This report presents an assessment of commercial, social and environmental risk for the Koukoutamba dam, in Guinea, using the Riverscope tool. Riverscope has been built by ESG and investment experts to provide a repeatable, comparable and comprehensive way to assess hydropower assets and impacts.

Riverscope suggests that backers should reconsider support for Koukoutamba. The project could be delayed by ten years mainly as a result of a combination of social and environmental challenges. Under the most plausible scenario, Koukoutamba will be 46% more expensive than solar by 2027, which is the likely starting date of operation, and 90% more expensive by 2035.

Alternative ways of delivering energy security and economic development – such as solar and wind - are cheaper, much less environmentally damaging and much more likely to succeed. They can deliver social benefits more equitably and can deliver better economic outcomes, locally and nationally.
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### Glossary

<table>
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<tr>
<td><strong>Buffer</strong></td>
<td>In the Riverscope analysis, we use an area around the specific location of analysis to ensure we capture all the impacts that are experienced.</td>
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<td><strong>Capacity Factor</strong></td>
<td>Capacity Factor provides the relationship between the real output and the theoretical output.</td>
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<td><strong>CSO</strong></td>
<td>Civil Society Organizations “refers to a wide array of organizations: community groups, non-governmental organizations (NGOs), labor unions, indigenous groups, charitable organizations, faith-based organizations, professional associations, and foundations” (World Bank, 2021). In general, these organizations ensure that justice and fairness prevail in society.</td>
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<td><strong>Dam</strong></td>
<td>When we say dam, we refer to the construction of the dam wall, immediate connecting infrastructure and the impacts of the resulting inundated area.</td>
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<td><strong>DCM</strong></td>
<td>Discounted Cashflow Model is a cashflow model of the investment over the expected lifetime of the project and where the net cashflow is discounted in order to calculate the NPV.</td>
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<td><strong>Discount Rate</strong></td>
<td>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.</td>
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<td><strong>ECOWAS</strong></td>
<td>The 15 members of the Economic Community of West African States (ECOWAS) are Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.</td>
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<td><strong>ESG</strong></td>
<td>Environmental, Social and Governance are three commonly used factors in measuring impact in terms of investments and are used to determine future financial viability.</td>
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<td><strong>GDP</strong></td>
<td>Gross Domestic Product is the total monetary or market value of all the finished goods and services produced within a country’s borders in a specific time period.</td>
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<tr>
<td><strong>KBA</strong></td>
<td>Key Biodiversity Areas are the most important places in the world for species and their habitats.</td>
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<tr>
<td><strong>LCOE</strong></td>
<td>Levelized Cost of Energy is the cost per unit of electricity produced presented in current terms. This is useful to compare different energy generation technologies on a consistent basis.</td>
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<tr>
<td><strong>NGO</strong></td>
<td>A non-governmental organization (NGO) is a citizen-based association that operates independently of government, usually to deliver resources or serve some social or political purpose.</td>
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<tr>
<td><strong>NPV</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>PA</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Sediment Flow</strong></td>
<td>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.</td>
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1. OVERVIEW

This assessment of commercial, social and environmental risks for the Koukoutamba hydropower plant in Guinea shows that the planned dam poses a series of real risks to the local environment and to local people. This includes destruction of unique ecosystems, possible extinction of critically endangered species and the incitement of conflict. Overall, Koukoutamba provides a good example of the way in which weak cost-benefit analysis leads to poor decision-making in the hydropower sector.

This document goes on to demonstrate that:

1. Social and environmental challenges add to already long delays in hydropower, which critically undermines the financial proposition of large-scale dams.

2. Better cost-benefit analysis would show that the environmental impacts of Koukoutamba could result in a reduction of the number of critically endangered Western chimpanzees as a result of inundation and deforestation within the Moyen-Bafing National Park. This should be unacceptable at any price.

3. Alternative energy technologies could deal with the urgent challenge of energy poverty more cheaply and rapidly than Koukoutamba without these negative impacts.

Many hydropower projects are delayed by years or even decades, pushing up costs just as alternative technologies and approaches become increasingly competitive. Overall, our assessment shows that Koukoutamba is likely to be 46% more expensive than solar by 2027, when we expect it to start operation, and is likely to be 90% more expensive by 2035. It also shows that alternatives such as solar and wind can deliver greater benefits, more equitably and more rapidly.

Governments and financial investors can use this assessment and its methodology to review the way that hydropower projects are approved and financed. In many instances, we believe that this sort of review will demonstrate that large-scale hydropower is outmoded, with unacceptable and essentially unavoidable negative impacts.

Meanwhile, alternatives are attractive and capable of distributing equitable benefits at scale.

BACKGROUND

Dams are capable of delivering cheap energy alongside benefits for water management. They can boost economic development while providing consistent, low-carbon power at scale – which are considerable attractions. However, large dams inevitably bring large social and environmental impacts.

Their location and design are therefore particularly sensitive. Dams are, all too often, proposed and developed in sensitive areas where they are unnecessarily controversial. Our examination of 281 dams (see full methodology at www.riverscope.org/resources for details) found that developments in remote, biodiverse areas with little prior land use change, low population density and high recorded levels of poverty are more likely to face Environmental, Social and Governance (ESG) problems and conflict. We also found that dams which face ESG issues such as resettlement problems or biodiversity impacts can experience delays of ten years or longer. These risks can be reduced through high social and environmental standards so long as backers are willing to increase costs for projects that are already expensive.

COVID-19 is compounding these delays in hydro and other infrastructure projects. Hydropower projects involve a large number of workers, many of whom have to fly in from other parts of the world. Projects are often located in remote areas that are hard to access and require new infrastructure. These areas are also disproportionately inhabited by indigenous peoples and other groups that are highly vulnerable to the virus.

In hydropower, delays are so common that the sector has become insensitive to them and the problems that they create for different stakeholders. We urgently need a better way to...
assess the costs and benefits so that these delays are avoided. Supporters and opponents of dams like Koukoutamba regularly talk at cross-purposes, comparing qualitatively distinct issues and value systems.

In response, the Riverscope assessment process (see an outline in Section 2 and a more detailed explanation of the process here) delivers a comprehensive assessment of social, environmental and commercial risks by an expert third party. Riverscope provides a basis for data-driven dialogue between stakeholders via a repeatable process that could be applied at any stage in a dam’s development, including the very early years of planning when capital commitments are low, and flexibility is high.

Riverscope is based on an examination of 281 dams (see here for details of our methodology) and its underlying model is based on TMP’s experience with Landscope – a geospatial system for social risk assessment that was developed over years with development finance institutions (DFIs), NGOs, private investors, international companies and government expertise. Landscope has hundreds of regular users and features on Bloomberg’s Terminal.

Riverscope assesses three interlinked areas of risk:

a. **Commercial risks**: Section 3 uses a model to estimate the project’s Net Present Value (NPV) and Levelized Cost of Electricity (LCOE) – key financial and economic metrics – under different delay scenarios and discount rates. We compare these results with solar-based alternatives - which could be 32% cheaper by the expected operation date of 2027 and 47% cheaper by 2035.

b. **Environmental risks**: Section 4 assesses the serious environmental impacts that the hydropower project at Koukoutamba may have on local biodiversity, water management, climate and deforestation. It then links these risks to operational and reputational challenges.

c. **Social risks**: Section 5 looks at the problems and risks that the project will face in relation to resettlement, conflict and driving equitable development. If the project loses local support, it could be exposed to considerable risks and is highly unlikely to deliver the social and economic benefits that have been promised.

These assessments are followed by proposed alternatives (Section 6), which offer better options from a commercial, environmental and social perspective. Finally, Riverscope then provides recommendations for stakeholders (see Section 7), which are abbreviated at the end of this section.

This assessment is unique because it presents a robust statistical basis for an integrated risk assessment that has been reinforced through expert qualitative investigation.

**KOUKOUTAMBA**

Koukoutamba is a multi-purpose dam planned for flood control, navigation and hydropower, with a planned capacity of 294 MW and projected capital expenditure of $812 million. Three-quarters of the energy is intended for export to the West Africa Power Pool (WAPP), while a quarter will be used domestically.

Financing for Koukoutamba is still unclear at this stage. Although some reports have identified China Ex-Im Bank as the financial backer, no agreements have been signed. Sinohydro, who was commissioned by the Organization for the Development of the Senegal River (OMVS) to develop Koukoutamba in 2019, is still looking to secure funding. These financial uncertainties can be partly attributed to the unexpected and severe environmental impacts of the project.

