SUSTAINABLE ENERGY FOR ALL

Climate Finance for Powering Healthcare

Analysing Barriers and Opportunities

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Glossary

Adaptation refers to the process of adjusting and responding to the adverse effects of climate change. It involves the development and implementation of strategies and actions to reduce vulnerability, enhance resilience and minimize the negative impacts of changing climate conditions on ecosystems, communities and systems.

CAPEX, or capital expenditure, refers to the initial investment required for planning, designing and installing a particular climate solution, such as renewable energy infrastructure. It covers equipment costs, labour, site preparation, engineering and project development expenses.

Carbon footprint is a term used for the emissions generated directly from on-site activities, such as heating, cooling and electricity usage, as well as emissions from on-site combustion, such as from back-up generators.

Climate finance is a term used for financial resources, including grants, loans and investments, provided by governments, international organizations, corporations and other entities to support mitigation of greenhouse gas (GHG) emissions and adaptation to climate impacts.

GHG emissions savings/reductions (or avoided) refers to a quantifiable reduction in GHG emissions as compared to a valid baseline scenario. For avoided emissions, the baseline is an assumed future business-as-usual scenario.

Low carbon describes practices, technologies or policies that aim to reduce GHG emissions and the overall carbon footprint.

Low- and middle-income countries relates to the categorization of countries based on their Gross National Income per capita in 2022 (low-income countries: USD 1,135 or less; lower-middle-income countries: USD 1,136–4,465; middle-income countries to upper-middle-income countries: USD 4,465–13,845).

Mitigation of climate change refers to actions and strategies aimed at reducing or avoiding GHG emissions into the atmosphere to limit or slow down the extent of climate change. It involves efforts to minimize human activities that contribute to global warming, such as the burning of fossil fuels, with the goal of mitigating the long-term impacts of climate change on the environment and human societies.

OPEX, or operating expenditure, includes the ongoing costs for maintaining and operating a climate solution, such as maintenance, labour and insurance, occurring after the initial setup (CAPEX).

Reliable energy access refers to the continuous and uninterrupted availability of essential electricity and energy services that are necessary for the optimal operation of healthcare facilities, medical equipment and the preservation of critical supplies to ensure the delivery of high-quality healthcare services.

Resilience to climate change describes the ability of systems, communities or individuals to withstand and recover from the environmental, social, economic or health-related adverse impacts of climate change.

Stand-alone solar PV system refers to a self-sufficient renewable energy setup that generates electricity from sunlight. It consists of solar panels to capture sunlight, a charge controller to manage battery charging, a battery bank for energy storage and an inverter to convert stored energy into usable electricity.

Abbreviations

AEPC	Alternative Energy Promotion Centre
CAPEX	Capital Expenditure
CDM	Clean Development Mechanism
CIF	Climate Investment Funds
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DFIs	Development Finance Institutions
D-REC	Distributed Renewable Energy Certificate
EPI	Energy Performance Index
ESG	Environmental, Social and Governance
GCF	Green Climate Fund
GEAPP	Global Energy Alliance for People and Planet
GEF	Global Environment Facility
GHG	Greenhouse gas
kVA	Kilovolt-ampere
KwH	Kilowatt-hour
MW	Megawatt
MWh	Megawatt-hour
O&M	Operations and maintenance
ODA	Overseas Development Assistance
OPEX	Operating expenditure
OPM	Oxford Policy Management
PHCs	Primary healthcare centres
PV	Photovoltaic
REC	Renewable Energy Certificate
SEforALL	Sustainable Energy for All
SPV	Solar Photovoltaics
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VCMs	Voluntary Carbon Markets
VIU	Verified Impact Unit
WHO	World Health Organization

CHAPTER ONE

Introduction

Nearly 1 billion people in low- and lower-middle-income countries are served by healthcare facilities without reliable electricity access or with no electricity access at all (World Health Organization (WHO) 2023). As a result, these facilities are unable to provide basic services such as clean water, as well as to power the medical equipment required for immunizations, safe childbirth, and emergency procedures. The electrification of healthcare facilities is a crucial requirement for achieving universal health coverage.

In the past, it was assumed that the central grid will provide healthcare facilities with the electricity they need. However, 12 percent of healthcare facilities in South Asia and 15 percent in Sub-Saharan Africa (25,000 facilities in total) remain unconnected to the grid (ibid.). A further 68,350 facilities in these regions have an unreliable supply of electricity from the grid. An estimated USD 4.9 billion is urgently needed to bring healthcare facilities in the two regions up to a minimal or intermediate level of electrification (ibid.).

SEforALL's Powering Healthcare programme provides data, best practices, support, and leadership for the electrification of healthcare facilities in energy-deficit countries. This study investigates the feasibility and possibilities of using climate finance to advance this electrification. It aims to provide an introduction to climate finance for funders and practitioners involved in healthcare electrification efforts and a starting point to support national governments to access and effectively use climate finance to upgrade and climate proof healthcare facilities. The study is part of SEforALL's ongoing engagement with governments, funders, and the private sector to increase investment in powering healthcare as part of its wider commitment to tackling climate change.

The study starts in Section 1 by unpacking and quantifying the climate rationale for investments in sustainable electrification of healthcare facilities, looking beyond just the supply of energy to considering energy-efficient and climate-resilient technologies and measures that can be adopted. In Section 2, the study introduces the landscape of climate finance and the most relevant potential sources for advancing electrification of healthcare facilities in the Global South. Section 3 considers the key barriers to accessing and using climate finance for electrifying healthcare and good practices and opportunities for addressing these barriers and in building national readiness for climate finance.

The analysis is focused on public health facilities, and mostly primary healthcare centres (PHCs), which are defined differently across countries, but generally the term refers to the first port of call to a qualified doctor of the public sector in a rural area. PHCs provide comprehensive primary healthcare to the community and have around 5-10 beds for inpatient admission. It is particularly difficult to finance infrastructure upgrades for these facilities, and they suffer the most from unreliable or no electricity access.

The analysis is based on insight and data provided by national and international experts, through individual interviews and group discussions, including an expert workshop on the sidelines of the UN General Assembly on 21 September 2023. This was complemented with a review of existing literature and documents related to the climate benefits of healthcare facility investments and the opportunity and challenges posed by climate finance. In many cases the findings are applicable across South Asia and Sub-Saharan Africa, but case studies of Nigeria, India and Nepal were used to provide a more in-depth, context-specific analysis.

What is the potential for climate finance to advance electrification of healthcare and 'climate proof' healthcare facilities?

US$ 4.9 bn is needed to electrify two thirds of healthcare facilities in 63 countries to deliver quality healthcare

US$ 632 bn of climate finance was disbursed in 2019/2020 across the world

CHAPTER TWO

The climate rationale of powering healthcare

Healthcare facilities in South Asia and Sub-Saharan Africa are at the frontline of providing vital healthcare services to low-income populations, and infrastructure upgrades are viewed as an investment in improving health and development outcomes. However, healthcare facilities also consume energy from the grid and/or fossil fuel generators and are at risk from extreme weather events. An investment in low-carbon and resilient technologies and measures for these facilities can therefore provide climate mitigation and adaptation benefits while delivering positive health outcomes. This section explores the scale and nature of these climate benefits to understand the relevance of climate finance for healthcare facilities.

2.1 Baseline situation

The energy and emissions footprints of healthcare facilities, and their level of vulnerability to the impacts of climate change, varies significantly between and within countries. The global healthcare sector had a climate footprint of 2GtCO_2e in 2014, equivalent to 4.4 percent of global net emissions or 514 coal-fired power plants and nearly double the annual emissions of Japan's entire economy in 2020 (Karliner and Slotterback 2019, MOE 2022). However, this is dominated (57 percent) by healthcare emissions from the US, China and the European Union, and also includes emissions from the healthcare supply chain (ibid.). An accurate carbon footprint for healthcare facilities in South Asia and Sub-Saharan Africa is not available, although it is estimated that the healthcare sector as a whole represents around 4 percent of national emissions in these regions (ibid.). Within individual countries there is also a stark difference between the carbon footprint and level of vulnerability of facilities, particularly urban vs rural and private vs public.

Therefore, a bottom-up process of assessing the baseline situation of a specific facility or group of facilities is required before being able to calculate the specific GHG emissions abatement potential and resilience gains that are possible. There are three (interconnected) core parameters that determine the potential of a healthcare facility to reduce GHG emissions (i.e. the 'mitigation' potential) and adapt to the impact of climate change (i.e. the 'adaptation' potential):

Energy consumption: The energy needs of healthcare facilities in South Asia and Sub-Saharan Africa vary depending on their size, the services they deliver, their cooling and heating requirements, etc. The maximum daily supply of electricity required for a health post, subcentre or clinic that is the first point of care for community is 1.9–4.5 kWh, for a PHC with 5 to 10 beds is 10–18.4 kWh and for a secondary healthcare facility with 75 to 500 beds is up to 196,500 kWh (WHO 2023).

For various reasons, including the unreliability and costs of electricity supply but also availability of doctors and other 'demand' issues, most public sector healthcare facilities in these regions are not consuming at this level. This is limiting the quality and volume of services the facilities can provide. For example, PHCs with regular electricity provided delivery and vaccination services to 50 percent more patients than those without reliable electricity (Mani, Patnaik and Lahariya 2021).

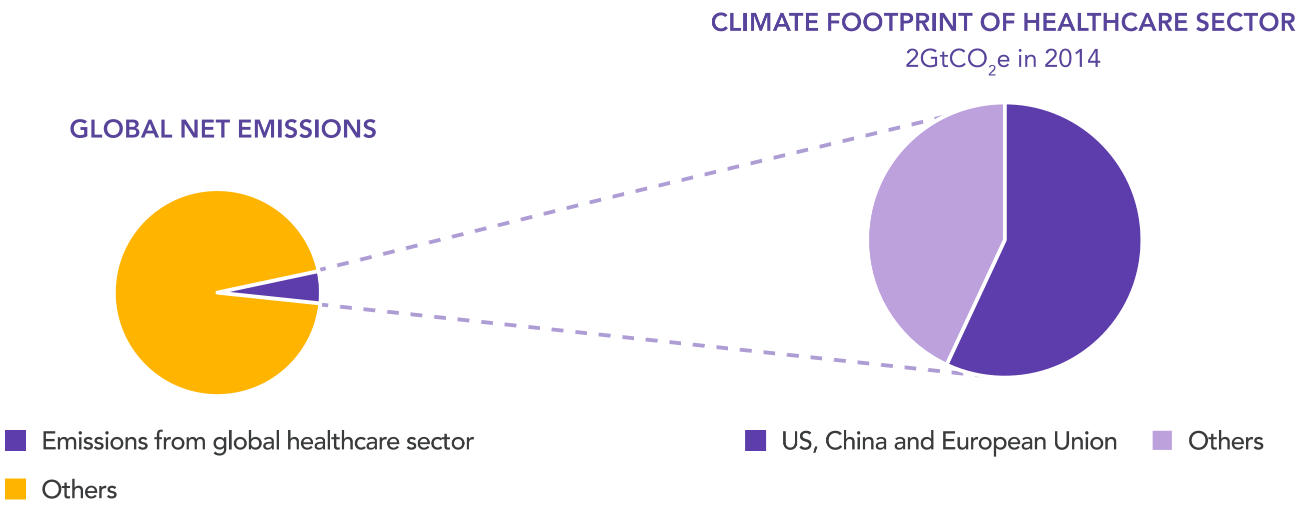
To achieve better healthcare outcomes, facilities in South Asia and Sub-Saharan Africa will on average need to consume greater volumes of energy in the future. For example, in India the median annual grid electricity consumption of a PHC is 5 MWh/year and for a private hospital of an equivalent size it is 7.5 MWh/year. This gives an indication of how energy consumption could increase if public hospitals reach the same services, thermal comfort, equipment and infrastructure standards (National Centre for Disease Control 2023). The supressed demand for energy for health services in the public sector in these regions complicates the baseline situation. The potential for healthcare facilities to reduce GHG emissions should therefore not be assessed using the current level of energy consumed but instead using the energy required to drive better healthcare services and outcomes.

Regardless of the levels of energy consumption, there is still scope to be more energy efficient. For example, there is a huge range in the Energy Performance Index (EPI)[1] of similar types of facilities in India, with the more efficient PHCs having an EPI of around 11 kWh/m2 year and the less efficient having an EPI of around 4 kWh/m^2 year. The large diversity in EPI scores can be attributed to the use of energy-efficient end-use appliances, behavioural factors, whether air conditioning is used, and type and volume of services provided (National Climatic Data Centre 2023).

Energy source: The source of energy supplied to healthcare facilities, together with the volume of energy consumed (see above), determines the contribution of these facilities to national GHG emissions. In South Asia and Sub-Saharan Africa, the source of energy is primarily electricity from the national grid, and the extent to which fossil fuels are used to generate this electricity determines the 'emissions factor' for the electricity grid for each country. However, an estimated 64 percent of all healthcare facilities in these regions either do not have a grid connection or the electricity supply from the grid is not reliable. A significant portion of these are using a diesel or petrol generator as a primary or back-up source of energy, although exact figures are not known. A lifecycle assessment of electricity generated from a 5 kVA diesel generator in Nigeria estimates that each unit contributes 1,625 kg CO_2/MWh, which includes the extraction and refining of crude oil, transportation, and other associated processing emissions, as compared to an estimated 751–1,095 kg CO_2/MWh for coal power (Onabanjo, Di Lorenzo and Kolios 2017, Gibon, Hahn Menacho and Guiton, 2021). In addition to their use of fossil fuels, generators also emit considerable health-affecting air pollutants, including black carbon (or 'soot')). This has been linked to premature death in adults via heart and lung disease and other health impacts (WHO and World Bank 2015, CCAC nd, Climate and Clean Air Coalition n.d.).

Vulnerability to climate hazards: There are a range of local factors that determine a healthcare facility's ability to function without interruption during or following an extreme weather event, such as cyclones, flooding, heatwaves, etc. This includes whether the building can withstand the hazard, whether medical equipment is protected from damage and whether critical services and community infrastructure (e.g. the supply of electricity and water and road access to the facility) are not disrupted (WHO 2015). For example, in areas of Mozambique affected by Cyclone Idai in 2019, travel time to a healthcare facility increased from 1.3 to 63 hours as a result of damage to 45 healthcare facilities and disruption to road transport. An estimated 136,941 children under five years of age were no longer able to reach the nearest facility within two hours' travel time (ACAPS 2019, Hierink et al. 2020). Devastating floods across Pakistan in 2022 also resulted in 10 percent of all healthcare facilities being fully or partially damaged, resulting in 8 million people without access to urgent health services (WHO 2023).

[1] The EPI is a widely used metric for measuring the energy efficiency of a building. It is the ratio of the total energy consumed by a building in a year to its gross floor area.



No accurate carbon footprint of healthcare facilities in South Asia and Sub-Saharan Africa BUT what we know about these regions:

HEALTHCARE SECTOR IS CONTRIBUTING TO CLIMATE CHANGE

Most primary health centres have unmet energy needs, i.e. they are not consuming enough electricity to delier services effectively.

64% of facilities do not have reliable electricity from the grid and rely on diesel/petrol generators – a significant source of GHG emissions.

HEALTHCARE SECTOR IS BEING IMPACTED BY CLIMATE CHANGE

Healthcare facilities are vulnerable to climate hazards, such as cyclone, heat wave, flood, etc.

