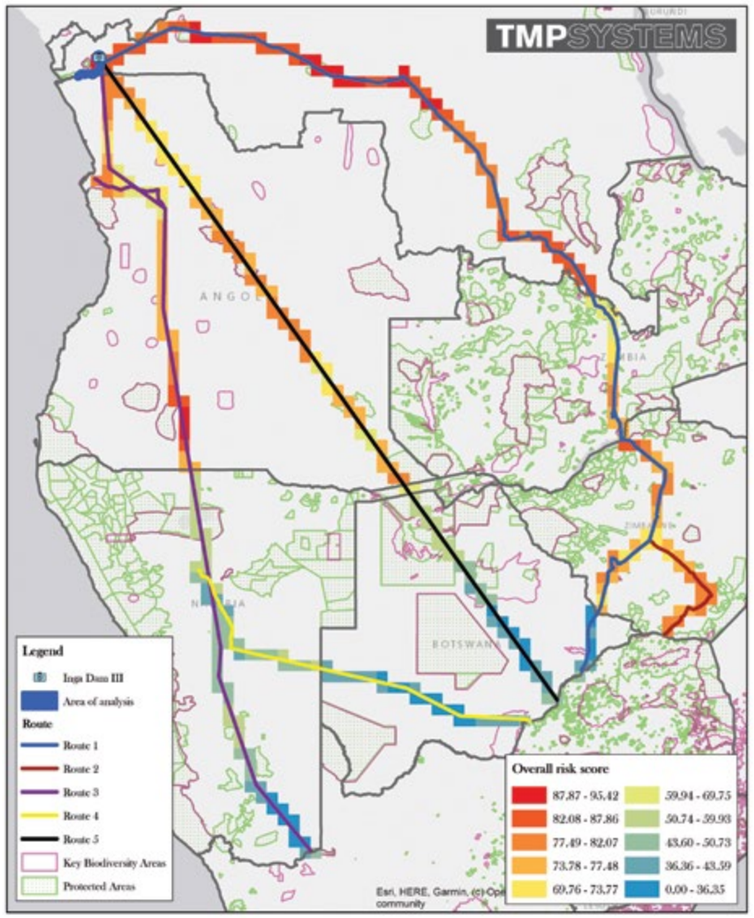
Much of the route between the DRC and South Africa has not been officially identified – some reports suggest they will not be seriously considered until construction starts – so we developed five potential routes using the existing and planned transmission lines as guidance.[79] Later, we consider three routes within South Africa. These routes are plotted out in the map below, along with an assessment of the risk of conflict or dispute in the areas the lines may pass through.

The graphic below shows the overall risk scores as calculated by our Rapid Assessment which was based on Landscope's social risk analysis processes[80] (see Transmission Line Risk Model in Appendix II for details) and the table overleaf provides average scores.[81]

These routes vary in terms of social and overall impact and risk but the map shows that all five routes have sections with very high risk scores, which means that they are likely to drive and/or become exposed to social conflict and dispute. While we reviewed a direct route (Route 5) as reflected above, we recognise that this would be a highly unlikely case given that transmission lines often need to navigate through tough terrain.[82]

73. Jones, T. "In debt and in the dark: Unpacking the economics of DRC's proposed Inga 3 dam" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/in_debt_and_in_the_dark.pdf ; International Rivers "The Women of Inga: A Portrait of Resilience" (4th July 2017): https://www.internationalrivers.org/news/the-women-of-inga-a-portrait-of-resilience/ ; International Rivers "Community History of Inga 1 and Inga 2" (no date): http://www.irn.org/files/en/node/2736.html ; Krüger, R. "Watering down justice: Energy justice in the Inga dams case in the DRC (2017): http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=8914763&fileOId=8914839
74. These figures are based on the GPWv4.
75. Forest Peoples Programme "Inga Dam in the DRC to Result in the Resettlement of up to 20,000 People" (1st June 2015): https://www.forestpeoples.org/en/topics/world-bank/news/2015/05/inga-dam-drc-result-resettlement-20000-people
76. WoMin "Extractives vs development sovereignty: building living consent rights for African women" (2017): https://www.tandfonline.com/doi/abs/10.1080/13552074.2017.1379782 ; Cultural Survival "Confronting Megaprojects: Development Without Our Consent is not Development" (2013): https://www.culturalsurvival.org/publications/cultural-survival-quarterly/confronting-megaprojects-development-without-our-consent
77. The Cahora Bassa transmission line from Mozambique to South Africa was sabotaged and interrupted supply for 17 years: Economic Consulting Associates "The Potential of Regional Power Sector Integration: South African Power Pool (SAPP) | Transmission & Trading Case Study" (2009): https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_South%20African%20Power%20Pool-Transmission%20&%20Trading.pdf
78. Pall, G.K., Bridge, A.J., Gray, J., & Skitmore, M. "Causes of Delay in Power Transmission Projects: An Empirical Study" (2020): https://www.mdpi.com/1996-1073/13/1/17/htm#B45-energies-13-00017
79. Excluding Route 5 which is a straight, direct line from Inga 3 to South Africa. I.e. the shortest possible route
80. The transmission risk scores were based on Landscope which reviews infrastructure projects. More information on Landscope can be found here: https://landscope.info/
81. See full transmission line model results in the Transmission Line Risk Model in Appendix II
82. We only considered existing and planned routes for this analysis based on the assumption that new transmission lines would likely be developed alongside existing lines.

Overall risk scores of transmission routes from Inga 3 to SA



	Social Score[83]
Route 1	76
Route 2	78
Route 3	62
Route 4	56
Route 5	59

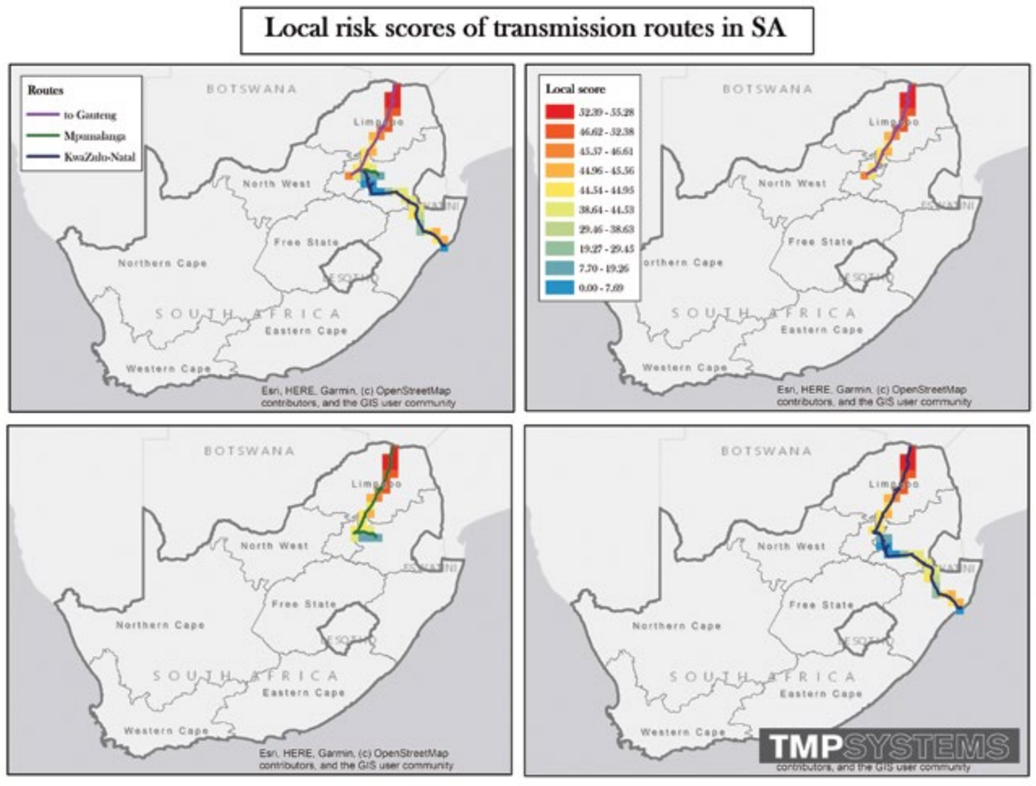
Many of the transmission areas in question are quite remote and those along its route will be disproportionately impacted by displacement and construction work. Those that are heavily reliant on traditional livelihoods struggle the most when those livelihoods are disrupted by reduced access to customary land and natural resources. These impacts will fall disproportionately on women, young people and vulnerable groups, who are less able to protect their rights and have less opportunity to get back on their feet.

