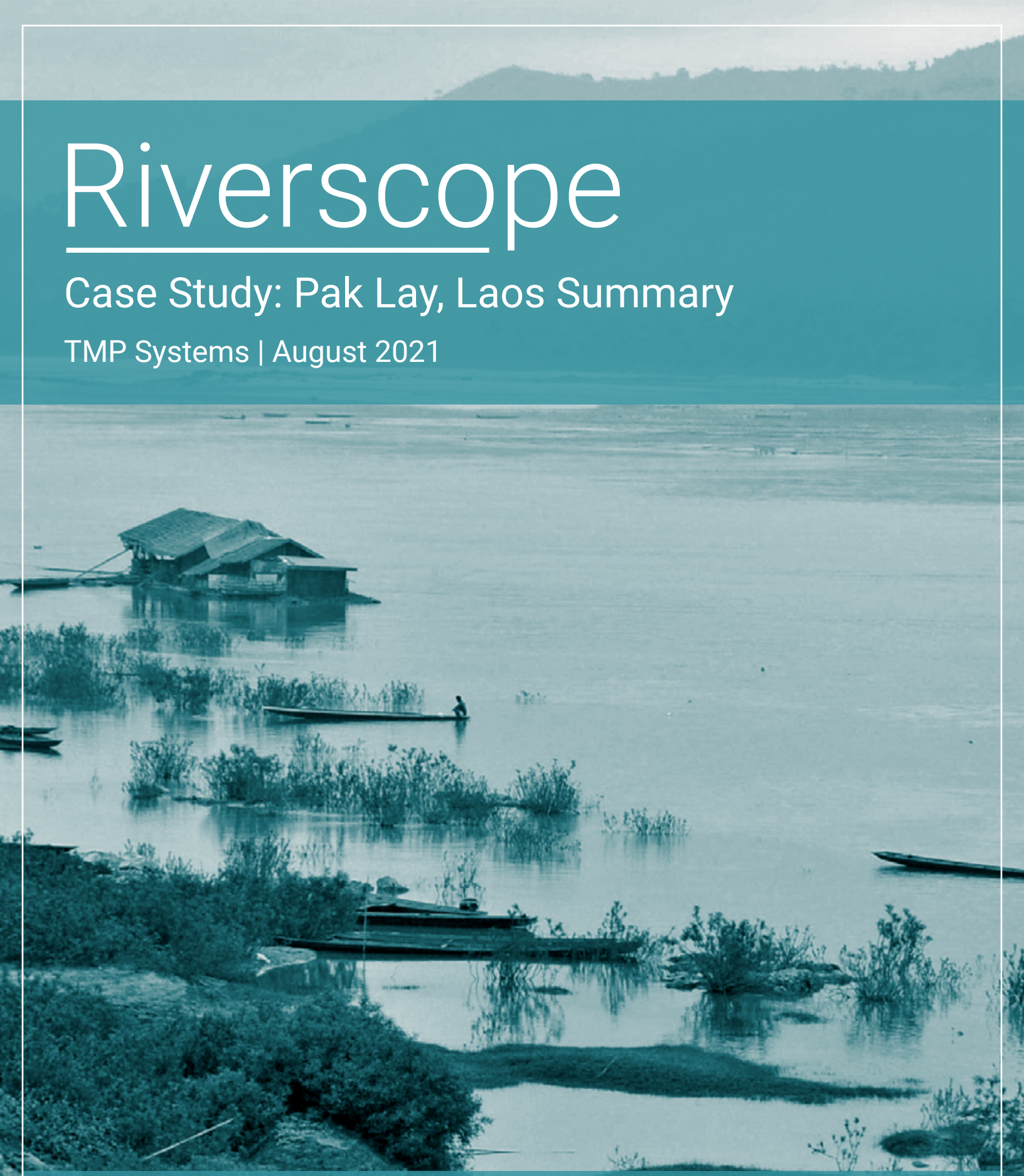
Riverscope

Case Study: Pak Lay, Laos Summary

TMP Systems | August 2021



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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 Pak Lay 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 Pak Lay shows that:

