Strengthening Climate Resilience of the Lao People's Democratic Republic (PDR) Health System

Annex 10: Economic and Financial Analysis

***Note*: this analysis was initially produced when this project was intended for PAP submission. It has been updated to reflect the SAP submission, but not against the final budget. The budget figures in the analysis are, therefore, outdated. As an EFA is not required for a SAP proposal, we have not updated it to match the final budget; however, we have included it as it shows a strong rationale for GCF investment.**

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Table of contents

1. Overview of the Economic and Financial assessment

We have carried out an economic and financial assessment, presented in the form of an integrated Cost Benefit Analysis (CBA). An integrated CBA is broad in nature, as it includes indicators that are relevant to the projects (e.g. investment, O&M costs, revenue creation) -financial assessment- as well as to society, even if these are not directly connected to the investment and its performance (e.g., improvement of human health) -economic assessment-.

The assessment includes the calculation of the financial Internal Rate of Return (IRR), Net-Present Value (NPV), and Benefit-to-Cost Ratio (BCR) of selected investment options. We also carry out an economic analysis, which includes the value of externalities. In this case we add an "S" (for societal, or sustainable) to the IRR, NPV and BCR.

For this assessment we consider investments in health facilities or the adoption of infrastructure/equipment both for (i) a fixed unit (e.g. one health facility) and (ii) for the amount of funding requested in 3 specific activities (activity 3.2.2, 3.2.3 and 3.2.4). We also consider the impact of an investment over its lifetime (e.g. 10 years).

Nine investments have been analyzed. This analysis should be interpreted as indicative of the likely impacts of the project as designed; on the other hand, observed outcomes may differ from the estimates presented in this report.

Overall, we find that an investment of approximately USD 10.3 million results in revenue generation for of USD 47.2 million, avoided cost of externalities of USD 17.2 million and an NPV of USD 14.3 million. The S-NPV, which includes externalities (economic analysis) reaches USD 21.9 million.

Concerning specific investments, the results are positive, indicating that the investments are economically viable with an average IRR of 52% and S-IRR of 88%. The only two exceptions are screened building, and latrines. However, it should be noted that these investments should not necessarily be economically viable from a financial perspective, since they are meant to improve the health of workers and patients, and hence generate intangible benefits for the investor. Also, investments like the undergrounding of transmissions lines may be more economically viable if applied in larger health centers.

Further, it is possible to note the size of the positive externalities generated, which is at times larger than the revenues generated by the project (e.g. for the strengthening of health centers, screened buildings and PV systems). This highlights the importance of considering the societal impacts of investments, in addition to the direct economic benefits these generate. When considering these additional, non-market impacts, all investments are economically viable (including screened building and latrines).

2. Economic and Financial analysis

2.1. Overview of the approach

An integrated Cost-Benefit Analysis (CBA) of seven interventions for LAO PDR was carried out to assess the extent to which investments are economically viable. Starting from the assumption of 1 item (such as one health facility being subject to the implementation of the investment), we have then customized the models to analyze the outcomes of each investment.

CBA is a "pre-investment tool" that can facilitate investment decisions (IFAD, 2015a). Since costs and benefits of investments often do not occur at the same time, with costs usually preceding benefits, the comparison is not straightforward, especially in the agricultural sector. The CBA can provide solid indicators to support decision-making as well as suggesting the best alternatives for different stakeholders, allowing to compare projects with one another using the same underlying framework of analysis.

In order to capture the full range of outcomes generated by a certain investment, we have expanded the boundaries of traditional CBAs, going beyond direct costs and benefits. In fact, the CBAs presented in this study can be considered "integrated" or "extended" in that they also include an economic valuation of indirect and induced project outcomes, often labeled as "externalities". The CBA, therefore, includes project investments and operation and maintenance cost, resulting in avoided costs (both tangible, like avoided cost of buying clean water or electricity, and intangible, such as the avoided costs of mortality). The CBAs provided in this assessment, therefore, estimate the societal value of the project, in alignment with the many benefits that climate-resilient and low emission projects generate.

We also calculated the net present value (NPV), the internal rate of return (IRR) of the project, and the benefit to cost ratio. The NPV can be defined as the sum of expected costs of the investment are deducted from the discounted value of the expected revenues (or benefits). When NPV is > 0 the project is considered viable. The IRR is defined as the discount rate (r) that produces a zero NPV. It represents the maximum interest rate that a project could face and still be profitable. The project is considered viable when IRR is > r. The benefit-to-cost ratio represents the ratio of the present value of benefits to the present value of costs over the period considered. If it is ≥ to 1 then the project is viable.