TABLE 1 Key baseline indicators for case study countries

INDICATOR	INDIA	NIGERIA	NEPAL
Percent of healthcare facilities without an electricity connection	~9 percent of PHCs have no electricity connection and ~41 percent have an irregular supply from the grid (Mani, Patnaik and Dholakia 2019)	~40 percent of PHCs have no electricity connection (SEforALL 2022)	~22 percent of facilities do not have a 'regular' supply of electricity, from the grid, generator or solar panels (Nepal Ministry of Health and Population 2022)
Average emissions rate ('emissions factor') for grid-connected electricity	0.85 kg CO_2/ kWh (49 percent installed generation capacity from coal) (Central Electricity Authority 2023)	0.57 kg CO_2/ kWh (73 percent installed generation capacity from oil) (USAID n.d.)	0.35 kg CO_2/ kWh (96 percent installed generation capacity from hydropower) (Basnet 2022)
Percent of healthcare facilities with on-site renewable energy system	~17 percent (private hospitals) and ~11 percent (public hospitals). Higher for some states (e.g. 56 percent in Chhattisgarh) (National Climatic Data Centre 2023)	~20 percent (SEforALL 2022)	~13 percent (Nepal Ministry of Health and Population 2022)
Percent of facilities using fossil fuel diesel generators	~7.5 percent of PHCs have a diesel generator (Ramji et al. 2017)	No data. However, the percentage of healthcare facilities with operational generators in other West African countries ranged from 15 to 32 percent (WHO 2023)	~12 percent of healthcare facilities with operational generator (Nepal Ministry of Health and Population 2022)

The key parameters that determine the carbon footprint and vulnerability of healthcare facilities vary significantly between and within countries. A case study of Nepal is provided in Box 1 below, which also highlights how the Government of Nepal is positioning the healthcare sector within its overall Green, Resilient and Inclusive Development Action Plan.

BOX 1 Case study of Nepal's healthcare facilities

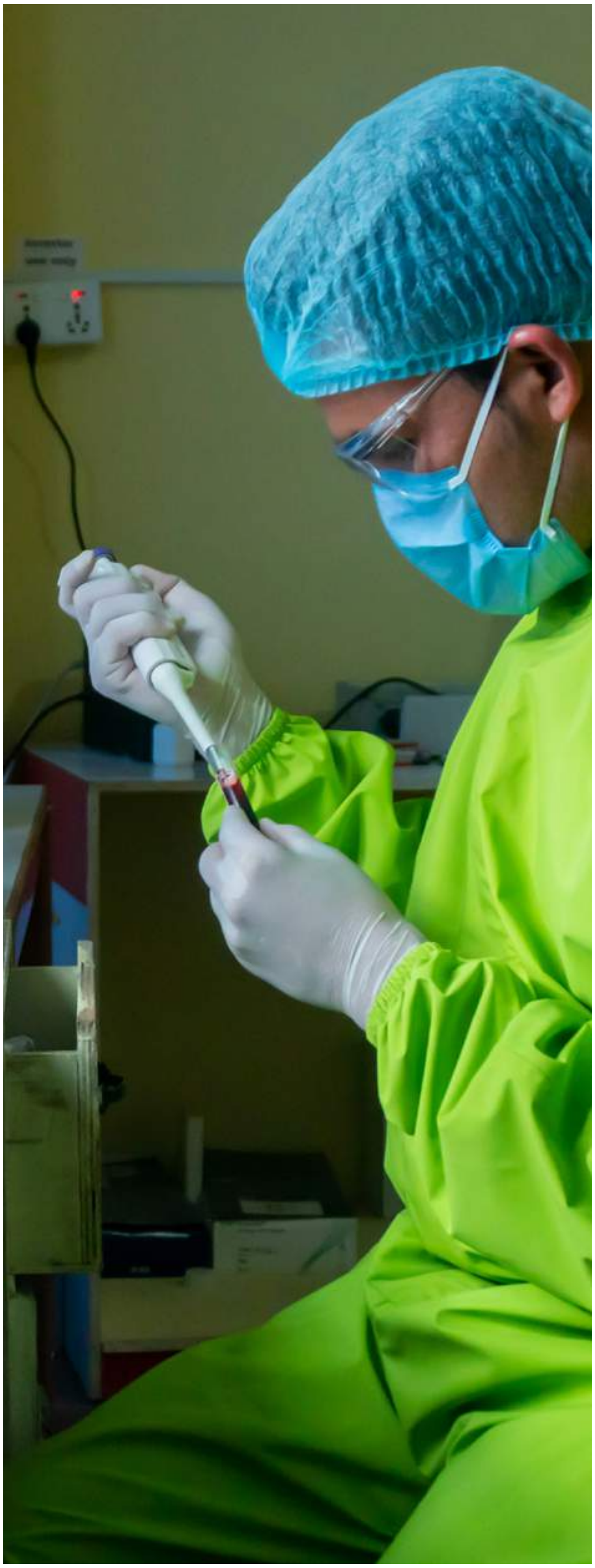
Nepal's National Health Survey provides insights into the scale and nature of the energy and carbon footprint situations of healthcare facilities in the country. In the 2021 survey, 78 percent of Nepal's public healthcare facilities reported having a 'regular' supply of electricity, through either the central power grid, a functioning generator with fuel and/or solar power. This was an increase from 49 percent in 2015. While this survey did not include data on the exact consumption by facilities of different sources of energy, it did report on expenditure on fuel consumption by facilities. There was in total USD 36,500 spent by all facilities in the country in 2021 on fuel to power the facility. Using a set of assumptions outlined in Annex 1, we estimate that **38,987 litres of fuel was consumed in 2021 across all facilities in the country, representing 97 tonnes CO_2e**. This does not include electricity consumed from the grid, although over 90 percent of this comes from hydropower and only 2 percent is thermal (Nepal Energy Outlook 2022).

It is worth noting that the volume of fuel consumed by healthcare facility power generators is far smaller than that used for healthcare facility vehicles: 90 percent of the fuel consumed by facilities was for vehicles. The total carbon footprint of the healthcare facility therefore extends far beyond just electricity.

The government has made efforts, particularly between 2007 and 2011, to solarize healthcare facilities, using financing from bilateral, multilateral and philanthropic sources. These were mostly small-scale efforts (see Annex I for available information), including installing solar back-up systems to power vaccine cold chains, telemedicine and operating snake bite treatment centres, birthing centres and PHCs.

Climate change is also already impacting the healthcare system in Nepal, and its effects are projected to worsen in the future. This includes health impacts that will add extra stress to the system (600,000 additional people in Nepal will become at risk of malaria and 400,000 of dengue) and also **the increasing exposure of healthcare facilities to extreme weather events.** The healthcare system in Nepal is already underfunded, receiving only 4.5 percent of the total national budget in 2019/20, and will struggle to manage the additional burden of dealing with increasing climate-related health impacts (Gyawali et al. 2020).

The Government of Nepal is developing the **Green, Resilient and Inclusive Action Plan** to guide domestic and international finance flows. There is a dedicated chapter on health that includes a commitment to establish **shock-responsive health infrastructure** and carry out a comprehensive **environment, disaster and climate risk assessment** of the sector.



2.2 The climate rationale for low-carbon and resilient investments in healthcare facilities

There are a range of potential low-carbon and resilient infrastructure and technology measures that would improve the functionality of healthcare facilities while also providing climate mitigation and/or adaptation benefits. To access climate finance, these benefits need to be described in detail, with as much quantification as possible, which is often described as the 'climate rationale'. The actual viability and nature of the benefits of a particular solution will depend on the local context, particularly for adaptation solutions, which should be selected based on the specific climate hazards of the location. The table below provides a qualitative description of the types of benefits that are possible.

TABLE 2 Climate benefits of a sample of low-carbon and resilient solutions

<table>
<tr><th>SOLUTION</th><th>ADAPTATION BENEFIT</th><th>MITIGATION BENEFIT</th></tr>
<tr><td>Stand-alone decentralized renewable energy system: Decentralized solution, usually based on solar panels, not connected to the central grid or a mini-grid, with energy generated used to power the facility and to charge a battery bank used for energy storage. Small systems can be used to power specific appliances, such as vaccine storage.</td><td rowspan="2">Provides a secure supply of electricity in the event of a natural disaster, which can disrupt the grid and supply of fossil fuels. However, decentralized renewable energy systems also need to be designed to withstand extreme weather events (e.g. lightning protection).</td><td rowspan="2">Avoids GHG emissions from diesel generators and/or grid electricity. See quantified benefits in the next section</td></tr>
<tr><td>Mini-grids: Decentralized generation using renewable energy and distribution to power several users, buildings or communities.</td></tr>
<tr><td>Energy-efficient appliances: This includes energy efficiency for basic systems, such as lighting and medical equipment.</td><td rowspan="2">Many of the same measures can make the building more resilient and reduce energy consumption. For example, cool roofs reduce indoor temperature and therefore reduce requirements for air conditioning and help manage the impacts of extreme heat.
Reducing energy demand from a healthcare facility also helps to minimize the impact of electricity supply being disrupted by an extreme weather event.</td><td rowspan="2">Reduced demand for energy and therefore reduced generation of energy (which ultimately reduces pressure on renewable energy capacity additions). For example, energy-efficiency measures for PHCs in India have the estimated potential to reduce energy consumption by 45 percent, required solar panel capacity by 56 percent and costs by 55 percent (SELCO Foundation 2022).</td></tr>
<tr><td>Energy-efficient buildings: The design of the building, such as natural ventilation or insulation, can reduce the energy requirements for heating and cooling.</td></tr>
<tr><td>Climate-resilient buildings: This includes ensuring the siting of healthcare facilities and the design and construction methods consider current and future projected climate risks. For example, the use of rainwater harvesting systems to withstand droughts, cool roofs to withstand extreme heat, raised buildings to avoid flooding and storm-resistant walls and windows.</td><td>Able to withstand the impacts of extreme weather events, which are projected to increase in the future. (Note that there is a much wider set of actions that can increase the disaster and climate resilience of the healthcare system as a whole, explored in Box 2 below.)</td><td>Many of the same measures can make the building more resilient and reduce energy consumption (see above).</td></tr>
</table>

These low-carbon and climate-resilient solutions can also provide important benefits in regard to the effectiveness of the services provided by healthcare facilities and ultimately manifest in improved health outcomes. For example, switching from kerosene lamps will reduce indoor air pollution that contributes to respiratory diseases and other health impacts. A reliable supply of electricity will allow facilities to provide services 24/7 and a facility able to withstand damage from a cyclone will be able to provide vital emergency services. It was estimated using modelling that for one hospital in Islamabad, Pakistan with 545 beds, approximately nine patients of productive work age are at risk of mortality due to power shortages every year. This represents an economic cost to the country of USD 4,781,710 per year (WHO 2023).

Projects to climate-proof healthcare facilities can also provide gender and social inclusion benefits, although the scale and nature of these benefits depends on how the project is designed and delivered. For example, in Zimbabwe, UNICEF targeted the installation of solar PV systems in 30 healthcare facilities that serve children, adolescent girls and women and as a result contributed to reduced child mortality and death (UNCIEF, 2022). In the case study from Ghana described in Box 8 the project trained local community members and businesses to provide installation and O&M services for the solar panels on the healthcare facilities. Using a 'women on the roof' initiative, it targeted female engineers, and for just one facility it trained and employed four new female engineers. It is therefore important to consider such investments in healthcare facilities as providing an integrated set of climate, health and economic outcomes.

BOX 2 Case study on resilient healthcare facilities

Strengthening the resilience of healthcare facility infrastructure so they are able to withstand extreme weather events is just one element of a wider strategy of preparing the healthcare sector as a whole to climate change impacts. **The WHO Operational Framework for Building Climate-Resilient Health Systems has identified ten components required to ensure a climate-resilient health system**, related to leadership and governance, the health workforce, health information systems, essential medical products and technologies, service delivery and financing **(WHO 2015)**. Only one relates to 'climate-resilient and sustainable technologies and infrastructure'.

Therefore, **an investment in the resilience of healthcare facilities could be designed as part of a wider project considering the health system as a whole**. For example, facility managers should have plans in place to manage any emergency situation and surge in demand for services, such as sourcing additional supplies required and coordinating with other nearby facilities (Rentschler et al. 2021).

This is line with the Green Climate Fund's (GCF) Sectoral Guide on Health and Wellbeing, which identifies two paradigm-shifting pathways: building health systems and services resilient to a changing climate and facilitating climate-informed health advisory and risk management services and community action (GCF 2022). Specific actions include low-carbon and resilient procurement policies and supply chains for medical appliances, integrating climate and weather data in health surveillance and early warning systems and promoting telemedicine, etc.

Climate proofing a healthcare facility can also be designed as part of a wider effort to build a community's resilience to natural disasters and climate change. For example, ensuring that access and transport routes to the facility are protected in the event of a flood or landslide and providing a secure supply of safe drinking water even during periods of droughts. In addition, monitoring and addressing the climate- and weather-related drivers of demand for healthcare. For example, cholera outbreaks in Dar es Salaam tend to occur during periods of flooding and flood-prone areas have a 20 percent increase in cholera infections, causing a surge in demand in these locations for healthcare services (Rentschler et al. 2021). Therefore, reducing the risk of flooding in these areas of the city would also ensure healthcare facilities have the capacity to provide high-quality services.

2.3 Quantifying the climate benefits of a sample of solutions

For many climate finance sources, it is necessary to quantify the expected climate benefits from a project. For mitigation benefits, this refers to the volume of GHG emissions and/or energy savings expected. Various standardized approaches, such as the Clean Development Mechanism (CDM) methodology, can be used to measure the scale of these benefits (United Nations Framework Convention on Climate Change (UNFCCC) 2022). For adaptation benefits, it is more difficult to quantify the benefits as there is no clear and unique metric for measurement (see Box 3 below for options).

This section provides an example of quantifying the climate benefits of two low-carbon and climate-resilient 'solutions' for healthcare facilities: stand-alone solar PV systems and solar lanterns. These are calculated independent of each other, although in reality a project would likely combine multiple technologies. The volume of GHG savings that each measure provides is location specific and would ideally be calculated for the context of the specific project site. To demonstrate the calculation process, this section uses three country examples (India, Nigeria and Nepal) and quantifies the financial and climate benefits for a single facility and across the country.

Quantification of mitigation benefits for stand-alone solar PV systems on healthcare facilities: There are a variety of facility-specific variables that determine the scale of the GHG emissions savings, but the most significant is the volume of fuel consumed under the baseline scenario.[2] This is affected by the actual requirement for energy by the facility and the reliability of the supply from the grid. Therefore, as detailed in the annex 2, three scenarios have been modelled, varying the volume of electricity assumed to be provided from the grid and from diesel/ petrol generators:

- *On-grid 'low' scenario:* On-grid healthcare facility receiving 30 KwH of electricity from the grid per day with a 2.5 kVA diesel/petrol generator as a back-up electricity source (consuming 1.5 litres of fuel per day). The use of the back-up generator is replaced by a 2kWp stand-alone solar PV system.
- *On-grid 'high' scenario:* On-grid healthcare facility receiving 15 KwH of electricity from the grid per day with a 2.5 kVA diesel/petrol generator as a back-up electricity source (consuming 3 litres of fuel per day). The use of the back-up generator is replaced by a 5kWp stand-alone solar PV system.
- *Off-grid scenario:* Unelectrified facility using a 2.5 kVA diesel/petrol generator as the sole source of electricity (consuming 4.5 litres of fuel per day). The use of the generator is replaced by a 10kWp stand-alone solar PV system.

The baseline scenario recognizes that, due to affordability and other factors, only a portion of the energy deficit from grid-connected electricity is met through generators (and the remainder is unmet).[3] In the sustainable scenario, the facility installs a stand-alone solar PV system either as a replacement back-up or sole source of electricity as a direct replacement for the volume of energy previously generated from the generator. This modelling is therefore an effort to estimate the costs and benefits of a direct switch from the current use of diesel/petrol generators to a future use of a solar system, rather than considering the need to increase the overall supply of electricity to facilities.