1. **The project could be delayed by up to 12 years,** mainly as a result of significant social and environmental challenges. This delay significantly reduces the dam's financial value.
2. Under the most likely scenario, **Pak Lay will be 26% more expensive than solar by 2032** (the most probable starting date of operation), and 70% more by 2041.
3. **Alternative energy technologies could deal with energy poverty and security more cheaply and more rapidly** than Pak Lay without incurring substantial negative impacts.

PAK LAY

The Pak Lay hydropower project is a "run-of-river" scheme in the planning phase, backed by a joint venture involving PowerChina Resources Limited and China National Electronics Import-Export Corporation.[1] Project financing is still unclear at this stage even though Pak Lay has been on the table since 2007,[2] with a current planned capacity of 770 MW. Electricity will either be exported to Thailand,[3] or used primarily for domestic consumption.[4]

The estimated budget is $2.1 billion, with construction expected to start in late 2022 and operation in 2029.[5] However, the COVID-19 pandemic has delayed multiple hydropower projects around the world,[6] Southeast Asia included.[7] Pak Lay may also be affected, and our research suggests that these delays will be compounded by social and environmental challenges.

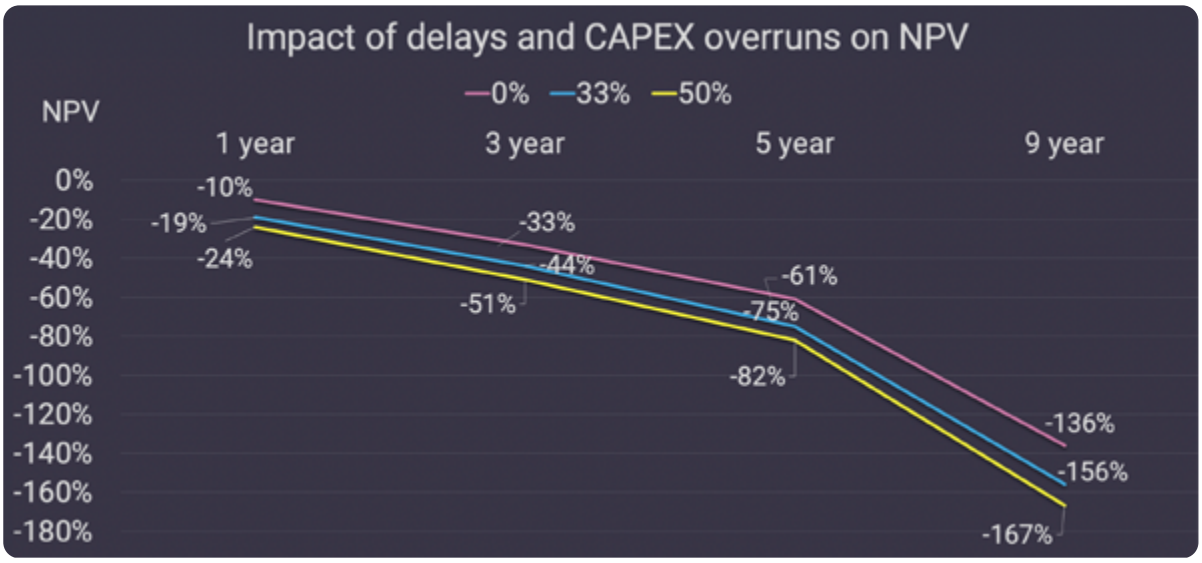
2. COMMERCIAL ASSESSMENT

Our commercial assessment of Pak Lay 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 Pak Lay highly unattractive from a financial point of view.

DELAYS AND SLIPPAGE

Pak Lay was originally slated to start operation in 2029. But our analysis based on similar cases suggests 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).

