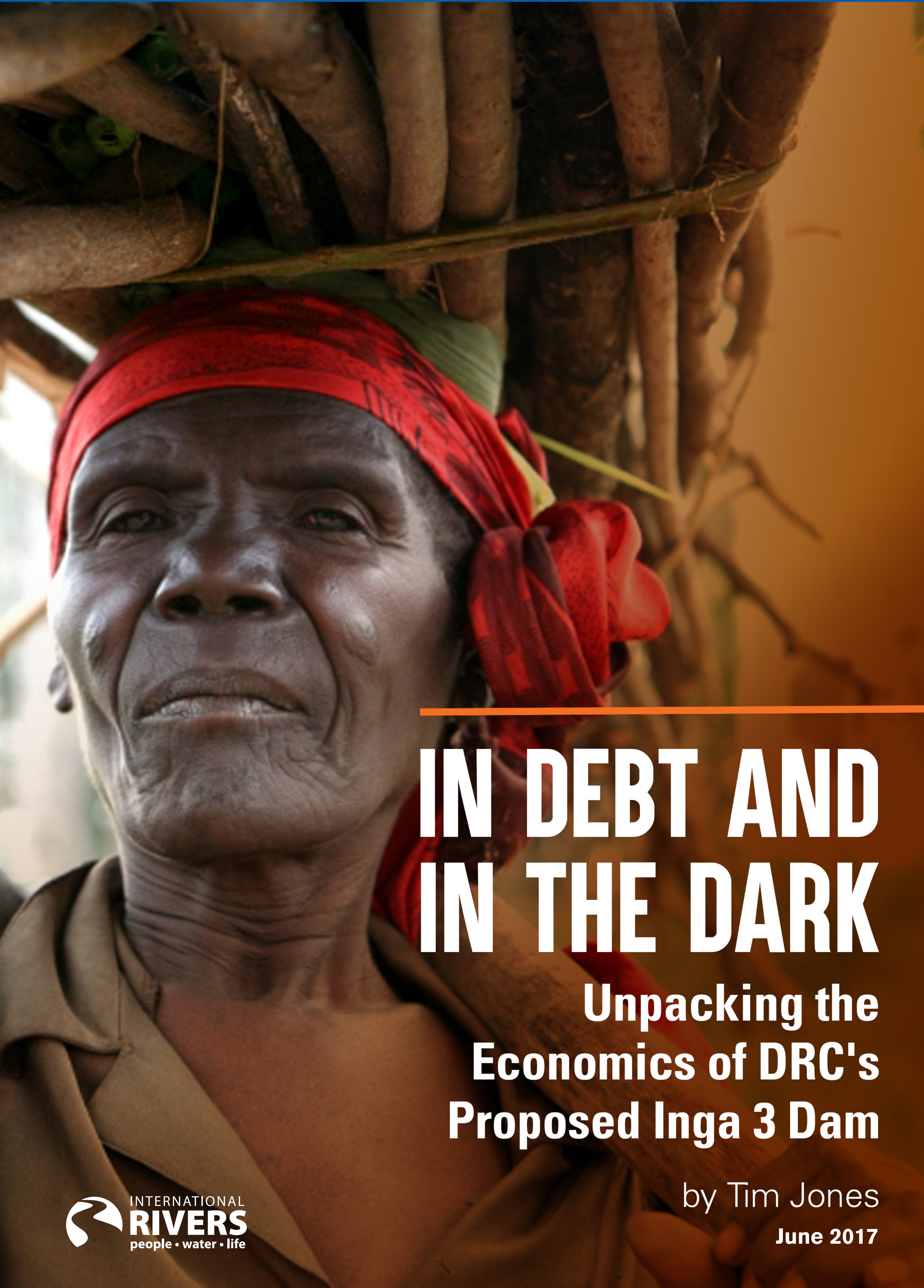


IN DEBT AND IN THE DARK

Unpacking the Economics of DRC's Proposed Inga 3 Dam

by Tim Jones

June 2017

INTERNATIONAL RIVERS
people • water • life

About the Author

Tim Jones is an economist and researcher with 15 years of experience working in international justice organisations. He has a double first class degree in economics, politics and philosophy from the University of Oxford, and a masters with distinction in International Political Economy from the University of London. He worked for Global Justice Now for eight years and has since worked for the Jubilee Debt Campaign for seven years. His published research includes reports on debt risks for countries in the global South, including public-private partnerships, trade agreements, financial speculation on food and the economics of the coal mining industry in Mozambique.

About International Rivers

International Rivers protects rivers and defends the rights of communities that depend on them. We work to stop destructive dams and promote water and energy solutions for a just and sustainable world. We seek a world where healthy rivers and the rights of communities are valued and protected.

Published by International Rivers
Suite F8 ProEquity Court
1250 Pretorius Street
Hatfield 0083. Pretoria, South Africa

Tel: +27 124302029
Fax: +1 510 848 1008
internationalrivers.org

Design by Design Action Collective

Cover photo: *Zahra Moloo/IRIN © UN/OCHA*

INTERNATIONAL RIVERS
people • water • life

"Which large projects get built? My research associates and I found it isn't necessarily the best ones, but instead those for which proponents best succeed in designing – deliberately or not – a fantasy world of underestimated costs, overestimated revenues, overvalued local development effects, and underestimated environmental impacts."[1]

— Professor Bent Flyvbjerg, University of Oxford

Contents

Executive Summary

The Democratic Republic of Congo (DRC) needs reliable energy to power economic development and increase its prestige and standing in Africa. Although it's one of the most resource-rich countries in the world, the DRC suffers from massive energy poverty. In 2012, only 16% of Congolese had access to electricity, and outside of big cities, this number drops to less than 6% – less than one of every 15 people. This energy deficit stunts economic development, as evidenced by the DRC having the lowest GDP per capita of any country in the world in 2013.

Inga 3 will sink the DRC deeper into debt while other countries and international investors reap the benefits.

In its bid to address these urgent needs for electricity and economic development, the DRC government has pinned its hopes on the Congo River's Inga 3 Dam, the first in a planned series of hydropower projects known collectively as Grand Inga. Proponents of Grand Inga say that the project would harness the mighty Congo River and act as a battery for the continent, exporting power to all corners of the continent and even as far away as Europe.

This report analyzes the Inga 3 project to understand whether the dam will accomplish its goals of energy production and economic gain to benefit the DRC. Our analysis finds that Inga 3, in most scenarios, will sink the DRC deeper into debt while other countries (notably South Africa) and international investors reap the benefits.

The DRC should hit the brakes on Inga 3 and repurpose its investment share into alternative ways of powering mines in Katanga and bringing electricity and development to the Congolese people. DRC can power its future – and become a model for energy development on the African continent – by making visionary investments in small hydro, micro-hydro and solar energy.

INGA 3 BACKGROUND

Inga 3 has a stated capacity of 4,800 MW, and its power is primarily intended for export to South Africa and mining companies in eastern DRC. Any remaining power would be sold to consumers in the capital, Kinshasa.

The proposed dam and hydropower project is planned as a public-private partnership involving investment by both the DRC government and a consortium of private international companies.

Proponents of the project argue that Inga 3 will help reduce poverty and boost shared prosperity in the DRC by:

- generating revenues for the DRC government, which could be allocated to poverty reduction programs;
- providing electricity to more people in DRC; and
- creating jobs in a country with a chronically high unemployment rate.

METHODOLOGY

To examine these claims, we analyzed the project proponents' claims based on Inga 3's likely technical and financial performance. We used empirical evidence from the performance of similar hydropower projects in Africa and globally to test the claims regarding Inga 3's socioeconomic benefits.

Our analysis lays out five possible scenarios for the socioeconomic performance of the Inga 3 project: best, good, median, worse, and worst-case scenarios. The best-case scenario is based on the highly optimistic and favorable conditions assumed by the project's proponents; our analysis discusses the factors that make these assumptions unrealistic. The worst-case scenario, on the other hand, assesses the project under highly unfavorable conditions. While equally unlikely as the best-case scenario, this scenario demonstrates the enormous risks that Inga 3 creates for the DRC government. The median-case scenario presents our assessment of the most likely outcomes, using the most realistic assumptions of project performance.

Figure 1: Scenarios for financial benefits and costs of Inga 3 to DRC government

REVENUE GENERATION

Proponents claim that Inga 3 will lead to a significant increase in revenue for the government, which can then be invested in underfunded sectors such as health and education. We conducted a financial analysis to determine the likely revenue levels for the DRC government, under the five scenarios, based on construction and operating costs, price and amount of power sold, technical losses, and borrowing costs. Our analysis shows that Inga 3 could generate modest revenues under highly favorable conditions in the best and good-case scenarios. However, under the worst, worse, and most realistic median-case scenarios, Inga 3 would not even cover the DRC government's debt payments for the project, let alone constitute a windfall that could fund development priorities. It would instead become a significant drain on the country's finances. Figure 1 illustrates the financial benefits and costs associated with each of the five scenarios.

