

What is the Dam Worth?

How Cambodia Came to Build an Internationally Unpopular Dam

Introduction

The year is 2013. Sreypich works for the Royal Government of Cambodia in the Ministry of Mines and Energy. She was recently reassigned to a project her boss is very excited about: building a large Hydropower dam on the Sesan River. Plans for the dam have been in the works for decades, but she is told the reports are finished and funding is secured, so it looks like the project should be able to start soon. Sreypich's role is to liaise with the different stakeholders in this project and report to her boss the "important" information. Sreypich is not quite sure what her boss considers "important," as she only just came into the role, and already her phone has been ringing almost off the hook with both demands to hurry the project along and to immediately halt the project. All of these callers claim to be stakeholders central to the project. Without giving too much information, Sreypich listened to these callers and took careful notes. Now she needs to organize her notes and decide what to include in the report to her boss. She also needs to give a recommendation as to how to proceed with the project.

Background

The proposed Lower Sesan II dam is to be built in Stung Treng province's Sesan district, just below where the Sesan and Srepok rivers meet. While Cambodia has been interested in building hydropower dams for decades, this particular dam was originally proposed in the 1990s by the Asian Development Bank. However, the ADB dropped out after their 1999 report on the project's viability indicated the project would cause more harms than benefits¹. Yet the Cambodian government was still keen on building the project, and later found support from Vietnam's EVN International Joint Stock Company (henceforth referred to as EVN).² Cambodia officially approved the Lower Sesan II dam in November 2012, and later on became a joint venture between Cambodia's Royal Group and China's Hydrolancang International Energy, with Vietnam retaining a minor stake.³

¹ Coren, Michael. "Yali Falls: Cambodia appeals to Vietnam." *The Phnom Penh Post*. November 21, 2003.
<https://www.phnompenhpost.com/national/yali-falls-cambodia-appeals-vietnam>

² Kunmakara, May. "Dam in Sesan Begins Operations." *Khmer Times*. December 18, 2018.
<https://www.khmertimeskh.com/560364/dam-in-sesan-begins-operations/>.

³ Trandem, Ame. "Lower Sesan 2 Dam." *BankTrack*. October 6, 2016.
https://www.banktrack.org/project/lower_sesan_2_dam#.

This case has been written by Alta Alonzi, Deepakshi Rawat, and Lin Yuying under the guidance of Dr Selena Ho, Lee Kuan Yew School of Public Policy, National University of Singapore. This case is based largely on actual events with characters and proceedings altered for the purposes of this case study. The case does not reflect the views of the sponsoring organization nor is it intended to suggest correct or incorrect handling of the situation depicted. The case is not intended to serve as a primary source of data and is meant solely for class discussion.