For each intervention various interest rates are considered (in this assessment, all the discount rates have been set to 10%, but they can be manually changed in the model).

2.2. Investment, resulting benefits and avoided costs

Data for calculating the investment (or project cost), benefits, and avoided costs of the various interventions were retrieved from grey literature and from a report of the Asian Development Bank (ADB, 2020). The full description of the methodology can be found in Annex I.

Table 1, Table 2, Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, and Table 9 show the monetary costs, benefits and tangible avoided costs, and intangible avoided costs of each intervention.

General strengthening of health centers – Lifetime: 30 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/health facility	30,000
O&M	USD/health facility	6,000
Intangible avoided costs		
Avoided impacts on human health (mortality)	USD/health facility	8,684
Increase in risk of mortality due to climate impacts	%	5%
Patients that are risk of mortality	%	5%
Personal annual average income	USD/person	2536
Average avoided years lost	years	10
Avoided impacts on human health (morbidity)	USD/health facility	1,737
Increase in risk of morbidity due to climate impacts	%	10%
Patients that are risk of higher morbidity	%	5%
Personal annual average income	USD/person	2536
Average avoided years lost	years	1
Added benefits and tangible avoided costs		
Water savings	USD/health facility	800.00
Water use	m3/year	10,000
Price of water	m3/USD	0.40
Water savings with efficiency retrofit measures	%	20%
Energy savings	USD/health facility	650.43
Electricity use	kWh/year	21,900.00
Price of electricity	USD/kWh	0.132
Energy savings with efficiency retrofit measures	%	22.5%
Avoided impact of climate damages to buildings and equipment (reconstruction costs + cost of furniture for a new center)	USD/health facility	8,356
Other data		
Number of patients	People	137

Table 1: General strengthening of health centers.

Screened buildings to reduce vector-borne diseases – Lifetime: 5 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/health facility	1,369.86
Economic cost of screening	USD/person	10.00
O&M	USD/health facility	0
Intangible avoided costs		
Avoided cost of vector borne diseases with screening	USD/health facility	1,359
global average economic cost of treating one person per year due to vector control diseases	USD/person	49.62
Avoided CO2 emissions from reduced electricity consumption (if electricity is produced from non-renewable sources)	USD/health facility	0.4417
CO2 emitted per kWh produced with fossil fuels	Tons of CO2 / kWh	0.0002
Avoided costs of CO2 emissions	USD / Tons of CO2	10
Added benefits and tangible avoided costs		
Energy savings	USD/health facility	24.09
Electricity use	kWh/year	1,825.00
Price of electricity	USD/kWh	0.132
Decline in energy costs with screening	%	10%
Other data		
people served per health service	People	27
Number of patients	People	137

Table 2: Screened building to reduce vector-borne diseases.

Climate proofing: implementation of passive and active design measures for building resilience - Lifetime: 20 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/health facility	2,650
The cost of implementing passive design measures, to achieve a minimum reduction of 20% in energy and water use in existing buildings, amounts to US$ 13.25 per m2	USD/m2	13.25
O&M	USD/health facility	132.5
% of O&M compared to capital costs	%	5%
Intangible avoided costs		
Avoided CO2 emissions from reduced electricity consumption (if electricity is produced from non-renewable sources)	USD/health facility	35
CO2 emitted per kWh produced with fossil fuels	Tons of CO2 / kWh	0.0002420
Avoided costs of CO2 emissions	USD / Tons of CO2	10
Added benefits and tangible avoided costs		
Water savings	USD/health facility	69
Water savings per m2	m3/m2	0.86
Price of water	USD/m3	0.40
Energy savings	USD/health facility	1,900.80
Energy savings per m2	kWh/m2	72
Price of electricity	USD/kWh	0.132
Other data		
m2 of a health facility	m2	200

Table 3: Climate proofing: implementation of passive and active design measures for building resilience.

Climate proofing: undergrounding of transmission lines - Lifetime: 20 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/health facility	389,499
Cost of converting overhead distribution lines to underground ones per km (urban areas only)	USD/km	389,499
Assumed number of km to reach the first transmission node	km	1
O&M	USD/health facility	7,790
% of O&M compared to capital costs	%	2%
Intangible avoided costs		
Avoided impacts on human health (mortality)	USD/health facility	14,936
Increase in risk of mortality increases on days in which health facilities are affected by a power outage for 2 or more hours	%	43%
Patients that are risk of mortality	%	5%
Visitors per days	People	27
Personal annual average income	USD/person	2,536
Average avoided years lost	years	10
Added benefits and tangible avoided costs		
Avoided power outages	USD/health facility	695,695
Cost of a power outage per minute	USD/minute	386
Cost of a power outage considered in the Ponemon institute study	USD/minute	7900
Average m2 of a centre considered in the Ponemon institute study	m2	14000
Number of patients that can be accommodated	People	137
Number of m2 per patients	m2/patients	5
Avoided hours of power outage per year	hours/year	30

Table 4: Climate proofing: undergrounding of transmission lines.