Most African women are still denied education and employment, and have limited opportunities in trade, industry and government positions. Furthermore, primary development policies focusing on poverty reduction in many Southern African countries still do not account for income and power disparities between men and women and therefore hamper the efforts of programs to reduce such inequalities.[84]

83. These scores indicate the social risk exposure of the routes to social conflict and dispute. Scores over 45 indicate that risk of dispute and conflict is above average, while any score above 60 indicates a very high risk.
84. Mutume, G. "African women battle for equality" (2005): https://www.un.org/africarenewal/magazine/july-2005/african-women-battle-equality

Internal transmission assessment

Our main concern in this sub-section is the impact of Inga 3's planned transmission lines within South Africa. The map below presents three likely routes based on the most likely point of entry for transmission lines to South Africa. Again, we used planned and existing transmission lines to guide our analysis here, assuming that new transmission lines would likely follow these same routes. The highest demand routes are those that transport electricity to Gauteng, Kwa-Zulu Natal (KZN), and Mpumalanga, according to StatsSA.[85]



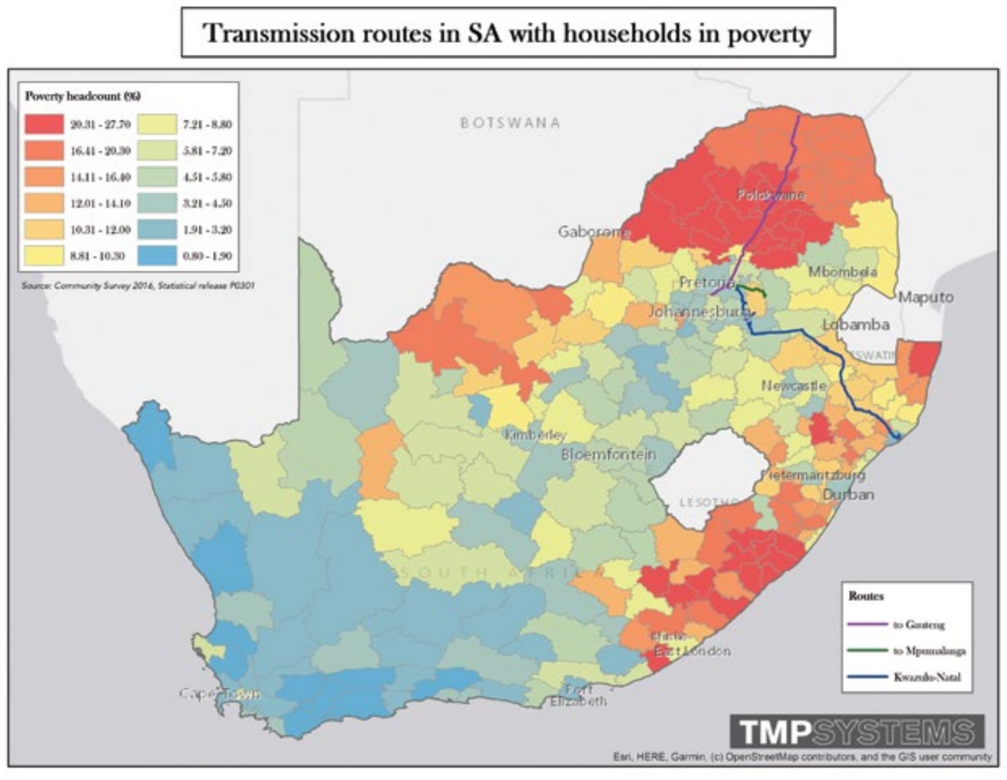
	Social Risk Score[86] [87]
Gauteng	64
KZN	67
Mpumalanga	62

85. Statistics South Africa "Electricity generated and available for distribution (Preliminary)" (June 2019): http://www.statssa.gov.za/publications/P4141/P4141June2019.pdf
86. See Transmission Line Risk Model in Appendix II for full Indicator List and scores for SA transmission lines
87. These scores indicate the social risk exposure of the routes to social conflict and dispute. Scores over 45 indicate that risk of dispute and conflict is above average, while any score above 60 indicates a very high risk.

These scores are above average, suggesting the construction of transmission lines in these areas will have negative social impacts that will lead to opposition, delay and possible conflict. Our analysis suggests that between 211,920 – 333,423 people could face disturbances from the construction of new lines, depending on the route selected.[88] South Africa's recent history of land disputes and engrained unemployment will likely make local people resentful of and vulnerable to any displacement or curtailed opportunities associated with transmission line construction.

The negative social impacts of internal transmission development will likely fall disproportionately on South African women. The land used for the construction of transmission lines is more likely to be worked by women both in and outside of South Africa. In addition, South African women are often subsistence farmers who support families and local markets and who are vulnerable to any disruptions to their already challenging conditions (e.g. through biodiversity loss and climate change). Because the land that women live on is usually owned by their male spouses or male traditional leaders, when these men sell the land women are left displaced and penniless. This places women in an even more vulnerable position.

Similarly, areas of acute poverty, like the Limpopo region, will bear the brunt of negative impacts within South Africa (see map below). These areas have experienced major changes in recent decades, including through mining and large private agriculture, which have led to the displacement of many local communities[89] and disrupted already vulnerable livelihoods.



88. These figures are based on the GPWv4 with a 2km buffer on either side the three internal transmission lines
89. South African Human Rights Commission "Mining-related observations and recommendations: Anglo Platinum, affected communities and other stakeholders, in and around the PPL Mine, Limpopo" (2008) https://www.sahrc.org.za/home/21/files/Reports/Anglo%20Report%20Final%202008_Chp%201%20to%203.pdf ; Wisborg, P., Hall, R., Shirinda, S. & Zamchiya, P. "Farm workers and farm dwellers in Limpopo, South Africa: Struggles over tenure, livelihoods and justice" (2013): http://repository.uwc.ac.za/xmlui/bitstream/handle/10566/4563/wisborg_farm_workers_farm_dwellers_south_africa_2013%20%281%29.pdf?sequence=1&isAllowed=y

More specifically, mining has left a legacy of forced removals where an estimated 1.6 million South Africans live on or near mine dumps, with severely polluted water, air and soils,[90] a loss of agricultural livelihoods and limited access to ancestral lands.[91] The pollution also tends to impact women and children disproportionately. Moreover, many people were neither compensated nor provided jobs, as promised. Women and their households rarely escape poverty after such forced removals. This legacy both heightens the vulnerability of these areas to such development practices, while also raising the risk of local opposition.

Impacts around end use

Energy from Inga 3 would be sent to the mining sector in Katanga or exported to South Africa, with just over 20% allocated to residents in Kinshasa and surrounds.[92] This sub-section briefly considers the negative impacts of this allocation in the DRC and in South Africa before considering positive impacts relative to alternatives in the next sub-section.

Within the DRC, energy from Inga 3 is going to the places that already enjoy relatively high levels of electrification. Overall, 19% of people in the DRC have access to electricity[93] but in Kinshasa the rate is as high as 80%.[94] So although the 20% allocation from Inga 3 may have positive social impacts for Kinshasa residents and some surrounding areas, it will likely have limited to no impact on the majority of the DRC population in need. This is especially concerning given that low energy access has been linked to using wood and charcoal for energy,[95] which is driving deforestation and local biodiversity loss. Because of patriarchal norms, women are also the ones who have to go out in search of, collect and bring back fuel sources and water, which can then be used by them for cooking. When resources are captured by dams and other projects, women have to travel further distances putting themselves at greater risk of sexualised violence and other kinds of abuse.