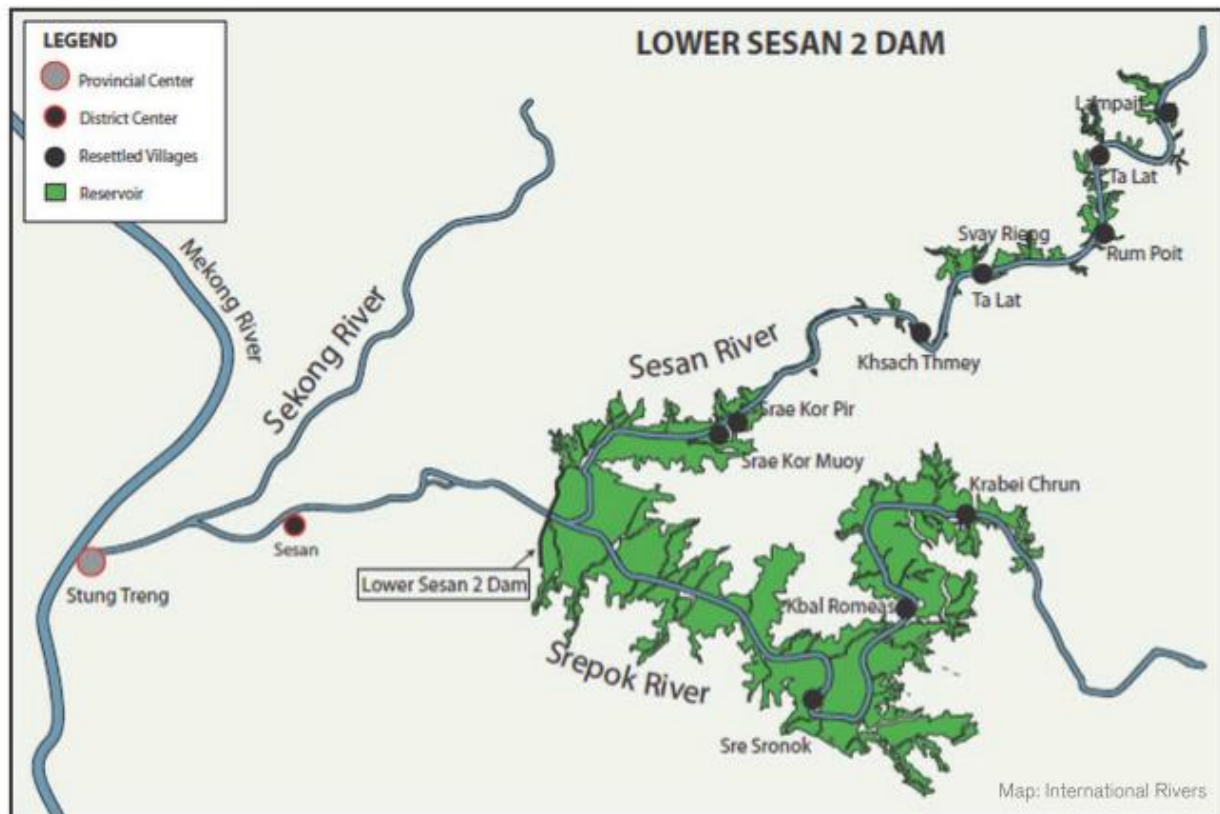


Fig 1: Location of Lower Sesan 2 Dam. (Source: Environmental Justice Atlas)

The dam is estimated to cost some USD \$800 million. The dam, upon completion, would be one of the biggest hydropower dams in the country. Cambodia faces high levels of energy shortage and is highly reliant on energy imports. According to figures from the Electricity Authority of Cambodia, the country imported 2104 GWh of electricity in 2012⁴. The proposed 400 MWh⁵ dam is projected to ease the import burden by contributing to almost 20% of the country's total electricity output, according to the Ministry of Mines and Energy.⁶ However, Sreypich has come across some troubling reports as well. In order to build the dam, tens of thousands of people living along the proposed dam site will need to be displaced from their homes.⁸ Furthermore, many of the affected people will also lose access to migratory fish which is a major source of their livelihood. There also seem to be a massive detrimental impact on the environment. According to various reports, the dam would lead to loss of biodiversity due to a predicted 6%-8% decrease in river sediment.⁹

⁴ General Department of Energy and General Department of Petroleum, Ministry of Mines and Energy of Cambodia. "Cambodia National Energy Statistics 2016". October 07, 2016.

<https://www.eria.org/publications/cambodia-national-energy-statistics-2016/>

⁵ One GWh is 1000 MWh

⁶ Kunmakara, May. "Dam in Sesan Begins Operations." Khmer Times. December 18, 2018.

<https://www.khmertimeskh.com/560364/dam-in-sesan-begins-operations/>.

⁷ The total energy consumption in Cambodia in 2012 was 2917 Ktoe.

⁸ Trandem, Ame. "Lower Sesan 2 Dam." *BankTrack*. October 6, 2016.

https://www.banktrack.org/project/lower_sesan_2_dam#

⁹ Ibid

Here is what Sreypich has compiled so far based on her notes and outside research on each stakeholder. As someone completely new to this project, Sreypich also does some research on the history of this project.

Stakeholders,¹⁰ Problems, and Policy Options

International Financing Institutions

Since 2007, Cambodia has been working with Vietnam on this project. Vietnam Electricity (EVN) in collaboration with the Cambodian Ministry of Mines and Energy was conducting a comprehensive feasibility study and environmental impact assessment. Furthermore in 2011 the Vietnamese Ministry of Planning and Investment had approved US\$816 million for EVN to invest in the dam.¹¹ However, Sreypich has already heard rumors that the Vietnamese are planning to withdraw. And yet, Sreypich's boss is not worried. Apparently, China is interested in investing in the project under their new upcoming Belt and Road Initiative (launched formally in 2013). The company Hydrolancang International Energy, under China Huaneng Group, have engaged in high-level talks with the higher-ups in Cambodia on this issue.