Using the assumptions outlined in the annex 2, potential CO_2 emissions savings for a single health facility per year are estimated as **1.4 tonnes CO_2 (for the 'low' on-grid scenario), 2.8 tonnes CO_2 (for the 'high' on-grid scenario) and 4.2 tonnes CO_2 (for the off-grid scenario).**

Quantification of the mitigation benefits of solar lanterns in healthcare facilities: The calculation assumes a baseline scenario of a facility using kerosene lamps (the more efficient 'hurricane' lamp) for four hours every day. In the sustainable scenario these lamps are replaced with high-end solar lanterns. In addition to avoiding CO_2 emissions from the use of the fossil fuel, it also prevents the damaging health effects from the emissions of black carbon from the kerosene lamps.

A range of emissions savings is provided under a 'low' scenario (which assumes in the baseline that six kerosene lanterns consume 263 litres of kerosene per facility per year) and a 'high' scenario (which assumes in the baseline that 12 kerosene lanterns consume 526 litres of kerosene per facility per year). Using the assumptions outlined in the annex 2, potential CO_2 emissions savings for a single health facility per year are estimated as **0.7 to 1.3 tonnes CO_2**, with black carbon savings of **0.3 to 0.6 tonnes** for the switch to solar lanterns.

[2] The EPI is a widely used metric for measuring the energy efficiency of a building. It is the ratio of the total energy consumed by a building in a year to its gross floor area.

[3] This baseline scenario does not factor in suppressed demand for energy by healthcare facilities. It estimates the current amount of energy consumed, rather than a possible future scenario where healthcare facilities have greater demand for energy and can afford higher volumes of fuel to generate what is required. It therefore underestimates as per the CDM methodology for the GHG emissions potential for such investments (UNFCCC 2022).

TABLE 3 Estimated emissions and cost savings/year for a single health facility through climate-resilient solutions

SOLUTION		EMISSIONS SAVINGS	COST SAVINGS
Installing stand-alone PV system as replacement to fossil fuel generator	'low' on-grid scenario	1.4 tonnes CO_2	USD 630 - 1066
	'high' on-grid scenario	2.8 tonnes CO_2	
	Off-grid scenario	4.2 tonnes CO_2	USD 1,411
Switching from kerosene lamps to solar latterns		0.7 – 1.3 tonnes CO_2 0.3 – 0.6 tonnes BC	USD 259 - 591

These per facility level potential GHG emissions savings can make a significant contribution to a country's overall emissions trajectory if the clean technology investments are multiplied across all the healthcare facilities currently without a reliable and affordable supply of electricity. Using the assumptions detailed in the annex 2, the table below summarizes the total GHG emissions savings if all facilities requiring an intervention are covered in the three focus countries.

TABLE 4 Summary of total GHG emissions reduction/avoided potential if solution is scaled up nationwide

	INDIA	NIGERIA	NEPAL
Total annual CO_2 emissions savings if all grid-connected healthcare facilities requiring a back-up supply invest in a **solar PV system** (low-high scenario)	190,322–380,643 tonnes of CO_2 *(131,030 facilities)*	13,130–26,260 tonnes of CO_2 (10,445 facilities)	4,727–9,453 tonnes of CO_2 (2,254 facilities)
Total annual CO_2 emissions savings if all unelectrified healthcare facilities invest in a **solar PV system**	91,822 tonnes of CO_2 *(21,072 facilities)*	102,867 tonnes of CO_2 *(27,277 facilities)*	1,564 tonnes of CO_2 *(359 facilities)*
Total CO_2 and black carbon emissions savings if all unelectrified healthcare facilities switch from kerosene to **solar lanterns**	13,844–27,689 tonnes of CO_2 and 6,280–12,560 tonnes of black carbon *(21,072 facilities)*	17,921–35,842 tonnes of CO_2 and 8,129–16,258 tonnes of black carbon *(27,277 facilities)*	236–472 tonnes of CO_2 and 107–214 tonnes of black carbon *(359 facilities)*

Using estimates of the number of energy deficit healthcare facilities across South Asia and Sub-Saharan Africa, it is possible to illustrate the scale of these potential benefits if adopted across each region. In South Asia, if all 179,539 facilities adopt both the solutions (solar PV and lanterns), it will deliver 0.35–0.58 $MtCO_2$ GHG emissions savings. In Sub-Saharan Africa, if all 123,128 facilities adopt these solutions, it will deliver 0.4–0.52 $MtCO_2$ GHG emissions savings (see Annex 2).

This analysis also does not consider the full carbon footprint of the entire healthcare facility, for example, the GHG emissions associated with the production and transportation of medicines. As the Nepal case study (Box 1) indicates, the GHG emissions associated with the use of diesel generators are far less than the emissions from the fuel used for the facility-owned vehicles. The lifecycle emissions of a stand-alone solar photovoltaic (SPV) system have also not been compared with those of the diesel generator it is replacing.[4] In reality, the climate benefits of any such

[4] An estimate of life cycle emissions from 1kWh of electricity generation via a 5Kwh and 10Kwh PV-battery system are 80 and 84g CO_2-eq/kWh respectively (Krebs et al. 2020), amounting to 1.3 and 1.4 tonnes CO_2e/kWh annually.

investment would need to be closely monitored. For example, there was anecdotal evidence from India that facilities that had installed solar systems did not always stop using diesel generators, but simply used the additional supply of electricity to power additional services and equipment.

Despite these methodological limits, the estimates of the potential GHG emissions savings from these sample clean technology investments in healthcare facilities provide a clear indication of the scale of the mitigation benefits. If both solutions are fully adopted (meaning all electrified and unelectrified healthcare facilities that are assumed to be currently using diesel generators switch to a solar PV system and all unelectrified facilities that are assumed to be currently using kerosene lamps switch to solar lanterns), the CO_2 emissions savings represent on average 0.03 percent of total national emissions.

While the mitigation potential of these solutions is relatively small, they represent just two of a long list of potential mitigation solutions that healthcare facilities could adopt to reduce their carbon footprint. The contribution of such mitigation measures will also increase considerably in a future scenario where their current unmet energy demand is supplied by electricity from the grid or fossil fuels. Both solutions will also provide adaptation co-benefits and should help protect the supply of electricity during a natural disaster.

BOX 3 Case study on measuring adaptation benefits

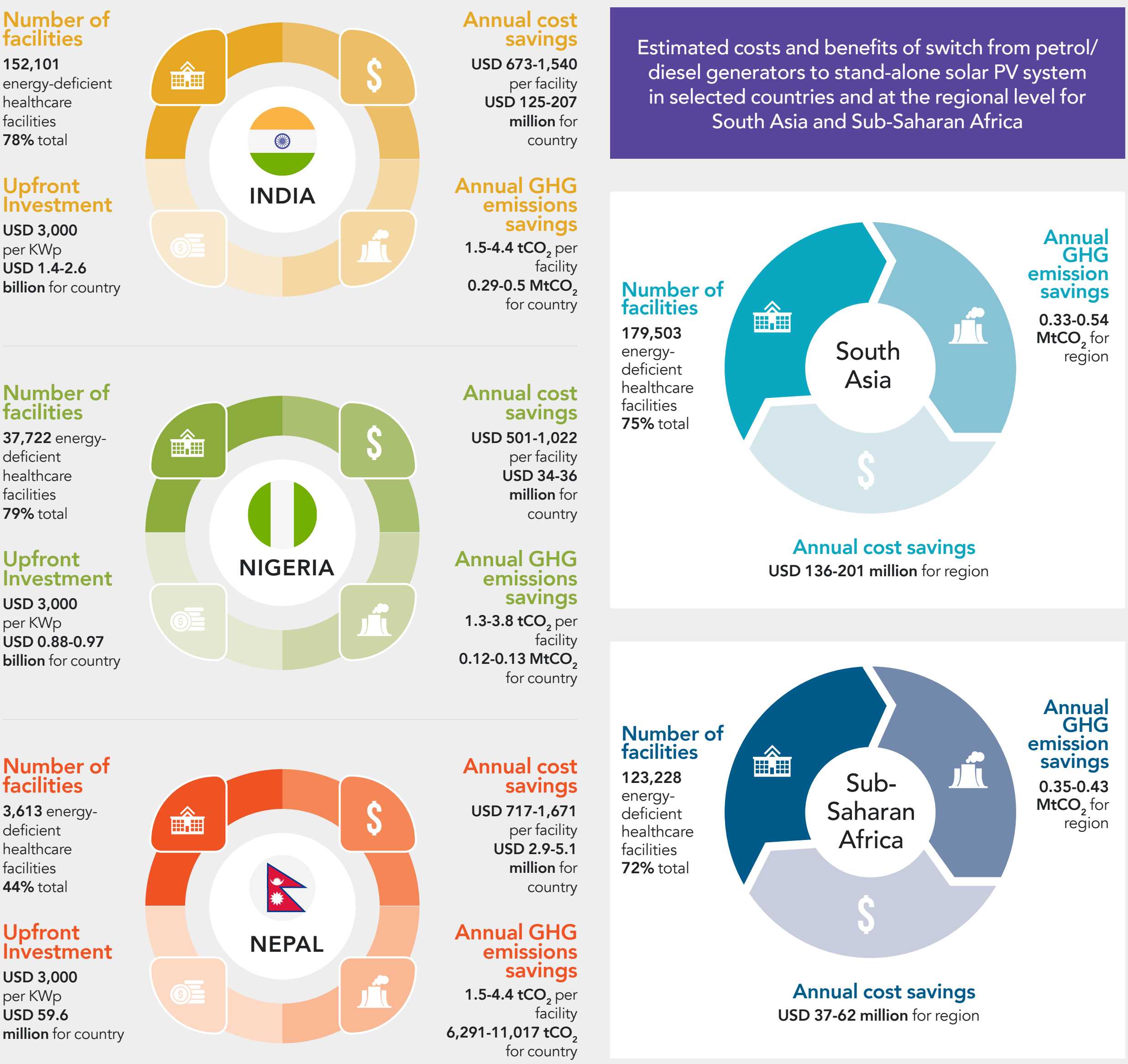
Cost-benefit assessments of adapting to the impacts of climate change are considerably more difficult than measuring the returns expected from a low-carbon solution. To simply quantify the adaptation benefits, the number of individuals with reduced vulnerability to climate impacts can be measured. The use of subjective scoring and ranking can be used to compare the expected adaptation benefits from various adaptation options. For example, Bhutan prioritized investments under its National Adaptation Programme of Action using multi-criteria analysis and ranked options by scoring each against a set of criteria, including the scale of benefits to human life and health (National Environment Commission 2006).

To put a financial or economic figure on the adaptation benefits, it is possible to calculate avoided loss and damage from extreme weather events and long-term climate impacts (UNFCCC 2011). Metrics include, for example, the avoided loss of life, loss of income and cost of replacing damaged or destroyed infrastructure. This therefore requires estimating the cost of inaction, both in terms of market-related costs (e.g. crops destroyed) and non-market costs (e.g. impact on human health and ecosystem services). For example, in Brazil cost-effectiveness analyses of different options for controlling dengue were considered under a scenario of climate change increasing the burden of dengue in the future. The study compared options in terms of their costs (direct medical and non-medical costs and indirect costs from workdays lost because of dengue) and their benefits (disability adjusted life-years saved) (Luz et al. 2011).

These investments in clean technology for healthcare facilities also provide significant cost savings in terms of operations and maintenance (O&M) and fuel costs. The scale of these savings depends on local prices. For an average for India, Nigeria and Nepal, the annual cost savings for a grid-connected facility switching from the use of a diesel/petrol generator to a solar PV system as a back-up source of electricity is USD 630–1,066 ('low'–'high' scenarios), the annual cost savings for an unelectrified facility switching from use of diesel/petrol generator to a solar PV system as sole source of electricity is USD 1,411 and for a facility switching from the use of kerosene lamps to solar lanterns is USD 295–591 ('low'–'high' scenarios).

If all energy-deficient healthcare facilities in India, Nigeria and Nepal install both solar PV systems and switch to solar lanterns, the approximate annual cost savings are USD 128–214 million, 45–59 million and 3–5.3 million respectively. If the estimated per facility cost savings in these three countries was applied to all energy-deficient healthcare facilities in South Asia and Sub-Saharan Africa, the approximate annual cost savings would be USD 200–319 million. Estimated costs and benefits of switch from petrol/diesel generators to stand-alone solar PV system in selected countries and at the regional level for South Asia and Sub-Saharan Africa are shown below.

FIGURE 1 Estimated financial and GHG emissions savings from solar PV systems on healthcare facilities



The estimates of emissions and cost savings potential of the clean technology solutions provide an indication of the financial and economic returns from an investment in the capital cost of the technology across all energy-deficient facilities in the country:

- **For an investment in a 2–5 kWp stand-alone back-up solar PV system** for all grid-connected healthcare facilities assumed to be currently using a back-up diesel/petrol generator, the financial returns on the investment are 5–11 percent over the 25-year life span of the system (for the smaller solar systems, there is payback on the initial investment within five years). If the social costs of GHG emissions[5] are factored in, the payback period is quicker and the returns increase to 7–12 percent within 25 years.
- **For an investment in a 10 kWp stand-alone solar PV system** for all unelectrified healthcare facilities assumed to be currently using a diesel/petrol generator as the sole source of electricity, the financial returns on the investment are positive only after 25 years. If factoring in the social cost of the GHG emissions, the economic returns are 3 percent after 25 years.
- **For an investment in solar lanterns** to replace kerosene lamps for all unelectrified healthcare facilities, the financial returns on the investment vary significantly across the three countries, primarily due to the price of kerosene in the baseline scenario. After two years (the assumed lifespan of the solar lantern), the financial returns are minus 66 percent for India, 17 percent for Nepal and 157 percent for Nigeria. When factoring in the social cost of both the CO_2 and black carbon emissions, these returns are improved considerably.

These are high-level estimates that would need to be verified through facility-level analysis.[6] For example, they do not factor in the avoided costs of power shortages (e.g. in terms of disrupted services and revenue generation) nor the economic benefits delivered through enhanced health services and resilience to natural disasters and climate change. However, the estimates of financial and economic returns do indicate that public sector investment, including climate finance, is required to incentivize these investments given the strong public good they deliver (i.e. GHG emissions savings). Even in cases when there is a strong financial rationale for a facility or country to invest in this technology, there are additional barriers such as the availability of financing for upfront costs, lack of information on technologies and no local O&M service providers (Concessao et al. 2023, Dholakia 2018, Moner-Girona et al. 2021).

Despite a strong climate and economic rationale, there are barriers to adoption of climate-resilient and low-carbon technology

FINANCIAL BARRIERS

High upfront CAPEX – depending on local factors, rate of return can be up to 25% over the lifetime of the technology

NON-FINANCIAL BARRIERS

Information and capacity constraints, access to finance, local technology providers and suppliers, etc.

[5] The social cost of GHG emissions is an estimate of the cost, in USD, of the damage done by each additional tonne of emissions. As detailed in the annex, a value of USD 51 is assumed per tonne of CO_2 or black carbon using guidance from the US Environment Protection Agency.
[6] Any change in the underlying assumptions used for these estimates (see the annex for full details), particularly in regard to the capital cost of the technologies, fuel prices and discount rates, means that the payback period for the capital investment could improve significantly.

BOX 4 Case study: Nongpoh civil hospital in Meghalaya, India

The SELCO Foundation supported Nongpoh civil hospital to integrate solar energy with efficient appliances. This is resulting in **cost savings of more than USD 110,000 over a five-year period, by reducing diesel costs on critical loads by 76 percent and total energy costs by 68 percent**. These savings are being allocated to provide outpatient services for nearly 100,000 patients over five years. In addition to the cost implications, this also contributes significantly to reducing carbon emissions, avoiding 18,000 litres of diesel usage annually amounting to carbon savings of more than 81.8 tonnes of CO_2 over a 20-year period for this hospital alone.