Within South Africa, Inga 3 may improve the country's overall energy capacity but is unlikely to improve energy access for average South Africans, of which an estimated five million people are without electricity. It is unclear where the bulk of the energy from Inga 3 will go. However by locking in a model based on large scale generation assets and on distribution via Eskom, Inga 3 could serve to further embed structural problems in the South African economy, that deliver significant negative impacts to large parts of the population, particularly the poor and vulnerable.

As we go on to see in the next section, alternatives could offer considerably more support for local entrepreneurship and bottom up development. Solutions such as solar geysers and rooftop solar systems offer alternative options that could directly improve energy access and end use options for South Africans in both rural and urban areas.

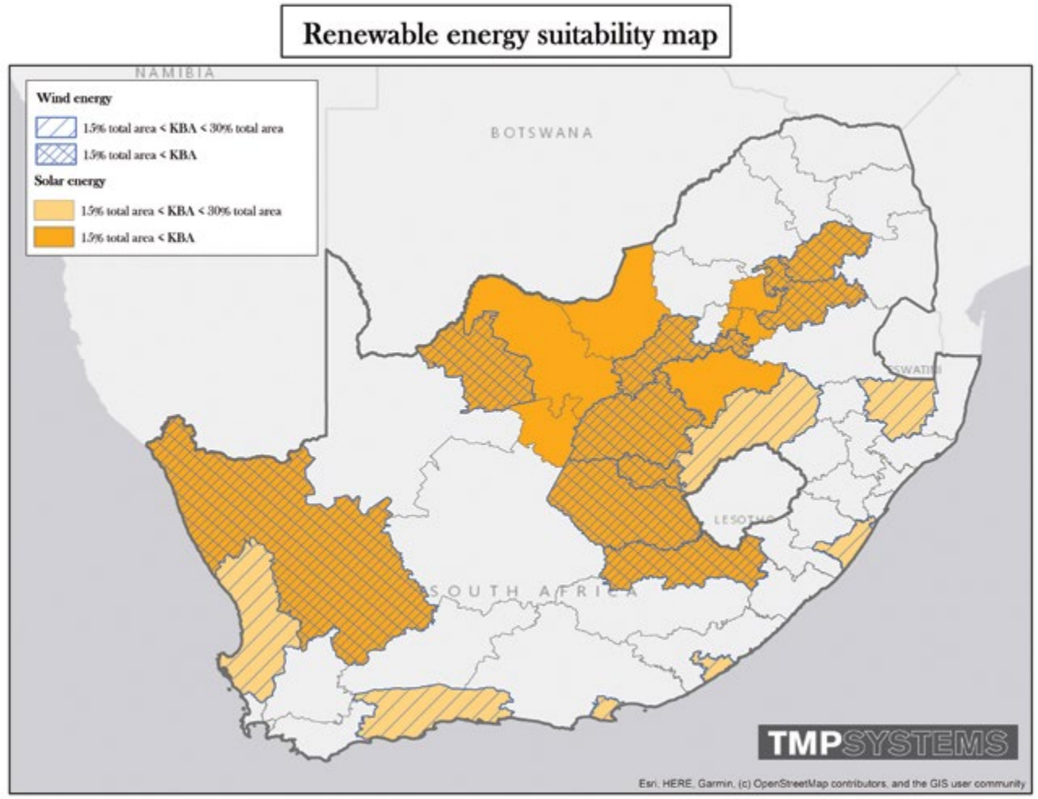
Solutions such as solar geysers and rooftop solar systems offer alternative options that could directly improve energy access and end use options for South Africans in both rural and urban areas.

90. Nkosi, V. "How mine dumps in South Africa affect the health of communities living nearby" (2nd May 2018): https://theconversation.com/how-mine-dumps-in-south-africa-affect-the-health-of-communities-living-nearby-77113
91. WoMin "'No longer a life worth living': Mining impacted women speak through participatory action research in the Somkhele & Fuleni communities, Northern Kwazulu Natal, South Africa" (2017): https://womin.africa/no-longer-a-life-worth-living-report/
92. The World Bank "International Development Association project appraisal document on a proposed grant in the amount of SDR 47.7 million (US$ 73.1 million equivalent) to the Democratic Republic of Congo for an Inga 3 basse chute and mid-size hydropower development technical assistance project" (2014): http://documents1.worldbank.org/curated/en/817971468245430631/pdf/774200REPLACEM0140Box382121B00OUO90.pdf
93. The World Bank "Access to electricity (% of population) - Congo, Dem. Rep." (no date): https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=CD&view=chart
94. USAID & Power Africa "Off-Grid Solar Market Assessment: Democratic Republic of the Congo" (2019): https://www.usaid.gov/sites/default/files/documents/1860/PAOP-DRC-MarketAssessment-Final_508.pdf
95. Kusakana, K. "A Review of Energy in the Democratic Republic of Congo" (2016): https://www.researchgate.net/publication/306380971_A_Review_of_Energy_in_the_Democratic_Republic_of_Congo

Positive impacts: Inga vs. Alternatives

Our assessment into the positive social impacts of Inga 3 compares possible benefits of Inga 3 with those offered by alternative energy sources. This comparative assessment focuses on the employment and economic opportunities created for South Africans. Given the high rates of unemployment and inequality in South Africa, we look closely at both the number and quality of jobs created for South Africans.

As noted, Inga 3 is likely to support Eskom's existing distribution pathways as large chunks of capacity are dropped into the grid and largely allocated to energy-intensive industries. This supports the national economy but does not create jobs or spur economic activity. It also risks leaving underserved regions and locations behind. Solar and wind are much more flexible and can be sited in locations with low social risk (see map below)[96] and high levels of energy poverty. This means the assets can be installed more rapidly at lower risk and with substantially more potential to address social challenges in those locations. As we can see below, these areas are extensive.



96. This suitability map for wind and solar potential indicates areas where the Landscope social risk score is less than 60; the DNI is greater than 1200kWh/m2 per annum for solar; the average wind speed is greater than 6m/s at 50 and 100m for wind; and Key Biodiversity Areas (KBAs)/Protected Areas (PAs) are less than 10% of the total L2 district area.

South Africa's REIPPPP supports community development and job creation through development requirements for bidding.[97] The REIPPPP is far from perfect and has been criticised for lacking community development guidance for developers, as well as an overfocus on socially negative ownership models. However, the REIPPPP's potential for creating jobs and attracting private finance into poor rural communities has been quite well demonstrated to date, with R19 billion already secured for socio-economic development across South Africa.[98]

Impact on jobs

Inga 3 will create jobs, but these jobs will mostly be in the DRC and associated positive social impacts will therefore be limited within South Africa. The construction phase of Inga 3 has been estimated to provide an average 3,000 jobs, peaking at 7,000, almost all of which will be within the DRC. Following construction, however, this figure is expected to drop to a few hundred. [99]

We have not found any official estimates on potential job creation in South Africa, again reflecting the lack of a feasibility assessment on the South African side. We can assume that any jobs created by the line from Inga 3 to the South African border would be largely unavailable to South Africans, as these lines would be located outside of the country.

Although there will be jobs created by the construction of any new transmission lines within South Africa, or by the upgrading of existing lines, these are unlikely to compensate for the livelihoods lost and disrupted, and especially for women. Transmission construction is often contracted, technical work,[100] suggesting local and affected communities are unlikely to reap these employment benefits.