Photovoltaic system - Lifetime: 20 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/health facility	12,000
O&M	USD/health facility	1,200
% of O&M compared to capital costs	%	10%
Intangible avoided costs		
Avoided impacts on human health (mortality)	USD/health facility	5,890
Increase in risk of mortality increases on days in which health facilities are affected by a power outage for 2 or more hours	%	43%
Patients that are risk of mortality	%	5%
Number of patients	People	14
Personal annual average income	USD/person	2,536
Average avoided years lost	years	10
Avoided CO2 emissions	USD/health facility	53.00
CO2 emitted per kWh produced with fossil fuels	Tons of CO2 / kWh	0.0002420
Avoided costs of CO2 emissions	USD / Tons of CO2	10
Added benefits and tangible avoided costs		
Avoided electricity costs	USD/health facility	2,891
Electricity produced	kWh/year	21,900.00
Price of electricity	USD/kWh	0.132

Table 5: Photovoltaic system.

Water wells - Lifetime: 10 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/item	2,700
O&M	USD/item	270
% of O&M compared to capital costs	%	10%
Intangible avoided costs		
Avoided cost of diarrheal disease	USD/item	301
People served per health service	People	27
Reduction in diarrheal disease (and consequent diseases) compared to unimproved facility	%	79%
Days lost per patient with diarrhea	days/patient	2
Personal annual average income	USD/person	2,537
Added benefits and tangible avoided costs		
Water savings	USD/health facility	1,200
Price of water	USD/m3	0.40
Water savings with water wells	m3	3000

Table 6: Water wells

Water catchment - Lifetime: 10 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/item	555
O&M	USD/item	55.5
% of O&M compared to capital costs	%	10%
Intangible avoided costs		
Avoided cost of diarrheal disease	USD/item	171
People served per health service	People	27
Reduction in diarrheal disease (and consequent diseases) compared to unimproved facility	%	45%
Days lost per patient with diarrhea	days/patient	2
Personal annual average income	USD/person	2,537
Added benefits and tangible avoided costs		
Water savings	USD/health facility	800
Price of water	USD/m3	0.40
Water savings with water catchment	m3	2000

Table 7: Water catchment.

Latrines - Lifetime: 10 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/item	275
O&M	USD/item	13.75
% of O&M compared to capital costs	%	10%
Intangible avoided costs		
Avoided cost of diarrheal disease	USD/item	263
People served per health service	People	27
Reduction in diarrheal disease (and consequent diseases) compared to unimproved facility	%	69%
Days lost per patient with diarrhea	days/patient	2
Personal annual average income	USD/person	2,537

Table 8: Latrines

Rainwater harvesting - Lifetime: 10 years		
Investment	**Units**	**Value**
Costs		
Capital cost	USD/item	6,789
O&M	USD/item	339.45
% of O&M	%	5%
Intangible avoided costs		
Avoided cost of diarrheal disease	USD/item	129
People served per health service	People	27
Reduction in diarrheal disease (and consequent diseases) compared to unimproved facility	%	34%
Days lost per patient with diarrhea	days/patient	2
Personal annual average income	USD/person	2,537
Added benefits and tangible avoided costs		
Water savings	USD/health facility	2,312
Days per rainfall per year	days/year	149.00
Price of water	USD/m3	0.40
Water savings with rainwater harvesting	m3	39

Table 9: Rainwater harvesting.

2.3. Results, investment by investment

The results of the analysis performed for the investments are shown in Table 10. The analysis of each investment accounts for the lifetime of each specific intervention.

Overall, the results are positive, indicating that the investments are economically viable. The only two exceptions are screened building, and latrines. However, it should be noted that these investments should not necessarily be economically viable from a financial perspective, since they are meant to improve the health of workers and patients, and hence generate intangible benefits for the investor. Also, investments like the undergrounding of transmissions lines may be more economically viable if applied in larger health centers.

Further, it is possible to note the size of the positive externalities generated, which is at times larger than the revenues generated by the project. This highlights the importance of considering the societal impacts of investments, in addition to the direct economic benefits these generate. When considering these additional, non-market impacts, all investments are economically viable (including screened building and latrines).