According to this analysis, under the best-case scenario, Inga 3 would generate $749 million per year for the DRC government. This scenario is, however, based on highly unlikely and optimistic assumptions, including zero cost overruns, a capacity factor well above the world's most efficient hydropower plants, high prices for the electricity generated, very low transmission losses, and low rates of interest on financing that do not increase for 35 years. Furthermore, even if these assumptions were met, it is likely that a portion of the $749 million would accrue to the private investors as profit, rather than to the government.

In the good-case scenario, Inga 3 offers a marginal return of just $78 million per year for the DRC government. This scenario is based on slightly less optimistic assumptions compared to the best-case scenario. Thus, even if all assumptions in the good-case scenario are met, the DRC government would still receive only a modest financial return.

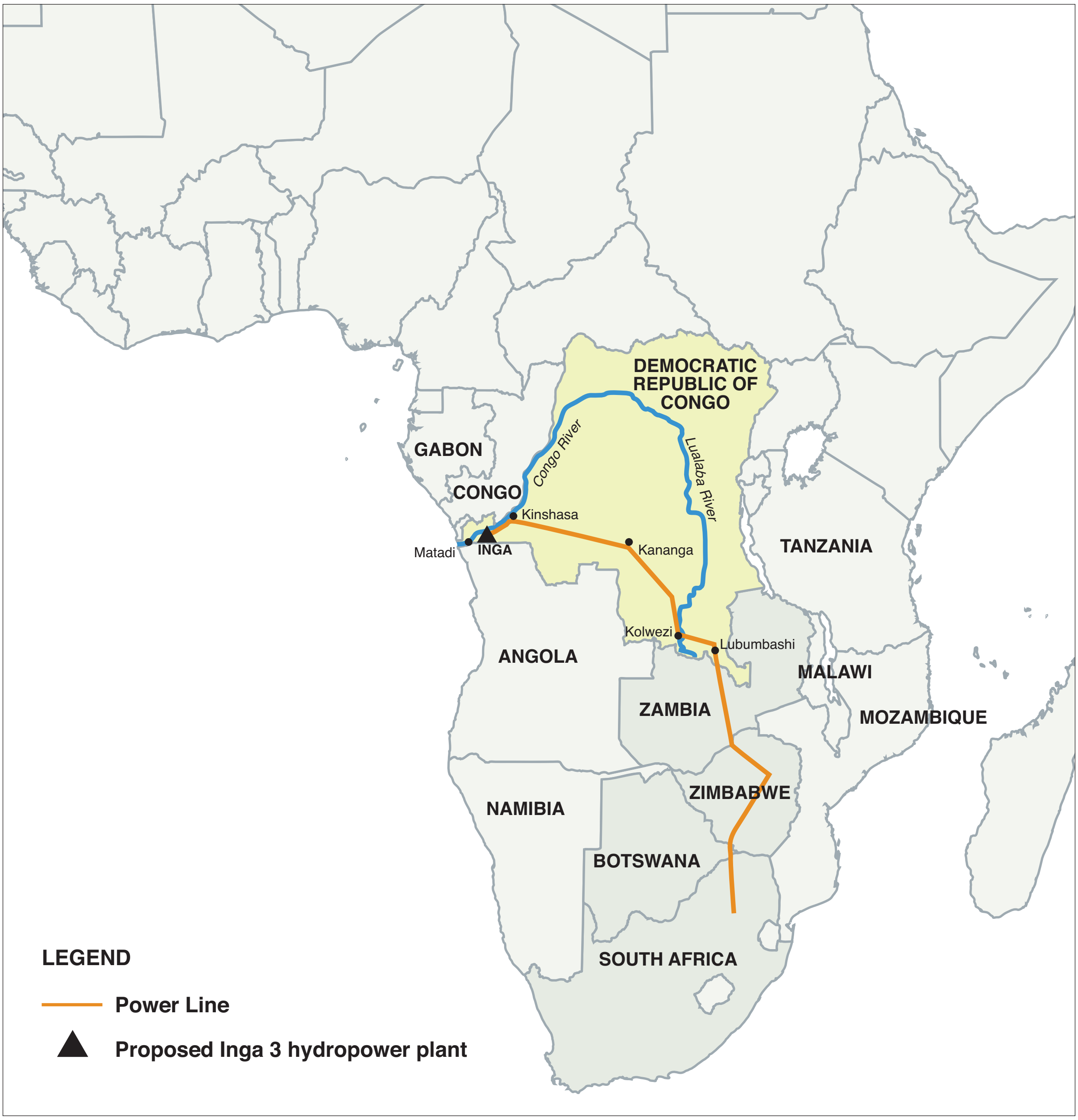
In the median, worse and worst-case scenarios, the DRC government will lose money on Inga 3. The median case – with fairly conservative estimates of cost overruns and generous assumptions of electricity tariffs, capacity factor, transmission losses, and interest rates – would result in a loss of $618 million per year. These financial losses could be as high as $1.5 billion per year in the worse scenario and over $2 billion per year in the worst-case scenario, demonstrating the extreme risk that Inga 3 poses to the country's fragile financial position.

INCREASE IN ACCESS TO ELECTRICITY

Project proponents claim that Inga 3 will increase access to electricity in the country. Our analysis, however, shows that increased electricity access, if any, would be quite limited. The project will sell most of its electricity to South Africa and to mines in the Katanga region. In the median-case scenario, only 3% of electricity from Inga 3 would be available to non-mining businesses and residents of Kinshasa. In this median scenario, Inga 3 would provide electricity for only 340,000 additional people in Kinshasa, without any impact on electrification rates in other cities and rural areas, where the need is greatest. Under the worst-case scenario, no power at all would be available for sale to consumers in Kinshasa.

After observing the limited potential energy access benefits of Inga 3, we examined alternative ways to increase energy access in the DRC and compared them with Inga 3. DRC could achieve more energy access for its population if it used the funds intended for Inga 3 on other energy sources. The cost of the Inga project is currently estimated at $14 billion, with the DRC government expected to contribute $3 billion obtained via concessional loans. Private partners would provide the balance of $11 billion. Our analysis showed that if the DRC government spent that $3 billion on other sources of energy, including micro-hydropower and solar energy, it could generate enough electricity to increase access by 2.7 million people and to increase average electricity consumption by 48 percent.

Our analysis also shows that consumers would pay much less for electricity from micro-hydro than for electricity from Inga 3. Electricity from micro-hydro would cost between US 1.8 cents and 3.1 cents per kWh, well below the 7–8 cents per kWh projected as the cost of



electricity for domestic users in Kinshasa from Inga 3. Furthermore, developers could build micro-hydro at many sites across the country, thereby achieving a far higher geographical distribution of electricity than Inga 3 and reaching more people in rural communities.

Our analysis demonstrates that investing in solar photovoltaic (PV) electricity, while not as attractive as micro-hydro, would still outperform an investment in Inga 3. The DRC would still bear significant financial risk if it used the concessional funds solely for solar PV, though less so than Inga 3. It would also achieve a high geographical distribution of power across the country and provide electricity to more people across more diverse areas. Globally, the rapid scaling up of solar PV technology has seen prices fall rapidly. Consequently, the return on investment in PV power is likely to enjoy progressive increases with time. Our analysis showed that an extra 960 million kWh to 3 billion kWh of PV power would enable between 400,000 and 1.5 million more people to gain access to electricity, and electricity consumption would increase by between 6% and 21% for those with access. Similar to micro-hydro, investing in solar would outperform an investment in Inga 3.

Our report therefore demonstrates that the DRC is more likely to meet its objectives of energy production and economic gain if it redirects funds intended for Inga 3 to micro-hydro and PV power.

JOB CREATION

Project proponents claim that Inga 3 would create jobs. Our analysis shows that Inga 3 is not likely to create significant numbers of jobs, and would actually destroy more livelihoods than it creates. The national electricity company, Société Nationale d'Electricité (SNEL), estimates that the construction phase would create 3,000 jobs on average, with a peak of 7,000 additional jobs. After construction is finished, the number of direct jobs would likely fall to a few hundred. In economic terms, our analysis shows that it would cost $1 million in concessional loans to create just one temporary job during the construction phase, and $6 million in concessional loans to create one permanent job during dam operation.

In contrast, an estimated over 10,000 people would be displaced and therefore stand to lose their livelihoods from loss of land or fishing resources because of the dam. This figure significantly outweighs the number of people who would gain livelihoods from the few hundred jobs generated.