Photo courtesy of WoMin

97. WWF "A review of the local community development requirements in South Africa's renewable energy procurement programme" (2015): https://wwfafrica.awsassets.panda.org/downloads/local_community_development_report_20150618.pdf?14322/A-review-of-the-local-community-development-requirements-in-South-Africas-renewable-energy-procurement-programme
98. Eberhard, A. & Naude, R. "The South African Renewable Energy Independent Power Producer Procurement Programme: A review and lessons learned" (2016): http://www.scielo.org.za/scielo.php?script=sci_abstract&pid=S1021-447X2016000400001&lng=en&nrm=iso
99. Jones, T. "In debt and in the dark: Unpacking the economics of DRC's proposed Inga 3 dam" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/in_debt_and_in_the_dark.pdf
100. African Development Bank "Eskom transmission improvement project: Environmental and social impact assessment summary" (2017): https://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/South_Africa_-_Eskom_transmission_improvement_project_%E2%80%93_ESIA_Summary.pdf

Potential construction and maintenance jobs will be largely unavailable to women, who are also unlikely to command many of the skilled or senior positions on site. This is partly because not many women have the skills required and because women are endangered by camps of male workers required for construction, particularly in remote areas, and especially given the levels of gender-based violence South Africa experiences.[101] Women may often find themselves limited to activities such as providing accommodation, food and services to construction and maintenance workers, which would be short-term income streams.[102]

Solar and wind energy projects, by comparison, may each be capable of creating large numbers of high-quality jobs for South Africans. These jobs do not have high barriers to entry but can transfer skills in a sector that is likely to continue to grow over the coming decades. In fact, a COBENEFITS study found that South Africa could create at least 1.2 million job years across the renewable energy supply chain by adopting the CSIR's proposed least-cost energy mix which significantly increases the share of renewables.[103]

In terms of direct job creation, the REIPPPP has led to the creation of at least 55,217 full time jobs by Q2 2020/2021.[104] That is 8.8 construction jobs per MW installed,[105] relative to 0.6 - 1.4 construction jobs per MW estimated for Inga 3 [106].[107] This means that South Africa could create 8,096 full time jobs[108] for South Africans should it rather invest in alternatives. However, the REIPPPP is by no means a perfect solution.

By 2017 there had been 3,892 job opportunities created for women[109] under the REIPPPP which equated to just 9%[110] of total employment opportunities in the renewables sector, with 33% of top management positions filled by women during the construction phase of renewable projects and 31% of operational phase positions filled by women.[111] Based on this premise, the REIPPPP could create just 729 full time job opportunities for women,[112] which reflects significant room for improvement.

The value of supplies procured from women owned companies by 2017 was R1.4 billion.[113] This reflects progress for women in a nascent sector and there are considerable opportunities for increasing the number and options for women in coming years. Already at least one of the renewable energy companies that manufactures wind turbines in the Western Cape is majority women owned.[114]

101. Seleka, N. "Crime stats show that SA's women, children live in constant fear daily" (14th November 2020): https://www.news24.com/news24/southafrica/news/crime-stats-show-that-sas-women-children-live-in-constant-fear-daily-20201114
102. Parshotam, A. "Opportunities and challenges in engendering the African energy value chain" (2018): https://saiia.org.za/research/opportunities-and-challenges-in-engendering-the-african-energy-value-chain/
103. CSIR & IASS "Cobenefits study: Future skills and job creation through renewable energy in South Africa: Assessing the co-benefits of decarbonising the power sector" (2019): https://www.cobenefits.info/wp-content/uploads/2019/03/COBENEFITS-Study-South-Africa-Employment.pdf
104. Of these jobs 44 290 (80%) were created during construction and 10 927 (20%) in the operational phase of projects, as in: IPP Office "Independent Power Producers Procurement Programme (IPPPP): An overview" (30th September 2020): https://www.ipp-projects.co.za/Publications/GetPublicationFile?fileid=24721acc-cb80-eb11-952f-2c59e59ac9cd&fileName=20210222_IPP%20Office%20Q2%200verview%202020-21.pdf
105. Calculated using figures from: CSIR "Statistics of utility-scale power generation in South Africa in 2020" (2021): https://researchspace.csir.co.za/dspace/bitstream/handle/10204/11865/CalitzWrightMarch2021.pdf?sequence=3&isAllowed=y
106. Calculated from SNEL estimates here: Jones, T. "In debt and in the dark: Unpacking the economics of DRC's proposed Inga 3 dam" (2017): https://archive.internationalrivers.org/sites/default/files/attached-files/in_debt_and_in_the_dark.pdf
107. We have only included a comparison of construction jobs because official estimates for Inga 3 operational jobs are unavailable.
108. That is 8,096 job years from an investment into 920MW of solar or wind, rather than an equivalent investment into Inga 3.
109. As of 2020, black South Africans have averaged 67% of top management positions, while during construction phases, black South Africans, youths and rural / local communities have made up 81%, 44% and 49% of total job opportunities, respectively: IPP Office "Independent Power Producers Procurement Programme (IPPPP): An overview" (30th June 2020): https://www.ipp-projects.co.za/Publications/GetPublicationFile?fileid=498aff3b-e50d-eb11-9524-2c59e59ac9cd&fileName=20200917_IPP%20Office%20Q1%200verview%202020-21%20WEB%20VERSION.PDF
110. Employment figures differ slightly between sources which may be attributed to different metrics used, however women seem to make up between 9-12% of total employment opportunities in the renewable energy sector.
111. IPP Office "The REIPPPP contribution - Women in energy: empowerment, engagement and employment" (2017): https://sawea.org.za/wp-content/uploads/2018/03/Women-in-Energy-Feature-august-2017.pdf
112. Again, this is based on an investment into 920MW of solar or wind, rather than an equivalent investment into Inga 3
113. IPP Office "The REIPPPP contribution - Women in energy: empowerment, engagement and employment" (2017): https://sawea.org.za/wp-content/uploads/2018/03/Women-in-Energy-Feature-august-2017.pdf
114. McDaid L. "Renewable Energy Independent Power Producer Procurement Programme Review 2016: A critique of processes of implementation of socio-economic benefits including job creation" (2016): https://aidc.org.za/download/climate-change/Renewable-Energy-Where-are-the-Jobs.pdf

Women have shown themselves to be adept at running wind farms,[115] biogas digestors[116] (although these are more challenging because they need water) and a variety of solar home systems[117] and solar PV[118] installations.

The modular nature of renewable technologies, meaning they can be deployed at small scale, improves the chances that South Africans will benefit from the renewable energy roll out, both in terms of direct access and indirect economic opportunities. This also opens the door for alternative avenues to the REIPPPP, through which South Africa could promote the roll-out of renewable energy at a local level. These alternatives are important because there are clear limitations with the REIPPPP, especially regarding gender diversity, impact for vulnerable groups and protection of ecosystem services.

Job creation is particularly important in South Africa at the moment due to the exceptionally high unemployment rate (>30%) and in that the second quarter of 2020 alone saw the number of unemployed persons increase by 2.2 million to 14.1 million.[119] Women consistently bear the brunt of this unemployment[120] in addition to low wages.[121] This level of unemployment will fall during recovery from the pandemic but the issue is chronic.[122] South Africa's unemployment situation, with a majority unskilled and semi-skilled labour force,[123] further underscores the need for both immediate and sustainable job creation for these groups.

Impact on energy access

In South Africa, the energy poverty challenge demands at least an increase in the number of people connected to the grid, and an assurance that those with access have sufficient energy at an affordable price to meet their energy needs. Both electricity access and affordability issues increase usage of cheaper, hazardous and dirty non-electricity energy sources.[124] In terms of improving basic access, renewables are preferable because it is easier to connect small loads and to construct systems like mini-grids with solar and wind than it is to connect people to high voltage, large-scale power lines.

The case is even stronger for accessing affordable energy. According to the CSIR, alternatives like solar and wind are now able to provide electricity that is at least 40% cheaper than coal,[125] with the potential to address affordability issues faced by many South African women.[126] As we have shown in our Financial Assessment of Inga 3, they are also likely to be much cheaper than hydropower. Per rand, investors and consumers get more alternative capacity than from any other source. This is critical because it means that private money will be used in ever greater quantity to support the roll out of alternatives (see Financial Assessment).