Regarding the IRR, NPV, and BCR, we estimate two results: one considering only tangible benefits and tangible avoided costs, and one including also externalities and intangible outcomes (presented as S-IRR, S-NPV, and S-IRR). The results can be compared with the literature: for example, a paper presented the benefits of sanitation interventions in Ethiopia, indicating that latrines have a BCR of 3.7 (Cha, et al., 2020). According to our analysis, latrines have a S-BCR of 3.64, a value close to the one indicated by the literature found online.

Table 10 presents the results of the complete assessment.

	Item	Total investment	Revenues generated	Value of externalities	NPV	S-NPV	BCR	S-BCR	IRR	S-IRR	Payback Period (Years)	S-Payback Period (Years)
1	General strengthening of health centers	$210,000	$294,202	$312,608	$5,863	$104,032	1.07	2.20	12%	47%	8.00	3.00
2	Screened building to reduce vector-borne diseases	$1,370	$120	$6,799	$(1,279)	$3,875	0.07	3.83	-49%	98%	NEGATIVE	1.00
3	Climate proofing: passive and active design for building resilience	$5,300	$39,392	$697	$12,982	$13,279	4.44	4.52	69%	71%	2.00	2.00
4	Climate proofing: undergrounding of transmission lines	$545,299	$13,913,894	$298,715	$5,463,972	$5,591,062	12.99	13.27	176%	180%	1.00	1.00
5	Photovoltaic system	$36,000	$57,816	$150,417	$2,387	$66,383	1.11	3.99	13%	77%	8.00	2.00
6	Water wells	$5,400	$12,000	$3,008	$3,013	$4,860	1.69	2.12	32%	44%	3.00	3.00
7	Water catchment	$1,110	$8,000	$1,714	$4,018	$5,071	5.48	6.66	134%	165%	1.00	1.00
8	Latrines	$550	$-	$2,628	$(444)	$1,170	0.00	3.64	NEGATIVE	85%	NEGATIVE	2.00
9	Rainwater harvesting	$10,184	$23,125	$1,295	$5,330	$6,126	1.60	1.69	26%	28%	4.00	4.00

Table 10: Results of all the investments analyzed, for unit implementation.

2.4. Results, full program implementation

The results of the analysis of the simultaneous implementation of all investments is presented in Table 13, and considers the full budget allocated to the improved climate resilience of health facilities and WASH (activity 3.2.2, 3.2.3 and 3.2.4), related to infrastructure investment (see Table 11). As indicated earlier, the analysis of each investment accounts for the lifetime of each specific intervention.

Activity	Investments considered	Amount Year 1 (USD)	Amount Year 2 (USD)	Amount Year 3 (USD)	Amount Year 4 (USD)	Amount Year 5 (USD)	Total (USD)
Activity 3.2.2: Improve health facility infrastructure resilience to EWEs.	1. General strengthening of health centers 2. Screened building to reduce vector-borne diseases	698,474	758,483	759,939	748,772	211,167	**3,176,836**
Activity 3.2.3: Upgrade electrical services to be climate resilient and provide cold chain capacity to support the delivery of climate-resilient health services. Improvements will be site-specific based on site assessments.	3. Climate proofing: passive and active design for building resilience 4. Climate proofing: undergrounding of transmission lines 5. Photovoltaic system	749,904	817,052	813,038	779,417	243,212	**3,402,622**
Activity 3.2.4: Upgrade WASH services within climate-vulnerable HCFs to be climate resilient.	6. Water wells 7. Water catchment 8. Latrines 9. Rainwater harvesting	750,505	791,471	867,891	937,560	370,451	**3,717,878**
		2,198,883	2,367,006	2,440,868	2,465,749	824,830	**10,297,336**

Table 11: Activities, investments and amounts considered in the EFA.

The main differences with the economic and financial results presented in the previous page pertains to the absolute values (e.g. total investment, NPV). The ratios (IRR, BCR) are closely aligned with the implementation of unit investments (e.g. one solar PV system). Table 13 shows that, with an investment of approximately USD 10.3 million, the revenues generated are USD 47.2 million, the avoided cost of externalities is USD 17.2 million and the NPV of the program (considering the two activities analyzed) is USD 14.3 million. The S-NPV, which includes externalities (economic analysis) reaches USD 21.9 million.

Table 12 presents the number of health facilities, and the items of infrastructure/equipment that would require to be implemented to match the budget indicated for activity 3.2.2, 3.2.3 and 3.2.4.