The Asian Development Bank, while no longer interested in financing the project, are still semi-regularly in contact, and some of the Bank's representatives have been helpful in forging Cambodia's partnerships with both EVN and Hydrolancang International Energy. However, after the large floods in Cambodia resulting from the Yali Falls dam in Vietnam, international INOs and watchdog groups have raised questions about why the ADB did not warn Cambodia¹² of this possible risk while ADB was supporting the project.

Consultancy Firms

Sreypich tried to read the reports written by the Swedish and Norwegian consulting firms SWEKO International and Statkraft Engineering¹³. However, to be completely honest, the reports were long, highly technical, and largely in English. Sreypich, with no engineering background and at the same time juggling other projects, gave up on reading the reports in their entirety. However, the representatives of these companies are knowledgeable and have been helpful in answering many of Sreypich's questions about dams and the planning process. Still, sometimes these representatives also seem to be giving her a sales pitch on how they can assist in the actual implementation, which makes Sreypich question if these representatives truly have no vested interest in this dam being built. They have also been very blasé on answering her questions concerning environmental impacts.

¹⁰ Unless otherwise indicated, stakeholder information is largely based on analysis provided by Mathur, Vikrom, Mak Sitrith, and Joakim Öjendal. 2000. "Assessing Environmental Governance in the Lower Mekong River Basin: A Study of the Hydropower Site Selection Process in the Se San and Sre Pok Basins." *NGO Forum*. 2000. http://pdf.wri.org/mekong_governance_mreg_mathursitrithojendal.pdf.

¹¹ Trandem, Ame. "Lower Sesan 2 Dam." *BankTrack*. October 6, 2016. https://www.banktrack.org/project/lower_sesan_2_dam#.

¹² Coren, Michael. "Yali Falls: Cambodia appeals to Vietnam." *The Phnom Penh Post*. November 21, 2003. <https://www.phnompenhpost.com/national/yali-falls-cambodia-appeals-vietnam>

¹³ Mak Sitrith, and Joakim Öjendal. 2000. "Assessing Environmental Governance in the Lower Mekong River Basin: A Study of the Hydropower Site Selection Process in the Se San and Sre Pok Basins." p. 12. *NGO Forum*. 2000. http://pdf.wri.org/mekong_governance_mreg_mathursitrithojendal.pdf.

International Press

Sreyepich has received many requests from reporters for information on the project. Cambodia ranks in the bottom 20th percentile for press freedom,¹⁴ and Sreyepich had been warned multiple times not to talk too much to reporters. Still, her boss is concerned that most of the press coverage of the dam is negative; journalists focus on the villager resettlement issues and environmental impacts. Negative press could potentially reduce the interest of tourists and investors from visiting and investing in the country. Even more broadly speaking, Cambodia has foreign policy goals of increasing diplomatic ties, prestige, and regional cooperation with ASEAN and beyond.¹⁵ Sreyepich has heard her boss attending meetings with consultants and other officials on the importance of increasing transparency - including press freedom - to achieve all of these foreign policy goals. However, there is also a strong instinct in the government to avoid publicly sharing details which may appear to show a lack of good governance or domestic disputes. The government also wishes to avoid the appearance of caving in to international demands.

Environmental Activists and NGOs

Ever since the Lower Sesan II Dam project was first proposed, there had been considerable opposition against it, especially from environmental experts and activists. Sreyepich was reminded every day by environmental activists that the Mekong River is one of the most diverse eco-systems in the world and is home to over 1200 marine species. Approximately 60 million people living in the Mekong Delta region depend on the fish and other seafood from the river for their livelihood and food security.¹⁶ The river, which is also the world's largest inland fishery plays a big role in the domestic and global fisheries and aquaculture market with annual catches valued at \$1.7 billion per year.¹⁷ Activists say this dam could irreparably damage this entire ecosystem.