A delay of 2-3 years without overspend translates into a 21%-33% decline in NPV, or a loss of $269-$385 million, respectively. A similar delay with typical overspend (33%) translates into losses of $368-$475 million.

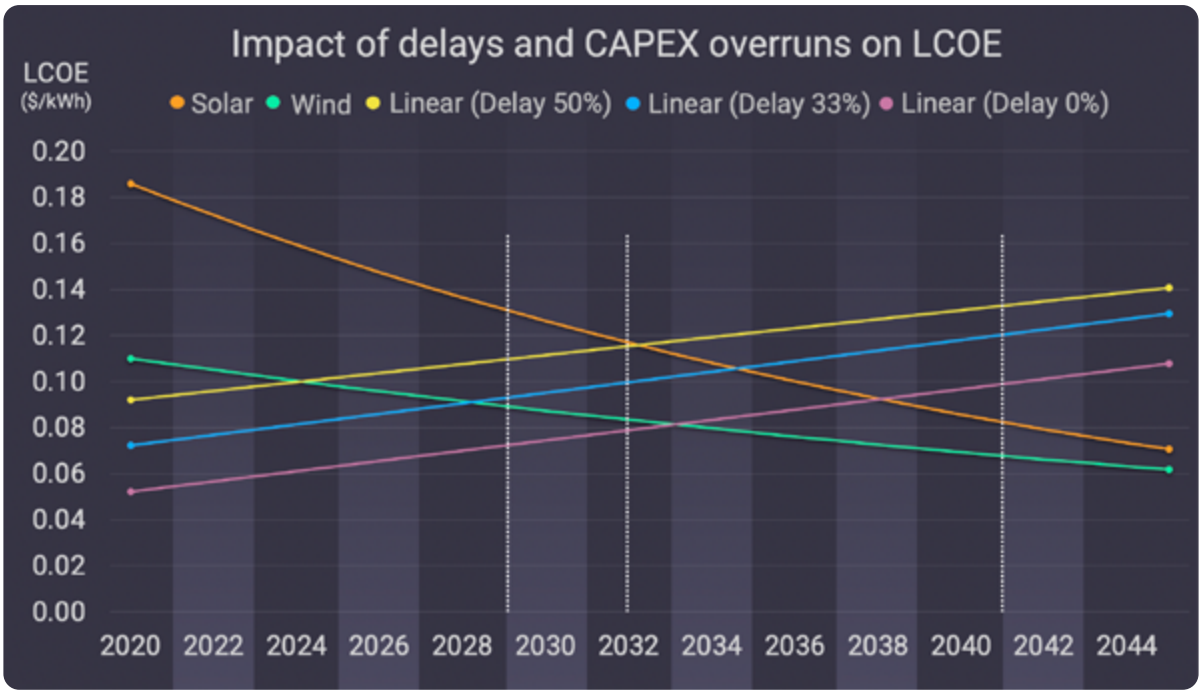


Graph 1. Created by TMP Public

LEVELIZED COST OF ELECTRICITY (LCOE)

The investment case for Pak Lay appears to be weak, particularly when compared to alternative energy investments available in Laos. We demonstrate the commercial superiority of local solar and wind projects by comparing the LCOE of Pak Lay with representative local values.

The graph below shows how the competitiveness of Pak Lay deteriorates in proportion to delay. In 2029, the original start date, the dam will be cheaper than wind, if not solar. But by 2032, solar is cheaper (2%) without overspend. If we assume Pak Lay also experiences budget overruns that are typical for hydropower (33%[8]), then the dam will be 26% more expensive than solar in 2032, and wind will be competitive. If the project is delayed to 2041, the electricity will be 70% 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.[9] Pak Lay has not yet secured a power purchase agreement (PPA) and so is at considerable risk due to these volatile and unpredictable conditions.[10]

There is no obvious need for further injections of energy capacity in Thailand. Pak Lay 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 Pak Lay could join several examples of energy projects in emerging markets that have been so hamstrung.[11]

3. ENVIRONMENTAL RISK ASSESSMENT

This section summarizes environmental risks for Pak Lay, which undermine the investment case for the dam. The environmental risks associated with large hydropower are so concerning from a financial and ecological perspective because they are hard or impossible to manage or avoid. Resulting controversies and measures taken by developers to deal with them hamper implementation and increase costs.