IMPACT ON DRC'S DEBT

Inga 3 will require large external borrowing by the DRC government. The most recent figures from the International Monetary Fund (IMF) and World Bank say the DRC government's external debt is $6.5 billion, which is 16% of GDP for 2016. Under the best-case scenario, Inga 3 will lead to $3 billion of new debt for the government, rising to $6 billion in the worst case. The new debt will increase government external debt from $6.5 billion (16% of GDP) to between $9.5 billion and $12.5 billion (24% to 31% of GDP), and could change the IMF and World Bank's assessment of DRC from being at moderate risk of debt distress to high risk of debt distress. Such an assessment would further reduce the number of lower-interest loans available to DRC from various public bodies, extending the DRC's cycle of poverty and indebtedness to foreign lenders.

KEY FINDINGS

- Construction of Inga 3 is likely to cause a financial loss for the DRC government and become a drain on the country's limited financial resources, rather than a source of new revenues.
- In the most likely scenarios, Inga 3 would generate little electricity for domestic users in the DRC. In the worst-case scenario, domestic consumers would receive no additional power at all.
- Inga 3 would lead to a large increase in external government debt, risking a downgrade in the risk assessment of DRC's debt distress and harming DRC's long-term economic health.
- If DRC invested its limited concessional loans in other energy options, that electricity would reach far more users at lower cost and in more diverse places, and create greater economic gain.
- Inga 3 risks destroying more livelihoods than jobs that it would support.

In conclusion, our analysis shows that if the DRC wants to achieve its stated goals of increased energy access and economic development, and become a true economic leader that sets a model for energy access in Africa, the DRC should press the pause button on the Inga 3 Dam and instead explore micro-hydro and solar power.

1. Introduction

The proposed 4,800 MW Inga 3 Dam would divert part of the Congo River into the Bundi tributary, where the dam would be built across the Bundi Valley.[2] South Africa would purchase the bulk of the electricity generated; the remainder would go to mining companies in the Katanga region of DRC. A smaller portion would be made available to residents in Kinshasa.

Inga 3 would not even cover the DRC government's debt payments for the project, let alone constitute a windfall for the government.

The World Bank supported technical assistance for the project in 2014, stating three reasons why Inga 3 would contribute to the goal of "ending extreme poverty and boosting shared prosperity":[3]

1) It would be a "first step" to providing electricity "for seven million people in the Grand Kinshasa and two million people in the hinterland";

2) It would generate revenues for the government of DRC, which could be invested in improving human development; and

3) It would create jobs through construction and providing electricity to businesses.

This report investigates whether Inga would achieve these objectives if built, and how it might contribute to extreme poverty or shared prosperity.

Camp Kinshasa, the former workers' camp for Inga 1 and 2, is now inhabited by a mix of displaced families from six clans.
Photo credit: International Rivers

2. Financial Costs and Benefits

The World Bank has estimated that the economic rate of return of Inga 3 Dam would be 17.1%, based on the following assumptions:

- Total construction costs of $10.5 billion
- Annual operating costs of $244 million
- 22.77 billion kWh of electricity per year is sold to South Africa at a price of 7 cents per kWh. This amount of electricity is the equivalent of 2,600 MW all day, every day.
- 8.892 billion kWh of electricity is sold to mines in DRC at a price of 12 cents per kWh. This amount of electricity is the equivalent of 1,015 MW all day, every day.
- 4.269 billion kWh of electricity is sold to residents and businesses in Kinshasa at a price of 7.87 cents per kWh. This amount of electricity is the equivalent of 487 MW all day, every day.
- A discount rate (i.e., cost of capital) of 10%.

The World Bank's analysis therefore assumes that the dam will produce 4,102 MW of electricity all day every day, working at an operating capacity of 86%. The economic analysis does not include an assessment of who would pay for construction, nor to whom the economic return would accrue. The World Bank has said that there is a risk that the "the rent [return] associated with the site [might be] captured by the investor developer."[4]

In contrast, the analysis below estimates what return lenders and equity investors in the project would require, and therefore what might be left over for the DRC government. Furthermore, it makes reasonable assumptions for actual construction costs, operating capacity and losses in transmission. It follows the World Bank in making the analysis cover the first 35 years of Inga 3's operation. While Inga 3 would, with extra repairs and maintenance, be able to operate for longer than this, any investment would require returns over this timescale. Moreover, benefits from Inga 3 need to be achieved within 35 years if they are to have any relevance for people living in the DRC today.

There is only one well for displaced families in Camp Kinshasa. Photo credit: International Rivers

2.1 COST OF CONSTRUCTION

In 2014, the World Bank said the costs of constructing Inga 3 and associated power transmission lines could be between $11 billion and $14 billion. NEPAD estimated the project cost at $12-$14 billion.[5]

The World Bank estimated these costs for different elements:[6]

- $2.6 billion for the intake, canal and dam
- $3.6 billion for the power station
- $2.3 billion for the transmission lines within DRC
- $2 billion for the transmission lines from DRC through SAPP and to South Africa

This totals $10.5 billion, which does not appear to capture all of the costs even of the World Bank's lowest estimate. The World Bank previously suggested that the DRC government would finance the intake, canal and dam (presumably with loans from institutions such as IDA, EIB, AfDB), while private companies would finance the rest of the project.[7]

A review of cost overruns for electricity projects found that hydropower projects, primarily in North America and Europe, have a median cost overrun of 30% and a mean cost overrun of 70%.[8] Moreover, the largest hydropower projects experience the largest percentage increase in costs. The World Bank has said that there is a risk that Inga 3 "might be constructed at a higher cost" than set out in its economic analysis.[9]

Research has found that transmission lines' proportional cost overruns increase the longer the power line. This research is influenced by one particular power line – the Inga-Kolwezi line built in 1982 – which cost 260% more than originally budgeted.[10]

Our best-case scenario (below) is based on NEPAD's lowest cost estimate of $12 billion; the median case projects a 30% cost overrun; the worse case projects a 70% cost overrun; and the worst-case scenario projects a 100% cost overrun.

Table 1. Construction cost scenarios

Cost Scenarios	Financed by government	Financed by private companies	Total
Best case	$3 billion	$9 billion	$12 billion
Good case	$3.5 billion	$10.5 billion	$14 billion
Median	$4 billion	$12 billion	$16 billion
Worse case	$5.1 billion	$15.3 billion	$20.4 billion
Worst case	$6 billion	$18 billion	$24 billion

2.2 PRICE OF ELECTRICITY SOLD

The World Bank says the average consumer of electricity in Kinshasa is willing to pay 7.87 cents per kWh. Katanga mines are willing to pay 12 cents per kWh, and South Africa / SAPP are willing to pay 7 cents per kWh, net of any transmission costs.[11]

The average electricity tariff in DRC is 6.6 cents per kWh,[12] but SNEL loses revenue; the tariff is ultimately subsidised by government revenue. This suggests the 7.87 cents price for Kinshasa consumers is achievable, though it might require price increases, or require that the government covers the cost difference and pays the private providers.

KPMG says that many mining companies have set up their own hydroelectric power schemes to supply electricity for their operations, with a cost of 10 cents per kWh.[13] If so, there's no reason the mines would pay 10 cents per kWh for electricity from Inga 3, let alone the 12 cents assumed by the World Bank's analysis.

The Inga 3 treaty signed by South Africa and DRC did not stipulate the price of electricity sold to the SAPP / Eskom.[14] Both parties will almost certainly need to agree on a guaranteed price before the private sector would begin to substantially invest in the project. The World Bank has identified one risk, saying that "political considerations might cause the Government of DRC to agree on a low electricity price with South Africa."[15]

Based on the above, we assume 7 cents per kWH is achievable in the best-case through median scenarios for the electricity sold to Eskom / SAPP, though this falls to 6 cents per kWH in the worse- and worst-case scenarios. For the mining companies, 12 cents per kWH is only achieved in the best case, with this falling to the price actually paid of 10 cents per kWH in the median scenario, and just under for the worse- and worst-case scenarios. (Given that mining companies can make their own electricity for 10 cents per kWH, there's no reason for them to pay this much.) Finally, for Kinshasa residents, we assume the price does rise to 7.87 cents per kWH in the best and good cases, but only to 7 cents per kWH in the median case. In the worse and worst cases, it stays at 6.6 cents per kWH.