Activists particularly object to the dam's location which would block the Sesan and Srepok Rivers, two of the largest rivers within the Mekong River Basin.¹⁸ The Sesan River is both an important route as well as breeding ground for migratory fish.¹⁹ Building the dam will impede fish migration between mainstream Mekong River and the Sesan and Srepok Rivers, leading to possible loss of fish species, thus affecting the basin's ecology. A journal in the Proceedings of the National Academy of Sciences of the USA also predicted that the dam could lead to approximately 9.3% loss of fish biomass in the basin and lead to the extinction of 50 species of fish.²⁰ Two of the largest NGOs strongly opposing this dam are International

¹⁴ "Cambodia." Reporters Without Borders. 2019. <https://rsf.org/en/cambodia>.

¹⁵ Sarith, Heng. "Cambodia's Foreign Policy Grand Strategy." *The Diplomat*. September 11, 2014. <https://thediplomat.com/2014/09/cambodias-foreign-policy-grand-strategy/>.

¹⁶ "Key Findings of NHI's Sambor Hydropower Dam Alternatives Assessment." *National Heritage Institute*. March 11, 2018. <https://drive.google.com/drive/folders/1ldxGigFOids-UUk1bKpTQdh2YvZd2HOa>.

¹⁷ Ibid

¹⁸ Trandem, Ame. "Lower Sesan 2 Dam." *BankTrack*. October 6, 2016. https://www.banktrack.org/project/lower_sesan_2_dam#.

¹⁹ "Lower Sesan 2 Dam." *Earth Rights*. <https://earthrights.org/what-we-do/mega-projects/lower-sesan-2-dam/>

²⁰ Ferrie, Jared. "In rush to electrify, Cambodia stirs the living and dead." June 2, 2018. *Reuters*. <https://www.reuters.com/article/us-cambodia-dams-electricity/in-rush-to-electrify-cambodia-stirs-the-living-and-dead-idUSKCN1IY01G>

Waters and Mekong River Watch. The Mekong River Commission has also expressed worries about this dam.

China

Starting from the early 2010s, Chinese influence in the lower Mekong Delta region has been steadily growing, especially through the financing of infrastructure projects. A large component of Chinese investment in the region, goes towards building hydropower dams.²¹

Chinese strategy in the Mekong Delta region is multi-faceted, connecting both the “Made in China” policy as well as the Belt and Road Initiative (BRI afterwards). The “Made in China” Policy focuses on using Chinese components for the construction of the dams. This includes using imported electro-mechanical equipment for the hydropower station from China. The design, construction, equipment installation, and operational management of the plant are also guided by Chinese standards whereas Cambodia mainly contributes in provision of labour.²²

The construction of the dam took several years till 2018. In the process, China has continuously adjusted and regarded this dam as a focus of cooperation between China and Cambodia. Energy cooperation is one of the key areas of the BRI. The regional focus of the BRI energy cooperation mainly includes promoting the connection with key areas in Southeast Asia and South Asia, taking the experience to other areas in the future. Through energy investment, China will build infrastructure such as power grids, oil and gas pipelines and hydroelectric dams to strengthen energy security for Southern China and Cambodia.²³ Hydrolancang is one of the biggest energy and power group in China. The company had participated in many BRI infrastructure projects with the aim of promoting international cooperation in the field of energy and power.²⁴ As of 2019, Cambodia was not able to meet electricity needs through domestic production, and needed to import about 1.583 billion kWh in 2016 according to the Central Intelligence Agency World Factbook,²⁵ mainly from Thailand, Vietnam, and, to a lesser extent, Laos. The Lower Sesan II project will aid in increasing domestic power supply in Cambodia and significantly reduce the cost of local electricity consumption. Furthermore, under the BRI cooperation framework, China and Cambodia have cooperated on numerous projects in five key areas (tourism, infrastructure, energy cooperation, financial innovation, and policy interaction). Therefore, the construction

²¹ Cronin, Richard P. “China and the Geopolitics of the Mekong River Basin: Part I.” March 22, 2012. <https://www.worldpoliticsreview.com/articles/11761/china-and-the-geopolitics-of-the-mekong-river-basin-part-i>

²² “The dam is 6,500 meters long. China completes construction of Cambodia's largest hydropower station”. *Morning Post*. December 18, 2018. <https://translate.google.com/translate?hl=en&sl=zh-CN&u=https://beltandroad.zaobao.com/beltandroad/news/story20181218-916731&prev=search>

²³ Mao, Xiaobei. ““一带一路”倡议下 国际能源合作将进入全新时代.” *China Sankei News*. September 5, 2019. <http://wap.cnki.net/touch/web/Newspaper/Article/CJXW201809050080.html>.