The results below suggest that biodiversity risks are significant and likely to drive delays. Our qualitative investigation confirms that biodiversity impacts may be severe and have been systematically underestimated by backers of Pak Lay.

INDICATOR	SCORE			COMMENT
	DAM	RIVER	DISTRICT	
Water Scarcity	57	59	59	Laos is water-rich, but scarcity could still be an issue as reflected in recent droughts. Climate change will exacerbate this vulnerability.
Sediment Flux	92	92	96	Local sediment flow is extremely poor and will be further affected, which could damage biodiversity, fisheries, farms and water quality downstream.
Species Richness	93	89	94	This area is very rich in biodiversity. The whole river is a Key Biodiversity Area (KBA), which is threatened by Pak Lay and unprotected officially.
Inter-Annual Variability	11	10		This low variability is typical in tropical regions but may now be upset by climate change.
Upstream Drainage	94	92	9	The area immediately around the dam is poorly suited for catching rain and providing water downstream.
Protected Areas			21	This low score suggests little conservation near the dam. This increases local biodiversity risks.
% Irrigated Cropland			51	The high number represents low levels of cropland: dams have greater problems in remote areas relatively untouched by development.
Drought Severity			22	This score is based on historical data. The recent drought suggests future challenges.

BIODIVERSITY

At least 167 fish species, including several endangered species, inhabit the stretch of the Mekong where Pak Lay will be built.[12] Yet, the project has not undertaken sufficient studies on impacts, let alone measures to mitigate them.[13] Expected sediment flushing threatens downstream habitats and aquatic invertebrates, but Pak Lay has not provided a set of water quality and aquatic monitoring protocols or a comprehensive baseline assessment of aquatic habitats.[14] Independent reviews have recommended multiple additional studies be undertaken, which will add to delays and weaken the commercial case for the dam.

CLIMATE

Climate change and increasing droughts are likely to reduce the capacity factor of the dam. Pak Lay has not comprehensively considered these impacts of climate change or the effects of upstream dam development.[15]

Dams in the tropics, like Pak Lay, are not necessarily low carbon: eutrophication in their reservoirs can lead to methane emissions.[16] Eutrophication is already a problem in the Mekong region.[17] Pak Lay will also drive climate change via deforestation, including clearing 14km^2 of forest before we even consider ancillary infrastructure in an area where deforestation is already prevalent.[18]

CUMULATIVE ENVIRONMENTAL IMPACTS

The Upper Laos Cascade[19] will transform the Mekong River in Northern Laos from a free-flowing river into a regulated cascade of reservoirs. This could lead to a 20%-30% loss of local fish species and will block long distance migratory species, which would be catastrophic environmentally.[20] Alarmingly, the Pak Lay transboundary and cumulative impact assessment was largely plagiarized.[21]

A woman panning for gold on the Mekong River near the proposed Pak Lay dam site in Laos. Photo by International Rivers

4. SOCIAL RISK ASSESSMENT

This social assessment of Pak Lay focuses on three key drivers of social risk: resettlement, food insecurity, and social conflict.