The SELCO Foundation's monitoring of the financial and climate benefits of its investments in healthcare facilities across India have shown that the additional investment in energy efficiency adds significant value. For example, for a COVID-19 care hospital in Bihar it calculated that the use of energy-efficient appliances reduced the size of the solar system required from 26 kWp to 16.2 kWp. A further investment in the efficiency of the built environment meant the hospital only required a 12 kWp system. There was more than a 29 percent additional energy cost saving from integrating energy efficiency into the use of solar energy.

Source: SELCO Foundation (2023)

2.4 Financing low-carbon and resilient investments in healthcare facilities

Each low-carbon and resilient technology or measure for healthcare facilities has its own financing needs. In general, the costs associated with the adoption of such solutions can be divided into four components:

Upfront capital costs (CAPEX): This includes the purchase, transport and installation of the technology or infrastructure. Although these costs vary depending on the location of the facility, the financial analysis for this study used a set of approximate standard costs[7] for each country (USD 3,000/ KwP for a stand-alone solar PV system including panels, batteries and inverter and USD 80 for a high-end solar lantern). Globally, the costs of these and other technologies are rapidly declining, which will further strengthen the financial viability of the solutions. For example, the levelized cost of electricity from decentralized renewable energy solutions has declined 9 percent annually since 2016, primarily due to reduction in technology costs (Weinand et al. 2023).

O&M costs (OPEX): This includes the repair and servicing of the equipment, any fuel costs and replacement parts. For solar PV systems this has been assumed to be 1.5 percent of the upfront costs. In cases where the clean technology is replacing an inefficient system (e.g. replacing traditional light bulbs with LED ones, or replacing a diesel generator with a solar PV system) then OPEX is typically reduced. However, if a healthcare facility is installing an additional piece of new technology (e.g. a solar vaccine refrigerator) then the OPEX is a new cost that needs to be managed.

Additional/enabling environment costs: There are a variety of indirect costs associated with healthcare facilities adopting these low-carbon and resilient solutions. Some of these the facility itself may have to bear, such as the internet and technology for energy monitoring. Others relate to the wider enabling environment required to incentivize, enable and support facilities to adopt these solutions. This includes building an ecosystem of local energy service providers for O&M, training healthcare facility managers and providing access to finance for upfront costs. These investments in capacity, institutions, policy, etc. will need to be made by the government and/or with support from development partners.

Healthcare systems investments: The low-carbon and resilient investments required for healthcare facilities in South Asia and Sub-Saharan Africa cannot be separated from the need to invest in healthcare systems a whole. The issues related to energy access, tackling climate change and universal healthcare are inherently linked. For example, solar panels supplying reliable electricity to healthcare facilities will only lead to improved health outcomes if there is a sufficient number of trained healthcare professionals able to perform procedures and use the equipment. Public sector healthcare facilities in these regions are typically using small amounts of energy per capita, not just due

[7] These costs are estimates based on WHO (2023) modelling of costs for 63 countries in Africa and Asia and include design, installation, permitting, transport etc.

to an unreliable supply of electricity but also because of limited capacity to use electricity equipment and appliances etc. Therefore, the opportunity presented by climate finance needs to be considered in the context of the wider need to mobilize wider investment in healthcare systems, such as personnel and medical equipment.

There are different potential financing models to cover these costs, given that healthcare facilities are typically extremely cash strapped. For example, in Nigeria PHCs cover approximately 75 percent of the facilities' entire running costs (including OPEX for any low-carbon and resilient solutions) through out-of-pocket expenses and user fees and they are not able to make any investments in infrastructure and equipment. The table below sets out some potential different financing models for the four types of costs.

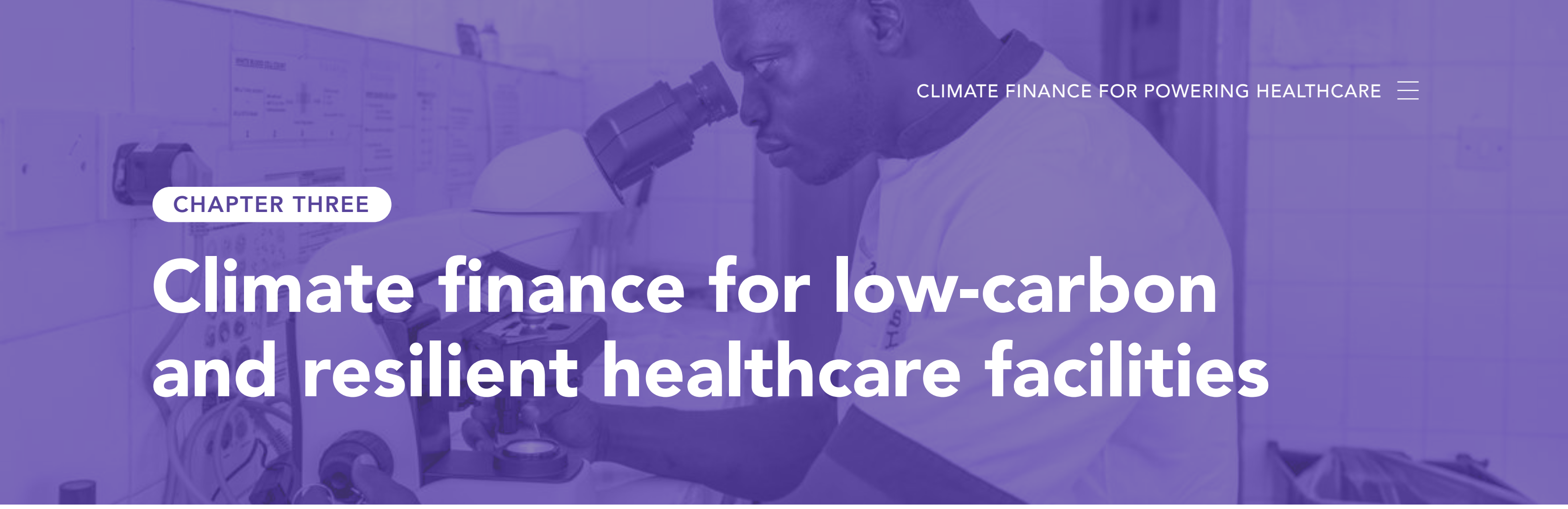
TABLE 5 Financing models for low-carbon and resilient solutions for healthcare facilities

TYPE OF COST	POSSIBLE FINANCING MODELS
CAPEX	• Government (or third-party) finances through an engineering, procurement and construction-type contract[8] or a subsidy for facilities to directly procure technology. • A company leases the technology or supplies renewable energy as a service to the facility (shifting the CAPEX to the company, not the facility) at a commercial or subsidized rate.
OPEX	• Government increases financing of facilities and/or facilities increase user fees.
Additional/ enabling environment costs	• Credit enhancement instruments and long-term concessionary loans to encourage private sector participation in providing/ servicing the clean technology solutions (e.g. guarantee mechanisms). • Technical assistance to strengthen the policy and regulatory framework and build institutional capacity.
Healthcare systems investments	• Government increases financing of healthcare sector and/or facilities increase user fees.

In most countries in South Asia and Sub-Saharan Africa, the national or local government would not be able to provide the funds required for these financing options. There has only been limited discussion within most national health systems in these regions on the potential role of private sector financing. In some cases, corporate and impact investors may be prepared to invest in companies providing/servicing the low-carbon and resilient technologies, although this is typically considered a highly risky investment. Given that health budgets for most countries in the regions are already extremely stretched, additional external sources of financing such as climate finance are required. The rest of this study considers the potential for climate finance to fill the void in domestic and private sector financing.

> Given the resource constraints of the public health sector in South Asia and sub-Saharan Africa, climate finance can serve as an additional external source of financing.

[8] Engineering, procurement and construction contracts involve a public sector agency contracting a company to provide the low-carbon and resilient solution to one or more healthcare facilities.



CHAPTER THREE

Climate finance for low-carbon and resilient healthcare facilities

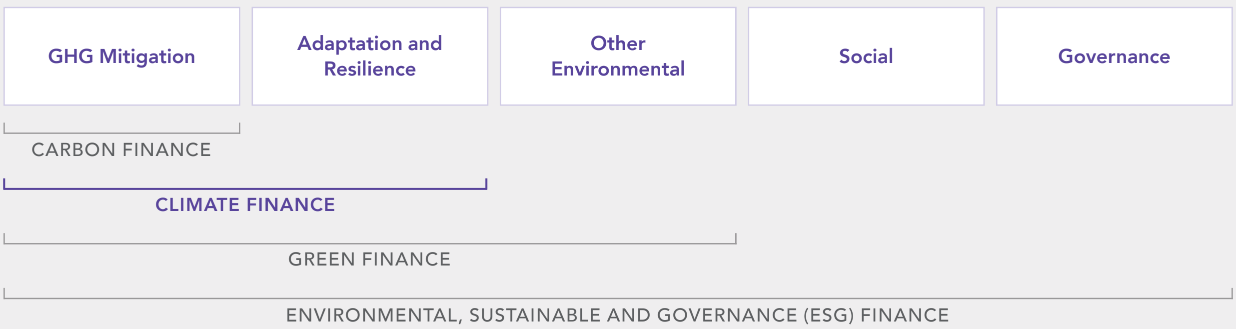
The previous section described a strong climate rationale for investment in low-carbon and climate-resilient technologies and measures for healthcare facilities in South Asia and Sub-Saharan Africa. There is also a clear need for additional financing to cover the associated CAPEX and OPEX and to strengthen the enabling environment to make these investments viable and sustainable. This section therefore considers whether climate finance can provide the volume and type of financing required. It includes an introduction to different sources of climate finance and identifies those with the most potential for healthcare facilities in these regions.

3.1 Landscape of climate finance

Climate finance is a very broad term, covering *"local, national or transnational financing – drawn from public, private and alternative sources for financing – that seeks to support mitigation and adaptation actions that will address climate change"* (UNEP nd). The main defining feature is what the finance is being spent on, i.e. reducing GHG emissions and/or adapting and building resilience to the impacts of climate change. The figure below illustrates that it is narrower than Environmental, Social and Governance (ESG) and green finance but broader than just carbon finance.

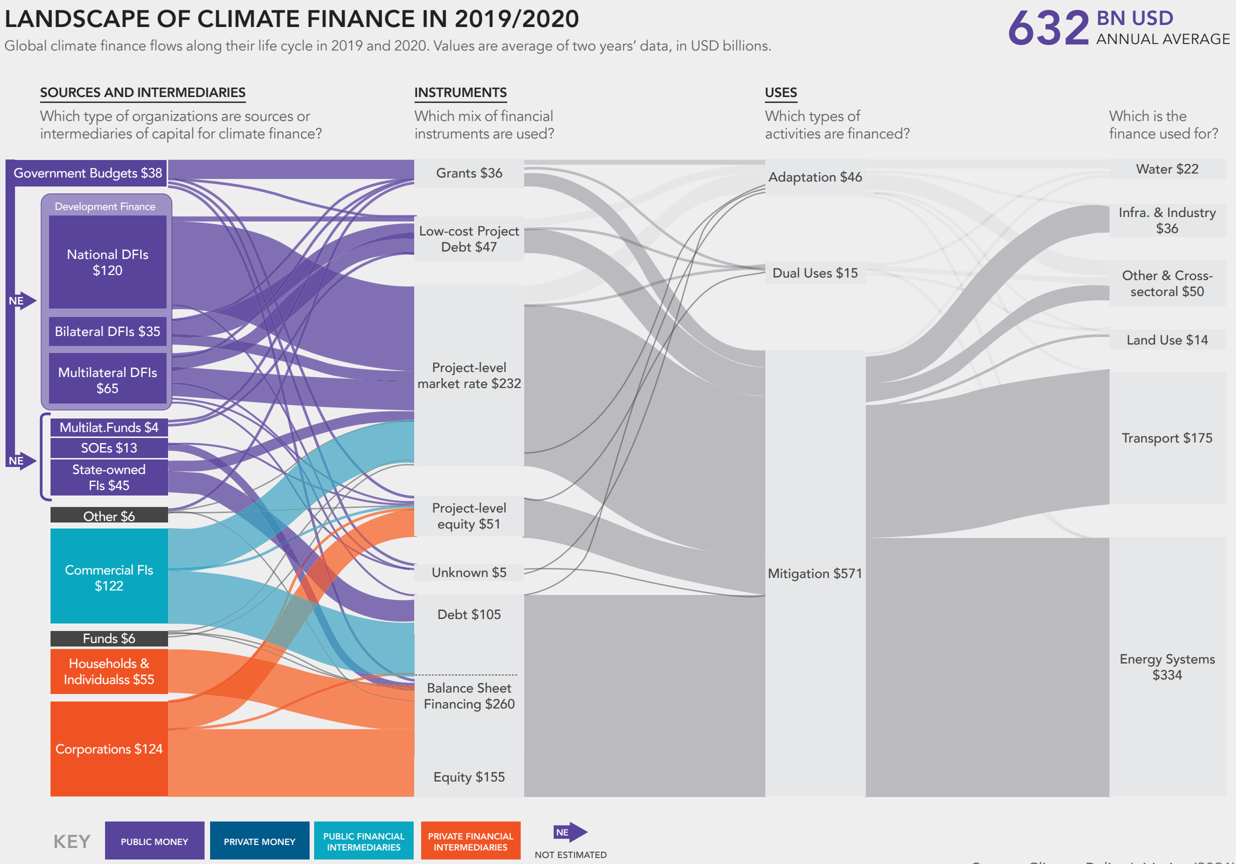
The volume of climate finance has steadily increased over the last decade, reaching USD 632 billion globally in 2019/20, although only USD 30 billion and USD 19 billion flowed to South Asia and Sub-Saharan Africa respectively (with three-quarters of the total flowing to industrialized countries) (Climate Policy Initiative 2021). To meet internationally agreed climate objectives, an estimated USD 4.35 trillion of climate finance is required annually by 2030, which is an increase by at least 590 percent on current levels (ibid.). Of the total climate finance flows in 2019/20, 90 percent was for mitigation action, 7 percent for adaptation and 3 percent for joint actions (ibid.). The figure below breaks down this finance by source, intermediary, instrument, use and sector.