115. Tyolwana, V. "Perdekraal East Wind Farm allows women to flourish in key roles" (7th August 2019): https://social-tv.co.za/perdekraal-east-wind-farm-allows-women-to-flourish-in-key-roles/
116. Msibi, S.S. & Kornelius, G. "Potential for domestic biogas as household energy supply in South Africa" (2017): http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S1021-447X2017000200001
117. Annecke, W. & Mohlakoana, N. "Socio-economic impact study of the KwaZulu Energy Services Solar Homes Systems programme" (2006). Report for Electricité de France, Paris.
118. Khan, M.T. "Encouraging Empowerment Progress on South African Public-sector Solar PV Projects" (2018): https://www.sapvia.co.za/encouraging-empowerment-progress-south-african-public-sector-solar-pv-projects/
119. Statistics South Africa "SA economy sheds 2,2 million jobs in Q2 but unemployment levels drop" (2020): http://www.statssa.gov.za/?p=13633
120. Statista "Unemployment rate in South Africa from Q1 2016 to Q4 2020, by gender" (2021): https://www.statista.com/statistics/1129142/unemployment-rate-by-gender-in-south-africa/
121. Yu, D. "Employed but still poor: the state of low-wage working poverty in South Africa" (2019): https://theconversation.com/employed-but-still-poor-the-state-of-low-wage-working-poverty-in-south-africa-118018
122. Over the past 11 years, the average unemployment rate is 26%. The upper (30.8%) and lower (21.5%) unemployment figures are almost 10 percent different where the low occurred in 2009 and the high in 2020: Trading Economics "South Africa Unemployment Rate" (2021): https://tradingeconomics.com/south-africa/unemployment-rate
123. Statistics South Africa "Employment, unemployment, skills and economic growth: An exploration of household survey evidence on skills development and unemployment between 1994 and 2014" (2015): https://www.statssa.gov.za/presentation/Stats%20SA%20presentation%20on%20skills%20and%20unemployment_16%20September.pdf
124. This includes paraffin, candles, wood and charcoal – commonly associated with fires and pollution. These resultant health and safety concerns fall disproportionately onto women, who are often responsible for household cooking.
125. Creamer, T. "CSIR cost study shows new solar, wind to be 40% cheaper than new coal" (17th October 2016): https://www.engineeringnews.co.za/article/csir-cost-study-shows-new-solar-wind-to-be-40-cheaper-than-new-coal-2016-10-17
126. WoMin "We are the victims of pollution and victims of energy poverty: Coal affected women in Phola-Ogies speak out!" (October 2020): https://womin.africa/community-activists-resources/women-activists-confront-energy-inequality/

This contribution from private capital, particularly where well regulated, could lighten the load on public and concessional finance. These resources could then be devoted to more targeted poverty and energy poverty alleviation processes, such as supporting the development of energy cooperatives, or for improving existing energy infrastructures to address inefficiencies, together creating a more enabling environment for faster and more equitable renewable energy growth.

One such example of targeted public finance includes the Renewable Energy Performance Platform's (REPP's) recent request for proposals that specifically targets women-led renewable energy project development.[127] With additional support and the introduction of incentives from government, such opportunities will become more frequent and could help address gender inequality in South Africa.

Social Evaluation Summary

Inga 3 is exposed to significant social issues as a result of deferred benefits and increased negative impacts from the construction process. These deferrals and impacts generally produce resentment, leading to organised opposition and, potentially delays. This was found in our evaluation of the project and is reflected by the existing delays.

The dam and transmission lines will likely displace up to tens of thousands of vulnerable people, disrupting rural livelihoods and driving these vulnerable groups further into poverty. Women will be particularly negatively affected by such displacement. Furthermore, the power from such large-scale energy generation is unlikely to address rural energy access and local socio-economic needs which are pressing in both South Africa and the DRC.

Inga 3 and its transmission lines will provide little to no jobs for South Africans. The project is expected to provide between 3,000 - 7,000 construction jobs for the DRC, with some jobs expected for South Africans during internal transmission line development or upgrades. This in comparison to a potential 8,089 full time jobs, with 729 created for women, should South Africa similarly invest in solar or wind. These alternatives could also create local economic opportunities for South Africans while addressing the energy gap of approximately five million South Africans without access to electricity.

Our social evaluation therefore shows that South Africa's procurement of electricity from Inga 3 will not sufficiently address the socio-economic and energy needs of its citizens. From a social perspective, the South African government could reap higher social returns on investment from solar and wind.

Photo courtesy of WoMin

127. ESI Africa "Big break for women-led renewable energy projects in Africa" (28th November 2019): https://www.esi-africa.com/women-in-energy/big-break-for-women-led-renewable-energy-projects-in-africa/

5. Environmental Evaluation

Our environmental evaluation briefly considers the potential environmental impacts of Inga 3 and its transmission line on the DRC, with potential implications for South Africa. We then take a more in-depth look at the environmental impacts of transmission lines within South Africa, focusing on how these could affect the country. This latter section also ends with a short comparative environmental evaluation of alternative energy technologies for South Africa.

This environmental evaluation shows that Inga 3 and associated transmission lines will have environmental impacts with local, national and even global implications. Large hydropower projects with long transmission infrastructure can directly threaten local biodiversity and natural ecosystems, and can also drive deforestation and induced climate change impacts.[128] High environmental standards for Inga 3 and the transmission lines could help mitigate these risks but they would also increase project costs.

> Our environmental evaluation shows that investments in solar and wind energy can deliver greater benefits, with lower environmental risks for South Africa, while avoiding most of the serious negative environmental impacts associated with Inga 3.

Our environmental evaluation shows that investments in solar and wind energy can deliver greater benefits, with lower environmental risks for South Africa, while avoiding most of the serious negative environmental impacts associated with Inga 3. Typically, the environmental damage done by large hydropower is justified by backers in terms of the economic and commercial benefits of these projects. However, in the case of Inga 3 this socio-economic case is very weak. Moreover, the environmental impacts of the dam and its extensive transmission infrastructure appear to be substantially negative and irreversible.

Impacts on the DRC

The construction of Inga 3 will have considerable impacts on biodiversity through the likely alteration of water and sediment flows[129] and increased pollution, with such freshwater ecological changes threatening endemic freshwater species in the area and downstream.[130] The 4,800 MW option of Inga 3[131] would inundate particularly the lower reaches of the biodiverse Bundi Valley tributary, destroying natural vegetation and impacting aquatic species.

Inga 3 and its ancillary infrastructure could also contribute to deforestation in the Lower Congo Rapids ecoregion.[132] However, given the relatively limited tree cover in the immediate impact area of the dam, these impacts on deforestation, with associated loss of biodiversity, would likely be primarily associated with transmission infrastructure to the DRC border.

Such extensive and severe environmental impacts give advocacy groups and locals the grounds to oppose and delay the project. This has direct implications for South Africa, as such delays will further increase project costs and ultimately increase the overall cost of electricity sold to South Africa.