Table 2. Electricity price scenarios (per KwH)

Electricity price scenarios	Price paid by Kinshasa residents	Price paid by mining companies in Katanga	Price paid by ESKOM / SAPP
Best case	7.87 cents per kWH	12 cents per kWH	7 cents per kWH
Good case	7.87 cents per kWH	11 cents per kWH	7 cents per kWH
Median	7 cents per kWH	10 cents per kWH	7 cents per kWH
Worse case	6.6 cents per kWH	9 cents per kWH	6 cents per kWH
Worst case	6.6 cents per kWH	9 cents per kWH	6 cents per kWH

2.3 AMOUNT OF ELECTRICITY GENERATED

The World Bank's economic analysis assumes Inga will produce, on average, 4,102 MW per hour each year,[16] which is a capacity factor of 86%.[17] However, nowhere in its economic analysis does the World Bank provide evidence to back up the implied 86% capacity factor that underlies its estimate for the economic rate of return.

Globally, the Intergovernmental Panel on Climate Change says hydropower plants operate, on average, at 44% capacity.[18] Inga 1 and Inga 2 operate at 52% capacity[19] after 44 and 34 years of use respectively. There are few modern, large, tropical dams for comparison. Five Chinese dams of more than 4,800 MW have been finished since 2007. They are operating at 43%,[20] 53%,[21] 55%,[22] 34%[23]

In rich economies, electricity transmission losses range between 4% and 9%. In developing countries, this number tends to be significantly higher.

and 47%[24] capacity. Based on our own calculations of stated capacity and production, the most efficient large dam in the world (3,000 MW or more) is Churchill Falls in Canada, which operates at 74% capacity.[25] Yacyreta on the Paraguay / Argentina border has operated at 74% capacity for one year, though its average production is 54%.[26] In Brazil, the highest capacity factors on large hydropower dams are achieved in the tropical northeast, but these are still only 63%.[27] One expert we spoke to said, "Who has ever heard of a hydropower dam with a capacity factor as high as 86%? However, maybe the hydrology at Inga would easily permit this."

Climate change in the Congo basin is expected to increase "the intensity of heavy rainfall events," though "the frequency of dry spells during the rainy season is projected to substantially increase" as well.[28] Furthermore, higher temperatures are expected to increase evaporation rates.

Therefore, a report for the German government concludes on hydropower in the Congo basin:

> "In general, our analyses shows that more water will be available for hydropower in the future. So on average, climate change will have a positive impact on potential electricity production. However, the rainfall variability will also increase which means that in some years power production will be much lower compared to other years. Countries should therefore ensure that they have enough other sources of electricity to cover the reduced hydropower production during dry periods."[29]

While developers can expect that the Congo River's flow rate will generally stay steady and high, climate change may mean the flow rate (and therefore potential power production) will drop with increasing frequency. Hydropower projects have an upper limit on how much electricity they can produce at any given time, so intense rainfall will not be beneficial, whereas low flows will be detrimental. If there were significant periods of drought, and the DRC was committed to supplying a given output for a given price even when the dam was not producing, this would bring off-balance sheet liabilities onto the balance sheet.

Because a capacity factor of 86% would be far beyond the experience of hydropower plants in other countries, and because climate change is likely to lead to an increased frequency of periods of reduced flow, we do not feel able to include this figure in our analysis of 35 years of Inga 3's operation. Instead, we estimate the best-case average capacity factor over the first 35 years of Inga 3's operation at 80%, still above any other hydro dam in the world. We decrease this to 75% for the good case, and 70% for the median. If 70% was achieved, this would make Inga 3 one of the most efficient hydropower dams in the world, and more efficient than tropical dams in Brazil. For the worse case, this falls to 65% and worst case 60%, still nearly 10% above the capacity factors on Inga 1 and Inga 2.

Table 3. Scenarios for electricity generated

Scenarios for electricity generated	Capacity factor	Average MW generated per hour each year
Best case	80%	3,804
Good case	75%	3,566
Median	70%	3,329
Worse case	65%	3,091
Worst case	60%	2,853

2.4 TRANSMISSION LOSSES

In rich economies, electricity transmission losses range between 4% and 9%. In developing countries, this number tends to be significantly higher.[30] The International Energy Agency says that DRC loses 20% of its electricity in transmission.[31] This is because of the physical losses in transmission, and because some electricity is used without being paid for. In South Africa total losses are 12%.[32]

The power lines from Inga to Katanga, and from Katanga to South Africa, would be High Voltage Direct Current (HVDC). This is the cheapest transmission technology, and it suffers the smallest transmission losses over long distances. Siemens says that, roughly, transmission losses are 3% for every 1,000 km on a HVDC power line.[33] This does not include losses elsewhere in the transmission process, including at transformers, local distribution lines and non-metered electricity use.

Currently, the longest electricity transmission line in the world is the 2,385 km-long line from northwest to southeast Brazil.[34] If the line from Inga 3 through Katanga to the South African border is ever built, it will be the longest line in the world, which brings further uncertainty over the actual losses.

For transmission to Kinshasa, our worst- and worse-case scenarios assume that 20% of the electricity will be lost, as is the average at the moment. For the median case, we assume that newly-built transmission lines and SNEL's focus on tariff collection will reduce transmission losses to 17%. For the good scenario, this falls further to 15%, while the best-case scenario matches South Africa, with losses of 12%.

The reasonable assumption for losses on transmission to the mines in Katanga would again be 20% based on the DRC average. However, because this transmission and distribution system would have less contact with residents, losses from non-metered use may be less. On the other hand, the longer distance of transporting electricity to mines in Katanga may mean transmission losses are higher. The distance from Inga to Katanga, via Kinshasa, is 1,900 km. So, if losses to Katanga were reduced to the South African average of 12%, but 3% extra added on for the distance over 1,000 km (in line with Siemens figures for losses on a HVDC long-distance line), this would be 15%. We therefore assume the best case on losses to Katanga is 15%, rising progressively to 19% for the worst case.

Assuming the DRC and South African governments would agree to provide 2,500 MW of power to the border with South Africa, losses for distributing within South Africa would be borne by Eskom and so do not need to be included in calculations here. This reduces the assumption of electricity losses. However, the longer distance increases transmission losses.

The distance from Inga to Lubumbashi via Kinshasa is 1,900 km. From Lubumbashi to the South African border is a further 1,200 km over the most direct route, totalling 3,100 km. Therefore, transmission losses just from the HVDC cables would be 9%, with further technical losses such as transformers on top of this. Losses of 12% would seem the absolute minimum, with 15% a more likely scenario.

The project will sell most of its electricity to South Africa and to mines in the Katanga region, bypassing the Congolese people.

Table 4. Transmission loss scenarios

Transmission losses - scenario	To Kinshasa	To mines in Katanga	To South African border
Best case	12%	15%	12%
Good case	15%	16%	13%
Median	17%	17%	15%
Worse case	20%	18%	17%
Worst case	20%	19%	18%

2.5 ELECTRICITY SOLD AND REVENUE GENERATED

Various references suggest that Inga 3 would have a contractual relationship to sell Eskom the equivalent of 2,500 MW a year. If transmission losses were 12% to the South African border, it would need to use 2,840 MW of its electricity generation to do so. This number rises to 3,049 MW in the worst-case scenario, based on transmission losses. However, 3,049 MW is more than Inga would actually generate in the worst-case scenario in an average year. This means there would be no electricity left for the Katanga mining companies or Kinshasa residents.

In scenarios where electricity remains to be sold, we divide this up proportionately between Kinshasa residents and the mines in Katanga, in the same ratio as the World Bank economic analysis (72% for the mines, 28% for Kinshasa).

Table 5. Consumer share of generated electricity

Electricity generation scenarios	Total electricity generated	To Kinshasa	To mines in Katanga	To South African border
Best case	3,804 MW	300 MW	694 MW	2,840 MW
Good case	3,566 MW	194 MW	498 MW	2,874 MW
Median	3,329 MW	109 MW	279 MW	2,941 MW
Worse case	3,091 MW	22 MW	57 MW	3,012 MW
Worst case	2,853 MW	0 MW	0 MW	3,049 MW

The electricity losses incurred in delivering 2,500 MW to South Africa would mean a reduction in the power available to be sold to Kinshasa and Katanga mines. Inga would supply South Africa with the contractual amount of 2,500 MW in all cases except the worst case, where not enough is generated and transported to hit the 2,500 MW target. Instead, an average of just 2,339 MW is supplied over 35 years.

Table 6. Consumer sales scenarios

Consumer sales scenarios	To Kinshasa	To mines in Katanga	To South African border
Best case	264 MW	590 MW	2,500 MW
Good case	165 MW	418 MW	2,500 MW
Median	90 MW	232 MW	2,500 MW
Worse case	18 MW	46 MW	2,500 MW
Worst case	0 MW	0 MW	2,339 MW

Given scenarios for prices paid in Table 2 above, we can now model the amount of revenue received in each scenario. 1 MW is 1 MWh of electricity, so over the course of a year, 1 MW above is 8,760 MWh, or 8,760,000 kWh. The corresponding total revenues are also given for each scenario.