²⁴ Ibid

²⁵ Central Intelligence Agency. Date unknown. The World FactBook: Cambodia. url accessed 1 March 2020. <https://www.cia.gov/library/publications/the-world-factbook/geos/cb.html>

of this dam will further aid in deepening strategic ties between Cambodia and China in the field of energy security.²⁶

Local Villagers

Local activists and villagers living in areas that would be flooded by the dam are especially concerned and vocal about this project. An estimated 5,000 people, largely of ethnic minorities, will need to be resettled as the reservoir is predicted to flood their villages and homes.²⁷ These villagers are not persuaded of the benefits of cheaper energy because they are suspicious this benefit will only impact the large cities, and that the electricity generated will not meet their basic food needs. Some villages upstream would also have to be moved entirely, leaving the homes of their ancestors to be flooded by the dam's reservoir. Some of these villagers managed to contact Sreypich and directly share with her their troubles. A few were angry, a few cried, but all were worried about their future and distraught at the thought of uprooting their lives and leaving their homes for some place they had never been before. Many who called also swore they would refuse to move, and were unimpressed by or doubtful of the government's promised relocation and renumeration plans. Beyond those 5,000 people, thousands more living downstream of the proposed dam, while not required to move, are also up in arms because fishing could be put at risk, which would affect both their livelihoods and basic access to food. Some of these villagers have also contacted Sreypich with questions of how the dam will impact them and how the government plans to compensate them for their losses.

Maintaining trust and high regard among citizens is important for Cambodia's political leaders. The government had in fact halted dam projects in the past due to local criticism.²⁸ The government is also concerned about domestic unrest and its possible ramifications in public opinion and foreign policy including prestige and ability to attract international tourism, aid, and investments.

Royal Government of Cambodia

Sreypich knows how badly her government wants large, cheap sources of energy. Living in the big city, Sreypich is directly impacted by the price and availability of electricity. She also knows that the city is growing, and so are energy demands; experts estimate the country's electricity needs will increase every year by nearly 10% through 2020²⁹. Her boss is very concerned about meeting these needs. This is in part to maintain the support of the people, but also for practical reasons. The government wants to build bigger, more technically-advanced hospitals, but these facilities require constant access to the grid. Other plans

²⁶ Hensengerth, Oliver. "Regionalism, Identity, and Hydropower Dams: The Chinese-Built Lower Sesan 2 Dam in Cambodia." *Journal of Current Chinese Affairs* 46, no. 3 (December 2017): 85–118. doi:10.1177/186810261704600304.

²⁷ Gyorvary, Sabrina, Suk, Wora, and Medallo, Jocelyn Soto. "Cambodian Village Now Fully Submerged by Lower Sesan 2 Dam." EarthRights International. February 2, 2018. <https://earthrights.org/media/cambodian-village-now-fully-submerged-lower-sesan-2-dam/>.

²⁸ Pye, Daniel and Seangly, Phak. "Dam route blocked." *The Phnom Penh Post*. March 17, 2014. <https://www.phnompenhpost.com/national/dam-route-blocked>

²⁹ "National policy, strategy and action plan on energy efficiency in Cambodia." *The Ministry of Industry, Mines and Energy*. 2013. http://www.euei-pdf.org/sites/default/files/field_publication_file/EUEI_PDF_Cambodia_Energy_Efficiency_May2013_EN.pdf

including building more schools, improving business and tourism, as well as promoting internet access all rely on steady, inexpensive, and readily available energy.

However, Sreypich has also noticed something interesting about the decision-makers in her department. They are largely all very knowledgeable and are supporters of dams. Their knowledge is unsurprising; after all, Cambodia has been interested in building dams since the 1960s, and already had a number of smaller dams built³⁰, as well as thousands of pages of documentation for future proposed dams. However, they seem to lack much knowledge or even interest in non-dam energy sources. One of the higher-ups even sounded vaguely dismissive of alternatives like solar panels instead of another dam. These decision-makers have seen China, Laos, Vietnam, and Thailand all build dams³¹ and make money from selling the power generated and seem to want to follow this trajectory. This is in spite of the fact that, being downstream of many of these dams, Cambodia has experienced negative side effects including decreased water supply and increased flooding (Exhibit 2).