	Unit	Value
General strengthening of health centers	Health facility	**14.00**
Screened building to reduce vector-borne diseases	Health facility	**180.00**
Climate proofing: implementation of passive and active design measures for building resilience	Health facility	**60.00**
Climate proofing: undergrounding of transmission lines	Health facility	**2.00**
Photovoltaic system	Health facility	**60.00**
Water wells	Item	**220.00**
Water catchment	Item	**220.00**
Latrines	Item	**220.00**
Rainwater harvesting	Health facility	**220.00**

Table 12: Assumed number of health facilities and units of infrastructure/equipment implemented (the total investment required matches the budget indicated in the funding proposal for activity 3.2.2, 3.2.3 and 3.2.4).

	Item	Total investment	Revenues generated	Value of externalities	NPV	S-NPV
1	**General strengthening of health centers**	$2,940,000	$4,118,827	$4,376,515	$82,084	$1,456,453
2	**Screened building to reduce vector-borne diseases**	$246,575	$21,681	$1,223,904	$(230,141)	$697,587
3	**Climate proofing: passive and active design for building resilience**	$318,000	$2,363,520	$41,818	$778,927	$796,719
4	**Climate proofing: undergrounding of transmission lines**	$1,090,597	$27,827,789	$597,429	$10,927,944	$11,182,124
5	**Photovoltaic system**	$2,160,000	$3,468,960	$9,025,033	$143,234	$3,982,994
6	**Water wells**	$1,188,000	$2,640,000	$661,829	$662,752	$1,069,280
7	**Water catchment**	$244,200	$1,760,000	$376,991	$883,978	$1,115,544
8	**Latrines**	$121,000	$-	$578,053	$(97,662)	$257,406
9	**Rainwater harvesting**	$2,240,370	$5,087,456	$284,838	$1,172,668	$1,347,629

Table 13: Results of all the investments analyzed, for the implementation of the program.

2.5. Sensitivity Analysis

The sensitivity analysis shown in this section considers three different alternative scenarios. The first scenario assumes that costs are 20% higher than the base case; the second scenario assumes that both (i) costs are 20% higher and (ii) benefits and tangible avoided costs are 20% lower. Finally, the third scenario assumes that benefits and tangible avoided costs are 20% lower than the base case. In Table 14, we compare the results of the IRR and NPV.

		Base case		Costs +20%		Benefits -20%		Costs +20% Benefits -20%	
		IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV
1	General strengthening of health centers	12%	$5,863	6%	$(11,427)	5%	$(12,604)	-4%	$(29,916)
2	Screened building to reduce vector-borne diseases	-49%	$(1,279)	-51%	$(1,553)	-52%	$(1,297)	-54%	$(1,571)
3	Climate proofing: passive and active design for building resilience	69%	$12,982	57%	$12,227	54%	$9,630	44%	$8,875
4	Climate proofing: undergrounding of transmission lines	176%	$5,463,972	147%	$5,372,815	141%	$4,280,021	117%	$4,188,864
5	Photovoltaic system	13%	$2,387	8%	$(2,055)	7%	$(2,532)	2%	$(6,975)
6	Water wells	32%	$3,013	24%	$2,141	22%	$1,538	15%	$667
7	Water catchment	134%	$4,018	110%	$3,839	105%	$3,035	86%	$2,856
8	Latrines	NEGATIVE	$(444)	NEGATIVE	$(533)	NEGATIVE	$(444)	NEGATIVE	$(533)
9	Rainwater harvesting	26%	$5,330	19%	$3,555	18%	$2,489	12%	$715

Table 14: Sensitivity analysis

As Table 14 shows, only two of the proposed investments are not economically viable under the base case scenario: Screened Building, and Latrines. However, when the value of costs and/or benefits is changed, the general strengthening of health services and solar PV become negative. All the other investments remain economically viable under all scenarios.