FIGURE 2 Landscape of climate finance



Source: Adapted from Dalhuijsen et al. 2021

FIGURE 3 Overview of climate finance flows



Source: Climate Policy Initiative (2021)

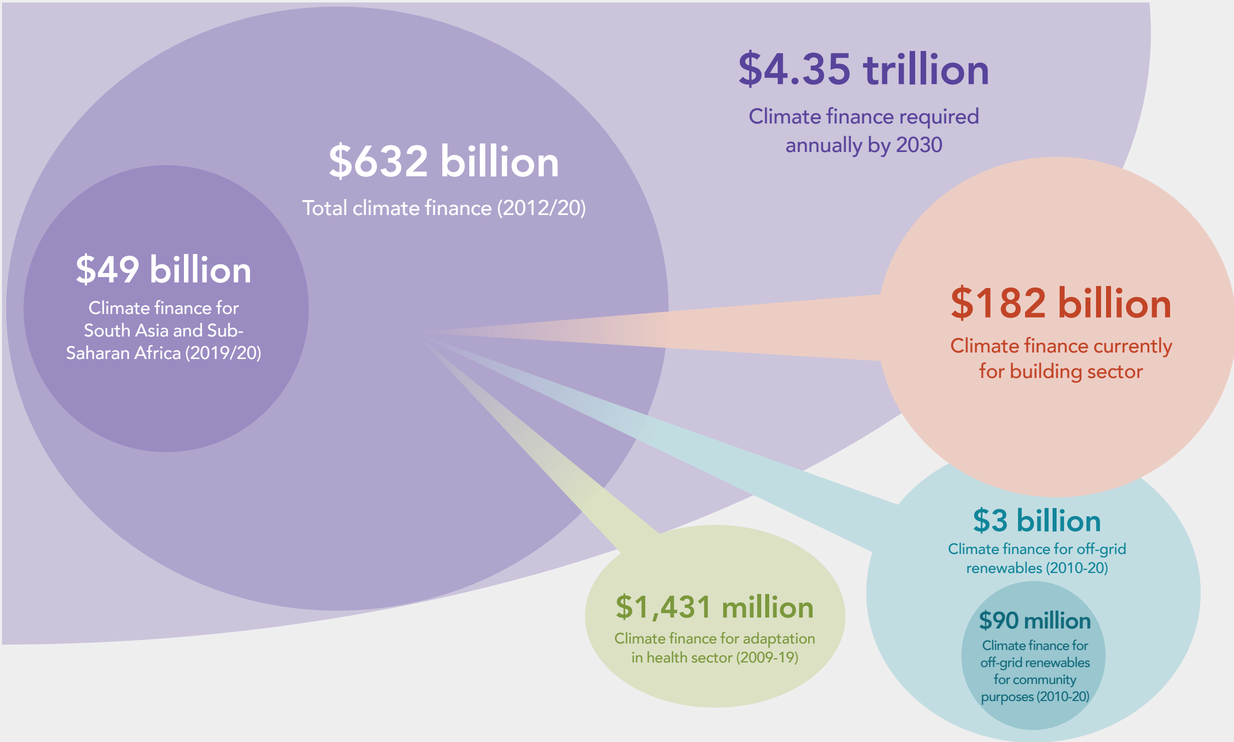
While there is no comprehensive tracking of climate finance in the healthcare sector,[9] there is some useful data on finance flows to some of the low-carbon and resilient solutions relevant for healthcare facilities (Donor Tracking, 2020). These are described below and then illustrated in the (not-to-scale) Figure 4.

- **Off-grid renewable energy:** USD 90 million of climate finance between 2010 and 2021 went to off-grid renewable energy for community purposes, covering healthcare and education facilities and streetlighting in low- and middle-income countries. This is just 3 percent of the total cumulative climate finance commitments in off-grid renewables (over USD 3 billion for 2010 to 2021). South Asia – primarily India – dominated the overall share of off-grid renewable energy financing in 2021 (57 percent of the total), followed by East Africa (19 percent) and West Africa (18 percent) (International Renewable Development Agency and Climate Policy Initiative 2023).
- **Green buildings:** There is only partial data available for mitigation solutions for buildings (energy-efficiency measures and on-site production and use of renewable energy). Funding from development finance institutions (DFIs) for energy efficiency in existing and new buildings averaged USD 13 billion in 2019/20 (Climate Policy Initiative 2021). A top-down estimate of total current public and private investment in buildings' energy efficiency and electrification, district heat and renewable direct use is USD 182 billion, which is far less than the USD 480 billion–1.1 trillion required between 2020 and 2050 to achieve our internationally agreed climate goals (ibid.).

[9] Data is available for bilateral flows of climate finance, for which 3% was tagged to 'health' in 2018.

- **Adaptation solutions for healthcare:** An estimated USD 1,431 million of bilateral and multilateral adaptation finance (4.9 percent of total) between 2009 and 2019 was committed to the healthcare sector, although this includes projects focusing on infectious diseases, health systems and disease surveillance. Nearly 60 percent of this was provided by three sources: EU institutions (USD 373 million), the GCF (USD 314 million) and the US (USD 167 million). Some 99 percent of the financing was provided as grants (Alcayna and Chadaria 2023).

FIGURE 4 Stylized illustration of volume of relevant climate flows



Given the financing models for low-carbon and resilient investments in healthcare facilities in South Asia and Sub-Saharan Africa, the most relevant climate finance instruments are grants and low-cost project debt. This narrows down the potential sources and intermediaries of climate finance to bilateral flows from industrialized countries, DFIs, multilateral funds and private philanthropic funds. USD 83 million was made available via these instruments and from these sources in 2019/20, which includes the financing flows to healthcare facilities described above. The rest of this section will look more closely at whether and how these sources could be further leveraged for healthcare facilities (Donor Tracker 2023).

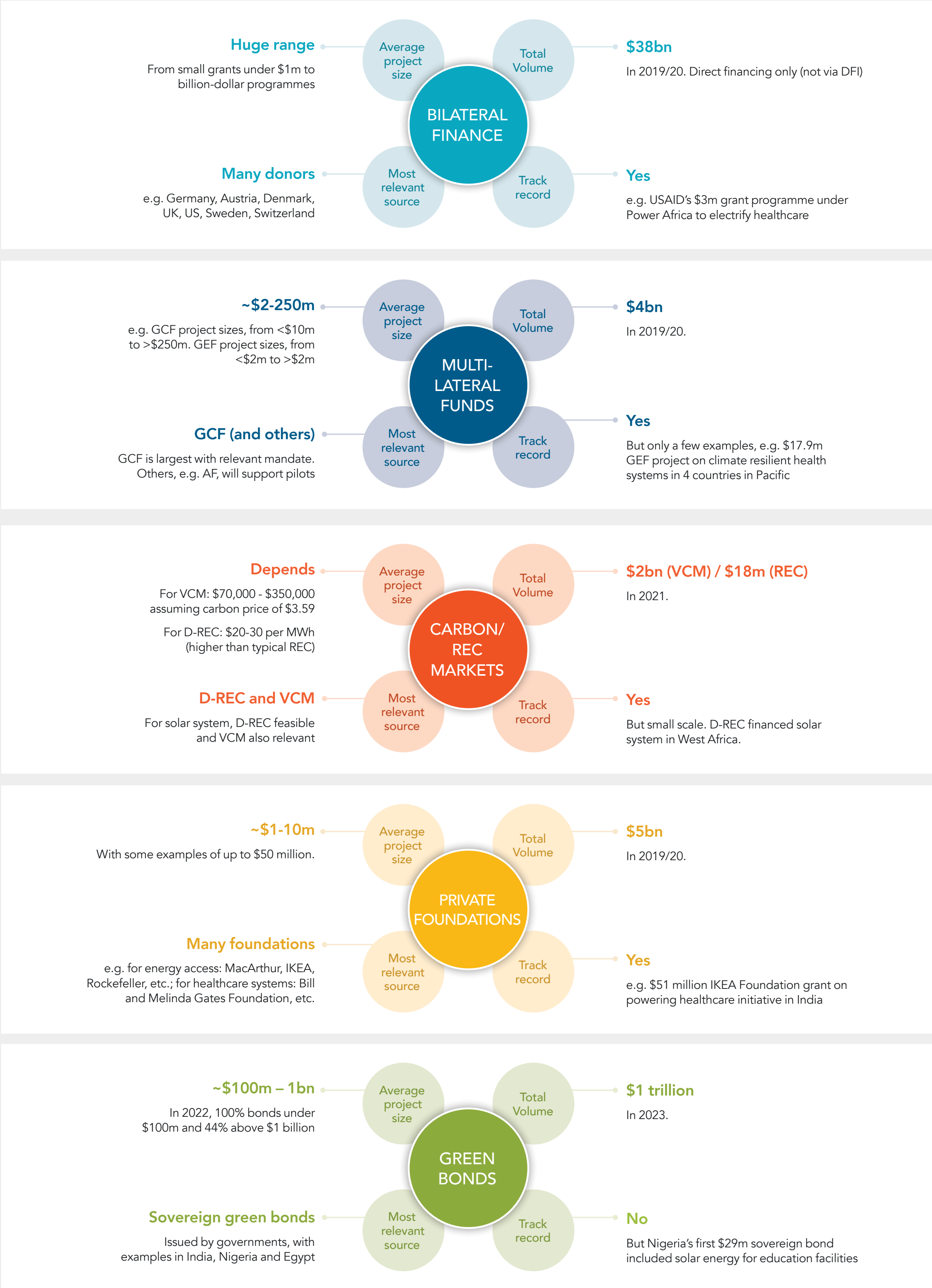
3.2 Potential climate finance sources for healthcare facilities

This section describes the sources of climate finance with the most potential to finance low-carbon and resilient technologies in healthcare facilities in South Asia and Sub-Saharan Africa. This includes identifying specific opportunities that appear to be the most likely to invest in such projects, even if they are not currently doing so.

The figure below (Figure 5) is a summary description of the five categories of climate finance sources that are explored in detail in this section. It highlights the range and variety in the total volumes of financing from each source and the approximate average size of an individual project. It also identifies some examples of specific donors, funds or markets that have or look likely to invest in healthcare facilities and their track record of financing relevant projects.

FIGURE 5 Summary of potential climate finance sources for healthcare facilities

Summary of total volume, average project size, track record and examples of five most relevant sources of climate finance

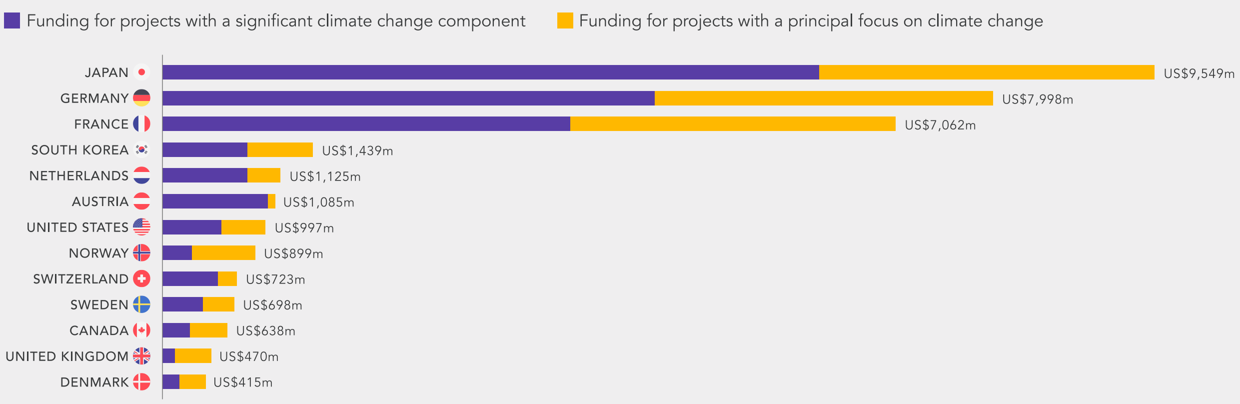


Bilateral climate finance: This includes a direct transfer in finance from an industrialized country's Overseas Development Assistance (ODA) budget via their bilateral aid agency to directly support mitigation and/or adaptation efforts in developing countries. In total, such flows amounted to USD 38 billion in climate finance in 2019/20 (Climate Policy Initiative 2021). The largest donors of climate-related ODA in 2021 were Japan, Germany and France, which collectively represent 71 percent of all bilateral climate finance (Donor Tracker 2021).

This funding is often part of a bilateral diplomatic relationship between the two governments or with multiple governments in a region, and the specific scope of the finance is defined by their respective priorities in regard to climate change. An estimated 6 percent (USD 2,167 million) of bilateral climate finance was focused on health, of which the vast majority (USD 2,140) was focused on adaptation.[10] One example of a mitigation-focused project financed by bilateral climate finance is USAID's 'Power Africa' and the Global Health Bureau initiative to electrify and digitally connect 10,000 healthcare facilities in Sub-Saharan Africa by 2030, which has included USD 2.6 million of grants from USAID to solar energy companies to provide off-grid solar electricity to 288 healthcare facilities in nine countries (USAID n.d., Power Africa 2020). Some countries have set up dedicated bilateral climate funds to coordinate and pool resources across government. These are often more flexible than direct bilateral donor funding and can include calls for proposals from recipient governments in partnership with the private sector and non-profit organizations. For example, Germany's International Climate Initiative has financed over USD 4.7 billion for over 750 mitigation and adaptation projects since its inception in 2008. The UK, together with Germany, Denmark and the European Commission, has also pooled some of its bilateral funds under the Mitigation Action Facility, which runs calls for proposals for ambitious mitigation projects in low- and middle-income countries (see Box 5).

A large proportion of bilateral climate finance flows via national and bilateral DFIs such as Germany's KfW and Norway's Norfund (USD 155 billion in total in 2019/20) and via multilateral DFIs such as the World Bank, Asian Development Bank etc. (USD 65 billion in total). The majority of the bilateral finance flowing via DFIs was for market rate project debt and is therefore not directly relevant for the purposes of investments in mostly public healthcare facilities.

FIGURE 6 Total ODA commitments related to climate change



Source: Donor Tracker (2023)

[10] It is not clear whether this data tracking source would 'tag' projects related to renewable energy and energy efficiency for healthcare facilities under the 'health' or the 'energy' category, and therefore this could underestimate the amount of mitigation-focused bilateral climate finance for the healthcare sector.

BOX 5 Case Study: Mitigation Action Facility

The Mitigation Action Facility has to date supported USD 705 million of transformational mitigation projects in Africa, Asia and Latin America, across multiple sectors. The facility is a joint initiative of the German, UK and Danish governments, the European Union and the Children's Investment Fund Foundation. The average project size is around 10 years with a budget of USD 11–27million. It provides mostly grant-based funding, with some including concessional loans/ guarantee funds. The facility is a relatively accessible source of bilateral climate finance. It announces calls for proposals from government and implementing partners (local or international private/public organizations). It first requests concept notes and if shortlisted provides finance and support for the design process.

The selection criteria include:

- Transformational change potential – related to the project having a catalytic effect and being replicable, scalable and sustainable;
- Potential to leverage additional finance – including both public and private finance; and
- Mitigation potential – the scale of GHG emissions savings expected and cost-effectiveness of these savings.

The facility has supported relevant projects, although none directly related to healthcare facilities. This includes projects on energy efficiency in public buildings in South Africa, solar-powered cold chain services in Kenya and self-supply renewable energy systems in Chile.

For more information see: https://mitigation-action.org/

Multilateral climate funds: These funds are established through international agreements, in particular under the UNFCCC, and are financed by industrialized countries in recognition of their historic contribution to climate change. The funds increased annual funding to USD 3.5 billion in 2019/20, which is a rise of 18 percent from 2017/18, of which 47 percent went to adaptation projects or those with dual objectives (a much higher proportion than other climate finance sources) (Climate Policy Initiative 2021). The GCF was designed to simplify and consolidate the complicated network of multilateral and bilateral climate funds and initiatives and represents around half of the current financing of multilateral funds (ibid.). However, there continues to be other funds with specific focuses, such as the Global Environment Facility (GEF) (which represents 27 percent of total multilateral financing) and the Adaptation Fund.

The most relevant funds for investments in low-carbon and resilient healthcare facilities are explored below.

GREEN CLIMATE FUND (GCF)

The GCF has one of the broadest mandates, supporting projects that build the resilience of communities to climate change, reduce GHG emissions and increase carbon sinks. Since being established in 2010 it has committed USD 12.7 billion (but disbursed only 3.7 billion), of which approximately half is for mitigation and half for adaptation. Of the 228 projects it has approved, 97 are in Asia-Pacific and 92 in Africa, while, of the total, 65 percent are targeting the public sector and 35 percent the private sector. 41 percent of GCF funds are being provided as grants, 41 percent as loans, 11 percent as equity, 4 percent as results-based payments and 3 percent as guarantees (GCF 2023a).