Epilogue

Even after reviewing all of her notes, Sreypich is still not sure what to think of this proposed dam. There are clear benefits to her as a Phnom Penh resident in terms of cheaper, more plentiful energy as well as economic development, but she is also swayed by the plight of local villages and the environment. And there are so many people and details involved that she is not sure how she could possibly summarize all their perspectives for her boss. In the end, Sreypich knows her boss wants the dam to be built and that the environmental impacts seem vague and hard for her to convince her boss otherwise, who was clearly a supporter of dams. She sends in a report that focuses on the economic development benefits and lightly summarizes the known cons of the project. Her boss is happy, and the Lower Sesan II dam project is eventually approved.

Sreypich felt some misgivings over her decision not to offer dissenting information regarding the dam's approval. Yet, years pass, and with her boss's support she is eventually promoted within the department. On December 17, 2018, the Lower Sesan II dam is officially inaugurated. An official report says that all the villagers were successfully relocated, and they are even better off.³² However, Sreypich has only read the report but has not seen this new village for herself. Overall, the official launch of the dam was received positively by Cambodian media outlets.^{33 34} At the same time, the dam has generated significantly

³⁰ "Mekong Mainstream Dams." International Rivers. <https://www.internationalrivers.org/campaigns/mekong-mainstream-dams>

³¹ Thanthong-Knight, Randy. "Thailand Aims to Be Southeast Asia's Power-Trading Middleman." Bloomberg. August 26, 2019. <https://www.bloomberg.com/news/articles/2019-08-25/thailand-wants-to-be-southeast-asia-s-power-trading-middleman>

³² Danapal, G. "Families No Longer Displaced by Dam." *Khmer Times*. May 7, 2018. <https://www.khmertimeskh.com/487015/families-no-longer-displaced-by-dam/>.

³³ Koemsoeun, Soth. "Lower Sesan II Dam Opens." *The Phnom Penh Post*. December 18, 2018. <https://www.phnompenhpost.com/national/lower-sesan-ii-dam-opens>.

³⁴ Kunmakara, May. "Dam in Sesan Begins Operations." *Khmer Times*. December 18, 2018. <https://www.khmertimeskh.com/560364/dam-in-sesan-begins-operations/>.

negative international press over the years.^{35 36 37} Even some domestic press stories have been critical,³⁸ with one piece in particular showing dramatic visuals of the before-and-after dam landscape from space (Exhibit 2).³⁹ Both international and domestic pressures on building dams have also increased in recent times after a major dam collapse in Laos caused the deaths, injuries, and homelessness of thousands.⁴⁰

Now, Sreypich faces a new challenge: a few years after approving Lower Sesan II, her government also proposed an even larger new dam at Sambor, also financed by China. The three-year environmental report her government commissioned⁴¹ came out months ago but was quickly put under wraps. Sreypich was asked to write another report to her boss, this time on the Sambor dam. Sreypich read the 600-page environmental report and was shocked by its contents: all the negative environmental impacts of the Lower Sesan II, but much more and much worse. Plus, the Mekong River Irrawaddy dolphin, an endangered species found in Cambodia and important both to the ecosystem and to tourism, may completely die out due to this dam.

However, this report is not all negative. The report includes alternative assessments with detailed plans of other energy solutions. The report especially promotes floating solar photovoltaics set on the lake formed by the Lower Sesan II dam as an option that is far superior to Sambor or any other dam in terms of cost, energy output ratio, environmental impact, impact on fisheries, and timeframe (Exhibits 4 and 5).⁴²

Around the same time Sreypich is researching this report, part of the document is leaked, prompting new rounds of phone calls to Sreypich's office from various stakeholders. In this contentious environment, Sreypich again is unsure how to proceed. Should she once again avoid making waves in her department, and write a report encouraging her boss to approve the project like last time? Or should she risk her boss's ire by speaking out against the dam, possibly looking like she is giving in to outside pressure? And even if she does criticize the dam, has the domestic context and stakeholder positions changed enough since the Lower Sesan II dam that Sreypich can effectively convince her boss and her government to end the project?