Sinohydro has not started construction on Koukoutamba, which is the fourth large dam project commissioned by the OMVS. Hydropower potential in Guinea is widespread (see figure overleaf). Koukoutamba is one of numerous recent dams planned or built in the country, including Kaleta, Souapiti and Foumi, amongst
Koukoutamba has already attracted international attention, primarily because of its expected negative impacts on the rare Western chimpanzee populations in the immediate vicinity of the dam. Our assessment confirms that biodiversity is an important driver of risk for the project. It also shows us that social risks around Koukoutamba are very high despite apparent support for the project in some local circles.

The dam will drive large-scale displacement and is likely to result in disputes over resettlement and the distribution of project benefits. Local expectations have not been well-managed, and people are likely to be angry when reality bites. These disputes could contribute to significant delays for the project.

Overall, our assessment strongly indicates that Koukoutamba will be expensive, socially disruptive and environmentally damaging. It will likely not come online until 2027 and even then, it is unlikely to drive local economic development. Benefits are likely to be inequitably distributed, while the negative impacts will be felt across a large area and will severely impact the area surrounding the project.

By contrast, solar can be rolled out at an equivalent or lower financial cost and without substantial negative impacts. Such alternative technologies, including wind energy, can also attract private finance, reducing the burden on Guinea’s public finances. Moreover, they can be rolled out increasingly efficiently in response to demand, which is harder to project in the wake of the pandemic. In the process, these technologies will directly and indirectly produce many jobs that are more accessible, higher quality and less exposed to disruption.

Our overarching recommendation is therefore to reassess this project and consider the scope for alternatives. If this is totally unfeasible, we believe that significant improvements in the implementation of high social and environmental standards will be needed to avert disastrous outcomes for the area and the project alike.

RECOMMENDATIONS FOR GOVERNMENT:

- Avoid liability for delays, or for transmission lines or connection, in any power purchase agreement (PPA) signed by a state-owned utility or in any kind of sovereign guarantee.
This project is likely to be a large loss-leader and the developer should carry the risk.

- Consider alternative sites with less obvious and fewer unavoidable environmental risks. This site will invite notoriety and the story will deter responsible investors from the country. It will not be the landmark project some hope for to spark the economy into life.

- Ensure that all energy projects deliver benefits (including electrification) locally and equitably to build support and drive economic development. This is likely to be easier through alternatives. Otherwise, improve the benefits that are delivered to local people from the project, ensuring that some of these benefits are felt soon.

- Review the energy policy framework for new renewable energy to provide an enabling environment for private investment. Consider supporting well-regulated independent power producers (IPPs) to spark energy entrepreneurship.

- Consult developers of alternatives to understand how to de-risk investments in them and so ensure a pipeline of bankable projects capable of attracting private finance. These measures may involve working with developers, civil society and local people to identify appropriate sites and anchor businesses.

- Demand high social and environmental standards from developers to reduce delay and boost the benefits that public investments deliver. Ensure these are independently assessed and monitored according to robust frameworks. Ensure that unique natural heritage is protected from unnecessary development.

**RECOMMENDATIONS FOR PROSPECTIVE FINANCIERS:**

- Work with OMVS and Sinohydro on the above recommendations, including and especially options for solar solutions at scale. It should be possible to spark a critical mass of renewable energy roll out in Guinea with the scale of resources being considered for Koukoutamba.

- Evaluate how alternative technologies might perform in terms of LCOE and delay in different locations if they had access to the same advantages as hydropower (e.g., concessionary finance, PPP arrangements).

- Request updates to risk and impact assessments to help evaluate the current context, which has been rocked by the pandemic and political violence in Guinea. These assessments will show the high risks that Koukoutamba is exposed to and that it creates.

- Adjust the approach to financial modelling for projects like Koukoutamba using Riverscope. This adjustment is likely to show that this project is a significant loss-leader that is uncompetitive with alternatives.

- Consider a new cost-benefit analysis for this project. Use the data we have produced to develop a more reliable assessment of the risks of delay and impacts on NPV. This must apply to transmission lines as well as generating capacity. This should be compared with solar and the socio-economic advantages that the technology may have.

- Reevaluate demand growth and distribution in the wake of COVID-19. This may suggest that a more gradual approach to energy roll out is needed in this area and that alternatives are less exposed to virus-related risks.

- Demand higher social and environmental standards from developers as a way to improve impact and mitigate risk. Ensure that hydropower projects do not drive either significant biodiversity loss or large-scale displacement, as Koukoutamba will.

**2. RIVERSCOPE ASSESSMENT PROCESS**

Riverscope combines a rapid quantitative geospatial assessment (Rapid Assessment (RA))
with a qualitative, desk-based Deep Dive into critical project issues (see more details on the Riverscope assessment process here). This combination of approaches delivers a comprehensive, data-driven assessment that allows for a fair comparison across hydropower sites and projects. It does this by linking commercial, social and environmental risks based on a statistical research process (see here for full methodology).

For Riverscope, we compared the geospatial profiles of 91 dams that are known to have significant Environmental, Social and Governance (ESG) problems with 190 dams that have not experienced reported problems. By comparing these two groups, we were able to identify 17 social and environmental indicators that show statistically significant correlations with known problems (see table below and here for a full list of sources). As you will see in the table below, these indicators relate to a diverse range of ESG conditions including factors such as poverty/deprivation, population density, conflict, water management, biodiversity and land use management.

We developed an approach for defining the impact area of a dam that could be universally applied to capture these characteristics, using the most granular data available from our indicators. This resulted in three generic and distinct levels of analysis: Dam, River and District. Each level of analysis is supported and can be extended via the desk-based research involved in the Deep Dive process.

### List of statistically significant indicators for Environmental and Social issues. Indicator weightings

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<th>Indicator</th>
<th>Dam</th>
<th>River</th>
<th>District</th>
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<tr>
<td>Minimum Percentage Water Scarcity Over the Year (Blue Water Scarcity Database)</td>
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<td>Species Richness that are Critical, Endangered, Vulnerable (IUCN Red List Species Database)</td>
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<td>Global Sediment Flux (Modeled Global Suspended Sediment Flux)</td>
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<td>Inter-Annual Variability (Aqueduct Global Maps)</td>
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<td>Upstream Drainage Area (Global Drainage Basin Database)</td>
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<td>Protected Areas (World Database on Protected Areas)</td>
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<td>Percentage Cropland (SEA CCI)</td>
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<td>Drought Severity (WRI)</td>
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<td>Percentage of People Who Are Poor and Deprived in Living Standards: Improved Sanitation (Multidimensional Poverty Index)</td>
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<tr>
<td>Percentage of People Who Are Poor and Deprived in Education: Schooling (Multidimensional Poverty Index)</td>
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<tr>
<td>Percentage of People Who Are Poor and Deprived in Living Standards: Drinking water (Multidimensional Poverty Index)</td>
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<td>Multidimensional Poverty Index of the country (Multidimensional Poverty Index)</td>
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<td>Population Vulnerable to Poverty (Multidimensional Poverty Index)</td>
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<td>Population Density (GPWv4)</td>
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<td>Night Lights (Earth City Lights Database)</td>
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<td>Conflict Number of Explosions and Remote Violence (ACLED)</td>
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<tr>
<td>Conflict Events Including Protests, Strategic Developments and Riots (ACLED)</td>
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The RA process demonstrated a few interesting facts about hydropower:

- Dams which suffer from ESG problems can experience long delays. On average, our test group experienced delays longer than ten years.
- Dams which suffer from ESG problems are more likely to be in remote, biodiverse areas with little prior land use change and this increases the prevalence/likelihood of conflict.
- Dams which are most at risk are situated in areas with a low population density and with high recorded levels of poverty.

Other studies reinforce our findings that the hydropower sector is prone to significant delays and slippage. The fact that these problems are connected to ESG risks is well evidenced by our analysis. But we also found something unexpected: efforts to reduce ESG risk by developing projects in remote locations is increasing risk, rather than mitigating it.

We have complemented our rapid geospatial assessment with a Discounted Cashflow Model (DCM) that provides a risk-adjusted assessment of a project’s Net Present Value (NPV) and the likely Levelized Cost of Electricity (LCOE) that it will deliver. These financial metrics are widely used and can be easily compared with alternatives like solar and wind. Overall, this approach to financial modelling recognizes that there is considerable uncertainty in the way that dams are developed and so it provides projections for a range of scenarios.