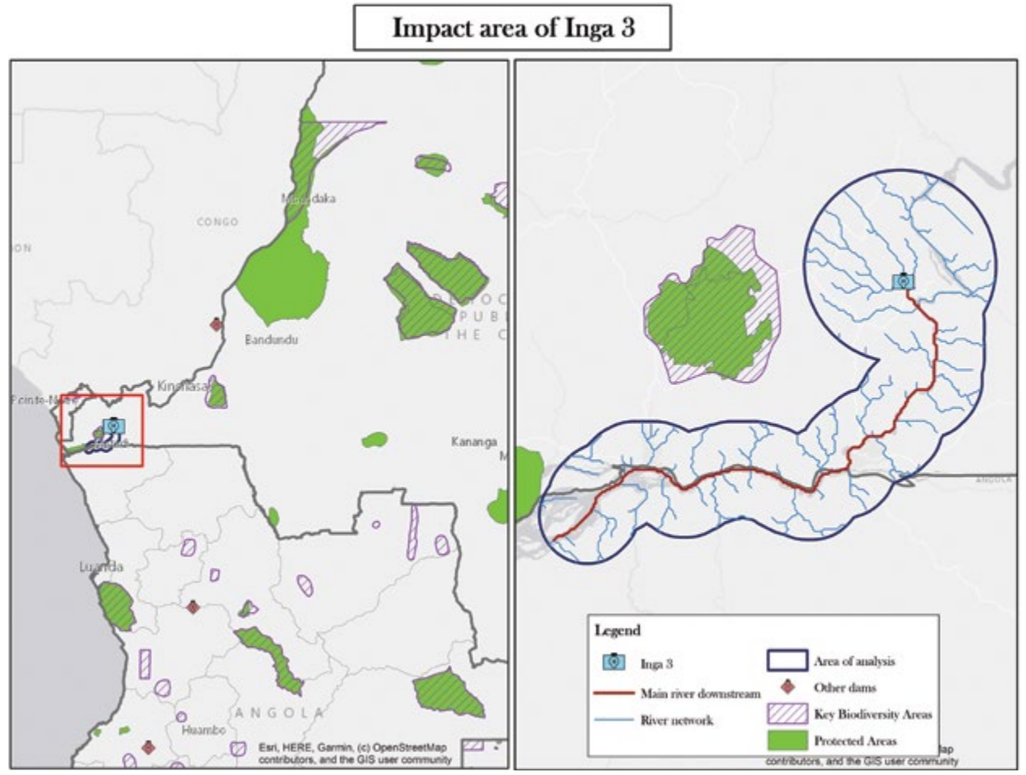


Photo courtesy of WoMin

128. Moran, E.F., Lopez, M.C., Moore, N., Müller, N., & Hyndman, D.W. "Sustainable hydropower in the 21st century" (2018): https://www.pnas.org/content/115/47/11891 ; Rosenberg, D. M., McCully, P., & Pringle, C. M. "Global-scale environmental effects of hydrological alterations: introduction" (2000): https://academic.oup.com/bioscience/article/50/9/746/269195?login=true ; Hyde, J. L., Bohlman, S.A., & Valle, D. "Transmission lines are an under-acknowledged conservation threat to the Brazilian Amazon" (2018): https://www.sciencedirect.com/science/article/abs/pii/S0006320718308565

129. River sediment will likely increase during construction activities and be trapped behind the dam wall during operation. Sediments play an important role in maintaining natural balances in river ecosystem structure and function.

130. Brookes, E.G.E., Allen, D.J. & Darwall, W.R.T. "The Status and Distribution of Freshwater Biodiversity in Central Africa" (2011): https://portals.iucn.org/library/sites/library/files/documents/RL-67-001.pdf

131. President Tshisekedi has recently opted to start with the 4,800MW Inga 3 option and to add further capacity in phases, to a total capacity of 11,000MW (Engineering News " DRC reverts to 4 800 MW plan for Inga" (16th December 2019): https://www.engineeringnews.co.za/article/drc-reverts-to-4-800-mw-plan-for-inga-2019-12-16). While details around these options remain uncertain, this increased capacity would raise the dam head and further inundate the Bundi Valley, exacerbating the environmental impacts mentioned here.

132. Deforestation is already an issue in the Lower Congo Rapids ecoregion, where Inga 3 is situated, due to human activities. See: Harrison, I.J., Brummett, R., & Stiassny, M.L. "Congo River Basin" (2016): https://www.researchgate.net/publication/311154427_Congo_River_Basin

Impacts on South Africa

While the environmental impacts of Inga 3 will likely be severe for the DRC, the most relevant impacts for South Africa are those associated with transmission lines. One of the more significant environmental concerns of transmission line expansion is the necessary clearing of vegetation or forest cover, leading to habitat and forest fragmentation.[133] At a local level, such deforestation directly threatens biodiversity that is reliant on these natural habitats, but when these impacts are brought to scale, they can also have regional and even global impacts on climate. Transmission corridors can also hinder the movement of certain species with potential long-term impacts on breeding and species diversity.[134] These same changes can further enable the colonisation of new species,[135] with uncertain impacts on ecosystem dynamics.

External transmission assessment

The table below looks at routes from the DRC border to South African and shows their environmental risk score, as calculated by our Rapid Assessment. This assessment was based on Landscope's environmental risk analysis process (see Transmission Line Risk Model in Appendix II for details).

	Environmental Score[136]
Route 1	73
Route 2	75
Route 3	58
Route 4	55
Route 5	63

These high (negative) Environmental scores are likely due to areas of high biodiversity, such as Key Biodiversity Areas (KBAs) and Protected Areas (PAs), and relatively high forest cover (especially within the DRC and Angola) that the routes directly pass through (see External Transmission route map in Social section). These areas may have also seen significant land use change in the last few years or experience water-related risks which can be very destructive environmentally.

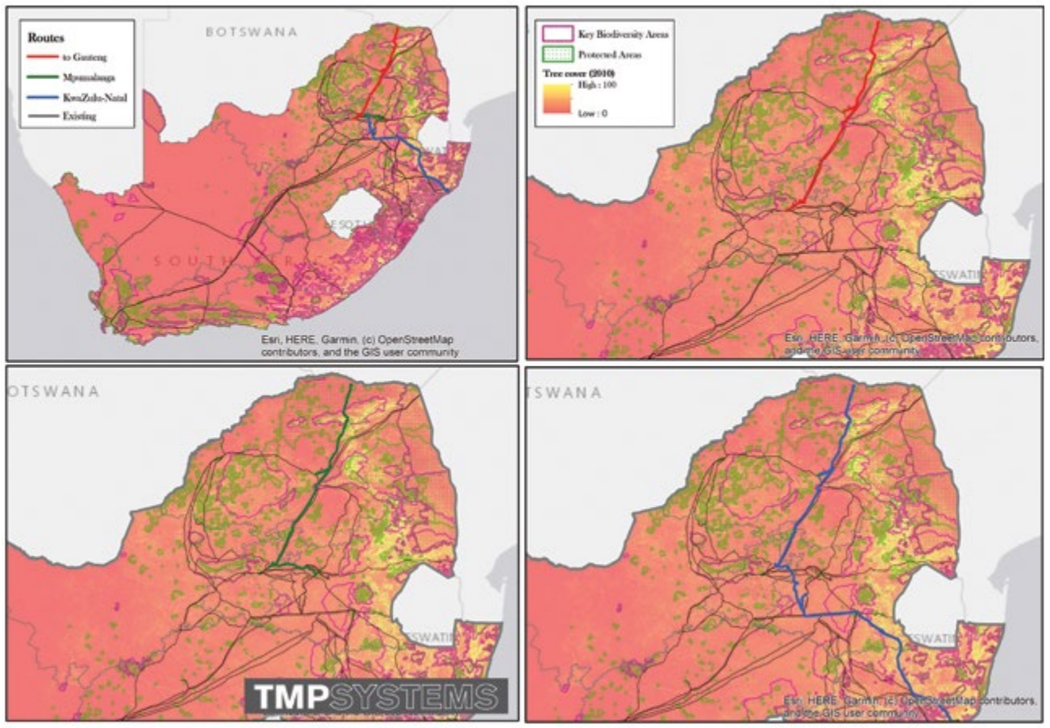
Internal transmission assessment

South Africa would be directly affected by the environmental risks associated with new transmission lines within the country. We assume that no new lines would be needed, however all lines would need to be upgraded to accommodate the additional load.[137] Nevertheless, the existing transmission lines already have ongoing environmental impacts.[138]

The graphics below show the three likely internal transmission routes, based on the energy demand and load of each province within SA and guided by existing and planned transmission routes. The top left graphic includes all potential routes, while the remaining three show each potential route to either Gauteng, Mpumalanga or KZN. The table that follows then provides the risk scores for these routes.