Table 7. Annual revenue generation scenarios

Revenue Generation Scenarios	To Kinshasa	To mines in Katanga	To South African border	Total revenue
Best case	$182 million	$620 million	$1,533 million	$2,335 million
Good case	$114 million	$403 million	$1,533 million	$2,050 million
Median	$55 million	$203 million	$1,533 million	$1,791 million
Worse case	$10 million	$36 million	$1,314 million	$1,361 million
Worst case	$0	$0	$1,229 million	$1,229 million

**Note revenue based on cent per KwH given in Table 2*

2.6 COST OF FINANCE

The European Investment Bank says that in a typical Public-Private Partnerships (PPP) project, 70-80% of financing would be from debt and 20-30% from equity.[35] Research for the UK's DfID says that on average, African PPP projects it investigated financed 70% of a project through debt, 30% through equity.[36]

2.6.1 Equity rates of return

In the UK, the average annual rate of return on equity invested in PPP projects has been 29%, double the 12-15% presented in business cases at the start of projects.[37]

African contracts typically guarantee equity investors a 20%+ annual rate of return. In Lesotho, a hospital PPP is expecting a 25% annual rate of return.[38] The Takoradi 2 Oil Power Plant in Ghana has a guaranteed 20% annual rate of return, with additional protections against ex-

The village of Lubuaku would be displaced by Inga 3 Dam. Photo credit: International Rivers change rate changes and oil prices that mean it could be higher.[39] An investigation by Nick Hildyard of The Cornerhouse found that average annual rates of return on PPP projects in the global South are 25%.[40]

Inga 3 is clearly a risky project given its scale and complexity, including transmission over several borders. Equity investors will almost certainly require contracts that guarantee them at least 20% annual returns.

Private equity investors in PPP projects ensure that such returns are achievable in the way they structure the contract. For example, with the Takoradi 2 Oil Power Plant in Ghana, the contract protects the private operator from all exchange rate and fuel price changes by guaranteeing that an amount of electricity will be bought, at a given price, in dollars. Private equity investors in Inga 3 are almost certain to require similar provisions from the South African and Congolese governments regarding electricity purchases and price. Therefore, they largely avoid the operational risk.

The only remaining potential risk concerns construction. It may be possible, in a best-case scenario, that contracts ensure the private equity investors do bear the risk of construction cost overruns for the elements they are financing, though it is also possible that developers could pass this risk on to the DRC or South African governments.

In all of the scenarios below, we assume 33% of the private sector-funded part of the project is funded by equity, which is 25% of the whole project. Therefore across the whole project, 25% is equity finance, and 75% debt. In the best-case scenario, the contract is structured so that the equity investors make a 20% annual return, which rises up to 25% for the median case. For the worse and worst cases, we assume that the equity investors take on some of the risk of the construction cost overruns, so that their annual revenues remain the same as in the median case, and the rate of return falls.

Table 8. Scenarios for equity investment and returns

Scenarios for equity investment and returns	Amount of equity finance	Annual rate of return on equity finance	Annual revenues going to equity finance
Best case	$3 billion	20%	$600 million
Good case	$3.5 billion	22.5%	$788 million
Median	$4 billion	25%	$1 billion
Worse case	$5.1 billion	20%	$1 billion
Worst case	$6 billion	16.6%	$1 billion

2.6.2 Debt interest

Costs of government borrowing

For the project to proceed, the DRC government will almost certainly need to access concessional loans to fund its part of the project. The World Bank previously indicated the government intends to finance the intake, canal and dam. We have assumed this is the case. The cost in the best-case scenario is $3 billion, rising to $6 billion in the worst case.

The DRC currently receives on average $170 million of concessional loans from bilateral and multilateral donors every year.[41] At current rates, Inga 3 would therefore use up 20 years of the concessional loans available to the DRC government, a huge opportunity cost.

In reality, although development banks may increase their lending to DRC because they argue this is an important regional project (though the World Bank's recent cancellation makes this less likely), it is questionable whether the DRC would be able to raise the money to fund the construction of the intake, canal and dam itself.

If it did, below is a summary of interest rates that might be available to DRC:

- World Bank IDA: 0.75% - 1.33%,[42] though this might increase as US Federal Reserve interest rates increase. And the World Bank has recently cancelled its involvement in the project, so there is no reason to expect loans from the World Bank.
- African Development Bank: 1.25%,[43] though again this might increase as US Federal Reserve interest rates increase.
- European Investment Bank: The interest rate charged on the EIB's funding of the rehabilitation of Inga 1 and 2 is 2%.[44]
- China: Libor + 100 basis points,[45] currently 2.7%.
- Development Bank of South Africa: Net interest income on international financing is 4.4%, in rands.[46] However, as this is a net figure, it does not include the costs of the DBSA raising the finance itself. Gross interest is 105% higher, so an estimate for its loans would be 9%.[47]
- Private markets: DRC has not issued any Eurobonds, so there is no publicly-listed yield available to estimate rates if it did resort to private financial markets. In May 2016, when halting plans for a debut Eurobond, the government said it would have had to pay 12-14% interest.[48] Rightly, this was viewed as too expensive. However, since then financing conditions for African governments have been getting worse. There is no reason to expect DRC would be able to get a lower interest rate in the future.[49] Moody's currently rates the DRC

government as Caa1, which means "poor quality and very high credit risk."[50]

A combination of the above bilateral and multilateral lenders might be able to put together a package of loans that keeps the interest rate for $3 billion of investment fixed at 2% for the next 35 years, in a best-case scenario. However, this might not be possible, and as costs rise under the different scenarios, it is likely the interest rate would rise as well, since the DRC government would have to turn to other lenders to fill the gaps. We therefore assume the interest cost for DRC starts at 2% in the best case, rising to 3% in the median case and 5% by the worst case.

Table 9. Debt finance scenarios

Debt Finance Scenarios	Debt Finance via Government	Average interest rate on debt	Annual debt payments (over 35 years)
Best case	$3 billion	2%	$120 million
Good case	$3.5 billion	2.5%	$150 million
Median	$4 billion	3%	$186 million
Worse case	$5.1 billion	4%	$273 million
Worst case	$6 billion	5%	$366 million

Costs of private company borrowing

According to research for the UK's Department for International Development, it is difficult for a project to "pierce the sovereign ceiling," that is, "have a higher rating than the country in which it is based."[51] Therefore, the lowest interest rates a project can attract are equivalent to the interest rates the government of the country concerned could borrow at.

Debt financers of PPP projects in Africa, including in energy, normally require public guarantees. The government of the country concerned typically gives guarantees, but multilateral development banks also give partial risk guarantees. According to research for the UK's DfID: "In Kenya, five out of seven IPPs closed in the period 2010-15 have required PRG support across a range of government commitments. In Nigeria, four out of four projects have also required PRG support."[52] Often these partial guarantees cover particular aspects of a project – such as the government concerned providing connecting infrastructure in time – rather than guaranteeing the whole debt payments on the project.

Given that for the project to go ahead, multilateral and bilateral financiers are already likely to need to provide concessional financing to the DRC government, their appetite to take on further financial exposure to the project through guarantees will be limited. However, private investors will almost certainly require some level of guarantees, beyond just the DRC government, for the debt financing.

Publicly-owned development finance institutions (such as the UK's CDC or France's Proparco) are also possible sources of funding. However, these seek to make significant financial returns and often lend at interest rates on a comparable level with private markets.

Research suggests that interest rates on foreign exchange bonds in PPP projects in sub-Saharan Africa range from 8.5% - 10.5%, though this is for more "developed" markets such as Nigeria and Kenya, and rates were for re-financing existing projects. The same research says that "Large greenfield capital raisings are even more challenging to finance institutionally, given investor aversion to greenfield risk."[53]

The World Bank uses a 10% discount rate for the whole project in its economic analysis, though it does not give any reasoning for that figure.[54] However, assuming that some of the components of Inga 3 would be paid for by concessional loans to the DRC government, a 10% discount rate for the whole project implies a higher interest rate on the loans to the private partners.

Furthermore, the period since 2009 has been one of exceptionally low interest rates on foreign exchange because of low interest rates and quantitative easing programmes in Western countries, including the US, Eurozone, Japan and the UK. Interest rates, particularly on the dollar, are expected to rise over coming years. The US Federal Reserve increased its rates by 0.25 percentage points in December 2015, and again by 0.25 percentage points in December 2016. Further increases are expected in 2017. Since July 2016, the yield on 10-year US government debt has increased from 1.4% to 2.4% (as of the end of December 2016).[55]

Loans for such a long-term project as Inga 3 are more likely to have interest rates based on a certain number of percentage points above LIBOR, rather than a fixed rate. The 12-month LIBOR rate has increased from 1% at the start of 2016 to 1.7% as of the end of December 2016.