Similarly, we also recognize that the quantitative RA process has weaknesses. For this reason, the RA is followed by a qualitative Deep Dive. The Deep Dive helps us to engage with complex and/or recent issues that are not well or fully captured by currently available geospatial data.

In the case of Koukoutamba, the Deep Dive issues identified are:

- **Commercial risks:**
  - Delays and slippage: Koukoutamba has already been delayed but when can we really expect it to start operating?
  - Levelized Costs of Electricity: Will Koukoutamba provide cheap electricity? How does this compare to realistic alternatives under different scenarios?
  - Offtake arrangements: How solid is demand for Koukoutamba’s electricity?

- **Environmental risks:**
  - Biodiversity: What are the impacts on biodiversity and on Western chimpanzees? Could this project constitute an extinction level threat in some cases?
  - Water management: Will the dam lead to contamination or shortage issues and will it deliver benefits for water management?
  - Climate impacts: Will the dam contribute to climate mitigation and/or adaptation?

- **Social risks:**
  - Impacts relative to expectations: Will local people continue to support the project when the real impacts of the dam are felt and when the delivery of benefits is delayed?
  - Social tension or conflict: Will the dam exacerbate existing tension or conflict, and could this conflict escalate beyond the immediate locality of the dam?
  - Political risks: Is the support of the government solid and is it valuable?

The Deep Dive process relies on reviews of key project documents, such as the Environmental and Social Impact Assessment (ESIA) produced by Tractebel Engie; relevant research reports (e.g., the Feasibility Study for the Moyen-Bafing Park, completed by The Biodiversity Consultancy (TBC); and limited use of media and NGO reports. In general, we treat this latter category
with caution because of occasional reliability issues.

Despite the extensive information used throughout our analysis, there are still unanswered questions that publicly available data does not address. We therefore list any “Remaining Uncertainties” from our Deep Dive in Appendix II.

3. COMMERCIAL ASSESSMENT

Our commercial assessment of Koukoutamba underlines two of the unusual features of the hydropower sector. First, our research based on the sample of dams examined for delays, found that the median delay was approximately four years.18 Other research has suggested that on average, dams that have been developed post-2000 could experience an 18% delay.19 Second, these delays typically translate into budget overruns: Large hydropower projects in emerging markets come in around 33% over budget on average.20 Electricity from hydropower is therefore typically much more expensive than expected. In our view, there is an endemic problem in the way that hydropower is planned and modelled. Our assessment addresses these problems through a more realistic treatment of the challenges of implementing projects with such significant impacts.

The assessment process helps to underline the double impact of delays on hydropower for decision-makers and investors. Delays reduce the value of dams and increase the cost of electricity from them. But they are also long enough that they make a consequential difference to a comparative assessment with alternatives. These alternatives, such as solar and wind, are becoming cheaper all the time, and quickly. In some cases, they will be a lot cheaper when a dam is operating than when it was initially planned, particularly once COVID-19 delays are also factored in.

This assessment compares Koukoutamba with solar because good data is more available for solar than for other technologies and because solar has relatively universal application. However, we realize that in practice, investors and governments should consider a basket of compatible energy technologies suitable to local conditions and needs. In the case of solar, wind and geothermal, projects can be rolled out rapidly with lower ESG impact and so less risk of delay.

Our commercial assessment of Koukoutamba evaluates:

1. Delays and slippage: Our Rapid Assessment suggests that Koukoutamba could be delayed by between one and ten years (not including disruptions caused by COVID-19), with a median expected delay of two years. This is above average for hydropower projects (the average is an 18% schedule overrun)21 but well in line with our Deep Dive.

2. Levelized Costs of Electricity (LCOE): Koukoutamba is expensive and a comparison with solar shows that it is, in real terms, uncompetitive. Under most plausible and conservative scenarios,22 Koukoutamaba will be 46% more expensive than solar by the likely start date of operation in 2027, and 90% more expensive by 2035.

3. Offtake arrangements: In the context of COVID-19 and political upheaval in the region, we briefly consider the strength of offtake arrangements. There are risks here for a project as large as Koukoutamba which may merit an altered, stepwise approach.

The commercial case shows how an investment in Koukoutamba, that is implemented and executed perfectly, does prove to be competitive initially. However, this is unrealistic, and the Deep Dive shows that cost and time overruns are to be expected, which makes Koukoutamba significantly less attractive from a financial point of view. Therefore, the commercial case is extremely weak, particularly relative to such significant and negative social and environmental impacts.
DELAYS AND SLIPPAGE

Hydropower projects that invite local or international opposition are likely to be delayed. If the dam has a significant negative impact on local livelihoods or on the environment, it is likely to invite such opposition. In some cases, delays can reach into decades. The graph below shows how a range of potential delays and CAPEX increases could impact Koukoutamba’s NPV, relative to an ideal scenario free from delays or overspend.

Koukoutamba was originally slated to start operation in 2021, then 2023. Recent reports suggest initial site development is underway but there is no evidence to suggest construction has officially started. If construction started immediately, Koukoutamba might be able to start operation in 2025. Our analysis based on similar cases suggests further delays are likely and that the earliest plausible date of operation will be 2027. These delays and deferred cash flows would lead to a considerable decline in the NPV.

A delay of one to two years without overspend translates into a 10-21% decline in NPV, or a loss of $66-$126 million, respectively. A similar delay with typical overspend (33%) translates into losses of $122-$177 million.

These projections are realistic as the Tekeze dam in Ethiopia demonstrates clearly. This project was initially approved in 2002 but faced delays primarily due to environmental concerns and as such, only became operational late in 2009 – a 38% schedule overrun. Furthermore, the project was completed at a staggering cost of $360 million and ran over the initial budget by 61%. The NPV of this project would be worse than the most likely outcome for Koukoutamba, showing that this sort of thing can and does happen in the hydropower sector.

Should Koukoutamba come online in 2027, this would imply a protracted construction period of at least six years. Evidence from the Deep Dive suggests that our model’s prediction is entirely plausible. Hydropower is particularly exposed to COVID-related delays as well as to ESG-related delays. These projects have large workforces, a portion of which must be flown in, that are concentrated in areas near vulnerable people, such as indigenous and ethnic minority groups.
LEVELIZED COST OF ELECTRICITY (LCOE)

Our commercial assessment also looks at LCOE as we know that some or all of Koukoutamba’s financial backers would be public lenders.29 These lenders, especially public lenders, are not necessarily driven by financial return and may justify energy investments in terms of their ability to relieve energy poverty rapidly, and so drive sustainable economic development through large construction projects. Hydropower is often justified in these development terms.

We have already seen that hydropower is generally slow to deliver energy because of delays and long construction periods. This subsection shows that it is also more expensive than alternative energy technologies. It shows that alternatives can be rolled out more cheaply and more quickly than hydropower, which makes them a much better bet for public lenders. For this comparison with solar or wind to be meaningful, we need to compare actual values for Koukoutamba with representative local values for alternatives (see table below).30

For this reason, our local solar and wind values come from IRENA studies and a local master’s thesis using actual prices based on local conditions.31 However, due to many uncertainties such as with the offtake, cost of capital and full CAPEX, we have had to rely on the best available information. The values we have used for Koukoutamba are outlined in the table below.

First, we want to show the financial impact of delays on the LCOE even in the absence of any increases to Koukoutamba’s budget. However, such increases seem very likely. In the graph overleaf,38 the pink line represents Koukoutamba’s price without overspend, which keeps climbing with additional delay. In contrast, the green and orange lines show that solar and wind are falling, respectively. We do not know what discount rate will be used for Koukoutamba so we used 10%, as we have for solar and wind.39

If they started construction on Koukoutamba now, the dam might produce electricity by 2025 (see first white dotted line), making it around 12% more expensive than solar. However, this is unlikely and earliest operations will probably start in 2027 (see second white dotted line). At this time Koukoutamba would be 19% more expensive than solar, under the most plausible scenario. But delays could be much longer, according to our model. They could push the date of operation to 2035 or later (see third white dotted line), at which time Koukoutamba could be 54% more expensive than alternatives.

So, delay makes a big difference but, on average, large hydropower projects also experience budget overruns of 33%.40 In the case of Koukoutamba these increases are very likely and will make a significant difference to the commercial and development case for the project. These differences can be seen in the blue and yellow lines on the graph overleaf.