The topic of low-carbon and resilient healthcare facilities cuts across a number of the GCF's eight thematic priorities, and in the GCF's health and wellbeing sector guide both the mitigation and adaptation connections with the healthcare system are highlighted (GCF 2022). However, to date no project has been approved that exclusively focuses on climate resilience and low-carbon healthcare facilities, although some projects do include investments in healthcare facilities. For example, the GCF finances the World Bank's USD 157 million Cooling Facility, which supports the deployment of clean cooling technologies, including reliable and climate-friendly vaccine cold chains and clean cooling in health facilities (ESMAP 2021). The GCF's strategic plan for 2024 to 2027 includes a set of targets relating to *"expand[ing] access to sustainable, affordable, resilient, reliable renewable energy, particularly for hardest to reach"*, *"a shift toward clean and efficient energy end-use for…building[s]"* and *"access adaptation funding"* (GCF 2023b).

GLOBAL ENVIRONEMT FACILITY (GEF)

The GEF was established in 1992 and provides grants and concessional financing for projects that promote sustainability and biodiversity conservation while addressing climate-related challenges. For the period 2022–2026, the GEF has USD 5.33 billion of funding available and these resources have been allocated across a set of focal areas and integrated programmes (GEF 2023). The healthcare sector does not feature prominently in these current strategic priorities, although the GEF has supported relevant projects in the past and is supporting related initiatives such as energy efficiency of buildings. In particular, a series of WHO/United Nations Development Programme (UNDP) projects in Asia and the Pacific aimed to build the resilience of the healthcare sector to the impacts of climate change, including 'climate proofing' healthcare facilities (see Box 6 below).

BOX 6 Case Study: GEF financing of a WHO/UNDP project on climate-resilient health systems in the Pacific

The UNDP and WHO are supporting four countries – Kiribati, Solomon Islands, Tuvalu and Vanuatu – to increase the resilience of their health systems to climate change. With USD 17.85 million of GEF funding and USD 76 million of co-financing (from the four national governments and two international agencies), the funding proposal for the five-year project was first submitted in early 2015 and approved for implementation only at the end of 2020. The project is working to improve hygiene in healthcare facilities, implement climate-resilient water safety plans, build the capacity of health professionals, develop climate-informed early warning systems and disseminate climate change and health-related technical guidelines.

One expected outcome of the project is that healthcare facilities are better equipped to cope with potential climate-induced hazards. This includes technical assistance for detailed and site-specific vulnerability assessments and the establishment of technical design and business/investment plans (involving cost–benefit analyses) for implementing 'climate-proofing' measures. This includes planning and installation of robust structural elements (e.g. facility roofs, doors, windows etc.) and supportive elements (such as drainage and flood protection structures, water capture, storage and filters, water saving devices, etc.), as well as non-structural components (e.g. computers, diagnostic equipment, back-up generators, etc.) to withstand extreme weather events such as high winds, intense precipitation, floods and droughts.

For more information see:
www.thegef.org/projects-operations/projects/8018

ADAPTATION FUND

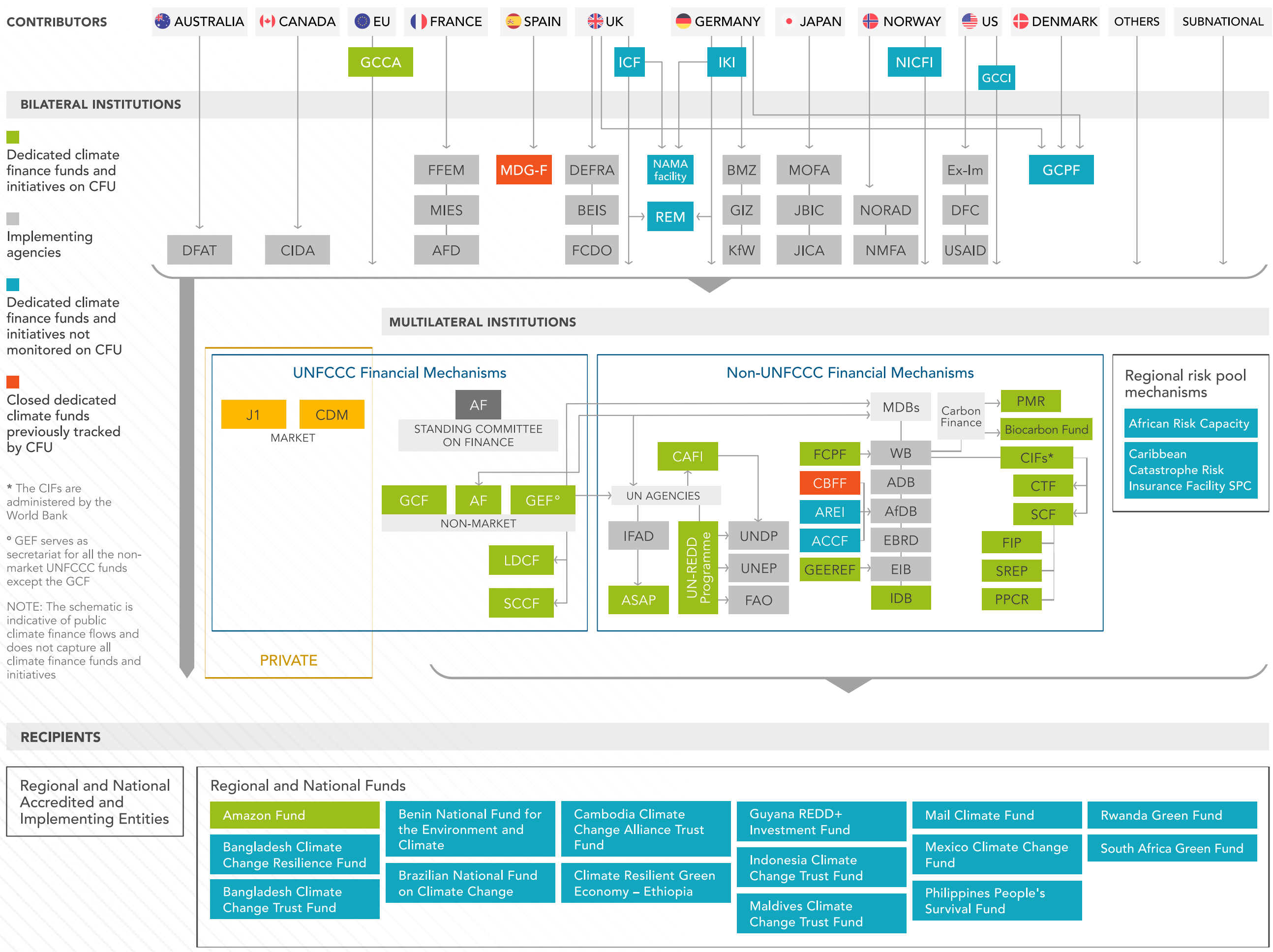
The Adaptation Fund has since 2010 committed USD 1 billion for climate change adaptation and resilience projects supporting the most vulnerable communities. By 2022, 132 projects have been approved (totalling USD 790.2 million of grants), 86 projects are under implementation (totalling USD 604.2 million of grants) and 33 projects have been completed (Adaptation Fund 2023). In terms of the geographic focus of the approved project portfolio, 48 percent of projects are located in Least Developed Countries and Small Island Developing States. In terms of thematic distribution, 14.6 percent relate to the agriculture sector, 14.3 percent to food security and 12.2 percent to disaster risk reduction and early warning systems (ibid.). The Adaptation Fund's 2023–2027 strategy references the need to build synergies between adaptation and related areas such as health, although it does not appear to have yet funded a project directly focused on the healthcare sector (Adaptation Fund 2022).

CLIMATE INVESTMENT FUNDS

Since 2008, CIF has supported 370 projects in 72 countries, organized under two funds – the Clean Technology Fund and the broader Strategic Climate Fund – and a set of programmes related to specific technologies, sectors or geographies. Of these programmes, the most relevant are the Scaling Up Renewable Energy in Low Income Countries programme (which has committed USD 585 million of blended finance for energy access) and the Pilot Programme for Climate Resilience (under which 17 percent of its USD 997 million of approved funding is focused on building the resilience of infrastructure in low-income countries). It channels concessional finance through six multilateral development banks (CIF 2023).

These are just a sample of the sources of bilateral and multilateral climate finance available, and as the figure below demonstrates there is a complex set of relationships between them. The multilateral DFIs, particularly the World Bank and regional development banks, play a crucial role in administering much of this climate finance. For example, the World Bank acts as the GEF Trustee and services a functionally independent secretariat, which also doubles up as the secretariat for the Adaptation Fund. The World Bank Group is also the implementing partner of CIF's investments and channels and manages bilateral finance via a set of climate-focused trust funds. Some of the recipient countries have also set up their own national or regional climate funds, such as the Bangladesh Climate Change Trust Fund, to help coordinate climate finance disbursements.

FIGURE 7 Map of the complex multilateral and bilateral climate finance architecture



Source: Watson, Schalatek and Evéquoz (2022)[11]

[11] See source for full list of acronyms https://climatefundsupdate.org/wp-content/uploads/2022/03/CFF2-Global-CF-Architecture_ENG-2021.pdf

Philanthropic foundations: Climate finance from private funds, such as the IKEA Foundation, The Rockefeller Foundation, Bill and Melinda Gates Foundation and Hewlett Foundation, provided USD 5.3 billion in 2019/20, which was mostly focused on renewable energy. Some of these foundations have been investing in relevant energy access initiatives. For example, the IKEA Foundation has committed a USD 51 million grant to the SELCO Foundation in India to integrate sustainable energy solutions, efficient equipment and energy design elements into 25,000 healthcare facilities across India by 2026. Over the last five years, The Rockefeller Foundation has provided USD 935 million, primarily in grants, for climate and health initiatives globally.

Carbon markets: Carbon markets are a trading system intended to promote reductions in GHG emissions by assigning a monetary value to carbon emissions. Companies or individuals can use carbon markets to compensate for their GHG emissions by purchasing carbon credits from entities that remove or reduce GHG emissions. One tradable carbon credit equals one tonne of a GHG reduced, sequestered or avoided. There are two broad types of carbon markets: Compliance carbon markets and project 'offset' carbon markets, with the latter being the more relevant for this study.

Compliance carbon markets: Participation by entities in these markets is mandated via national or regional legislation or regulation. This includes emissions trading systems (or 'cap and trade' systems) in which there is a cap on the total allowable GHG emissions within a jurisdiction and businesses or entities have an 'allowance' of emissions permits to ensure the total cap is not exceeded. If they have fewer emissions than their allowance, they can sell the excess to others, providing a financial reward for emissions reductions. Such schemes are in place in industrialized countries and are spreading to a much wider set of countries such as China and Mexico, with plans also underway in India and Colombia. Under Article 6 of the Paris Agreement there has been an effort to enable cooperation between these compliance carbon market schemes to meet national governments' commitments to reduce GHG emissions.

Project 'offset' carbon markets: Carbon markets also allow countries or companies to 'offset' their own GHG emissions through a project that is avoiding or reducing emissions elsewhere. Such projects are those that either prevent emissions (compared to business-as-usual scenario) – such as through energy efficiency, renewable energy or avoided deforestation – or remove existing emissions from the environment, such as through reforestation or direct air carbon capture, etc. Each credit purchase represents one tonne of CO_2e that can in turn compensate for one tonne of an entity's CO_2e emissions. Once a credit is used for this purpose, it becomes an offset and is then moved to a register for retired credits and is no longer tradable.

The CDM, which was created under the UNFCCC's Kyoto Protocol in 1997, allows emissions reduction projects in developing countries to generate credits that can be purchased by industrialized countries to meet part of their reduction targets. Since 2006 it has supported more than 1,650 projects, providing annual financing for emissions reductions achieved in projects involving, for example, rural electrification schemes using solar panels, the installation of more energy-efficient boilers and the construction of biogas digesters (UNFCCC n.d.). In Nepal, the Alternative Energy Promotion Centre (AEPC) has used the CDM to finance 450 mini/micro hydro projects with 15MW cumulative capacity (resulting in 24,611 carbon credits).[12] These projects typically serve a whole community via a mini-grid, which often includes a PHC.

The CDM has faced a number of challenges since its inception, including demand-supply mismatches and the 2008 financial crisis. These challenges have resulted in fluctuations in the prices projects have received for a credit. The CDM was not designed to explicitly target low-income countries, although it was expected to increase the transfer of technology and knowledge from industrialized countries to other

[12] Information provided to authors directly by key informants at AEPC.

countries. However, it has benefited a narrow set of countries and sectors: China and India accounted for 70 percent of all registered projects, while, of the total projects, 75 percent have been in the energy sector and 11 percent in the waste sector (Muthyanolla 2022). Under Article 6 of the Paris Agreement, the CDM will transition to a new set of rules that aim to avoid double counting of emissions reductions. This uses a system of 'corresponding adjustments' for all authorized credits, meaning that the country in which the credit is being generated and sold has to deduct them from its own GHG inventory before another country or company can count them toward its own target.

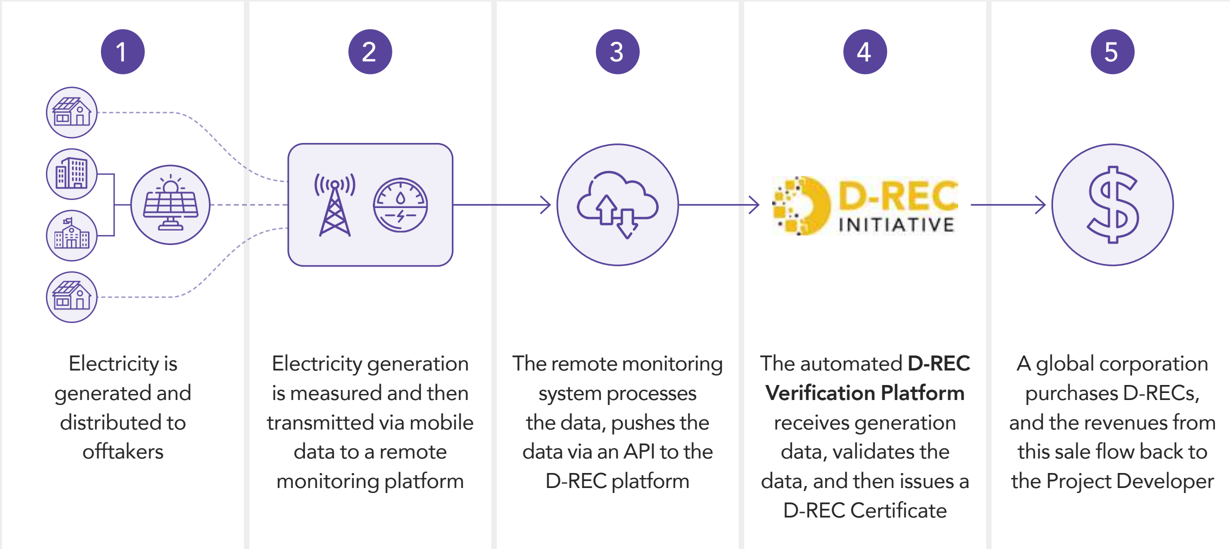
Voluntary carbon markets (VCMs) have existed since the 1980s, allowing organizations and individuals to voluntarily purchase carbon credits from projects that are reducing GHG emissions to 'offset' their own emissions. Voluntary carbon credits are not limited by geographic boundaries and have the potential to be accessed by every sector of the economy. VCMs have seen rapid growth in the last decade, as countries and companies commit to reduce their carbon footprint. In 2021, the global value of VCMs reached USD 2 billion and is expected to reach USD 40 billion by 2030 (Bursa Sustain 2023). An estimated 25,159 of carbon credits have been issued via the Berkeley Voluntary Registry Offset Database related to solar home systems in Africa (Jabbar, Bindslev and Jabbar, 2023).