Based on all of the above, with a significant amount of multilateral and bilateral guarantees, an average interest rate on the debt component of the private investment is likely to be over 10%, with a risk it could increase over the course of the construction and operation of Inga 3.

In the best-case scenario, we assume the average interest rate on the private sector debt is 10%, which rises to 12% by the median case and 14% by the worst case.

Table 10. Private debt finance scenarios

Scenarios for private debt finance	Amount of debt finance via the private sector	Average interest rate on debt	Annual debt payments (over 35 years)
Best case	$6 billion	10%	$622 million
Good case	$7 billion	11%	$790 million
Median	$8 billion	12%	$979 million
Worse case	$10.2 billion	13%	$1,345 million
Worst case	$12 billion	14%	$1,697 million

Figure 1: Scenarios for financial benefits and costs of Inga 3

2.7 OPERATING COSTS

The World Bank estimates that the operating costs of the power plant would be $76 million per year, common infrastructure $39 million, transmission lines in DRC $69 million and transmission lines to the South African border $60 million.[56] This means total annual operating costs of $244 million. We have found no further information on which to estimate the costs, so have kept these amounts the same in all the scenarios.

2.8 THE POTENTIAL RETURN TO THE DRC GOVERNMENT

Putting all these figures together, we can estimate the potential revenue available to the DRC government (see Table 13 and Graph 1 below). These show that in the median-case scenario – our best estimate of what would happen based on the reasoned assumptions above – there would be a $617 million loss each year from Inga 3. Some of this loss may fall on the private investors through returns on equity not being met. However it is unlikely Inga 3 will even generate enough revenue for the DRC government to make its debt payments. Moreover, private equity investors would likely require guarantees in order to invest, which would be linked to their targeted rates of return. This could mean costs beyond debt payments fall on the DRC government and/or South African government.

In the absolute best-case scenario, Inga 3 would generate an annual return of $749 million. However, we regard this as highly unlikely as it requires the best case in every single assumption, including no cost overruns, high capacity factor, high prices for the electricity generated, far lower transmission losses than at present, and relatively low rates of interest on financing, which do not increase over 35 years.

If Inga 3 achieved all the good-case scenarios, it would see a marginal return of just $78 million a year. So even if all assumptions turn out very well, there is little if any return available to the DRC government.

Finally, in the worse and worst cases, the annual costs would be huge, increasing to $2 billion in the absolute worst case. This is less likely than the median scenario, but all three scenarios reveal Inga 3 to be the white elephant many of its critics have long argued it is. In the worse and worst cases, it is likely further costs would fall on the DRC government beyond its debt payments. But it could also mean costs for Eskom/South Africa and investors in the project, including public institutions through debt default or restructuring.

Table 11. The overall economic return, average per year (all figures in $ million)

Scenario	Revenue	Operating costs	Government debt payments	Private debt payments	Private equity return	Annual Return to Government
Best case	$2,335	$244	$120	$622	$600	**$749**
Good case	$2,050	$244	$150	$790	$788	**$78**
Median	$1,791	$244	$186	$979	$1,000	**-$618**
Worse case	$1,361	$244	$273	$1,345	$1,000	**-$1,501**
Worst case	$1,229	$244	$366	$1,697	$1,000	**-$2,078**

3. Other Economic Considerations

3.1 THE OPPORTUNITY COST

The work on Inga 3 has already used up concessional funding which could have been used elsewhere. In March 2014, the World Bank agreed to a grant of $73.1 million for technical assistance for Inga 3, alongside a further $33.4 million from the African Development Bank. Only $4.4 million of the World Bank grant had been disbursed by the time the Bank suspended the project in July 2016.[57] However, all the money has effectively been tied up rather than being disbursed for other investment in DRC. The World Bank states that the reason for the suspension is the "Government of DRC's decision to take the project in a different strategic direction to that agreed between the World Bank and the Government in 2014."[58]

The African Development Bank funding is part of a $66.5 million Inga Site Development and Electricity Access Support. Of this, $7.5 million is grants and $59 million loans.[59]

In the scenarios above, we assume the DRC government would use up $3 billion or more of concessional loans to fund its part of Inga 3's construction. Given that between 2010 and 2014 the DRC government only received an average of $170 million of concessional loans from bilateral and multilateral donors every year,[60] this would be a huge amount, which would deny lower-interest loans for other activities in the DRC. There are much more beneficial and less risky uses for this concessional money, including in energy generation, which we look at next.

3.2 ENERGY BENEFITS FROM INGA 3 AND ALTERNATIVES

We have shown above that, at most, Inga 3 would supply only 264 MW of electricity to Kinshasa. More likely, Inga 3 would provide just 90 MW and possibly even nothing. The contractual commitments to South Africa and mines in Katanga would mean there would be little, if any, electricity supply left for Kinshasa. Any electricity to Kinshasa would therefore also rise and fall in line with Inga 3's output, while supplies for South Africa and Katanga would be guaranteed.

90 MW represents 790 million kWh a year. DRC currently consumes a total of 7.9 billion kWh of electricity a year, according to the International Energy Agency,[61] so Inga 3 could increase consumption by 10% in the median scenario.

In 2013, it was estimated that 9% of the DRC population has access to electricity, or 6.9 million people.[62] Therefore, on average, these 6.9 million people consume 1.14 MWh a year. In South Africa, electricity consumption per person is 4.24 MWh a year.[63] The possible 10% increase in domestic (non-mining) electricity supply from Inga 3 would likely be split between increasing electricity consumption for those who already have access, and providing access for some more people. If it were split 50/50 in this way, then 340,000 more people would have access to electricity, and average consumption would increase from 1.14 to 1.20 MWh a year. Whether the Inga 3 electricity is used to increase consumption or increase access, both would be for urban users in the Kinshasa area.

In contrast, the concessional loans available for Inga 3 could be used in alternative ways to create other electricity generation. In the median case for Inga 3 above, we have assumed that the government would need to borrow $4 billion, and manage to do so at a 3% interest rate on average. In the best-case scenario, we estimated they would only need $3 billion, and achieve a 2% interest rate on average.

Below are figures for estimated costs for different forms of electricity. However, these are based on a 10% cost of capital.

Table 12. Cost of electricity from different sources

Source	Cost, cents per kWh
Onshore wind	$0.03 - $0.16
Hydropower	$0.02 - $0.35
Solar photovoltaic	$0.07 - $0.4
Concentrated solar power	$0.17 - $0.28

**Costs based on cost of capital of 7.5% in OECD and China, and 10% in the rest of the world in 2014*[64]

Micro-hydro: IRENA says that micro- and small-scale hydro installation costs between $1,300 and $8,000 per KW, with annual running costs of between 1% and 4% of the installation.[65] With its large water resources across the country, DRC has large potential for using micro-hydro.[66] Moreover, developers could build micro-hydro units across the country, reaching communities well beyond Kinshasa, including in rural areas.

In our above scenarios, we assumed that for Inga 3 to proceed, DRC would need $3 billion of loans at an interest rate of 2% (the average interest rate then rose, as cost overruns led the amount of borrowing to increase). Based on the figures above, $3 billion could be invested to install between 375 MW and 2,300 MW of micro-hydro capacity. The mid-range for these figures is 1,350 MW. If, on average, this micro-hydro operated at 70% capacity, the same as the median assumption we have made for Inga 3, this would generate 8.3 billion kWh a year of electricity.

Debt payments would cost $120 million annually over 35 years, plus between $30 million and $120 million on operation and maintenance, so $150 million to $240 million in total. To cover these costs, the utility would need to charge between 1.8 cents per kWh and 2.9 cents per kWh. Even if the interest rate on the debt was 3%, as in our median scenario for Inga 3, this would still only increase annual costs to $260 million, and so imply an electricity cost of 3.1 cents per kWh.

Therefore, if the same amount of concessional finance needed for Inga 3 were invested in micro-hydro across the country, the amount of electricity generated for domestic use could increase by 8.3 billion kWh, compared to a median scenario for Inga 3 of 0.8 billion kWh. Furthermore, this electricity's cost would fall substantially below the Inga 3 electricity price of 7 cents per kWh, thus making it both financially as well as geographically more likely to reach people outside of urban elites.

8.3 billion kWh a year could, for example, increase the number of people with access from 6.9 million to 9.6 million, while also increasing average consumption from 1.14 MWh a year per person to 1.69 MWh.