<table>
<thead>
<tr>
<th>ASSUMPTION DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Capital Expenditure</td>
<td>$812 mil³²</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>10%</td>
</tr>
<tr>
<td>Loan Duration</td>
<td>30 years</td>
</tr>
<tr>
<td>PPA cost per kWh</td>
<td>$0.09/kWh³³</td>
</tr>
<tr>
<td>Inflation</td>
<td>5.8%</td>
</tr>
<tr>
<td>Solar LCOE 2020</td>
<td>$0.17/kWh³⁴</td>
</tr>
<tr>
<td>Solar LCOE price decrease per year</td>
<td>2.28%³⁵</td>
</tr>
<tr>
<td>Wind LCOE 2020</td>
<td>$0.22/kWh³⁶</td>
</tr>
<tr>
<td>Wind LCOE price decrease per year</td>
<td>3.8%³⁷</td>
</tr>
</tbody>
</table>
In the most likely scenario of a 33% budget overrun (blue line), Koukoutamba will be 46% more expensive than solar in 2027. Any delays past this date see a real deterioration in competitiveness. Should Koukoutamba suffer the worst-case delay of ten years, we expect the date of operation to be 2035 at which point it will be almost double the cost of solar (or 90% more expensive).

Someone must lose out. Either the buyer of the electricity is going to pay over the odds, or the financial backers will have to eat a significant loss. The only solution is to turn attention to the alternatives which can be delivered more cheaply and more rapidly. There are local examples of good solar projects, and as we see in the next section, opportunity is abundant.

OFFTAKE ASSESSMENT
Under normal circumstances, strong demand for energy in the region both for development and for energy-intensive sectors like mining would make the offtake an attractive part of Koukoutamba’s proposition. Roughly three quarters of the energy produced is slated for the WAPP while much of the domestic portion is due to be sent hundreds of kilometers to Labe and Conakry via the transmission line (see figure overleaf).

In the context of COVID-19, we will not attempt macroeconomic projections for the WAPP but would add that this is a time of significant regional uncertainty. The WAPP inherently relies on regional cohesion as well as on the economic health of its members. Both are being called into question at the moment, as the virus undermines economies and contributes to existing long-standing political tensions in countries such as Mali.

Similarly, there are questions about the health of the bauxite market that supports the Guinean economy. At a time of general economic decline, sectors like aerospace (which are major buyers of aluminum) are being hit hard. Along with political upheaval, this economic picture suggests that domestic offtake could pose challenges. We would expect the transmission line to be delayed and to run over budget due to similar ESG challenges.

Several studies have identified common causes of delays in the completion of transmission lines, some of which are unavoidable. There are also several examples of energy projects in emerging markets that are becoming hamstrung by an inability to bring power produced to the market.
COMMERCIAL ASSESSMENT SUMMARY
The commercial case for Koukoutamba has been weak from the start because the dam is expensive, complicated and located far from sources of demand. Delays are likely and will be extended by social and environmental challenges as well as the COVID-19 pandemic. By the time Koukoutamba starts to operate, solar could be as much as 32% cheaper under a relatively conservative scenario.

Koukoutamba will not produce consistent baseload power and may have a capacity factor not dissimilar to solar. So, arguments that solar will require storage miss the mark and are easily outweighed by the problems Koukoutamba will have with transmission lines, as well as with the generating asset itself. These pieces of infrastructure are exposed to cost increases and delay. Given their extent and planned routes, they are highly exposed. In contrast, storage solutions are rapidly becoming cheaper and more flexible.

Finally, under current circumstances, dumping a large amount of energy into the WAPP does not seem to be the most sensible energy strategy even though energy poverty is pressing. Alternatives allow for a more gradual or stepwise approach which can be linked more closely to demand and are less exposed to the risks associated with transmission lines. Given the uncertainty of the impact of COVID-19 on offtake and the ability of solar to be brought online much more rapidly than hydropower, this seems like a consequential mistake.

4. ENVIRONMENTAL RISK ASSESSMENT
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 Koukoutamba the commercial and economic case is weak. The environmental impacts also appear to be substantially negative and irreversible in a sensitive location (see figure overleaf).

In this section, we assess the environmental impacts of the dam, which have local, national and even regional implications. These impacts directly weaken the commercial case for Koukoutamba because they can be linked to delays as well as increased costs. They also
remove any argument for concessional or development financing.

The Deep Dive helps us to understand that Koukoutamba threatens Western chimpanzee populations, which are critically endangered, very rare and high profile. Indeed, the dam could represent an extinction-level threat to these animals. The presence of these chimpanzees increases the costs of the project, as well as the risks it creates and is exposed to. It is hard to see how any project, let alone one with the commercial and social problems covered in this paper, could merit this level of environmental destruction.

Our environmental assessment looks at three important drivers of risk: biodiversity, water management and climate. These sections help us to see that the meagre environmental benefits of the dam are heavily outweighed by the negative impacts.
### RAPID ASSESSMENT

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SCORE</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum % Water Scarcity Over the Year</td>
<td>48</td>
<td>Guinea is a water-rich country but this score shows water scarcity could still be an issue. This is reflected in low capacity factors.</td>
</tr>
<tr>
<td>Global Sediment Flux</td>
<td>43</td>
<td>This score is a little worse than average, suggesting that the dam could create problems for downstream food security and biodiversity.</td>
</tr>
<tr>
<td>Species Richness</td>
<td>29</td>
<td>This score is relatively low for two reasons, first most dams are in biodiverse areas. Second, we included vulnerable species, as well as critically endangered species. The area around Koukoutamba is known to be biodiverse but data is relatively scarce as it is so remote.</td>
</tr>
<tr>
<td>Upstream Drainage Area</td>
<td>46</td>
<td>This score is a little worse than average suggesting that the dam will create some issues for water management upstream.</td>
</tr>
<tr>
<td>Inter-Annual Variability</td>
<td>16</td>
<td>This is a low score which reflects the consistent nature of water supply in this part of Guinea.</td>
</tr>
<tr>
<td>Protected Areas</td>
<td></td>
<td>This high score suggests that highly sensitive ecosystems pose a risk to the project. As we know, the Moyen-Bafing park will be affected.</td>
</tr>
<tr>
<td>% Of Cropland Irrigated</td>
<td>75</td>
<td>This high score reflects a low level of irrigated cropland in the area which suggests the area is remote. This does not however reflect the presence of subsistence farming in the area.</td>
</tr>
<tr>
<td>Drought Severity</td>
<td>26</td>
<td>This low score suggests that droughts are not a major risk in the region. The region has a tropical climate and so generally does not experience long periods of drought.</td>
</tr>
</tbody>
</table>

The main gap in the Rapid Assessment relates to biodiversity. The metrics do not fully capture the importance of the Western chimpanzee and other critically endangered species. However, in general, this assessment does reinforce the results of the Deep Dive research.

The presence of a protected area in the impact zone is the major problem that dam backers have struggled to deal with. The cropland score suggests that the area has low levels of irrigation, suggesting that the location is remote. Although the qualitative assessment reveals the presence of subsistence farmers in the area, overall the region is quite remote which therefore raises the level of risk.

Finally, the relatively high score for water scarcity over the year is significant because the dam will have to be run seasonally, rather than constantly, which has an impact on the commercial case for the project.

**BIODIVERSITY**

Koukoutamba is highly unusual because it will impact critically endangered species in one of their last strongholds – the Moyen-Bafing National Park (see figure overleaf). The Park was itself created to mitigate the impacts of
large-scale bauxite mining in this part of Guinea.\textsuperscript{48}

The dam will lead to the deaths of around 1 500 Western chimpanzees (as well as hippos, leopards and other endangered animals) and the remaining population will struggle to recover.\textsuperscript{49} This could be an extinction level impact. Koukoutamba will also certainly lead to the extinction of recently discovered flora species. These fragilities will make the dam harder to construct and operate even if opponents fail to stop or significantly alter current plans. This all begs the question of whether less sensitive sites are available and why there is such a focus on a unique area of natural heritage.

