Riverscope

Case Study: Luang Prabang, Laos Summary

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INTERNATIONAL RIVERS
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TMP SYSTEMS

1. OVERVIEW

The electricity produced by large-scale hydropower is expensive in commercial, social, and environmental terms. Dams have significant and irreversible impacts on societies and ecosystems while being exposed to huge operational and financial risks. Yet, the way that these projects are assessed systematically underestimates these impacts and risks, meaning that investors, developers, and regulators often make the wrong decisions based on incomplete information.

This document summarizes an assessment of the proposed Luang Prabang hydropower project in Laos, using the "Riverscope" assessment tool. Riverscope offers a new way to assess large dams by combining geospatial analysis, expert investigation, and financial modeling. Riverscope is unique in that it presents a commercial comparison between hydropower, solar and wind, alongside a rapid but wide-reaching environmental and social risk analysis. As such, it provides relevant information and analysis for governments, investors, and the third sector. The full assessment report and methodology is available at www.riverscope.org.

This Riverscope assessment of Luang Prabang shows that:

1. **The project could be delayed by 13 years,** mainly because of a combination of social and environmental challenges. This delay significantly reduces the dam's financial value.
2. Under the most likely scenario, **Luang Prabang will be 77% more expensive than solar by 2030** (the most probable starting date of operation), and 150% more by 2040.
3. **Alternative energy technologies could deal with energy poverty and security more cheaply and more rapidly** than Luang Prabang without incurring substantial negative impacts.

LUANG PRABANG

Luang Prabang is a hydroelectric "run-of-river" dam planned by Luang Prabang Power Company Limited (LPCL).[1] It will be constructed by CH. Karnchang PCL[2] and is likely to be backed by a syndicate of predominantly Thai financiers.[3] A similar syndicate backed the Xayaburi dam.[4] This private investment is unusual for such a high-risk, low-yield investment, which normally depends more heavily on concessional finance.[5]

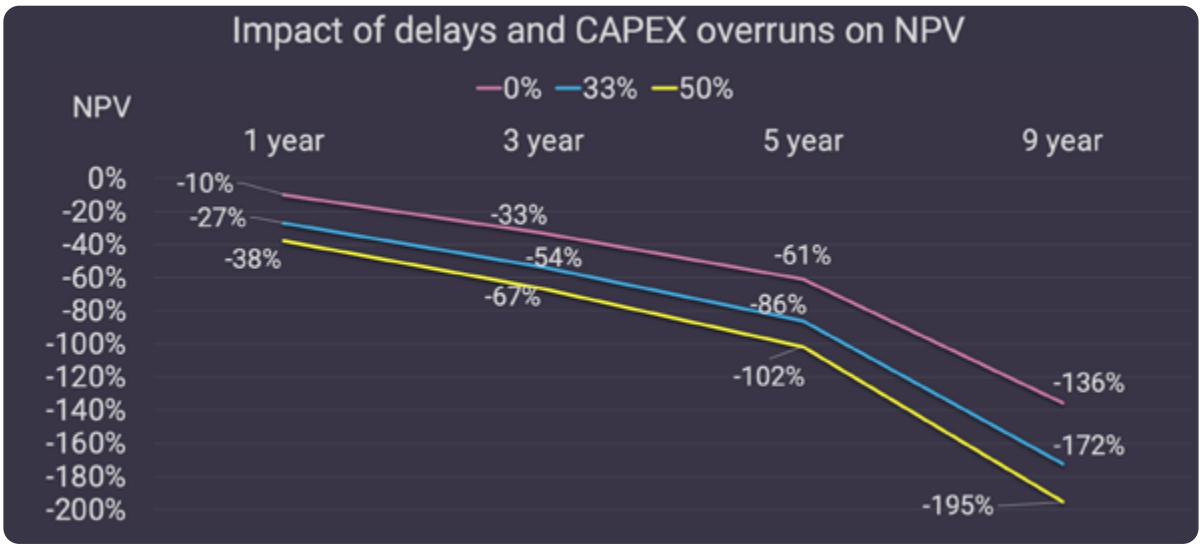
Luang Prabang has planned nameplate capacity of 1,460MW[6] and most of the energy it produces is likely to be exported to Thailand.[7] The estimated budget is $4.96 billion. Originally, the project was to start construction in late 2020 and commence operations in 2027.[8] However, the pandemic delayed the Prior Consultation process,[9] and the project has yet to secure and sign key agreements.[10] As a result, current estimates suggest construction may start in Q3 2021.[11]