Solar PV: Costs for solar PV have been falling rapidly across the world. IRENA says that global average cost fell by 62% between 2009 and 2015, and could fall a further 57% from 2015 levels by 2025.[67] Because it is modular, solar PV can be pursued at any scale, and therefore reach all kinds of settlements, from urban to rural. It also has short lead-in times for generation. It is not as dependent on location as micro-hydro, though it only generates for, at most, half the day.

IRENA says that in Africa, each watt of installed capacity currently costs between $1.3 and $4.1.[68] In our above scenarios, we assumed that for Inga 3 to go ahead,

Power lines by the Congo River. Photo credit: International Rivers

DRC would need $3 billion of loans at an interest rate of 2% (the average interest rate then rose as cost overruns led the amount of borrowing to increase).

Therefore, $3 billion of capital could lead to between 730 MW and 2,300 MW of installed capacity. The lifetime of solar PV units is uncertain because they are a new technology, though it is expected that current units will last at least 25 years.

However, despite its equatorial location, DRC's solar irradiation is lower than other African countries because of cloud cover. IRENA lists the DRC's solar resource as similar to Spain, Italy, Greece and Turkey.[69] The capacity factor in such countries appears to be between 13% and 18%.[70] If the capacity factor in DRC was 15% for solar PV, this would mean annual generation of between 960 million kWh and 3 billion kWh. An electricity price of 7 cents per kWh would generate between $67 million and $210 million of revenue a year. The annual cost of repaying $3 billion of loans over 25 years would be $154 million.

This means using the concessional funds solely for solar PV could generate a residual revenue of between $56 million and $87 million. This is still very risky, though less risky than Inga 3. Furthermore, generating between an extra 960 kWh and 3 billion kWh would enable between 400,000 and 1.5 million more people to have access to electricity, and electricity consumption to increase from 1.21 MWh to 1.39 MWh for those with access.

Therefore, while solar PV is still risky, investing concessional loans in solar PV projects would be less financially risky to the DRC government than Inga 3. It would generate more electricity and so enable more and better access, potentially substantially. This energy could serve a mix of rural and urban settlements in different parts of the country, not just residents in Kinshasa. Furthermore, solar PV costs are expected to continue to fall.

Smaller-scale energy options such as micro-hydro, solar PV or onshore wind have one final advantage: Unlike Inga 3, not all the concessional finance has to be committed up-front for projects to proceed. Instead, some small-scale projects can be implemented. The country can learn from these to decide which kinds of projects to continue with. The reality is that all the figures in this report are just estimates, whether for Inga 3 or small-scale renewables. But with small-scale renewables, plans can change as projects progress, whereas Inga 3 is a huge project with little flexibility once it begins.

3.3 JOB CREATION DURING AND AFTER CONSTRUCTION

The World Bank says Inga 3 would "create jobs," but they provide no further estimate of how many, over what time period and of what quality.[71] A presentation by SNEL says that there would be an average of 3,000 jobs during the construction phase, with 7,000 at its peak.[72]

Once operational, the ongoing costs of hydropower plants are relatively low.[73] A relatively small number of jobs are needed for operation and maintenance. The Private Infrastructure Development Group estimated that for every 500 jobs created in the short term, ten are created in the long term.[74] Therefore, if the total number of short-term jobs reaches 7,000, the number of long-term jobs would be just 140.

Globally there was 1,055,000 MW of installed hydropower capacity in 2015,[75] with an estimated 620,000 direct jobs in operation and maintenance.[76] This works out as 0.59 jobs per MW of installed capacity, which for Inga 3 would be 2,800 jobs. This seems a particularly high figure, though presumably this figure includes all the direct jobs, including in the transmission line maintenance.

The two estimates above give a range of ongoing jobs in operation and maintenance of between 140 (which seems too low) and 2,800 (which seems too high). The likely figure is somewhere in between. Regardless, even 2,800 jobs would be a relatively small amount for a total investment of $14 billion ($5 million per job, and $1,070,000 of concessional loans per job, if $3 billion in concessional loans was secured in total).

The project would create some indirect jobs, such as for local suppliers of materials or businesses serving the consumption needs of workers on the project. The latter is also known as "induced" jobs. However, even more than the direct jobs, indirect and induced jobs would experience a relative boom during the construction phase that would then die away. One research paper for the World Bank on jobs in energy projects says: "Indirect effects [creating jobs] are typically largely linked to the manufacturing [construction] stage of the original demand increase and are therefore of shorter duration."[77]

Developers will import many of the materials and technology from elsewhere in the world, so these purchases would not benefit the local economy. Where local resources are used, they would primarily be used for construction, so very few jobs would likely to be maintained once operational.

Local consumption by workers employed on the

In the median-case scenario – our best estimate of what would happen based on the reasoned assumptions above – DRC would experience a $618 million loss each year from Inga 3.

project will have a greater effect on the local economy, but this too would reduce after the construction phase. All jobs created in any project would bring such induced jobs as well. Therefore, the relatively small number of jobs created compared to investment in Inga 3 would also apply to indirect jobs which provide goods and services for workers on the project.

In one example, a World Bank research paper found that construction of an electricity transmission line in the US employed 2,258 people directly at its peak, though this was only for one year. The average was 760 jobs over the course of the project's construction. It was estimated that for each direct job created, .41 indirect jobs and .58 induced jobs were created.[78]

For the DRC transmission lines, we expect the number of indirect jobs will be significantly lower as more of the parts will be imported than in the US. However, even if the ratios above were used for the whole project, this would mean 1,200 indirect jobs and 1,700 induced jobs during construction, but these would then fall off after construction to a much lower number. Indirect jobs are likely to be very few, whilst induced jobs would be proportional to the number of workers employed directly.

3.4 COST OF TRANSMISSION LINE TO HOST COUNTRIES

The transmission line from DRC to the South African border would need to pass through Zambia, Zimbabwe and possibly Botswana. The World Bank's economic analysis makes no assessment of what these countries would require for the line to pass through their territory and use up land. Potentially they could benefit from electricity being sold through the Southern Africa Power Pool, though developers assume South Africa would purchase the electricity as the least risky government that private investors would be willing to commit to.

The World Bank economic analysis quotes a figure of 7 cents per kWH for the electricity bought by South Africa and says this is "net of transmission costs."[79] Our analysis in the scenarios above takes this at face value, but it could be that this does not include the wider costs (beyond the infrastructure and operation) to get the governments of Zambia, Zimbabwe and Botswana to agree to the line.

3.5 TAXATION ARRANGEMENTS

DRC could possibly increase its revenue by taxing the private company involved in the Public-Private Partnerships in various ways. However, the PPP investors would want to structure the contract to ensure they get a return after taxation arrangements. Furthermore, the financial structuring of the project will likely create multiple ways for private companies to ensure that they make a profit offshore rather than in DRC. For instance, interest rates on loans to subsidiaries in DRC could be manipulated so that interest payments mean the local subsidiary does not make significant profits, but instead profits accrue to the lending subsidiary, based for example in Mauritius.

3.6 LAND AND LIVELIHOOD LOSS

In 2014, the World Bank estimated that Inga 3's design would lead to the reservoir flooding 15.5km² of land. While that's a relatively low surface area for the reservoir of a large dam, this would still be over 1,500 hectares. In addition, the World Bank says the canal would use up 77 hectares.[80] As well as the loss of land, local communities who rely on fishing for their livelihoods are concerned that fishing will disappear if the dam is built.[81]

Inga 3 would displace around 10,000 people, disrupting the livelihoods of four times the number of permanent jobs created by Inga 3. In the economic analysis above we did not include any payments and reparations for those impacted by the dam. Past history shows that these costs can be substantial. However, while no financial amount or new land can fully compensate communities for the loss of their ancestral homes, adding this in to the economic analysis would further increase the overall financial burden of Inga 3 as set out above.

3.7 IMPACT ON DRC'S MACROECONOMIC DEBT POSITION

The IMF and World Bank assess DRC as being at moderate risk of not being able to pay its debt, with a high vulnerability to shocks.[82] This raises further doubt that DRC would be able to borrow the money to pay for some of Inga 3's construction costs, as the World Bank and African Development Bank are only meant to give half their finance as loans and the other half as grants to countries at moderate risk of debt distress.[83] Furthermore, the IMF and World Bank advice concludes that "given the uncertainties, the DRC should continue its cautious approach to external borrowing."[84] However, the plan for Inga 3 would require large external borrowing by the DRC government, and could therefore contribute to a future debt crisis for the DRC government.