A large number of NGOs – both local and international – have targeted Koukoutamba in advocacy campaigns, which have already led to mainstream media coverage and a petition signed by almost 150 000 people.\textsuperscript{50} These reputational problems are likely to grow over the life of the project as conservation issues come to the fore. These risks are currently mostly at an international level and are connected to possible financing of the project. Indeed, this advocacy may help explain the World Bank’s decision to withdraw support for the project.\textsuperscript{51}

Biodiversity impacts could also become connected to local social opposition in a way that creates enduring operational risks for the project and, in practice, lengthy delays to construction. The dam will be supported by roads and other infrastructure that will almost certainly lead to deforestation and negative biodiversity impacts. Given that local people are apparently supportive of local biodiversity, and of the chimpanzee populations\textsuperscript{52} in particular, an inevitable influx of poachers and loggers could spark conflict.

It is important to recognize that this is just one of many projects being developed in the region, with the bauxite mining boom in Guinea already severely threatening the chimpanzee populations through similar threats to habitat loss.\textsuperscript{53} The biodiversity threats of Koukoutamba should therefore be seen in cumulative terms, as they add to an already troubling trend of land use change and ecosystem destruction.
WATER MANAGEMENT

Koukoutamba promises flood control and increased water availability in the dry season. Perhaps more importantly still, the dam will help to improve the navigability of the river. Backers claim that the dam will enable commercial boats to travel along the river, enabling low cost, inter-provincial transportation of people and goods.\(^5^4\) Given the frequency of flood and drought issues in the area and the likelihood that these problems will only get worse with climate change, these attractions are considerable.

The area around the dam is isolated with low population density, high deprivation and a pronounced lack of transportation infrastructure. Understandably, locals are excited by the prospect of better market access and improved economic opportunities.\(^5^5\) Politicians, who have a natural interest in legacy, also see this as part of a plan to open up border areas and connect Guinea to Mali and the wider ECOWAS region.\(^5^6\)

However, the impact of Koukoutamba on water management poses risks to local people and to the finances of the project. In the area around the dam, local people will experience reduced water availability and increased water contamination during construction and initial operation (which could be protracted). Downstream, the dam may also lead to an increase in flooding.\(^5^7\)

So, although Guinea is water-rich in general, the dam can be disruptive enough to produce local shortages, especially due to mining activities like those in the area around Koukoutamba.\(^5^8\) To mitigate these social impacts, proposals suggest that Koukoutamba could be operated at a lower annualized capacity, in order to retain a degree of seasonality. This will reduce social and environmental risks, but it will also reduce the value of the project from an energy and commercial perspective (as discussed in the Commercial Assessment).

CLIMATE

Our discussion of water management takes on a new dimension in the context of climate risk, to which Guinea is highly exposed (see figures below).\(^5^9\) Koukoutamba may have the support of public officials and funders because it helps with both climate change mitigation and adaptation.

Guinea remains highly dependent on expensive and dirty oil imports for energy, and displacing these imports offers a range of benefits. For example, based on the current production expectations of Koukoutamba, it would save 380 952 metric tonnes\(^6^0\) of carbon per year.

But climate change and changing rainfall variability may affect the operation and output of the dam in negative ways. In countries like Brazil and Malawi, we have already seen the way that climate induced droughts create energy shortages at just the time when energy is needed for cooling and pumping water.\(^6^1\)
There is also uncertainty over the extent of the mitigation impact for a dam with a large reservoir in a tropical climate. Eutrophication of biomass can lead to significant carbon emissions for large hydropower projects in tropical regions. According to a recent study by the EC:

“Tropical reservoirs can act as ‘methane factories’, removing CO2 from the atmosphere and returning it as methane with a much greater impact on the environment. Water plants, phytoplankton and algae take up and bind CO2 as they grow, but when they die, they sink to the bottom where they are digested by methane-producing microbes in the sediment.”

Biomass clearance activities can reduce this methane output but, in this instance, would be highly undesirable as they would further increase the negative impacts that the project has on biodiversity, chimpanzee populations and local livelihoods.

The carbon footprint of the reservoir along with the cement required for a large dam is hard to quantify. But it is very reasonable to assume that this project would not have the same mitigation benefits as equivalent solar capacity. There is a risk that this kind of dam could be excluded from investors’ portfolios due to strengthening ESG standards. It is also likely to be excluded from processes like the Clean Development Mechanism (CDM).

Koukoutamba will be accompanied by additional infrastructure, including a 600 km transmission line (see figure below), substations and access roads. These will directly and indirectly contribute to climate change, via deforestation, with attendant problems for biodiversity. Additional negative impacts can include
resettlement and the loss of agricultural and local indigenous lands. The main problem, however, is likely to be illegal logging enabled by improved access to the area and limited oversight. This could increase the opposition of local people to the dam, leading to delays and possible increased costs.

We reviewed the environmental risks of Koukoutamba’s transmission line routes, which resulted in a risk score of 37. This is below average for a project of this size and means that the location of the transmission lines has a similar profile to locations where infrastructure projects have successfully been delivered with minimal or no delay.

To date, deforestation around the dam site has not been severe due to the remote nature of the site. However, this will change as access is provided through construction roads and other developments. Indeed, the figure below already shows that deforestation events in 2019 were quite common in comparison to events in the 20 year period prior to 2019. We can expect this deforestation to uptick significantly when construction actually starts.

Similarly, the high voltage transmission lines and their construction process will help to drive deforestation and open up relatively pristine ecosystems to development with low standards and little oversight. So we would expect deforestation and biodiversity loss to increase around each of the yellow lines that stretch across the figure below. This helps us to see that the environmental impact of Koukoutamba has national dimensions, especially when coupled with the cumulative impacts of other dams planned or built in Guinea.

**ENVIRONMENTAL ASSESSMENT SUMMARY**

Koukoutamba is very likely to have large and irreversible negative impacts on invaluable ecosystems and extremely rare species. It threatens some species with extinction. The dam
may also be a contributor to climate change and does not offer the mitigation benefits we might expect from solar. Furthermore, Koukoutamba is exposed to climate-related risks that may reduce the value of the project both financially and for development.

These negative environmental impacts are inherently undesirable, but they also create material risks for local people and for the project. Koukoutamba is already the focus of local and international advocacy efforts that create reputational risks for the project. More directly, environmental problems could erode local support for the dam, leading to conflicts, disputes and further delays.

The environmental impacts of Koukoutamba cannot be treated in isolation. There are already numerous other large dams planned or built in Guinea and the wider region by OMVS – Koukoutamba is the fourth but by no means the last according to current plans. All these dams create the challenges listed above. Moreover, they have a multiplying effect as water systems and natural heritage are increasingly and cumulatively affected by development.

These cumulative environmental impacts have national and regional dimensions. They seem totally out of proportion to the meagre benefits that these projects create, particularly when compared to alternatives that also have much lower environmental costs. Crucially, these high environmental costs can have a direct impact on the financial viability of Koukoutamba.

5. SOCIAL RISK ASSESSMENT

Hydropower projects are associated with serious social problems: forced displacement, deprivation of food and water, as well as conflict, to name but a few. Those negatively impacted by dams, unsurprisingly, often become their most committed opponents. This opposition can take various forms – from lawsuits to blockades to violence. As such, social problems create risks for dams and can reduce their financial viability as well as their contribution to reducing energy poverty.

Our social assessment is split into three important drivers of social risk: impacts relative to expectations, social tension or conflict, and political risk. It shows that Koukoutamba as currently conceived will do serious social harm that is likely to be financially consequential. The benefits of Koukoutamba, which have been overstated and are not justifiable, are also imperiled by the delays associated with social risk. Koukoutamba is unlikely to address the urgent need for energy in Guinea and the wider WAPP because of inevitable delays that will now be stretched out as a result of COVID-19. This need can be met by alternatives such as solar more rapidly, with greater social benefit and reduced financial risk.

A local CSO has demonstrated support for Koukoutamba by threatening to move the Moyen-Bafing Park’s animals in the event of project cancellation, and by drawing up a local governmental memorandum to dismantle the arguments made by advocacy groups against the project. However, our Rapid Assessment indicates high levels of social risk in the area (see table overleaf). If local people do not get the benefits they expect or are exposed to unanticipated negative impacts, they are likely to be disappointed, frustrated and angry. This seems likely for Koukoutamba, as the negative local effects - such as water contamination, reduced access to natural resources, and new threats to health and social cohesion – are significant and will extend throughout construction and the years to follow.