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

INDICATOR	SCORE			COMMENT
	DAM	RIVER	DISTRICT	
% Deprived: Sanitation	40		38	Local people do not lack access to basic services and similar government support.
% Deprived: Drinking Water	31			Local people have access to the most basic services and are not desperately deprived, which reduces the chance of frustration, dispute, or opposition.
% Deprived: Schooling	44			
Multidimensional Poverty Index	62			Extreme socio-economically vulnerability increases the risk of dispute. As people worry that developments put them at risk.
Vulnerability to Poverty	81			Project-related disruptions could tip local people into severe poverty, increasing the risk of dispute significantly.
Population Density		66		These high scores suggest low population densities. This remote area has little experience with development and is higher risk as a result.
Night Lights		65		

RESETTLEMENT

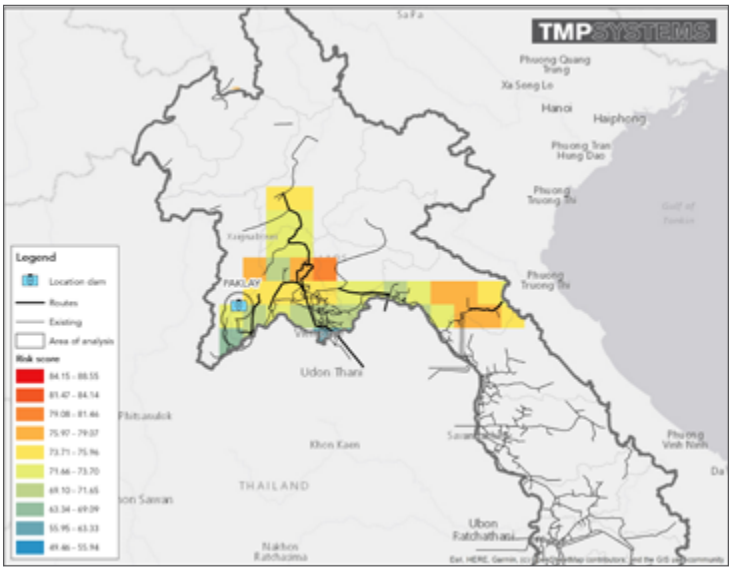
Pak Lay is expected to relocate 4,852 people, but 23,306 people are expected to be directly or indirectly affected by the project.[22] Our analysis[23] indicates this figure could be as high as 82,007.[24]

A small proportion of these people will be forcibly displaced physically but many may be displaced economically. PowerChina Resources Limited has a history of poorly managed resettlement processes (e.g. Nam Ou Cascade[25]), and so people affected by Pak Lay will likely face similar challenges. Pak Lay's compensation and resettlement costs are $162 million short of adequate compensation, according to IFC-type standards and our own calculations.

Transmission lines could drive further displacement and conflict, which may also contribute to overall project delays. Our risk score of the potential transmission lines was extremely high (see map overleaf),[26] which suggests that dispute and possible delay are likely (e.g. north of Vientiane).

FOOD INSECURITY

Pak Lay will likely have significant impacts on aquatic ecosystems, habitats, and fisheries. The MRC estimates that between 40,000-60,000 metric tons/year of fish are caught in the region of Pak Lay, which reflects a considerable reliance on fishing in the project area. Project documents do not account for the likely impacts of Pak Lay for the livelihoods and food security of people derived from the Mekong mainstream and down to the delta.[27]



Map created by TMP Public

SOCIAL CONFLICT

Pak Lay will likely employ a majority Chinese labor force, which could trigger cultural conflicts.[28] Large migrant workforces also create health risks for vulnerable local and indigenous communities. This potential "boomtown effect"[29] is often combined with the spread of infectious diseases (e.g COVID-19). An outbreak could heighten tensions between cultural groups and lay the groundwork for further conflict.

CUMULATIVE SOCIAL IMPACTS

The Upper Laos Cascade will affect food security at a local and regional level by transforming an 800km stretch of the Mekong into a series of lakes and inundating at least 84km^2 of agricultural land. Entire districts in the region could face food insecurity for more than 6 months of the year due to resulting impacts on fisheries. [30] Concerns about the cumulative impact of Pak Lay and the Upper Laos Cascade have already been raised many times by Vietnam, Cambodia, and Thailand, as well as various CSO and community groups.[31]

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 both 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 Pak Lay. There are already good examples of utility-scale solar projects in Laos.[32] There may even 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.