133. Li, X., & Lin, Y. "Do High-Voltage Power Transmission Lines Affect Forest Landscape and Vegetation Growth: Evidence from a Case for Southeastern of China" (2019): https://www.mdpi.com/1999-4907/10/2/162
134. Battaglini, A., & Bätjer, S. "Reducing the environmental impacts of power transmission lines" (2015): https://www.sciencedirect.com/science/article/pii/B9781782420101000094
135. BirdLife International "Reducing the impacts of power lines on birds" (2015): http://datazone.birdlife.org/sowb/casestudy/reducing-the-impacts-of-power-lines-on-birds
136. These scores indicate the environmental risk exposure of these routes that could trigger social conflict and dispute. Scores over 45 indicate that risk of dispute and conflict is above average, while any score above 60 indicates a very high risk.
137. This uncertainty over transmission requirements is partly due to the absence of feasibility studies carried out by South Africa.
138. For example, 8 out of the top 10 most frequently reported collision casualties of South African birds from transmission lines are red-listed species, including the Blue Crane and Ludwig's Bustard: Jenkins, A. R., Smallie, J. J., & Diamond, M. "Avian collisions with power lines: a global review of causes and mitigation with a South African perspective" (2010): https://www.cambridge.org/core/journals/bird-conservation-international/article/avian-collisions-with-power-lines-a-global-review-of-causes-and-mitigation-with-a-south-african-perspective/8C0875430F0C4376693820CA3A90369C

Transmission routes in SA with environmentally sensitive areas



All potential routes pass through areas of particularly high tree cover in the northeastern areas, while the KZN route also passes through areas of high tree cover towards the southeast. Another key factor to note includes the proximity of all the routes to PAs and KBAs, which further raises their environmental risks (see risk scores in table below).

The above scores are relatively low when compared to the route scores from the DRC to South Africa. While they suggest that some environmental risks are evident for South Africa, these risks appear to be lower than their social equivalents.

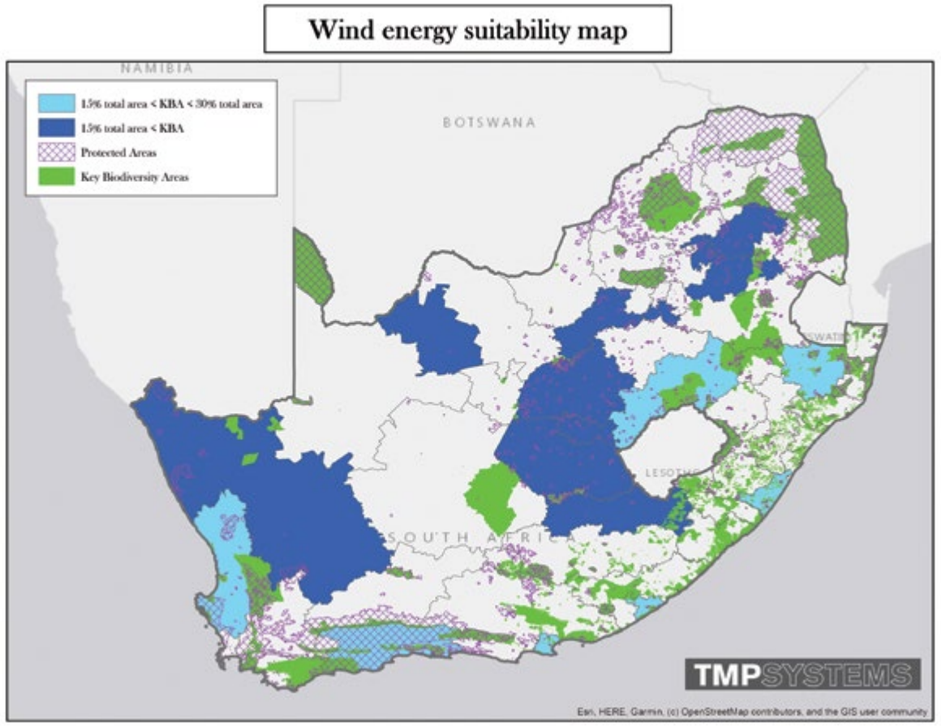
	Environmental Risk Score[139 140]
Gauteng	45
KZN	45
Mpumalanga	41

139. See Transmission Line Risk Model in Appendix II for full Indicator List and scores for SA transmission lines
140. These scores indicate the environmental risk exposure of these routes that could trigger social conflict and dispute. Scores over 45 indicate that risk of dispute and conflict is above average, while any score above 60 indicates a very high risk.

Alternative comparative assessment

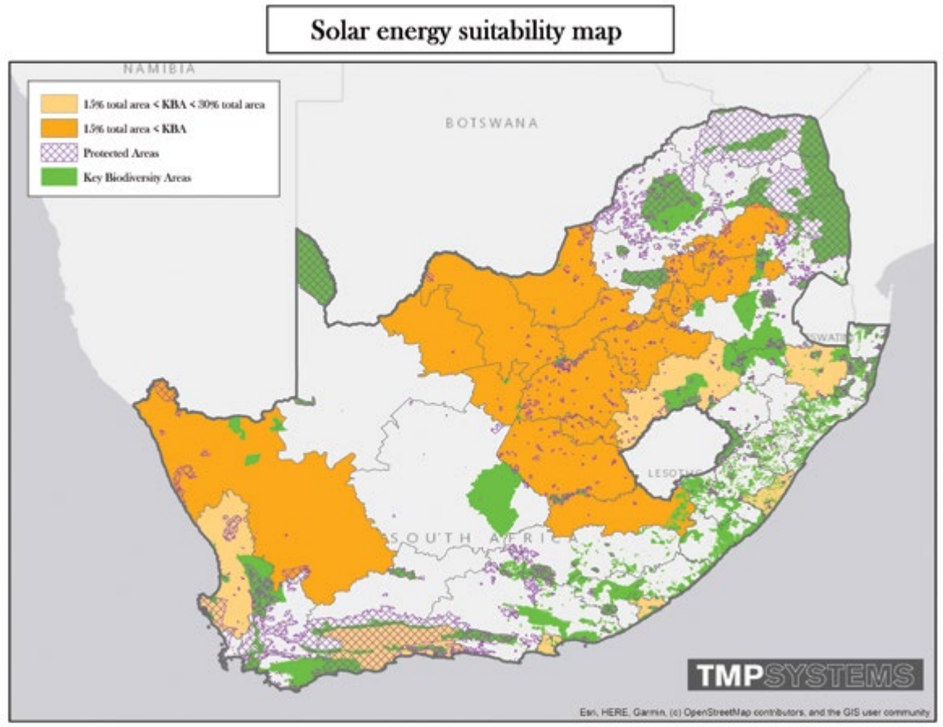
Alternatives like solar and wind provide South Africa with a way to limit environment risks by being both modular and decentralised. This is not to say that solar and wind rollout is "no regrets" from an environmental point of view. Large capacity will still require large amounts of land and some transmission lines will be needed too.

Solar and wind can be connected to problems like deforestation and biodiversity loss. The impacts of wind on bird migration provide one salient example here.[141] But these risks are smaller than those posed by Inga 3's transmission lines and they can be largely mitigated through appropriate site selection. As shown in the suitability maps below,[142] areas for solar and wind development with both renewable energy resources and relatively low social and environmental risks are abundant.