³⁵ "Negative Impacts of the Lower Sesan 2 Dam on Cambodia." *Mekong Watch*. November 12, 2015.

http://www.mekongwatch.org/platform/bp/supplement/english-LS2_20151112.pdf.

³⁶ Osborne, Milton. "A Bad Dry Season on the Mekong." *The Lowy Institute*. June 22, 2016.

<https://www.lowyinstitute.org/the-interpreter/bad-dry-season-mekong>

³⁷ Kaufmann, Amanda. "The Price of Power." *Globe_*. September 5, 2018. <https://southeastasiaglobe.com/an-alternative-to-catastrophic-hydropower-in-cambodia/>.

³⁸ Saroeun, Bou and Carsten Stormer. "Cambodia Ignored in Dam Environmental Study." *The Phnom Penh Post*. March 17, 2000. <https://www.phnompenhpost.com/national/cambodia-ignored-dam-environmental-study>.

³⁹ Sassoon, Alessandro Marazzi. "Before and After Satellite Images Show Extent of Sesan Dam Impact." *The Phnom Penh Post*. February 26, 2018. <https://www.phnompenhpost.com/national/and-after-satellite-images-show-extent-sesan-dam-impact>.

⁴⁰ Ariffin, Ejas. "Are Cambodia's Hydropower Plans Risky?" *The ASEAN Post*. February 5, 2019.

<https://theaseanpost.com/article/are-cambodias-hydropower-plans-risky>.

⁴¹ Thomas, Gregory et al. "Key Findings of NHI's Sambor Hydropower Dam Alternatives Assessment." *National Heritage Institute*. March 11, 2018. <https://drive.google.com/drive/folders/1IdxGigFOids-UUk1bkpTQdh2YvZd2HOa>.

⁴² Ibid.

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Fig 1: Map of Lower Sesan 2 Dam