2. COMMERCIAL ASSESSMENT

Our commercial assessment of Luang Prabang evaluates three key areas of commercial risk: delays and slippage, the Levelized Cost of Electricity (LCOE), and offtake arrangements. In this case, perfect implementation can produce a competitive project. However, Riverscope shows that cost and time overruns are likely to make Luang Prabang highly unattractive financially.

DELAYS AND SLIPPAGE

Luang Prabang was originally slated to start operating in 2027, but construction has been delayed by at least a year. Our analysis based on similar cases suggests further delays are likely, and the earliest plausible date of operation will be 2030. As seen in the graph overleaf, further delays and deferred cash flows would lead to a considerable decline in the Net Present Value (NPV).



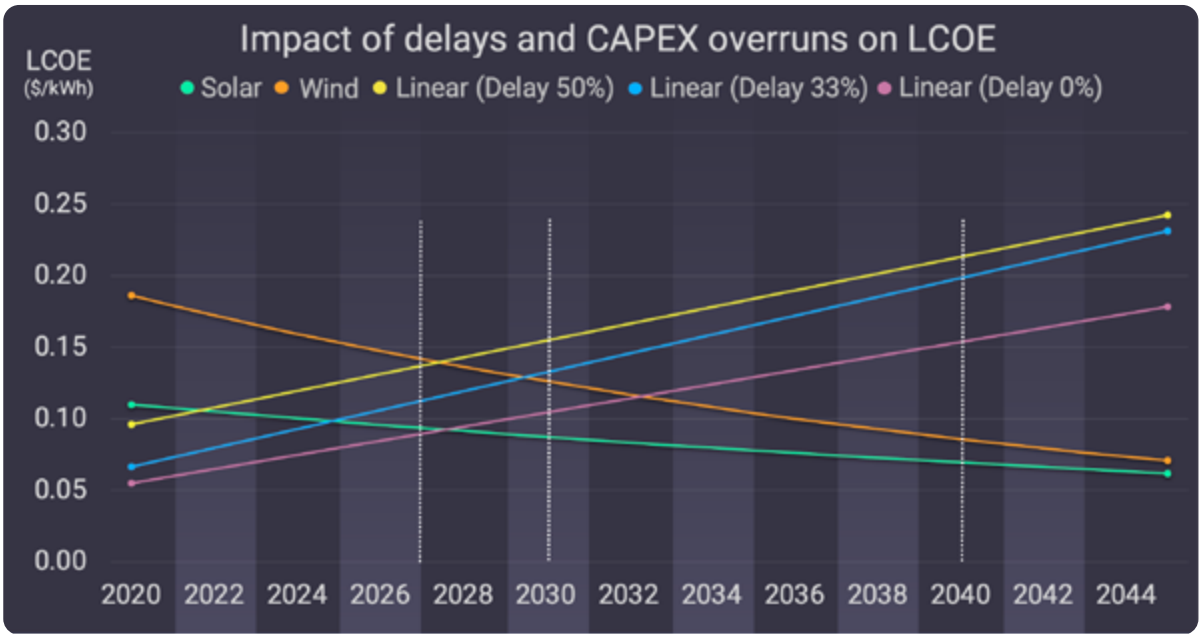
Graph 1. Created by TMP Public

A delay of 2-3 years without overspend translates into a 21%-33% decline in NPV, or a loss of $355-$509 million, respectively. A similar delay with typical overspend (33%) translates into losses of $585-$719 million.

LEVELIZED COST OF ELECTRICITY (LCOE)

The investment case for Luang Prabang appears to be weak, particularly when compared to alternative energy technologies. We demonstrate the commercial superiority of local solar and wind projects by comparing the LCOE of Luang Prabang with representative local values.