141. BirdLife South Africa "Wind energy's impacts on birds in South Africa: A preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme in South Africa" (2017): https://www.birdlife.org.za/wp-content/uploads/2018/06/Wind-Energy-and-Birds-Impacts.pdf

142. The map above shows suitable wind potential areas (dark and light blue areas) where the average wind speed is greater than 6m/s at 50 and 100m. The map on the next page shows suitable solar potential areas (dark and light yellow areas) where the DNI is greater than 1200kWh/m2 per annum. Suitable areas for both maps have a Landscope social risk score that is less than 60 and they indicate where PA areas are less than 10% of the L2 district area. The respective dark areas (dark blue and dark yellow) for each map indicate where KBA areas are less than 15% of the L2 district area and the respective light areas (light blue and light yellow) indicate where KBA areas are between 15% and 30% of the L2 area.



Moreover, South Africa's environmental regulations already help to ensure that solar and wind projects have minimal impacts on the environment through both the extensive Renewable Energy Development Zones (REDZ),[143] as well the strict EIA regulations.[144]

Environmental Evaluation Summary

Our environmental evaluation found that Inga 3 will have negative environmental impacts with local, national and possibly even global implications, raising the risk of project opposition and potential delays. This has direct implications for South Africa as these delays would increase project costs and ultimately the cost of electricity sold to South Africa.

The 2000+ kilometers of transmission line from the DRC to South Africa will add to Inga 3's environmental impacts and risks. These lines are likely to pass through environmentally sensitive areas which include areas of high forest cover, KBAs and PAs. Our evaluation found that environmental risks were greatest for external transmission routes, yet transmission development both in and outside of South Africa creates a risk of delay, which could increase overall costs to South Africa and delay the delivery of much needed energy to the country.

Alternatives offer a more modular and decentralised approach which would allow South Africa to target specific energy demands at the source, reducing the need for extensive transmission development. South Africa already has robust environmental regulations for these alternative technologies. Although alternatives like solar and wind can still have considerable environmental impacts, they demonstrate widespread potential in South Africa with areas of low overall environmental and social risks for both the South African government and its citizens.

143. Department of Environmental Affairs "Strategic Environmental Assessment for wind and solar photovoltaic energy in South Africa" (2015): https://sfiler.environment.gov.za:8443/ssf/s/readFile/folderEntry/19044/8afbc1c75aea91ba015b8b9c8bf64b7b/1427308743000/last/Final%20SEA%20Report_All%20sections.pdf

144. The REDZ minimise environmental impacts by ensuring close proximity to the grid and avoiding Key Biodiversity or Protected Areas, amongst other considerations, while each and every project must adhere to the EIA regulations, regardless of location.

6. Conclusion and Recommendations

Inga 3 has faced significant delays to date and will inevitably face further delay due to its considerable social and environmental impacts, in addition to a lack of funding. We estimate that the dam's ESG factors will lead to a three-year delay, with the most likely start for operation in 2032. Such delays undermine the project's viability and push up the cost of electricity it produces, which could fall onto the shoulders of ordinary South Africans, if it is not cancelled altogether.

So although the construction of Inga 3 will have fewer direct impacts on South Africa, its delays as a result of ESG factors could increase the costs of electricity sold to the country. The cost of electricity from Inga 3, when accounting for potential transmission line costs and losses could be between $0.122/kWh[145] – $0.134/kWh[146] by the time it starts operation. This is significantly higher than current South African electricity prices and could require ordinary South Africans to fit the bill of between $414m - $610m (~R6.19bn – R9.12bn) per year.

Inga 3 would require the development of the longest transmission line in the world from the DRC to South Africa. The footprint of these lines will cross farmlands, areas of high tree cover, KBAs and PAs, which will have considerable social and environmental impacts both within and outside of South Africa. Our estimates suggest that 211,920 – 333,423 people within South Africa could be disturbed or in some cases displaced by this work, which could spark conflict, additional delays and increases to overall project costs. Likely transmission delays would also prolong the delivery of energy to South Africa at a time of rolling blackouts and when an estimated five million South Africans live without access to electricity.

Inga 3 will create very few jobs in South Africa. In comparison, alternatives could create approximately 8,096 full time jobs for South Africans, including 729 for women, with similar investment into solar or wind.[147] Alternatives are also better suited to increasing energy access for individuals, households and SMEs.

South Africa has abundant solar and wind potential in areas with low social and environmental risks. These technologies offer a clear alternative case for energy generation in South Africa. Their modular and decentralised nature means that South Africa could rapidly meet energy demand, while creating local employment opportunities, including for women, and with lower costs of electricity. By the time Inga 3 comes online, solar and wind could respectively produce electricity at just $0.064/kWh (R0.96/kWh) and $0.044/kWh (R0.66/kWh), which is 89% and 175% lower than the cost of electricity from Inga 3. Overall, these alternatives minimise South Africa's exposure to lengthy energy delays and costs associated with investment in Inga 3.

Recommendations

To the South African government, including the ministries of finance and energy, and parliamentary oversight committees:

- Take steps to withdraw from the Inga 3 treaty with the DRC, with a view toward a renewed national energy plan that can deliver energy security, increased certainty for energy and economic planners, and bring electricity in at a much lower cost to South Africans.
- A feasibility study of Inga 3 must be urgently developed and made public, making transparent the assumptions under which South Africa continues to back the project. This study should inform a revision of the Integrated Resource Plan for the energy sector.
- This feasibility study must factor in environmental, social and governance (ESG) risks and impacts. It must also include a robust assessment of energy alternatives that factors in their respective financial, environmental and social costs of displacement, impacts to land-based livelihoods, and social costs such as gender-based violence. It should also assess the distribution of benefits and impacts for different groups, particularly women, who value socio-economic goods such as land, safety and energy differently because of the gender division of labour which assigns them primary responsibility for household food, water, electricity and the generalised work of care for families.
- The IRP should be revised to better support off-grid, mini-grid and community-led energy projects, especially where they support women. It is vital that the benefits of energy development are shared equitably to support job creation, livelihoods, sustainable industrialisation, social and public services, etc.
- Develop a clear set of requirements and support structures for community participation on decisions to implement projects, including community right to consent, to ensure that spending on socio-economic development initiatives is targeted, effective and approved by local communities in the short and long-term.
- Provide better and more accurate data, especially on energy demand, toward sparking rapid but flexible energy rollout while avoiding unnecessary new energy developments that may become stranded assets.

To NEDLAC, opposition parties, and labour unions:

- Advocate for an immediate and transparent feasibility assessment that fully considers who, if anyone, benefits from Inga 3 going ahead, and explores possible vested interests.
- Build on TMP's analysis by further establishing the superiority of alternatives over Inga for the purposes of job creation, energy access for all, and wider development.
- Produce sub-national estimates on job losses if Inga proceeds at the expense of wind and solar and analysis of the economic and employment impacts of future energy deficits.
- Lead calls for more robust energy demand forecasting, including in light of the impacts of COVID-19 on energy demand projections.

To civil society:

- Utilise findings from the study to motivate government, financiers, companies and other actors to reconsider the implementation of the Inga project.
- Push for South Africa to conduct a robust and transparent feasibility study of Inga 3 and a subsequent review of the IRP electricity sector plan.
- Work with communities and developers to build a pipeline of high quality energy projects that support the rights, interests, and welfare of South Africans via a just transition.
- Continue to examine and expose the harmful impacts of big dams such as Inga in a time of climate and ecological crisis, and contrast these with technologies like solar and wind which are more environmentally and socially responsible.
- Show how the impacts and risks for Inga 3 are unevenly distributed by pursuing a feminist lens that focuses on the costs to and impacts on women.

145. Assuming a transmission cost of $2bn and a 3 year delay, with a discount rate of 10% and a transmission loss of 10%
146. Assuming a transmission cost of $4.3bn and a 3 year delay, with a discount rate of 10% and a transmission loss of 10%
147. This is if South Africa were to rather invest $2bn for the cost of transmission into 920MW of either solar or wind.

Appendices

Appendix I: Riverscope Risk Model

Appendix II: Transmission Line Risk Model

Appendix III: Methodology

All appendices available at:

https://www.internationalrivers.org/resources/reports-and-publications/inga-3-too-high-a-cost-for-south-africa/

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