Annex I: documentation of models and related assumptions

General strengthening of health centers

INVESTMENTS	
Capital cost	According to a publication of the Asian Development Bank, strengthening the resilience of health centers in LAO PDR through repairs, retrofits and upgrades would require USD 30,000 in upfront costs (ADB, 2020)
O&M costs	We assumed that the annual O&M costs amount to USD 6,000 (or 20% of the capital costs)
INTANGIBLE AVOIDED COSTS	
Avoided impacts on human health (mortality)	To calculate this avoided cost, we used the following formula: *Avoided impacts on human health mortality = Number of patients (patients) * patients that are at risk of mortality (%) * increase in risk in mortality due to climate impacts (%) * average avoided years lost (years) * personal annual average income (USD/patient).* The % of the patients that are risk of mortality, the increase in risk in mortality due to climate impacts, and the average avoided years lost have been assumed. The number of patients was calculated by dividing the optimal size of a health center (10,000 patients - (ADB, 2020)) by 365 to obtain the daily number of patients, and then by 5, which is the assumed number of days of hospitalization per patient. The personal annual average income (2021) was retrieved from the World Bank (World Bank, 2023).
Avoided impacts on human health (morbidity)	To calculate this avoided cost, we used the following formula: *Avoided impacts on human health morbidity = Number of patients (patients) * patients that are at risk of morbidity (%) * increase in risk in morbidity due to climate impacts (%) * average avoided years lost (years) * personal annual average income (USD/patient).* The % of the patients that are risk of morbidity, the increase in risk in morbidity due to climate impacts, and the average avoided years lost have been assumed. The number of patients was calculated by dividing the optimal size of a health center (10,000 patients - (ADB, 2020)) by 365 to obtain the daily number of patients, and then by 5, which is the assumed number of days of hospitalization per patient. The personal annual average income (2021) was retrieved from the World Bank (World Bank, 2023).
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Water Savings	Water savings have been calculated by multiplying the annual water use of a health facility (assumed), by the share of water savings with efficiency retrofit measures (assumed), by the cost of 1 m3 of water in LAO PDR (Laos Savan Park, 2022)
Energy Savings	Energy savings have been calculated by multiplying the followings: - Electricity use of a health facility ((5 kWh retrieved from the ADB publication (ADB, 2020) * 24 h * 365 days in a year * 0.5 which is the assumed capacity load factor)) - The price of electricity in LAO PDR (Earth Journalism Network, 2021)

	- The share of energy savings with efficiency retrofit measures (Guenther & Balbus, 2014)
Avoided impact of climate damages to buildings and equipment (reconstruction costs + cost of furniture for a new center)	This avoided impact, retrieved from a publication of the Asian Development Bank (ADB, 2020), was divided by the lifetime of the investment (assumed to be 30 years), to obtain its annual value.

Screened building to reduce vector-borne diseases

INVESTMENTS	
Capital cost	According to Gimnig and Slutsker (2009) the economic cost of screening which include ceilings as well as windows and doors amounts to USD 10 per person. We multiplied USD 10 by the number of patients to obtain the capital cost of screened buildings. The number of patients was calculated by dividing the optimal size of a health center (10,000 patients - (ADB, 2020)) by 365 to obtain the daily number of patients, and then by 5, which is the assumed number of days of hospitalization per patient
O&M costs	O&M annual costs are assumed to be zero.
INTANGIBLE AVOIDED COSTS	
Avoided cost of vector borne diseases with screening	According to White et al. (2011), the global average economic cost of treating one person per year due to vector control diseases amounts to USD 49.62. We multiplied this value by the number people served per health service, which was calculated by dividing the optimal size of a health center (10,000 patients - (ADB, 2020)) by 365.
Avoided CO2 emissions from reduced electricity consumption (if electricity is produced from non-renewable sources)	Screening allows cutting energy costs by 10% (Svennson, 2023). We multiplied this value by the electricity use of a health facility, which, according to a ADB report "Health Clinics have low energy requirements of between 5-10 kWh (kilowatt hours)/day" (ADB, 2020). We used the lower estimate (5 kWh) and we multiplied it by 365 to obtain the annual electricity requirements as well as the reduction in electricity use thanks to screening. We assumed that the CO2 emitted per kWh produced with fossil fuels is 0.0002 tons/kWh, while the avoided cost of a ton of CO2 emitted is 10 USD (also assumed). By multiplying these values by the avoided electricity use, we were able to monetize the avoided CO2 emissions thanks to screening.
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Energy Savings	Screening allow cutting energy costs by 10% (Svennson, 2023). We multiplied this value by the electricity use of a health facility, which, according to a ADB report "Health Clinics have low energy requirements of between 5-10 kWh (kilowatt hours)/day" (ADB, 2020). We used the lower estimate (5 kWh) and we multiplied it by 365 to obtain the annual electricity requirements as well as the reduction in electricity use thanks to screening. To obtain the monetary value of energy savings thanks to screening, we multiplied the avoided energy use by the price of electricity in LAO PDR (Earth Journalism Network, 2021).