There is already evidence of discontent and opposition growing at other hydropower sites in the country (e.g., Souapiti), which reflects the potential cumulative social impacts of hydropower in Guinea. These risks are also significantly higher in the context of COVID-19. Local people will become more suspicious of outsiders and greater efforts will be needed to protect both community and employee safety. We would expect these social issues to translate into delays during the construction period, as considered in our Commercial Assessment.
<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SCORE</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Poor and Deprived: Improved Sanitation</td>
<td>47</td>
<td>This score is worse than average, suggesting that local people have poor access to basic services and may suffer health impacts from an influx of workers.</td>
</tr>
<tr>
<td>% Poor and Deprived: Drinking Water</td>
<td>91</td>
<td>Access to drinking water in the area is very low. This is concerning because the dam will have a significant impact on local water resources during construction and early operation. This is a human rights concern.</td>
</tr>
<tr>
<td>% Poor and Deprived: Schooling</td>
<td>94</td>
<td>This very high score suggests that the project has a real challenge with conveying information and making sure it is understood. Informed consent is therefore hard to attain or verify.</td>
</tr>
<tr>
<td>Multidimensional Poverty Index</td>
<td>89</td>
<td>High levels of deprivation exist locally which are linked to increased risks of social dispute and conflict over investment projects.</td>
</tr>
<tr>
<td>Population Vulnerable to Poverty</td>
<td>35</td>
<td>A low score here probably reflects the high level of absolute poverty in the area.</td>
</tr>
<tr>
<td>Population Density</td>
<td>77</td>
<td>These high scores are counter-intuitive, suggesting low population densities. 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.</td>
</tr>
<tr>
<td>Night Lights</td>
<td>100</td>
<td>This is an average score, suggesting that there are some pre-existing disputes in the impact area that could be exacerbated by the project.</td>
</tr>
<tr>
<td>Conflict</td>
<td>43</td>
<td></td>
</tr>
</tbody>
</table>

The Rapid Assessment suggests that disputes between the developer and local people are likely. The design of the dam will lead to displacement and compensation challenges, areas in which the Government of Guinea has a record of poor performance. Further insight is provided below on how these local challenges could become national or regional issues.

Overall, this Rapid Assessment reinforces the Deep Dive. Local people are unlikely to have insight into the impacts of the dam and its associated development processes. Local education levels are low, which makes it harder to obtain informed consent and when coupled with other issues like lack of access to clean drinking water, could spark disputes. In our view, these social risks are likely to be the most significant threats to the project’s viability.

**IMPACTS RELATIVE TO EXPECTATIONS**

Locals expect Koukoutamba to bring economic development locally and nationally, as well as better access to markets. They also expect and want the project to bring new people to the area. Some have said they are happy to give up land for the greater good. This may sound like evidence of low social risk.

These attitudes toward migration suggest that local support is based on a lack of information. It
seems that local people have not been informed of the threats that migration poses to local health (including sexual health), food security, water access or customary authority systems. Infrastructure to support the influx of outsiders will likely take years to construct and during this period competition for resources is likely. Outsiders may not share the same attitudes to conserving natural resources that we gather is prevalent among locals, which could lead to clashes over activities like logging and mining.

Similarly, the extent of displacement caused by the dam appears to be underappreciated by local people, which is a risk for the project. The official impact assessment suggests at least 8 700 people will have to be rehomed from upstream areas, and that 3 500-4 000 will be affected downstream. Given that the impact area may reach hundreds of kilometers downstream, this latter figure appears to be the larger underestimate, though both figures are suspicious.

Our assessment, using data from SEDAC for 2015, suggests that the population of the dam area is closer to 23 181 people, many of whom would be economically if not physically displaced. We also estimate that there are as many as 31 495 people downstream who may be impacted and in need of compensation. The cost of adequately compensating this number of people is currently not considered by the project.

Displacement is the most common cause of dispute and loss of social license. In over 600 disputes between local people and investment projects, displacement was the driver of dispute in over 46% of cases. Our research for the hydropower sector shows that these disputes average at six years and eight months (four years in feasibility; two years and eight months in construction). Failure to implement responsible resettlement can also lead to considerable reputational problems, particularly where indigenous people and vulnerable groups are concerned.

The COVID-19 pandemic increases the likelihood that migration and displacement will jeopardize the project’s social benefits as well as the likelihood of commercial success. The presence of project employees increases the risk that the virus will be transmitted to the area. The delays that the pandemic will cause for a large construction project dependent on international supply chains, will also have the effect of limiting and deferring local economic opportunity.

Given the current delayed schedule, it would be unrealistic to expect significant social or economic benefits from the project until the second half of this decade. The promise of jobs, better access to drinking water and functioning transportation infrastructure will likely be delayed until after 2027 and will likely be quite different in their dimensions and distribution than local people expect.

**SOCIAL TENSION OR CONFLICT**

Koukoutamba may lose local support if it cannot deliver economic opportunities in time and to the scale expected by local people. Other cases have shown that disputes between local people and project developers can lead to protest, violent conflict and blockades.

Loss of social license, or local approval, is particularly risky as much of the local population in the area are Fula (or Fulani people). Many leading figures across the region are Fulani (see figure overleaf for regional distribution). Therefore a local conflict in this case could escalate into a regional issue. Social tension between project developers and the Fulani has also led to significant delays and problems elsewhere. Even the ESIA for Koukoutamba recognizes that disputes over land could escalate into regional issues.

In the area around Koukoutamba, land is an important feature of social status and interaction, with tribal chiefs drawing authority and income from the patrimony of tenure rights. This customary tenure system will be disrupted by the dam and proposed migration, creating potential conflict. The region has already experienced riots and periods of civil unrest with locals protesting against the bauxite mining industry over wages and electricity cuts. Similarly, we have seen social conflict due to water shortages, which
may be a side-effect of the dam at least during early years of construction and operation.

It is possible that this kind of social conflict could be sparked in the dam areas, in the downstream impact area or in the areas around the extensive access roads and transmission lines needed for the project. The extent of these conflicts could therefore lead to political upheaval.

**POLITICAL RISK**

For projects like Koukoutamba, there are three important dimensions of political risk: first, does the project have the political support required to reach operation and is this support robust? Second, is the government a reliable counterparty in this kind of deal? Third, could political issues affect offtake? These political risks are all low frequency but have high impact considerations.

The Government of Guinea has certainly committed to the project and its support for Koukoutamba appears quite robust. It has been unmoved by local and international advocacy to date.

The real problem is that the Government of Guinea may not be a reliable counterparty. The government must play an important role in managing social and environmental risks and it is not capable of doing so. So much is clear from other projects in the region, including recent hydropower projects where highly sensitive issues, such as displacement, are being handled with a lack of due process or care.

Finally, a stable offtake relies on stable regional relationships because power is being fed to the WAPP. Again, this situation exposes Koukoutamba’s backers to risks that they have no capacity to control, including current political upheaval in Mali.

**SOCIAL ASSESSMENT SUMMARY**

Support for Koukoutamba amongst local people seems to be based on a lack of understanding or information. This makes things easy for dams in the very early stages but, as impacts are felt, a lack of informed consent can create operational problems for the project. Disputes with local people are a risk that is further exacerbated by the poor record that the Government of Guinea has with local engagement and dispute resolution.

Koukoutamba is exposed to a vicious cycle in which delays, caused by social issues or by
COVID-19, result in deferred benefits and increased negative impacts from the construction process. These deferrals and impacts can produce local resentment and opposition, leading to popular action and potentially longer delays. Overall, there are more rapid, reliable and cost-effective ways to deliver social benefits to the area and to Guinea as a whole.

As with the environmental assessment, it is also important to realize the cumulative nature of social risk in the hydropower sector. Koukoutamba is not the first large scale dam in Guinea. Stories of social conflict during the construction of Kaleta and now Souapiti are starting to filter through. These experiences may help to change local attitudes to Koukoutamba, making them more realistic in the face of what could turn out to be prolonged hardship. Meanwhile these dams, so far, show little promise of addressing the severe energy poverty issues that hold back Guinea and its people.

In this context of pre-existing social risk, concentrating risk in a single, large asset makes little sense. At a high level, the ability to allocate scarce expertise to one project may seem to offer economies of scale. In fact, it is more likely to make risk unmanageable and in so doing contribute to a project that is both heavily delayed and ineffective in driving economic development.

6. ALTERNATIVES

The above risk assessments of Koukoutamba beg the question as to why alternatives were not seriously considered. We understand of course, that alternatives can create challenges for storage, grid management and tariffs. But this section briefly shows that alternatives have considerable benefits from a commercial, environmental, and social perspective relative to energy strategies and investments that focus on hydropower. Alternatives such as solar and wind can be cheaper and much less environmentally destructive while delivering much more substantial and robust social benefits. This high-level case is so strong that it merits micro-level investigation in further studies.