The most recent figures from the IMF and World Bank say the DRC government's external debt is $6.5 billion,[85] which is 16% of GDP for 2016.[86] However, because government revenue is so low – 14% of GDP – annual external debt payments are estimated to vary between 6% and 12% between now and the mid-2020s. The IMF and World Bank estimate that if there was one economic shock, external debt payments could rise to between 8% and 18% of revenue.[87]

Under the best-case scenario, Inga 3 would mean $3 billion of new debt for the government, rising to $6 billion in the worst case. This would increase government external debt from $6.5 billion (16% of GDP) to between $9.5 billion and $12.5 billion (24-31% of GDP).

More importantly, we project that annual government payments on the debt would average between $120 million and $366 million a year from the best-case through to the worst-case scenarios. These would increase government external debt payments to between 8% and 19% of revenue (from 6-12%), or 10-25% if there were one economic shock.

DRC's rating of debt distress would shift from moderate to high if one of the IMF and World Bank's thresholds were breached in the baseline scenario. The threshold for external debt payments to government revenue is 18%, so in the worst-case scenario Inga 3 would cause this level to be breached and DRC to become high risk. In addition, any economic shock combined with the extra borrowing from Inga 3 could push DRC into the high-risk category.

If DRC were rated as being at high risk of debt distress, that would in turn further reduce the future concessional funding available from the World Bank and African Development Bank, as they are only allowed to give grants, not loans, to countries at high risk. In addition, the total amount of funding available would fall.

Finally, the IMF and World Bank are currently reviewing their Debt Sustainability Framework, and have indicated that they may include the ongoing costs and contingent liabilities of PPPs in these assessments for the first time. If so, the risk of other costs of Inga 3 falling on the DRC government – such as guaranteed payment for electricity – could push the IMF and World Bank to assess DRC as high risk of debt distress.

3.8 DUTCH DISEASE

"Dutch disease" is an economic situation in which the inflow of foreign currency into an economy to pay for investment in extractive sectors, and revenue from those sectors, pushes up the exchange rate of the domestic currency. This exchange rate appreciation makes it harder for domestic producers of goods to sell locally, because imports are cheaper, and harder for exporters to grow their businesses, because the high exchange rate means their goods are too expensive in foreign markets.

The ongoing operation of the dam is unlikely to have much distorting impact because it will lead to little revenue entering the country. As outlined above, the revenue that's generated will primarily be spent making debt payments or paying profits to equity investors, which will leave the country.

However, the construction of the dam could lead to a large one-off influx of foreign exchange that could distort the exchange rate for a few years, then lead to a bust once construction comes to an end. Total investment under the project could be between $12 billion and $24 billion.

According to UNCTAD, foreign direct investment inflows to DRC averaged $2.7 billion a year between 2010 and 2015.[88] The Inga 3 investment is expected to take place over five years, so the inflow would average between $2.4 billion and $4.8 billion a year. Much of this foreign exchange would not be changed into Congolese francs but spent on imports; however the same is also probably true of the UNCTAD FDI inflows.

While it is hard to know for sure, it is likely that Inga 3 would temporarily but significantly increase demand for local currency, causing a stronger Congolese franc. This would increase the ability of wealthier people in DRC to buy imports over this time period, at the expense of the competitiveness of local businesses. Following the end of construction, there could be a large drop in the value of the currency. This would reduce locals' ability to buy imports and increase the relative size of external debts. While local businesses would then be more competitive, they would have suffered from five years of less development.

Notes

1 Flyvberg, B. (2005). Design by Deception: The Politics of Megaproject Approval. Harvard Design Magazine 22(22):50-59

2 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

3 ibid.

4 ibid.

5 Inga 3 Project Webpage, NEPAD.

6 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

7 ibid.

8 Sovacool, B. (2014). Risk, innovation, electricity infrastructure and construction cost overruns: Testing six hypotheses. Energy. September 2014.

9 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

10 Sovacool, B. (2014). Risk, innovation, electricity infrastructure and construction cost overruns: Testing six hypotheses. Energy. September 2014.

11 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

12 ClimateScope 2016 Webpage on DRC

13 DRC Country Mining Guide, KPMG, 2014.

14 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

15 ibid.

16 ibid.

17 Calculated based on World Bank's Summary of Economic Analysis.

18 IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation, 2011. Based on there being 926 GW of installed capacity and 3,551 TWh of electricity produced.

19 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

20 China Is Adding a Three Gorges Dam Worth of Wind Every Year, Green Tech Media, March 28, 2016.

21 Xiluodu Hydroelectric Power Plant Project Page, Power-Technology.com

22 Xiangjiaba hydropower project, Water Power Magazine

23 Longtan Hydro Project

24 Largest hydropower station on Mekong River starts operation, Xinhua News

25 Bostan, I. et al. (2013). Resilient Energy Systems: Renewables: Wind, Solar, Hydro.

26 ibid.

27 Capacity factors of Brazilian hydroelectric power plants

28 Climate Service Centre. (2013). Climate Change Scenarios for the Congo Basin.

29 ibid.

30 International Energy Statistics, U.S. Energy Information Agency

31 International Energy Agency Report: DRC, 2014

32 International Energy Agency Report: South Africa, 2014

33 Siemens Energy: HVDC

34 World's Longest Transmission Lines, Power-Technology.com

35 Project Finance, European Investment Bank

36 Mobilizing Finance For Infrastructure, DfID, August 2015

37 PPP Equity Database, European Services Strategy

38 A Dangerous Diversion, Oxfam, 2014. Netcare, the project developer, states that the 'investment was made with an expectation of earning a return that compares with the norm on similar hospital PFI projects in the UK of between 13 per cent and 18 per cent".

39 The Rise and Fall of Ghana's Debt, Jubilee Debt Campaign, 2016

40 Hildyard, N. (2016). Licensed larceny: Infrastructure, financial extraction and the global South. Manchester University Press.

41 Calculated from World Bank's World Development Indicators database.

42 IDA Credit Rates and Charges, World Bank

43 African Development Fund Loan Terms, African Development Bank

44 Email from the European Investment Bank, November 30, 2016

45 US Eximbank versus China Eximbank, Deborah Brautigam, 2011.

46 DBSA Annual Report 2015-16.

47 ibid.

48 Congo Scales Back Eurobond Plans As It Seeks World Bank Support, Reuters, 2016.

49 Trump win pushes up future interest costs for African governments, Jubilee Debt Campaign, November 2016.

50 Moody's affirms the Democratic Republic of the Congo's sovereign issuer rating at B3; outlook stable, June 2016.

51 Mobilizing Finance For Infrastructure, DfID, August 2015

52 ibid.

53 ibid.

54 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

55 Bloomberg

56 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

57 Inga 3 Technical Assistance Project Financials, World Bank.

58 World Bank Group Suspends Financing to the Inga-3 Basse Chute Technical Assistance Project, World Bank, July 25, 2016.

59 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

60 Calculated from World Bank's World Development Indicators database.

61 International Energy Agency Report: DRC, 2014

62 Power Africa Fact Sheet: DRC, USAID

63 International Energy Agency Statistics: South Africa

64 Designing Low-Carbon Energy Futures, International Rivers, 2015. Original data IRENA renewable cost database.

65 Renewable Energy Technologies: Cost Analysis Series: Hydropower, IRENA, 2012.

66 Promotion of mini- and micro-hydropower plants in DRC, Global Environment Facility.

67 Solar PV in Africa: Costs and Markets, IRENA, 2016.

68 ibid.

69 ibid.

70 For example see The Efficiency of Solar Photovoltaics and Renewable Energy Snap Shot: Turkey, UNDP

71 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

72 The Grand Inga Project, DRC, Presentation by SNEL, 2014.

73 Renewable Energy Technologies: Cost Analysis Series: Hydropower, IRENA, 2012.

74 Uganda, Bugoye Hydro Power Project, PDIG

75 Hydropower – leading global renewable energy capacity growth, Hydroworld

76 Renewable Energy and Jobs, IRENA, 2016

77 Bacon, R. and Kojima. M. (2011). Issues in estimating the employment generated by energy sector activities. World Bank, Sustainable Energy Department. June 2011.

78 ibid.

79 Inga 3 Technical Assistance Project Appraisal Document, World Bank. 3 March 2014.

80 ibid.

81 Communities Sign Petition Against Inga 3 Dam, International Rivers, September 2014.

82 DRC Debt Sustainability Analysis, IMF, August 2015.

83 IDA Financing, World Bank

84 DRC Debt Sustainability Analysis, IMF, August 2015.

85 ibid.

86 GDP taken from IMF World Economic Outlook October 2016.

87 Press Release: 2015 Article IV Consultation, October 2015

88 UNCTADstat

The section of the Bundi River that will be flooded by Inga 3. Photo credit: Rudo Sanyanga

INTERNATIONAL RIVERS
people • water • life