Climate proofing: implementation of passive and active design measures for building resilience

INVESTMENTS	
Capital cost	According to a publication of the Inter-American Development Bank, The cost of implementing passive design measures, to achieve a minimum reduction of 20% in energy and water use in existing buildings, amounts to US$ 13.25 per m2 (IDB, 2020). We multiplied this value by 200, which is the assumed m2 of a health facility.
O&M costs	We assumed that the annual O&M costs amount to 5% of the capital costs
INTANGIBLE AVOIDED COSTS	
Avoided CO2 emissions from reduced electricity consumption (if electricity is produced from non-renewable sources)	According to the IDB, implementing passive design measures in existing hospitals results in saving 72 kWh per square meter (IDB, 2020). We multiplied this value by 200, which is the assumed m2 of a health facility. We assumed that the CO2 emitted per kWh produced with fossil fuels is 0.0002 tons/kWh, while the avoided cost of a ton of CO2 emitted is 10 USD (also assumed). By multiplying these values by the avoided electricity use, we were able to monetize the avoided CO2 emissions thanks to screening.
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Water savings	According to the IDB, implementing passive design measures in existing hospitals results in saving 0.86 m3 of water per square meter (IDB, 2020). We multiplied this value by 200, which is the assumed m2 of a health facility. Finally, we multiplied the number of saved m3 of water by the cost of 1 m3 of water in LAO PDR (Laos Savan Park, 2022).
Energy savings	According to the IDB, implementing passive design measures in existing hospitals results in saving 72 kWh per square meter (IDB, 2020). We multiplied this value by 200, which is the assumed m2 of a health facility. Finally, we multiplied the total saved kWh of electricity by the cost of electricity in LAO PDR (Earth Journalism Network, 2021).

Climate proofing: undergrounding of transmission lines

INVESTMENTS	
Capital cost	Converting overhead distribution lines to underground ones is estimated to cost on average USD 3,894,990 per km in urban areas. We consider 10% of this value for rural areas, given the limited presence of paved roads and the higher availability of space. We multiplied this value by the assumed number of km to reach the first transmission node (1 km).
O&M costs	We assumed that the annual O&M costs amount to 2% of the capital cost.
INTANGIBLE AVOIDED COSTS	
Avoided impacts on human health (mortality)	The literature shows that the risk of mortality increases by 43% on days in which health facilities are affected by a power outage for 2 or more hours (Apenteng, Opoku, Ansong, Akowuah, & Afriyie-Gyawu, 2018). We multiplied this value by the number of patients (ADB, 2020), by the assumed share of patients that are risk of mortality, by the assumed average avoided years lost, and by the personal annual average income (World Bank, 2023).
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Avoided power outages	It has been estimated that a minute of power outage in a hospital cost roughly US$ 7900 per minute for centers with an average size of 14,000 m^2 (Ponemon Institute, 2016). These values are too high for the context of Lao. We have therefore reduced the cost saving assumption, based on the smaller size of health centers in Lao when compared to those considered in the study mentioned above. Specifically, we assume that the space available per patient is 5 m^2, and that the total number of patients that can be accommodated in the health center is 137. Thus, the health facility that we are considering covers 685 $m^{2,}$ in total (possibly over 2 or 3 floors), which is 20.43 times smaller than a center with a size of 14,000 m^2. We therefore divided 7,900 USD/minute by 20,43 resulting in a total cost of roughly 386 USD/minute. We assumed the avoided hours of power outage per year to estimate the monetary value of the annual avoided power outages.

Photovoltaic system

INVESTMENTS	
Capital cost	According to the ADB a solar photovoltaic (PV) system with batteries would require 1200 W panels costing approximately USD 12,000.
O&M costs	We assumed that the annual O&M costs amount to 10% of the capital cost.
INTANGIBLE AVOIDED COSTS	
Avoided impacts on human health (mortality)	The literature shows that the risk of mortality increases by 43% on days in which health facilities are affected by a power outage for 2 or more hours (Apenteng, Opoku, Ansong, Akowuah, & Afriyie-Gyawu, 2018). We multiplied this value by the number of patients (ADB, 2020), by the assumed share of patients that are risk of mortality, by the assumed average avoided years lost, and by the personal annual average income (World Bank, 2023).
Avoided CO2 emissions	We assumed that the CO2 emitted per kWh produced with fossil fuels is 0.0002 tons/kWh, while the avoided cost of a ton of CO2 emitted is 10 USD (also assumed). By multiplying these values by the kWh of electricity produced through the PV system, we were able to monetize the avoided CO2 emissions. The electricity produced by the PV system was calculated as follow: 5 kWh retrieved from the ADB publication (ADB, 2020) * 24 h * 365 days in a year * 0.5 which is the assumed capacity load factor.
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Avoided electricity costs	The electricity produced by the PV system was calculated as follow: 5 kWh retrieved from the ADB publication (ADB, 2020) * 24 h * 365 days in a year * 0.5 which is the assumed capacity load factor. We then multiplied the number of kWh produced with the PV system by the price of electricity in LAO PDR (Earth Journalism Network, 2021).