There are various certification schemes that allow projects to demonstrate high quality and therefore receive a higher price, most notably Gold Standard. The price received for one tonne of CO_2e varies depending on the size and type of project, location, market demand and whether certified as high quality. At the end of 2022, voluntary carbon credit prices averaged USD 4–8 per tonne at wholesale (the price paid to the project developer), with prices for afforestation and reforestation projects being USD 8–15 and energy-efficiency projects being USD 2–6 per tonne (Barido et al. 2023). One example of a project financed using VCMs involved four health centres in Madagascar, which were supported to install an off-grid solar system using grant funding from Atmosfair and further supported with finance raised under the VCM in Germany (Andre-Bataille, 2022).

Renewable Energy Certificates (RECs): RECs can also be traded, either under a national compliance market or as an offset mechanism. They are similar to a carbon credit, but they represent one MWh of electricity generated from a renewable energy resource, rather than one tonne of CO_2e emissions savings. They can be purchased by companies that have made a commitment to run their operations using 100 percent renewable energy, such as the 400 companies under the RE100 global corporate renewable energy initiative, or in some cases RECs are traded under a compliance scheme (e.g. certain US states and India). While RECs are mostly traded within a country, there are international standards for REC tracking systems around the world (such as the International REC Standard). The global REC market was valued at USD 18 billion in 2021 and has been predicted to reach 111 billion by 2030 (CMI 2022). Similar to the carbon markets, there is a Gold Standard Renewable Energy Label, which was created to fulfil a market demand for guaranteed high-quality RECs.

A D-REC is a specific type of REC that certifies the generation of distributed renewable energy sources (typically up to 1MW in capacity) that provide energy in the location in which they are installed. The figure below describes how finance flows to projects. The market for D-RECs was created in 2020 and is issuing credits to 7,399 MWH at 683 sites in ten countries (D-REC Initiative 2023). The price of a D-REC usually ranges between USD 20 and USD 30 per MWh (Van der Merwe 2022).

FIGURE 8 Steps involved in the D-REC issuance



Source: D-REC Initiative 2023

BOX 7 Case study: EmPowered Social Impact – the use of D-RECs to promote quality healthcare delivery in Uganda

Kyabirwa Surgical Center, a flagship facility by GSI in Uganda's rural Jinja region, now runs on 100 percent renewable energy (46,574 kWh). This initiative addresses the **challenge of both access to reliable electricity and to quality surgical care with measured outcomes.** GSI partnered with PowerTrust to verify and issue D-RECs to finance ongoing energy service-related costs and data measurement every year.

This case is particularly interesting because it has combined the use of RECs and social impact markets. It has also partnered with OutcomesX – a global marketplace for verified outcome funding – and Impact Genome – a registry for Verified Impact Units (VIUs) – to finance specific health outcomes. The VIUs are tied to surgical care outcomes (30 days post-surgery) rather than just the volume of payments seen.

By linking 'Health' RECs and VIUs, GSI established a clear connection between electricity availability and health outcomes. For example, in 2023 GSI is 'selling' a bundle of RECs across multiple facilities in Uganda, including Kyabirwa, and 1,600 digitally linked and verifiable surgical procedure outcomes. This linkage has created a marketplace where the value of energy and data was linked to a social good, promoting better healthcare delivery.

Green bonds: Green bonds (or climate bonds) are a form of fixed income security, which are issued by corporations and governments (in the case of sovereign bond issuance) to raise debt finance.[13] They are a low-cost alternative to traditional bank loans, but are only viable in countries with sufficient creditworthiness. Green projects – including in the energy, transport and building sectors – are 'bundled' together to provide economies of scale. Green bonds grew by over 50 percent during the period 2016–2021 and are expected to touch an annual issuance of over USD 1 trillion by 2023 (CBI, 2022). A separate category of 'social' bonds focus on projects with a social good – such as affordable basic infrastructure and services – but can also have a climate co-benefit, while 'sustainability' bonds are a mix of green and social projects. Nigeria was the first country in Africa to issue a sovereign green bond, raising USD 29 million to fund projects that included solar power for university facilities and a renewable energy micro utility to provide solar power to off-grid communities (Policy Development Facility II 2020).

[13] The majority of the green bonds issued are green 'use of proceeds' or asset-linked bonds. Proceeds from these bonds are earmarked for green projects but are backed by the issuer's entire balance sheet. There have also been green 'use of proceeds' revenue bonds, green project bonds and green securitised bonds (Climate Bonds Initiative n.d.)

This section has highlighted that the scope, mandate and type of financing instruments supported by each climate finance source differ significantly. One important dimension is whether they can finance the four types of 'costs' involved in supporting low-carbon and resilient healthcare facilities in South Asia and Sub-Saharan Africa (see Section 1.4). The table below summarizes how likely it is that each climate finance source will cover these costs.

TABLE 6 Financing scope of climate finance sources in 2023

	BILATERAL FINANCE	MULTILATERAL FUNDS	PRIVATE FOUNDATIONS	CARBON/REC MARKETS	GREEN BONDS
Can it finance CAPEX?	**Yes**, via grant or low-cost loan	**Yes**, via grant or low-cost loan	**Yes**, via grant or low-cost loan	**Partly**, and can unlock additional sources of finance	**Yes**, government can finance via the debt security of the bond
Can it finance OPEX?	**Not typically.** Projects are time limited so not long-term solutions	**Not typically.** Projects are time limited so not long-term solutions	**Not typically.** Projects are time limited so not long-term solutions	**Yes**, ongoing sale of credits can provide long-term finance	**Not typically.** Usually only finances capital costs
Can it finance the enabling environment?	**Yes**, including technical assistance, piloting, capacity building etc.	**Yes**, including technical assistance, piloting, capacity building etc.	**Yes**, including technical assistance, piloting, capacity building etc.	**Not directly.** Finance is provided on basis of verified emissions reductions	**No**. Typically finances only capital costs
Can it finance health out-comes?	**Yes**, depending on priorities of the donor, projects can have multiple objectives and outcomes	**No**. While co-benefits are encouraged, this would need an additional co-financing source	**Depends** on the priorities of the foundation	**Not directly**, but parallel tradable credits for social impact can be generated	**No**, but broader social bonds can cover all ESG outcomes

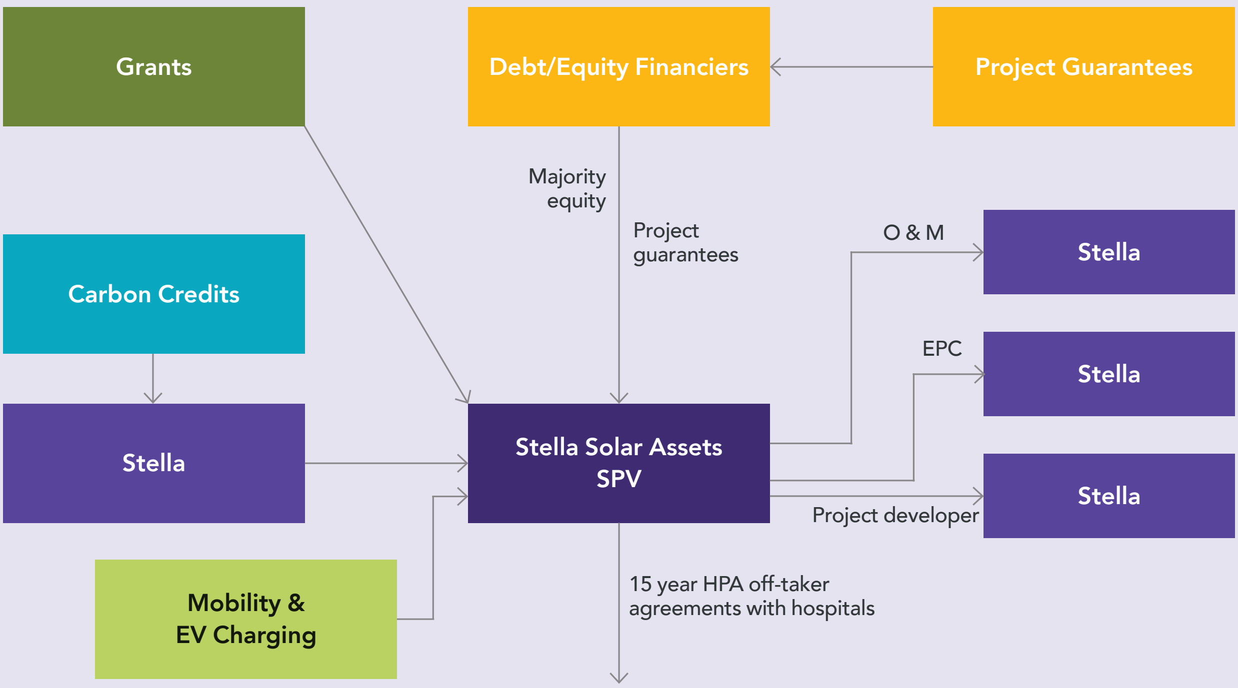
It is clear that no single source of climate finance is likely to cover all the associated costs of climate proofing healthcare facilities. Using a combination of sources has proven to be useful for a pilot project in Ghana installing solar PV systems on healthcare facilities (see Box 8), including to catalyse wider debt and equity financing.

No single source of climate finance will likely cover all the types of costs associated with climate proofing healthcare facilities; a combination of sources is required

BOX 8 Case Study: Combining climate finance sources using a blended finance model for solarizing healthcare facilities in Ghana

A pilot in four healthcare facilities in Ghana run by the Christian Health Association of Ghana has demonstrated the viability of using climate finance, combined with other sources, to support the installation and maintenance of solar energy systems. Project developer Stella Futura installed pilot grid-tied solar PV and battery storage systems ranging from 8kWp to 117 kWp on the facilities under a 'solar-as-a-service' (including maintenance) model. With zero down-payments required, facilities signed a hire purchase agreement with Stella Futura, making repayments in the local currency, and after 12 or 15 years ownership is transferred to the facility.

Stella Futura used grants to make the project attractive to wider financing, including support from the Shell Foundation and a German government-financed fund called Clean Capital Installations for Industrial Clients in Sub-Sharan Africa. This covered the upfront costs to develop the project and reduced CAPEX. Guarantees were used to derisk external debt/equity funding and lower the cost of capital, while D-RECs were used to mitigate currency risk. **It is estimated that the combination of grants and financing from D-RECs reduced the monthly repayments by healthcare facilities by 56 percent.** This financing model is described in the diagram below.



In partnership with Swedish company CAKE, Stella Futura's energy access model also incorporates e-mobility to enable safe and efficient cold chain vaccine distribution and other public health activities to doorsteps in remote village locations via the use of low-maintenance electric motorbikes equipped with chiller boxes.

It is estimated that for one facility that has benefited from these technologies, it has over the course of a year generated 157,789 kWh of solar energy, avoided 74,124 kg of CO_2 **emissions**, created 45 indirect jobs (of which 44 percent are female) and reduced energy costs by up to 50 percent.

> *Stella Futura's pilot Solarization of Africa's Healthcare Systems project demonstrates that, by utilizing an innovative blended financing model to transition to solar energy, health facilities shall expand energy access, build resilience, deliver quality services and record significant cost savings… The mix of carbon financing/D-RECs, grants and concessionary financing backed by project guarantees unlocks the viability of healthcare electrification projects to provide affordable, reliable and clean energy access to health facilities, while guaranteeing returns to investors.*
>
> FRANCIS ASANTE
> CEO Africa, Stella Futura

Source: Based on a presentation by Stella Futura

3.3 Access requirements for accessing climate finance

Each of the climate finance sources described in the previous section as having the potential to fund low-carbon and resilient investments in healthcare facilities have unique access processes and requirements. There is a complicated set of public and private sector entities that are involved in project development, approval, disbursement of finance and verification of activities and results.

In all cases, the mobilization of such finance takes time (at least one year), as well as some upfront investment in time from the partner(s) engaged in financing the investments in healthcare facilities. This section presents a brief overview of the key actors and processes involved in accessing these funds and the role of non-government partners.

Each source has specific access requirements, for example:

BILATERAL FINANCE	MULTILATERAL FUNDS	PRIVATE FOUNDATIONS	CARBON/REC MARKETS	GREEN BONDS
e.g. USAID, UK International Climate Fund (ICF), German International Climate Initiative (IKI)	e.g. Green Climate Fund (GCF), Adaptation Fund (AF), Global Environmental Facility (GEF)	e.g. IKEA Foundation, MacArthur Foundation, Rockefeller Foundation	e.g. D-REC, Gold Standard, Verified Carbon Standard	e.g. Sovereign green bonds
Mitigation/adaptation projects and programmes funded through Overseas Development Assistance (ODA).	Funds the *additional* cost of reducing GHG emissions/building resilience for a project/ programme.	Foundations typically support non-profit organizations to deliver a low-carbon or climate resilient programme.	Projects receive a credit for a volume of GHG emissions abated/ renewable energy produced.	Projects with environmental claims can receive a form of fixed income security, as a low-cost alternative to a loan.
Access: Variety of funding mechanisms, including competitive funds and government – government bilateral programmes	Access: National governments (and/or implementing partners) submit proposals to fund, based on specific criteria	Access: Non-profit organizations design a project, often in close collaboration, with foundation staff	Access: Project developers can develop and credit project under various registries for companies/countries to purchase to 'offset' their own emissions elsewhere	Access: Corporations or governments issue green bonds and can voluntarily get environmental claims certified by third-party.

Bilateral climate finance: ODA projects are typically defined by the priorities of the donor and recipient countries, and the exact scope of the projects depends on negotiations between the two governments (typically the donor aid agency and the recipient foreign affairs ministry) and the influence of expert organizations. For the bilateral finance that flows via competitive funds, such as the Mitigation Action Facility, the Africa-EU CO-FUND Action or the German International Climate Initiative, there are regular calls for proposals from the agency acting as the secretariat for these funds. Often these proposals can be submitted by a private or non-profit organization but usually the endorsement of a national government is required. Some offer financial support to cover the costs associated with designing a project. Each fund has a transparent set of eligibility criteria and are a relatively transparent route to access climate finance.

Multilateral climate funds: Each climate fund has its own secretariat and access process, and – apart from the GCF – a multilateral DFI, often the World Bank, has a key role.[14] There have been efforts to synergize and streamline the process, particularly between the GCF and Adaptation Fund, but each still operates very separately. Each fund's website provides comprehensive details of the process for applying and the criteria for selection.

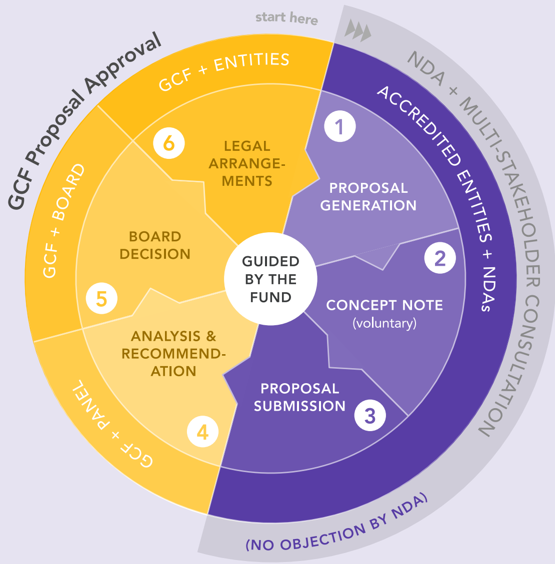
[14] www.climatefundsupdate.org provides details on access modalities for 27 multilateral climate funds.

For most funds, the recipient government has to be part of or leading the design and delivery of the project and has to approve all projects earmarked for their country. For the GCF and Adaptation Fund, the entities that can receive and disburse funds must be accredited and are called implementing entities and accredited entities respectively. The designated authorities for both funds are national government agencies, which have to endorse all accreditations and project funding proposals from the country.