The Mekong is an important transport route for local people. Photo by International Rivers

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 also more spatially efficient than hydropower[33], 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[34] 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.[35] The decentralized 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.[36]

6. SUMMARY AND RECOMMENDATIONS

Pak Lay does not make sense on commercial, economic, or social grounds. Current plans are expensive and have an unacceptable environmental cost. Pak Lay is unlikely to operate until 2032, at which point it will be 26% 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 Pak Lay is 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 to stimulate the sector.

RECOMMENDATIONS FOR FINANCIERS AND INVESTORS:

- **Review the investment case for Pak Lay 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 the Riverscope. Compare the investment case for Pak Lay to alternatives.
- **Demand higher social and environmental standards from developers.** Work with PowerChina Resources Limited and China National Electronics Import-Export Corporation 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 Pak Lay 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.

ENDNOTES

1. https://www.mrcmekong.org/assets/Uploads/01.1-Executive-Summary.pdf
2. https://ejatlas.org/conflict/pak-lay-dam
3. https://www.mrcmekong.org/assets/Uploads/01.1-Executive-Summary.pdf
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6. https://www.waterpowermagazine.com/features/featurehydropower-and-the-impact-of-covid-19-7929537/
7. For example, Myanmar's 151MW hydropower project in Yangon was brought to a halt by the travel ban and closed factories https://www.hydroreview.com/2020/03/09/coronavirus-may-significantly-delay-hydro-project-construction/
8. https://www.tandfonline.com/doi/full/10.1080/07900627.2019.1568232
9. https://www.iea.org/reports/electricity-market-report-december-2020/2020-regional-focus-southeast-asia
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15. https://www.mrcmekong.org/assets/Consultations/Technical-Review-Report_Pak-Lay-Project.zip
16. Hydropower, dam reservoirs lead to eutrophication through the build-up of nutrients, promoting excessive algal growth and oxygen-depleted waters. The further decomposition of this algae in addition to the plants and trees in the inundation area, result in both methane and carbon emissions, respectively.
17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4701190/
18. https://www.mrcmekong.org/assets/Uploads/3.2-Paklay-EIA-Jan-2018.zip
19. This includes the existing Xayaburi dam and planned Sanakham, Luang Prabang, Pak Beng, Pak Chom and Pak Lay dams.
20. https://icem.com.au/documents/envassessment/mrc_sea_hp/SEA_Final_Report_Oct_2010.pdf

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21. https://www.mrcmekong.org/assets/Consultations/Technical-Review-Report_Pak-Lay-Project.zip
22. https://www.mrcmekong.org/assets/Consultations/Technical-Review-Report_Pak-Lay-Project.zip
23. Our analysis used the Gridded Population of the World (GPWv4)
24. MRC TRR found that the SIA data appeared to be wrong in a number of places (for example, the same number of people are reported in different affected areas) and inconsistent in other places (for example, 12 or 20 downstream villages are included as affected). https://www.mrcmekong.org/assets/Consultations/Technical-Review-Report_Pak-Lay-Project.zip
25. https://www.rfa.org/english/news/laos/struggle-01092020131031.html ; https://www.rfa.org/english/news/laos/struggle-01092020131031.html
26. See full scores breakdown in the full report at www.riverscope.org.
27. https://www.mrcmekong.org/assets/Consultations/Technical-Review-Report_Pak-Lay-Project.zip
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33. 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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35. vol_3_ies_mke_lao_pdr_wwf_power_sector_vision_20160321_final_r4.pdf (d2ouvy59p-0dg6k.cloudfront.net)
36. http://wvfoodandclimate.com/home/portfolio-2/energy/solar-energy/

Cover Image: The Mekong River at Pak Lay. Photo by International Rivers.