Water wells

INVESTMENTS	
Capital cost	The capital cost of water wells is estimated to amount to USD 2,700 (ADB, 2020)
O&M costs	We assumed that the annual O&M costs amount to 10% of the capital cost.
INTANGIBLE AVOIDED COSTS	
Avoided cost of diarrheal disease	The number of patients was calculated by dividing the optimal size of a health center (10,000 patients - (ADB, 2020)) by 365 to obtain the daily number of patients found in a health centre. This value was then multiplied with the following values: - Share of reduction in diarrheal disease (and consequent diseases) compared to unimproved facility (79% with piped water, high quality) - (Hutton, Benefits and Costs of the Water Sanitation and Hygiene Targets for the Post-2015 Development Agenda, 2015) - Days lost per patient with diarrhea (Hutton, Haller, Water, & Organization, 2004) - Personal annual average income in 2021 (World Bank, 2023).
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Water Savings	The water savings with water wells have been assumed and multiplied by the price of water in LAO PDR (Laos Savan Park, 2022)

Water catchment

INVESTMENTS	
Capital cost	The capital cost of water catchment is estimated to amount to USD 555 (ADB, 2020)
O&M costs	We assumed that the annual O&M costs amount to 10% of the capital cost.
INTANGIBLE AVOIDED COSTS	
Avoided cost of diarrheal disease	The number of patients was calculated by dividing the annual number of patients hosted by a health center (10,000 patients - (ADB, 2020)) by 365 to obtain the daily number of patients found in a health centre, which is 27 daily visitors (we should note that the capacity of the health centre that we considered is for 137 beds for patients that required more treatment). This value was then multiplied with the following values: - Share of reduction in diarrheal disease (and consequent diseases) compared to unimproved facility (45% with basic piped water) - (Hutton, Benefits and Costs of the Water Sanitation and Hygiene Targets for the Post-2015 Development Agenda, 2015) - Days lost per patient with diarrhea (Hutton, Haller, Water, & Organization, 2004) - Personal annual average income in 2021 (World Bank, 2023).
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Water Savings	The water savings with water catchment have been assumed and multiplied by the price of water in LAO PDR (Laos Savan Park, 2022)

Latrines

INVESTMENTS	
Capital cost	The capital cost of one latrine is estimated to amount to USD 275 (ADB, 2020)
O&M costs	We assumed that the annual O&M costs amount to 10% of the capital cost.
INTANGIBLE AVOIDED COSTS	
Avoided cost of diarrheal disease	The number of patients was calculated by dividing the annual number of patients hosted by a health center (10,000 patients - (ADB, 2020)) by 365 to obtain the daily number of patients found in a health centre, which is 27 daily visitors (we should note that the capacity of the health centre that we considered is for 137 beds for patients that required more treatment).. This value was then multiplied with the following values: - Share of reduction in diarrheal disease (and consequent diseases) compared to unimproved facility (69% with "improved sanitation with formal excreta management") - (Hutton, Benefits and Costs of the Water Sanitation and Hygiene Targets for the Post-2015 Development Agenda, 2015) - Days lost per patient with diarrhea (Hutton, Haller, Water, & Organization, 2004) - Personal annual average income in 2021 (World Bank, 2023).

Rainwater harvesting

INVESTMENTS	
Capital cost	The capital cost of rainwater harvesting was retrieved from Enduraplas (Enduraplas, 2018)
O&M costs	We assumed that the annual O&M costs amount to 5% of the capital cost.
INTANGIBLE AVOIDED COSTS	
Avoided cost of diarrheal disease	The number of patients was calculated by dividing the annual number of patients hosted by a health center (10,000 patients - (ADB, 2020)) by 365 to obtain the daily number of patients found in a health centre, which is 27 daily visitors (we should note that the capacity of the health centre that we considered is for 137 beds for patients that required more treatment).. This value was then multiplied with the following values: - Share of reduction in diarrheal disease (and consequent diseases) compared to unimproved facility (34% with "improved community water source") - (Hutton, Benefits and Costs of the Water Sanitation and Hygiene Targets for the Post-2015 Development Agenda, 2015) - Days lost per patient with diarrhea (Hutton, Haller, Water, & Organization, 2004) - Personal annual average income in 2021 (World Bank, 2023).
ADDED BENEFITS AND TANGIBLE AVOIDED COSTS	
Water Savings	The annual water savings with rainwater harvesting was calculated as follow: - Assumed days of rainfall per year - Cost of 1 m3 of water in LAO PDR (Laos Savan Park, 2022) - Water savings with rainwater harvesting (Enduraplas, 2018)

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