The graph below shows how the competitiveness of Luang Prabang deteriorates in proportion to the delays it experiences. In 2027, the original start date, the dam may be cheaper than wind, if not solar. But by 2030 solar is considerably cheaper (38%), and wind is competitive. If we assume that Luang Prabang also experiences the budget overruns that are typical for hydropower projects (33%[12]), then the dam will be 77% more expensive than solar in 2030. If the project is delayed to 2040, the electricity will be 150% more expensive than local alternatives.



Graph 2. Created by TMP Public

OFFTAKE ASSESSMENT

The COVID-19 pandemic is likely to reduce electricity demand in Southeast Asia, which risks becoming saturated with competitive options.[13] Luang Prabang has not yet secured a power purchase agreement (PPA) and so is at considerable risk due to these volatile and unpredictable conditions.[14] There is no obvious need for further injections of energy capacity in Thailand. Luang Prabang is further exposed on the offtake side because it will need to transport electricity over long distances which in turn will require new or upgraded infrastructure. These transmission lines are likely to create further delays, and there are several examples of energy projects in emerging markets that have been so hamstrung.[15]

3. ENVIRONMENTAL RISK ASSESSMENT

This section summarizes environmental risks for Luang Prabang, which undermine the investment case. The large environmental risks associated with dams are hard to manage or avoid. Resulting controversies and measures taken by developers to deal with them hamper implementation and increase costs.

These results reveal several high-risk indicators, including species richness and sediment flow. We can see that the dam would place a heavy strain on water and nutrient management, potentially undermining high levels of biodiversity within the river system. Yet the official environmental impact assessment for Luang Prabang is weak and lacks in-depth analysis into the value of the habitats, ecosystems and biodiversity that will be lost.[16]

INDICATOR	SCORE			COMMENT
	DAM	RIVER	DISTRICT	
Water Scarcity	57	59	59	Laos is water-rich, but water scarcity could still be an issue as reflected in recent droughts.
Sediment Flux	92	89	89	Local sediment flow is extremely poor and will be further affected, which could damage biodiversity, fisheries, farms and water quality downstream.
Species Richness	96	96	97	This area is very rich in biodiversity. The whole river is a Key Biodiversity Area which is threatened by Luang Prabang.
Inter-Annual Variability	15	10		This low variability is typical in tropical contexts but may now be upset by climate change.
Upstream Drainage	91	85		The area around the dam is poorly suited for catching rain and providing water downstream.
Protected Areas			10	This low score suggests little conservation around the dam, which increases risks to biodiversity.
% Irrigated Cropland			77	The high number represents low levels of cropland: dams have greater problems in remote areas relatively untouched by development.
Drought Severity			18	This low score is based on historical data. The recent drought suggests future challenges.

An aerial view of Luang Prabang town in Laos. Photo by Thai Mekong People's Network.

BIODIVERSITY

Luang Prabang will destroy the natural habitats that support endemic and globally threatened species.[17] For example, it will block many migratory fish species, disrupting the spawning habits of the critically endangered Mekong giant catfish.[18] Upper Mekong dams have also significantly reduced sediment flow to the Lower Mekong mainstream, impacting its morphology and ecology.[19]