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Exhibits

Exhibit 1

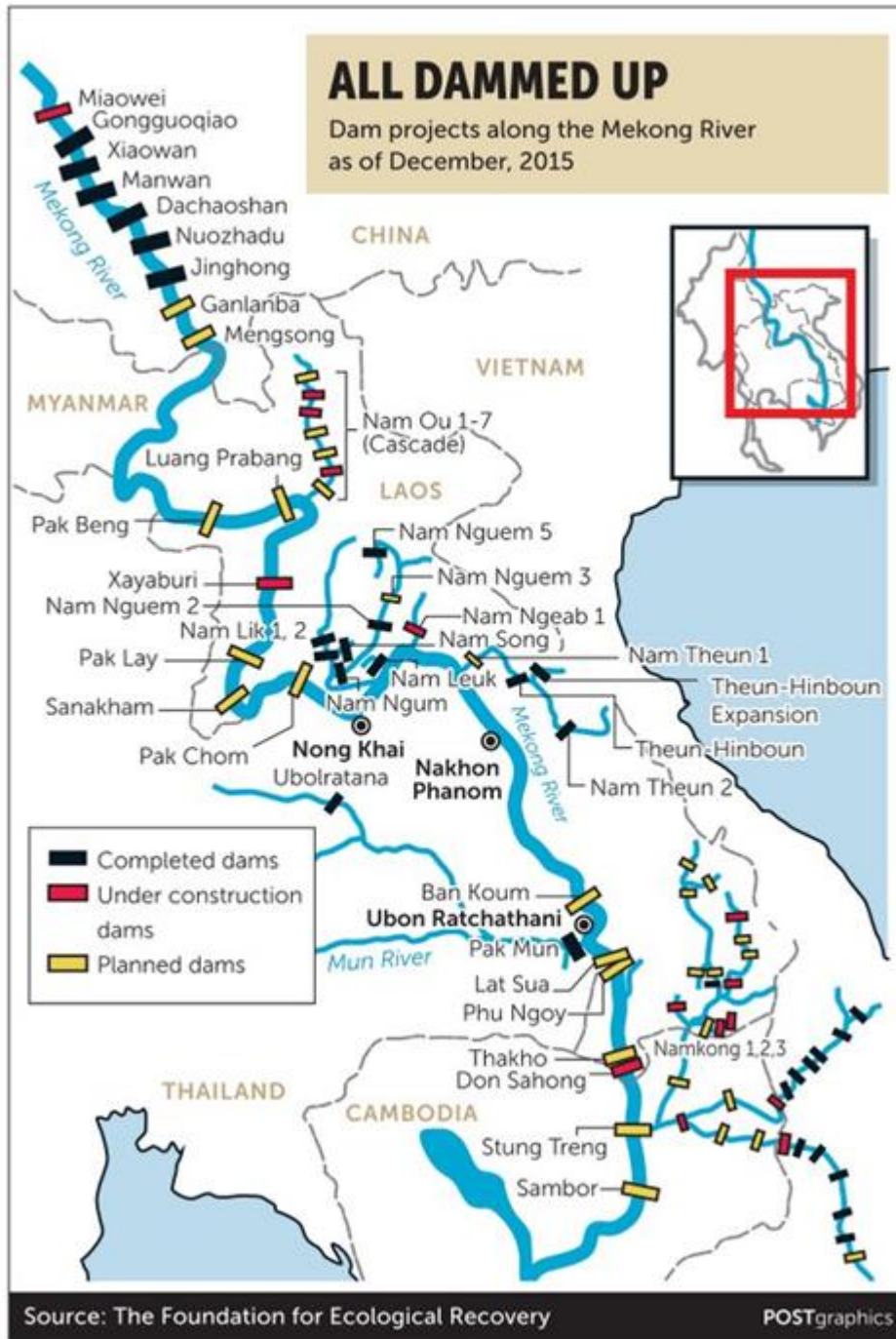


Exhibit 2

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Exhibit 3

Largest Dams in Cambodia by Production Capacity

Name of Dam	Year of Completion
Kirirom I (12MW)	2002
Kamchay (193MW)	2011
Kirirom III (18MW)	2013
Stung Atai (120MW)	2013
Lower Russei Chrum (338MW)	2013
Stung Tatai (246MW)	2014
Lower Sesan II (400MW)	2019

Source: Electricity Authority of Cambodia

Exhibit 4**Table 1: Key results of NHI Sambor Alternatives Assessment.**

Alternative	Result	Reason
1. Small dam on side channel (Alt. 6A)	Not <u>financially</u> feasible	Dam backs up water into main channel so not enough water goes through turbines
2. Large dam on main channel (Alt 7A) with all mitigation measures including fish screens	Not <u>financially</u> feasible	Large costs of the fish screens
3. Large dam on main channel (Alt. 7A) with all mitigation measures except fish screens	Not <u>economically</u> defensible	Large damage costs to migratory fishery
4. Floating solar PV at Lower Se San 2	<u>Outperforms</u> dam options on every criteria including cost	Sharp decline in costs relative to hydro, no impacts on fishery

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Exhibit 5

FLOATING PV vs. MAINSTREAM HYDRO	LARGE HYDRO	FLOATING SOLAR PV
Construction time	6-8 years: consequently, very high costs of interest during construction (IDC).	Less than one year even for 400MW-scale projects. IDC negligible.
Geotechnical risks	Significant. Substantial risk of delay and construction cost increase.	None.
Impact of climate change	Likely to be negative (fewer but more intense storms means higher spill).	Likely to be positive (more sunshine hours and lower average cloud cover).
Cost trends	Mature technology. Little scope for future cost decreases.	The costs of PV components continue to decrease. Staged development allows exploitation of lower costs.
Environmental impacts	Potentially catastrophic. Very high risk, with the performance of mitigation options themselves subject to high uncertainty.	None. Completely avoids all fishery damage and sediment impacts.
Relocation and resettlement	Upwards of 20,000 persons will need to be resettled. Inevitably controversial.	None.
Environmental clearance	Difficult, expensive and time consuming. Subject to intense opposition from NGOs and delay.	Straightforward. Small likelihood of change to water quality.
Implementation issues	Likely to be hugely controversial with major disruptions during construction.	Uncontroversial.

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<https://drive.google.com/drive/folders/1IdxGigFOids-UUk1bkpTQdh2YvZd2HOa>.