COMMERCIAL PERSPECTIVE

Solar can provide peak or base power to the grid or within a grid-tied, mini- or off-grid system, and so provide a financially viable way to decentralize electricity production and rapidly meet both domestic and export energy demand. In addition, storage is rapidly becoming more viable and would make alternatives much more flexible than Koukoutamba, which seems likely to have a capacity factor significantly lower than what is expected.

Taking solar as the most competitive alternative source, Guinea boasts a significant amount of suitable areas with good solar potential which also appear to have lower social and environmental risks than Koukoutamba. The figure overleaf shows these suitable areas for solar.\(^\text{82}\)

Alternatives such as solar and wind are often able to attract private capital, reducing the burden on public finance and helping to stimulate growth and maturity in the local energy market. Such commercial potential is reflected by an 82 MW Guinean solar project, one of the largest independent solar projects in West Africa, which has already secured funding from a Danish investment firm, and which is expected to have the lowest feed-in-tariff in Guinea.\(^\text{83}\)

ENVIRONMENTAL PERSPECTIVE

Alternatives can be located closer to demand, reducing the need for long transmission lines which will be likely drivers of deforestation, poaching and biodiversity loss. Similarly, solar and wind technologies are more spatially efficient than hydropower\(^\text{84}\) and the modular nature of these technologies means they can be placed in already inhabited areas, such as on rooftops and in existing settlement areas. This minimizes the disruption to surrounding ecosystems and biodiversity during development and operation. Most notably, these technologies could have little to no impact on the Western chimpanzee’s natural habitat and the vital ecosystem of Moyen-Bafing National Park, which will be highly impacted by Koukoutamba.
Despite being more spatially efficient than hydropower, these technologies can have quite large footprints (especially at larger scales), which could bring them into competition for land with agriculture and indeed with conservation. But this problem can be managed with relative ease through co-production models (e.g., solar sited along with crops or pastoral land) or via innovative approaches such as floating solar (which could be sited on some of the existing reservoirs), to allow ease of connection to the grid.

**SOCIAL PERSPECTIVE**

The decentralized renewable energy sector, including mini-grids, solar home systems and other small-scale alternatives, can be developed rapidly within or close to communities, meeting energy demand as and where it is needed. Solar projects are also inherently less complex than large hydropower, making them easier to explain and to understand. This smaller footprint and the widespread potential of alternatives further reduces the need for the relocation of vulnerable groups.

This decentralized renewable energy sector is becoming an increasingly important employer in emerging economies suffering from high unemployment. In some countries, such as India, this alternative sector even provides a comparable number of jobs to the national utility, and the sector is only expected to grow. These employment opportunities will also bring improved food security for the local population.

**7. SUMMARY AND RECOMMENDATIONS**

Koukoutamba does not make sense on commercial, economic or social grounds. Current plans would come at a very high financial price as well as at an extraordinary and unacceptable environmental cost. The project could drive
conflict and holds little potential for local economic development. Our assessment suggests that Koukoutamba will not operate until at least 2027 at which point it will be 46% more expensive than alternatives.

Rapidly increasing energy access in Guinea remains imperative. But our assessment shows that hydropower is not the right technology to deliver on this objective. There are zero-carbon options available that could be cheaper and quicker to roll out. These technologies do not have to be located in extremely sensitive and biodiverse areas that are so remote that the transmission of energy produces huge challenges in its own right. Indeed, our research shows that these remote areas are in fact riskier for hydropower. The greater flexibility in location of alternatives would make social and environmental damage easier to avoid and allows for a modular approach.

Modular energy roll-out increases resilience and reduces risk. It also makes it easier to deliver social benefits and economic stimulus to the places that need it most. Finally, technologies that support a more modular approach are rapidly becoming cheaper than hydropower. This mixture makes alternatives much more attractive and suitable for private finance than hydropower. In turn, private involvement increases efficiency and reduces the burden on public finances, which can be dedicated to competing priorities in pandemic recovery.

Overall, the case for Koukoutamba is extremely weak and we are left wondering how any assessment process allowed the project to move ahead. There are endemic problems in hydropower assessments, particularly in the way that they account for ESG risks. In locations like Guinea, the industries and infrastructure that support energy alternatives can be immature. This may explain why there is a willingness to concentrate risk and opportunity in hydropower projects: This is a known technology and it can be easier to get one big project right than to establish a new sector in-country.

This “putting all the eggs in one basket” approach is inherently weak, and it is enabled by dysfunctional assessment and comparison processes. Governments and international financial institutions can create an enabling environment for alternatives by offering them the same sort of concessional finance awarded to hydropower. Similarly, clear and well-planned government support for large-scale roll out of alternatives can help to stimulate the sector.

RECOMMENDATIONS FOR GOVERNMENT:

- Avoid liability for delays, or for transmission lines or connection, in any power purchase agreement (PPA) signed by a state-owned utility or in any kind of sovereign guarantee. This project is likely to be a large loss-leader and the developer should carry the risk.

- Consider alternative sites with less obvious and fewer unavoidable environmental risks. This site will invite notoriety and the story will deter responsible investors from the country. It will not be the landmark project some hope for to spark the economy into life.

- Ensure that all energy projects deliver benefits (including electrification) locally and equitably to build support and drive economic development. This is likely to be easier through alternatives. Otherwise, improve the benefits that are delivered to local people from the project, ensuring that some of these benefits are felt soon.

- Review the energy policy framework for new renewable energy to provide an enabling environment for private investment. Consider supporting well-regulated independent power producers (IPPs) to spark energy entrepreneurship.

- Consult developers of alternatives to understand how to de-risk investments in alternatives and so ensure a pipeline of bankable projects capable of attracting private finance. These measures may involve working with developers, civil society and local people to identify appropriate sites and anchor businesses.

- Demand high social and environmental standards from developers to reduce delay
and boost the benefits that public investments deliver. Ensure these are independently assessed and monitored according to robust frameworks. Ensure that unique natural heritage is protected from unnecessary development.

RECOMMENDATIONS FOR PROSPECTIVE FINANCIERS:

- Work with OMVS and Sinohydro on the above recommendations, including and especially on options for solar solutions at scale. It should be possible to spark a critical mass of renewable energy roll out in Guinea with the scale of resources being considered for Koukoutamba.

- Evaluate how alternative technologies might perform, in terms of LCOE and delay, in different locations if they had access to the same advantages as hydropower (e.g., concessionary finance and PPP arrangements).

- Request updates to risk and impact assessments to help evaluate the current context, which has been rocked by the pandemic and political violence in Guinea. These assessments will show the high risks that Koukoutamba is exposed to and that it creates.

- Adjust the approach to financial modelling for projects like Koukoutamba using Riverscope. This adjustment is likely to show that this project is a significant loss-leader that is uncompetitive with alternatives.

- Consider a new cost-benefit analysis for this project. Use the data we have produced to develop a more reliable assessment of the risks of delay and impacts on NPV. This must apply to transmission lines as well as generating capacity. This should be compared with solar and the socio-economic advantages that the technology may have.

- Reevaluate demand growth and distribution in the wake of COVID-19. This may suggest that a more gradual approach to energy roll out is needed in this area and that alternatives are less exposed to virus-related risks.

- Demand higher social and environmental standards from developers as a way to improve impact and mitigate risk. Ensure that hydropower projects do not drive either significant biodiversity loss or large-scale displacement, as Koukoutamba will.
8. APPENDIX I: TRANSMISSION LINE ANALYSIS

The scores from Landscope and conflict data were combined with a weighting of 90% for Landscape scores and 10% for conflict scores. We have analyzed the scores of the main existing or planned routes that export electricity to the most likely offtaking neighboring countries. The overall risk score is an equal weighting of all the potential routes.