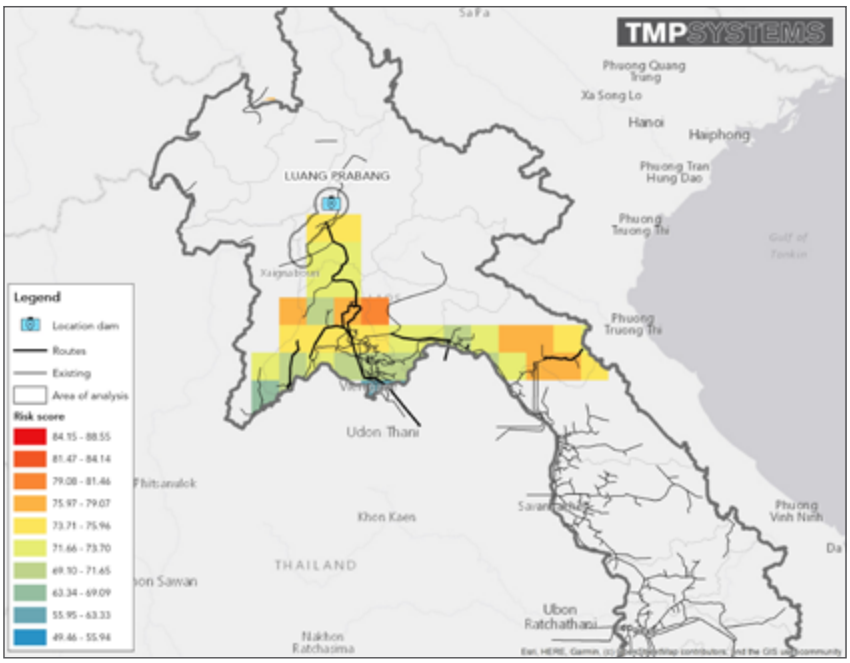
Luang Prabang will be prone to soil erosion, wastewater discharge, and oil spills, among other effects, yet existing environmental studies lack adequate baseline data to measure expected changes in biodiversity.[20] Finally, the transmissions lines planned for Luang Prabang will cut across and open up areas with high forest cover and biodiversity, which could now be exposed to predatory activities. These problems can further contribute to delays (see map and footnote for some examples).[21]

CLIMATE

Hydropower is very exposed to the way that climate change impacts will change water regimes. Hydropower-dependent countries have recently been left short of energy at a time of high demand.[22] Luang Prabang, as a run-of-the-river dam, is likely to be affected by these changes which will reduce the capacity factor of the dam.

CUMULATIVE ENVIRONMENTAL IMPACTS

Hydropower development in Northern Laos could have large cumulative impacts on biodiversity and climate. For instance, 40% of fisheries could be lost in the upper LMB due to the Upper Laos Cascade.[23] The Mekong's water levels have recently reached a 100-year low,[24] which has brought competition for water to the fore, including between dams.[25] Yet, the Mekong River Commission (MRC) found that Luang Prabang has ignored the effects of climate change and upstream dams on hydrology,[26] both of which can exacerbate the impacts of flooding and drought.



Map created by TMP Public

4. SOCIAL RISK ASSESSMENT

This social assessment of Luang Prabang focuses on three key drivers of social risk: food security, displacement, and cultural issues.

The results below suggest local people are highly likely to see severe reductions in the quality of their lives because of the development, the benefits of which will be largely exported.

neighboring governments are aware of these problems, and there are signs of organization against it.[28] Any food shortages are likely to provoke strong opposition and governmental concern.

DISPLACEMENT

Developers claim Luang Prabang will displace between 4,600[29] and 9,974 local residents[30] but our own assessment indicates that 122,037 live in the immediate impact area of the dam.[31] Many of these people will be physically or economically displaced.

INDICATOR	SCORE			COMMENT
	DAM	RIVER	DISTRICT	
% Deprived: Sanitation	47	43	44	Local people lack access to basic services and similar government support.
% Deprived: Drinking Water	72	58		Disruptions to the quantity or quality of water resources, upon which locals depend, will create opposition.
% Deprived: Schooling	80	61		Low levels of schooling in this area increase the risk of dispute or conflict.
Multidimensional Poverty Index	62			Extreme socio-economic vulnerability increases the risk of dispute.
Population Vulnerable to Poverty	80			Project-related disruptions could tip local people into severe poverty, increasing the risk of dispute significantly.
Population Density		56		This is an average score suggests quite low population densities. This remote area has little experience with development and is higher risk as a result.
Night Lights		58		

FOOD SECURITY

Luang Prabang will create three major threats to local and regional food security: first, disrupted sediment flow will undermine downstream agricultural productivity; second, impacts on migration and biodiversity will reduce fishery productivity; and third, inundation will destroy upstream aquatic habitats and river gardens.

The project developers have provided little information or reassurance on these economic and food security concerns.[27] Civil society and

Local people have already voiced concerns that compensation will be inadequate.[32] Previous dams have left a legacy of poor compensation and resettlement in Luang Prabang province (e.g. Nam Khan 2 and 3).[33] By our calculations, adequate compensation for those displaced by Luang Prabang based on IFC standards could cost over $300 million.[34] Disputes over compensation for the dam and associated transmission lines are likely to further contribute to delay.

CULTURAL ISSUES

The dam is 25km upstream from the Luang Prabang World Heritage Site. Should an extreme weather event occur that weakens the dam or leads to an accident there (as at Xe-Pian Xe-Namnoy), this ancient capital will likely be severely damaged or destroyed.[35] The World Heritage Committee raised such concerns in 2012, but the government has yet to undertake a Heritage Impact Assessment.[36] The World Heritage Committee state that dams with large reservoirs are incompatible with World Heritage status[37] and so this status for Luang Prabang City may be compromised, which could reduce tourist revenue and cultural protection.

CUMULATIVE SOCIAL IMPACTS

The Upper Laos Cascade could drive districts in Northern Laos to food insecurity for at least 6 months of the year,[38] with a potential decline in annual fish catch from 40,000-60,000 to 16,000-24,000 metric tons/year in the region.[39] Other planned developments in the LMB,[40] could impact the food security of at least 2.1 million people in Laos and Cambodia alone.[41] Such risks create transboundary tensions which are already playing out in Cambodia, Vietnam and Thailand.[42]

5. ALTERNATIVES

Alternatives have considerable benefits from a commercial, environmental, and social perspective relative to hydropower, despite potential storage, grid and tariff challenges.

COMMERCIAL PERSPECTIVE

Solar and wind 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 domestic and export energy demand. Laos has abundant potential (~516GW for solar and ~66GW for wind) in areas with much lower social and environmental risks than Luang Prabang. There are already good examples of utility-scale solar projects being developed in Laos.[43] There may be scope to adapt existing dams for pumped storage and/or floating solar arrays. Finally, alternatives are more attractive to private investors due to lower CAPEX requirements and shorter expected loan periods.

ENVIRONMENTAL PERSPECTIVE

Alternatives could have little-to-no impact on the Mekong's aquatic biodiversity. Alternatives can also be located nearer to demand, reducing the need for long transmission lines and their associated environmental impacts. Solar and wind technologies are more spatially efficient than hydropower,[44] reducing disruption to surrounding ecosystems and biodiversity. Compared to hydro, the environmental risks associated with alternatives can be managed cheaply and easily. Co-production models and innovative approaches like floating solar can reduce energy's hunger for land without undermining the commercial case for alternative energy investments. The difference with hydropower seems to be stark.

SOCIAL PERSPECTIVE

Solar and wind could drive job creation in Laos, while hydropower seems likely to heighten job losses[45] and may provoke dispute between foreign workers and locals. Significantly increasing solar, wind, and bioenergy technologies in Laos, while minimizing hydropower, could create up to 1.4 million job years by 2050 compared to just 475,452 job years under a business-as-usual scenario.[46] The decentralised renewable energy sector can be developed rapidly within or close to communities, meeting energy demand as and where it is needed, while minimizing displacement. Finally, solar has the potential to support food security, health, and nutrition, including through the use of solar lighting and solar water pumps for food crops.[47]

6. SUMMARY AND RECOMMENDATIONS

Luang Prabang does not make sense on commercial, economic, or social grounds. Current plans are expensive and have an unacceptable environmental cost. Luang Prabang is unlikely to operate until 2030, at which point it will be 77% more expensive than alternatives.

Our assessment shows that hydropower is not the right technology to deliver energy access to Laos. Zero-carbon options could be cheaper and quicker to roll out. These technologies can be located with greater flexibility which makes social and environmental damage easier to avoid and allows a modular approach. Alternatives are much more attractive and suitable for private finance than hydropower. 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 Luang Prabang is extremely weak. This suggests endemic problems in hydropower assessments, particularly in the way that they account for ESG risks. Governments and international financial institutions can create an enabling environment for alternatives by offering them the same sort of concessional finance awarded to hydropower. Clear and well-planned government support for large scale roll out of alternatives can help stimulate the sector.