<table>
<thead>
<tr>
<th>From To</th>
<th>Landscope only</th>
<th>Conflict Score</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mali</td>
<td>0.37</td>
<td>0.00</td>
<td>0.32</td>
</tr>
<tr>
<td>Labe</td>
<td>0.39</td>
<td>0.54</td>
<td>0.40</td>
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<table>
<thead>
<tr>
<th>MPI of the country</th>
<th>Headcount ratio: Population in multidimensional poverty (H) - % Population</th>
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<th>0.15</th>
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</thead>
<tbody>
<tr>
<td>MPI of the region</td>
<td>Intensity of deprivation among the poor (A) - Average % of weighted deprivations</td>
<td>0.20</td>
<td>0.25</td>
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<tr>
<td>% Pop vulnerable to poverty (experiencing intensity between 20–32.9%)</td>
<td>0.62</td>
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<tr>
<td>% Pop in severe poverty (experiencing intensity higher than 50%)</td>
<td>0.25</td>
<td>0.29</td>
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<tr>
<td>% People who are poor and deprived in Education: Schooling</td>
<td>0.17</td>
<td>0.23</td>
<td></td>
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<tr>
<td>% People who are poor and deprived in Education: Child school attendance</td>
<td>0.37</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>% People who are poor and deprived in Health: Child mortality</td>
<td>0.55</td>
<td>0.58</td>
<td></td>
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<tr>
<td>% People who are poor and deprived in Health: Nutrition</td>
<td>0.48</td>
<td>0.51</td>
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<tr>
<td>% People who are poor and deprived in Living Standards: Electricity</td>
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<td>% People who are poor and deprived in Living Standards: Improved sanitation</td>
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<td>% People who are poor and deprived in Living Standards: Cooking fuel</td>
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<td>% People who are poor and deprived in Living Standards: Asset ownership</td>
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9. APPENDIX II: REMAINING UNCERTAINTIES

Riverscope demonstrates that Koukoutamba is exposed to significant risks and suggests that alternatives should be pursued in preference to a large dam. However this assessment has been remote and has limitations. This section outlines further steps that can be taken to augment and verify Riverscope’s findings.

UNCERTAINTY 1: LOCAL ATTITUDES AND SUPPORT

The degree to which local people understand the impacts of the dam on livelihoods, and of migration on their livelihoods is unclear. It seems very likely that locals have not been sufficiently informed given the experience from other, simpler projects in Guinea. In particular, the delay between feeling negative impacts and getting positive impacts may be obscure to them.

A local consultation exercise guided by an international consultancy or NGO with the support of local implementing agents could provide a robust and cost-effective way to verify some of the key facts here. If this consultation process finds that a reasonable FPIC process has been followed, many of the risks explored in this assessment would be reduced significantly.

UNCERTAINTY 2: THE IMPACT OF COVID-19

We can already assume that the virus will make it impossible for the dam to start operations in 2023, as planned at the start of construction last year. The virus may also increase direct costs and local risks. However, since the impact of the virus is so uneven and hard to predict, this risk factor remains very hard to quantify or integrate into this assessment.

We would recommend that project backers consider a baseline survey of attitudes and expectations of virus impacts among key stakeholder groups. This survey should then be repeated on a regular basis over the next two or three years. In the meantime, backers should pay attention to the impact of the virus on the GDP of offtaking countries, the health of the bauxite sector and on the speed of Chinese construction projects in emerging markets.

UNCERTAINTY 3: ALTERNATIVES

This assessment considers alternatives such as solar, but this raises two questions for further investigation. First, is the solar sector mature enough in Guinea and if it is not, is large-scale solar installation feasible? Second, would a combined hydro and solar solution be feasible? A smaller dam in a different location would not be exposed to the same level of risk and might complement solar solutions (e.g., by providing storage options or through floating solar on existing hydropower dams). Further investigation is needed into the feasibility of such an arrangement.

UNCERTAINTY 4: LOCAL POLITICAL RISKS

The practice and capacity of local and national officials is opaque. Local insight over time will be required to deliver a complete assessment. We recommend identifying local NGOs or consultancies capable of delivering this assessment of political capacity, particularly at a local level. These local groups should be armed with best practice guidance on working with host governments.
ENDNOTES


2. Landscope has been tested thoroughly by comparing its results with real world experience and with the outputs of fieldwork. This process has benefited significantly from DFI support including testing across thousands of assets and dozens of portfolios. Landscope has been developed with particular reference to sectors such as agriculture and mining but the basic approach is valid for any emerging market investment according to users.


5. The OMVS is a regional cooperative management body of the Senegal River which currently includes Guinea, Mali, Mauritania and Senegal.


7. Figure created with ArcGIS Online: https://hydraulique.maps.arcgis.com/apps/MapTools/index.html?appid=7aaec100519149e8b10d86f39f9e9f7f


11. Some of the dams in our control group may have experienced problems that have not been reported.

12. Dam area of analysis considers a 20 km radius from the dam wall; River area of analysis considers an area 100 km downstream from the dam wall and 10 km on either side of the river; District/Regional area of analysis considers the GADM L2 district that the dam is situated in.

13. The weightings here are averaged for the specific area. For indicator specific weightings see the Data Report in here.

14. The dark colored cells represent the availability of the indicator for that level of analysis (i.e. at Dam, River and/or District level).


18. We found the median to be more representative than the mean, which was skewed by dams delayed over ten years.


22. That is a two year delay linked to a 33% increase in capital expenditure. We have used 6% inflation, 4% below current levels.

23. Souapiti dam has already displaced local vulnerable communities and will flood much needed agricultural land, which will likely lead to conflict and directly impact the dam. https://www.hrw.org/report/2020/04/16/were-leaving-everything-behind/impact-guineas-souapiti-dam-displaced-communities

24. Graph created by TMP Systems.
and projected LCOE data as published by IRENA


30 See full list of financial assumptions in the methodology document here.

31 Due to a lack of solid evidence of LCOEs for Guinea, we used the neighboring country of Senegal for some of the local values.


33 Because Koukoutamba has not secured a PPA, this purely serves as an indication of what it could be based on https://greenmininggrid.afdb.org/sites/default/files/guinea-english-3.pdf

34 https://openaccess.nhh.no/nhh-xmliu/bitstream/handle/11250/2612158/masterthesism.pdf?sequence=1&isAllowed=y

35 Global reduction in Solar LCOE calculated from historic and projected LCOE data as published by IRENA


37 Global reduction in Wind LCOE calculated from historic and projected LCOE data as published by IRENA

38 Graph created by TMP Systems.

39 IRENA uses a real cost of capital of 7.5% in OECD countries and China, and 10% in the rest of the world.


42 Figure created with ArcGIS Online:
https://utility.arcgisonline.com/arcgis/rest/directories/ar cgisoutput/Utilities/PrintingTools_GPServer/x__xm0UB-WtkZPNPpUSmv2yw_x__x_agz_b6a713c0-182a-11eb-9e80-22000ae11289.pdf

43 https://www.mdpi.com/1996-1073/13/1/17/htm


45 Figure created by TMP Systems.


47 Figure from:

48 This may have created a dynamic in which biodiversity risks are under-reported to companies and investors because local NGOs are worried to criticize the project lest the government withdraw support for the sanctuary.


projects can earn saleable credits, each equivalent to one tonne of CO2, which can be counted towards meeting Kyoto targets.

There is some uncertainty around Koukoutamba’s transmission line, as our research suggests a direct line to Labe, however the raw data we have used from the World Bank does not show this line. (https://www.africa-energy.com/article/guinea-koukoutamba-dam-tender)

Figure created by TMP Systems.

See breakdown of full scores in the Transmission Line Analysis in Appendix I.

Figure created by TMP Systems.

International advocacy groups have already created media attention through a petition with almost 150 000 signatures opposing the project and opting for solar instead. (https://www.theguardian.com/world/2019/feb/28/chinese-dam-project-in-guinea-could-kill-up-to-1500-chimpanzees)


https://www.lifegate.com/guinea-souapiti-dam-displacement


These figures likely ignore the large “floating population” – people who have left the area, often in search of economic opportunity, but still have claims to land that they may return to (especially if compensation is offered).


The Fula (or Fulani people) are an ethnic minority group spread across West African countries and associated with pastoralism and Islam. Also see: https://tariganter.wordpress.com/2011/09/17/who-are-the-fulani-people-their-origins/

The Clean Development Mechanism allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction credits, each equivalent to one tonne of CO2, which can be counted towards meeting Kyoto targets.

64 There is some uncertainty around Koukoutamba’s transmission line, as our research suggests a direct line to Labe, however the raw data we have used from the World Bank does not show this line. (https://www.africa-energy.com/article/guinea-koukoutamba-dam-tender)

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Figure created by TMP Systems, where the DNI is above 1 200 KWH/M2 per year, Key Biodiversity Areas and Protected Areas are less than 10% of the L2 district area, and the Social Risk score, as calculated by the Riverscope’s RA social indicators, is below 60.