RECOMMENDATIONS FOR FINANCIERS AND INVESTORS:

- **Review the investment case for Luang Prabang in the context of lengthy delays, regional opposition, high reputational risks and COVID-19** (both in terms of further delay and reduced demand for energy). Adjust the financial modeling approach using Riverscope. Compare the investment case for Luang Prabang to alternatives.
- **Demand higher social and environmental standards from developers.** Work with Luang Prabang Power Company Limited on the above recommendations.

RECOMMENDATIONS FOR GOVERNMENT:

- At minimum, **cooperate with efforts to establish up-to-date baselines for the project and to understand the cumulative and transboundary impact of hydropower development** along the Mekong. Compare the capacity of Luang Prabang to create foreign exchange relative to similar investments in alternatives.
- **Demand high social and environmental standards from developers.** Consult developers of alternatives to understand how to de-risk investments in them.

A jetty at Pak Ou, about 4km downstream of Luang Prabang dam site. Photo by International Rivers.

ENDNOTES

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3. http://ckp.listedcompany.com/newsroom/121120200808130901E.pdf
4. https://www.kaohoon.com/content/323196 ; https://fairfinancethailand.org/media/495434/challenges-of-dam-financing-for-thai-bank-the-case-of-xayaburi-and-xpxn-projects.pdf
5. Concessional finance is generally provided at lower interest rates than private finance, making lower yielding projects feasible.
6. https://www.mrcmekong.org/assets/Consultations/LuangPrabang-Hydropower-Project/Overview-of-key-features_LPB-Project.pdf
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18. https://www.mrcmekong.org/assets/Publications/TRR-of-LPHPP.pdf
19. https://www.mrcmekong.org/assets/Publications/SOBR-v8_Final-for-web.pdf: Examples of existing impacts on the Mekong's biodiversity include the Chinese paddlefish, which was recently declared extinct; the famed Mekong giant catfish, which seem near to extinction given these plans; and the Irrawaddy Dolphin that could be driven to extinction by Luang Prabang and similar hydropower projects.
20. https://www.mrcmekong.org/assets/Publications/TRR-of-LPHPP.pdf

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22. https://www.dfdl.com/resources/news/lao-pdr-challenges-and-opportunities-for-solar-power-development-in-the-lao-pdr/
23. This includes the existing Xayaburi dam and planned Sanakham, Pak Lay, Pak Beng and Luang Prabang dams.
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35. https://www.mrcmekong.org/assets/Publications/TRR-of-LPHPP.pdf
36. https://whc.unesco.org/en/soc/117
37. https://whc.unesco.org/en/decisions/6817/
38. https://www.mrcmekong.org/assets/Publications/Consultations/SEA-Hydropower/SEA-Main-Final-Report.pdf
39. https://www.mrcmekong.org/assets/Publications/TRR-of-LPHPP.pdf
40. This includes a total of 11 LMB mainstream dams, namely Luang Prabang, Pak Beng, Xayaburi, Pak Lay, Sanakham, Pak Chom, Ban Koum, Lat Sua, Don Sahong, Stung Treng and Sambor.
41. Between 60% and 95% of rural households in the countries of Laos, Cambodia and Vietnam are directly involved in fishing and farming but fish remains the main source of protein (https://www.mdpi.com/2071-1050/12/6/2408/pdf)
42. https://uk.reuters.com/article/us-mekong-river-dam/laos-to-move-on-third-mekong-dam-project-despite-neighbours-green-concerns-idUKKBN2425MC

ENDNOTES

43. https://renewablesnow.com/news/nvalid-seals-ppa-for-76-mw-solar-project-in-laos-700599/
44. Solar and wind have been shown to use far less land per megawatt produced than hydropower, with approximately 17.6ha/MW and 28.6ha/MW, respectively, versus 127.5ha/MW for hydropower (https://www.strata.org/pdf/2017/footprints-full.pdf)
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Cover Image: Luang Prabag, Laos. Photo by Joelle (Pixabay).