For example, in India the National Bank for Agriculture and Rural Development is a national implementing entity for the Adaptation Fund, but regional implementing entities (such as the International Centre for Integrated Mountain Development) and international implementing entities such as UN agencies could also receive funds from the Adaptation Fund for India. However, the Ministry of Environment, Forests and Climate Change in India has to approve all projects in the country. A similar set of stakeholders, although using different terms, is involved in the GCF process in India.

For the various funds that operate as a trust fund managed by a multilateral DFI, such as the 'Scaling-Up Renewable Energy Program in Low Income Countries', the design of projects and programmes is carried out by the DFI and with the recipient government and under the governance structure of the trust fund, which involves both donor and recipient governments.

BOX 9 Case study: Accessing the GCF



Accredited entities can present funding applications to GCF anytime (step 3 in the diagram), although these are considered by the GCF Board twice a year (step 5). These need to be endorsed by the National Designated Authority within the recipient government. There is often considerable back-and-forth between the accrediting entity and the GCF Secretariat on their proposal, particularly in response to the technical review by independent experts (step 4).

The review and selection process is guided by the GCF Investment Criteria:

- *Impact potential* – Quantified scale of the climate benefits
- *Paradigm shift potential* – How the project will catalyse action beyond the GCF funded project
- *Sustainable development potential* – Quantified evidence of social, environment and economic co-benefits of the project
- *Needs of the recipient* – Using evidence of how the project is aligned to the needs of the country
- *Country ownership* – How the project aligns with national plans and priorities
- *Efficiency and effectiveness* – The financial and economic viability of the project, including details of co-financing from the public and/or private sector.

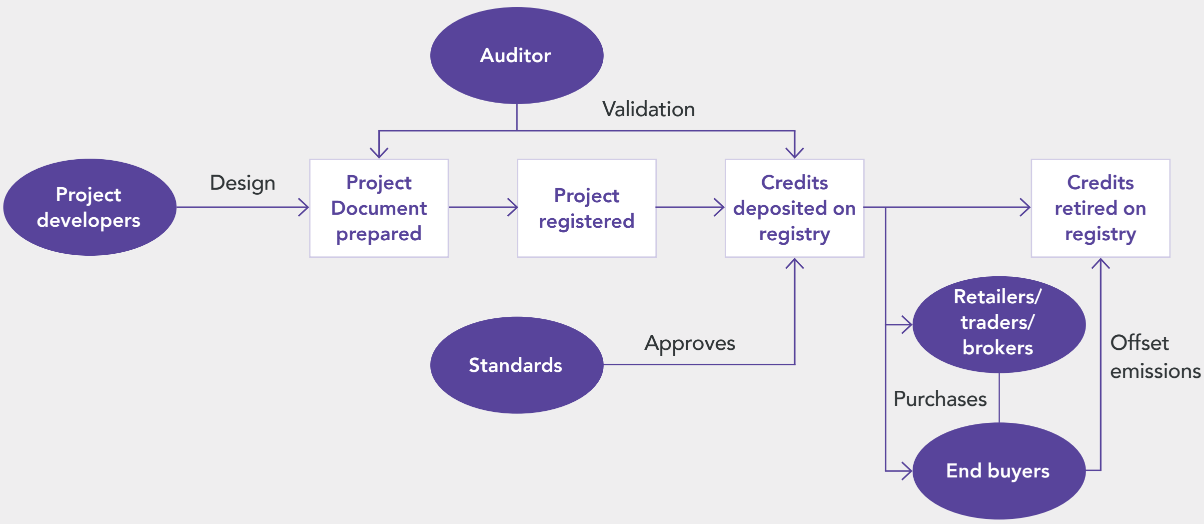
For more information: www.greenclimate.fund/project-cycle

Philanthropic foundations: Finance, typically in the form of programmatic or core grants, tends to be disbursed via non-profit organizations. The board of the fund is the ultimate decision-maker, but projects are typically directly negotiated and designed between staff and the recipient organization. Depending on the country in which the project is operating, the government will be more or less involved in these discussions.

Carbon markets: Offset carbon markets (VCMs and the CDM) and voluntary REC markets involve a very different set of stakeholders and processes from the other climate finance sources discussed in this section.

- Project developers design, mobilize finance and set up the project. Developers could be a government agency, company or non-profit organization. They also need to monitor the renewable energy generated or emissions reductions once the project is running, which are verified by a third-party auditor before the project can be registered.
- For VCMs, a certification standards body, such as Gold Standard or Verra, needs to certify that the project meets a particular set of standards. The D-REC Initiative provides a similar service for decentralized renewable energy projects. It then issues a credit and adds the project to its registry.
- The credit can then be directly purchased by a buyer, such as a company, to offset their own emissions or energy use. It can also be traded on the market, following the same broad principles of a commodity exchange.
- Brokers or retail traders, such as Numerco or Redshaw Advisors, are types of 'middlemen' that can purchase and aggregate credits to make it easier for buyers and in some cases provide initial funding to get a project running. Once the credit is eventually used to 'offset' emissions/energy elsewhere, the credit gets 'retired' so it cannot be re-traded. The figure below provides an example for the VCM.

FIGURE 9 Example of stakeholders involved in the VCM



Green bonds: A green bond gets designed, issued and financed like any corporate or government bond but with certain environmental claims, such as reducing GHG emissions. There is no requirement for the environmental benefits to be certified but this allays fear of 'greenwashing'. The Green Bond Principles were developed by the International Capital Market Association to promote integrity in green bond markets through guidelines that facilitate disclosure, transparency and reporting. The Climate Bonds Initiative also has a Climate Bond Standard and certification scheme.

3.3.1 The role of non-government partners in accessing climate finance

There is a range of national and international public and private sector organizations that are typically involved in accessing the sources of climate finance described in this section. The role of non-government partners[15] who are looking to support and advance the climate proofing of healthcare facilities (including SEforALL, but also national and international research institutes, non-profit organizations and corporates) varies depending on the specific sources. The table below attempts to describe the role of non-government partners in the process of accessing climate finance sources.

TABLE 7 Role of non-government partners in accessing climate finance sources

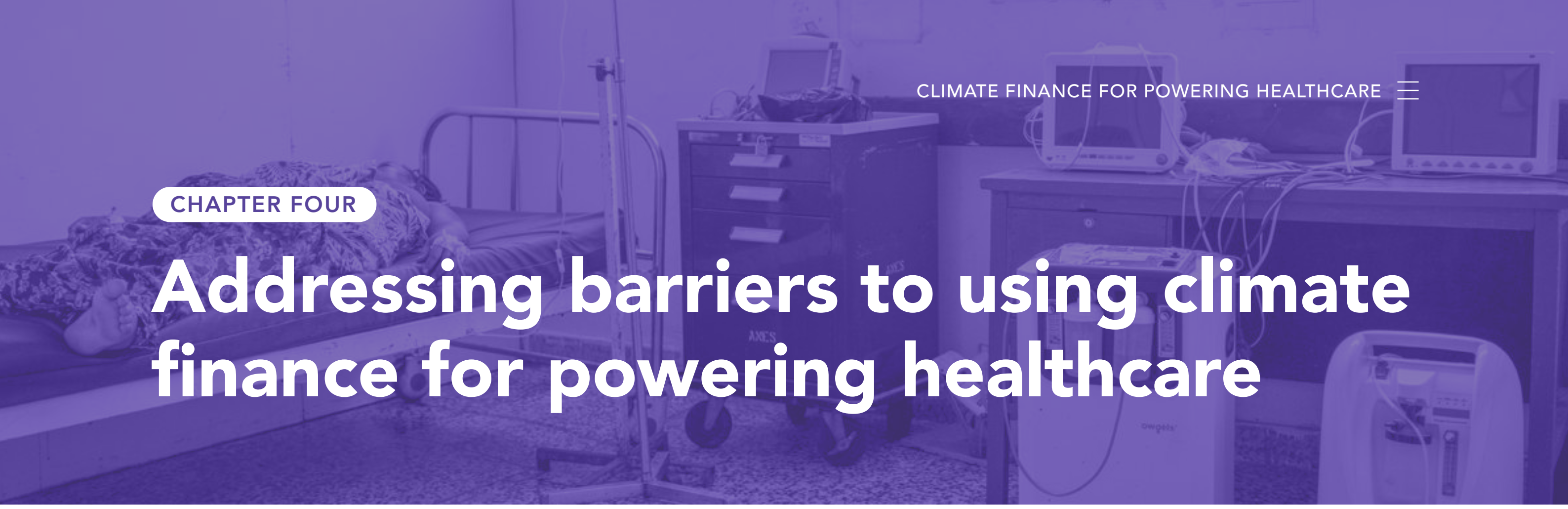
	BILATERAL FINANCE	MULTILATERAL FUNDS	PRIVATE FOUNDATIONS	CARBON/REC MARKETS	GREEN BONDS
Who 'designs' the project?	**National governments**, either directly through diplomatic channels or indirectly by endorsing an external organization's project	**Accredited entities** (non-profit, private or public organization), with endorsement of national government	**Non-profit organizations**, often in partnership with other organizations	**Project developer** (non-profit, private or public organization) in partnership with local partner	**National government, DFI or private company** often with support of a DFI
Role of non-government partner in design?	**Can influence priorities** of both recipient and donor governments. Some bilateral funds have direct access opportunities (usually smaller grants)	**Can directly access some funds** *if accredited* (restrictions and costs apply) or through *small grants mechanisms*. Finance flows from DFIs for some funds	**Can directly access funds** as recipient organization	**Can directly access funds** as project developer or partner	**Can influence priorities** of national government, DFI or company to encourage and support the design of the project
When to design?	**Varies.** Some bilateral funds have regular calls for proposals	**Ongoing or regular calls** for proposals	**Varies.** Grants approved regularly	**Annually**	**Ongoing**
Are there additional costs?	N/A	**Accreditation costs** in the event that direct access to funds is required	N/A	**Verification costs**	**Verification costs**

Non-government partners can therefore play a key role in accessing climate finance for climate proofing healthcare facilities, although this ranges from playing a supportive and influencing role (for bilateral funds and green bonds) to directly designing and mobilizing funds (for some multilateral funds, private foundations and carbon markets). The diagram below summarizes the key steps in accessing each climate finance source, as well as the role that non-government partners play at each step. However, it is worth stressing that there are important differences between specific donors, funds, foundations and markets within each category.

[15] This refers to any organization that is not the national government, and therefore includes non-profit organizations, corporates, research institutions and international organizations.

FIGURE 10 Summary of key steps for non-government partners to support accessing each climate finance source

	1. CONVENE PARTNERSHIPS	2. DESIGN PROJECT	3. APPROVAL PROCESS	4. FUNDS DISBURSEMENT
BILTERAL FINANCE	Engage national government to establish it is a priority. Find relevant supportive donor government	Support government to develop concept note and if invited, develop full design documents (design funds may be available)	Approved by donor government or DFI/ third-party managing a fund on behalf of donor organization	Funds may be disbursed directly from donor government or via recipient government or DFI
MULTILATERAL FUNDS	Engage relevant Accredited Entity (AE) (or DFI) and national government for agreement to engage relevant fund.	Support AE to develop concept note and if shortlisted develop full design documents (design funds may be available).	Approved by inter-governmental fund board but with review process by secretariat DFI managing fund.	Funds disbursed from secretariat to AE or DFI (or directly to non-government partner).
PRIVATE FOUNDATIONS	Engagement relevant public and private organizations required for deliver of project.	Directly develop project funding proposal (often in close collaboration with fund staff).	Approved by Board of Foundation.	Funds disbursed from foundation to recipient organization
CARBON/REC MARKETS	Engagement partners at site of project and secure financing for CAPEX (e.g. from broker).	Directly develop Project Design Document with partners at site. Some brokers support design process.	After project has been validated/verified a Certification body approves project and a registry issues carbon credit 'certificate'.	Carbon credits are purchased directly or traded on the market and 'retired' when ultimately used as offset.
GREEN BONDS	Engaging national government, DFI or private company to design project.	Support to develop the 'Green Bond Framework' with investment bank or an advisor.	Environmental claims of project can be verified by Climate Bonds Initiative or others.	Funds disbursed according to specific project milestones.



CHAPTER FOUR

Addressing barriers to using climate finance for powering healthcare

There is a range of significant barriers that make it a challenge to access and effectively use climate finance to invest in low-carbon and climate-resilient healthcare facilities in South Asia and Sub-Saharan Africa. Some of these relate to climate finance in general (e.g. complexity and time of the approval and disbursement process) and would apply for any type of project. Others are specific to the nature of the investments required. This section will focus on the latter, analysing a small number of projects that have received climate finance for healthcare facilities to consider how this can be scaled up going forward.

4.1 Barriers to using climate finance for low-carbon and resilient healthcare facilities

There are only a handful of examples of climate finance projects related to healthcare facilities, and few on health more generally. However, some of the stakeholders involved in these projects were interviewed to capture their experiences and learning. In addition, national government officials and experts from India, Nigeria and Nepal were consulted on their perception of the potential of climate finance for investing in low-carbon and resilient healthcare facilities. A summary of the key barriers identified is provided below.

The potential GHG emissions savings for a single healthcare facility are too small to attract climate finance on their own: The estimates of GHG emissions associated with the sample of climate solutions described in Section 1 indicate that a project needs to be designed at a national or regional level. The transaction costs associated with accessing climate finance mean it is only viable if a large number of facilities are part of the project. This requires a significant amount of engagement with healthcare facilities, manageable only by the national government or a very large external organization, to get their buy-in to the project before it gets designed. Coordinating and managing a project across a large number of healthcare facilities requires a significant level of internal delivery capacity.

Limited capacity of healthcare facility professionals to design, manage and report on a project: Healthcare facilities are unlikely to conceptualize, design and implement a climate finance project because deciding on energy-related investments and managing O&M issues are not part of their current mandate. Therefore, the government or a third party is required to not just design the project but manage the lengthy process of getting it approved, up and running and successfully delivered. For example, quantifying the climate rationale to make the case for climate finance can be challenging without historical baseline data, particularly in relation to the scale of GHG emissions savings. In addition, the investments in low-carbon and climate-resilient solutions should be planned for as part of the facility's long-term financial plan. This would help fulfil the investment criteria of some climate finance sources, such as the GCF, that the project is sustainable in the long term. In most countries in the region there is limited local capacity in the healthcare sector to carry out these and other technical tasks.

National data on healthcare facilities is not consolidated and does not cover key energy- and climate-related indicators. For example, in Nepal the national GHG emissions inventory has not disaggregated activity-level data related to emissions from health facilities and their supply chains, while the Nepal Health Infrastructure Information System has no record of volume and source of energy consumed. In all countries, a detailed current and projected energy needs assessment for each facility is required, which will require time and technical capabilities.

A single source of climate finance is unlikely to cover the entire costs associated with the project. While some sources are more likely to cover CAPEX only, others are more suited to cover OPEX or wider enabling environment investments. Some sources such as the GCF require co-financing (although for low-income countries this could just be the in-kind contribution of time from healthcare professionals and others), while others such as carbon markets are designed as additional finance that will make a project viable to attract wider investment. Carbon markets have been described as an opportunity to diversify income and enhance projects' viability but should not been seen as a replacement for equity or traditional sources of financing (Jabbar, Bindslev and Jabbar, 2023). Securing the necessary financial support to complement climate finance is often a complex endeavour.

Financing OPEX and finding local service providers is a risk for the long-term sustainability of investments. Most climate finance is designed to cover only the initial capital costs and is time limited. Given that healthcare facilities' budgets are already stretched, securing funding for additional ongoing costs is often unrealistic. Experts consulted also highlighted that maintenance costs are often underestimated or not adequately planned for at the project design stage. In some cases, when a facility has a long-term secure supply of finance (e.g. through carbon markets), it can still be a challenge to find skilled service providers locally who can carry out the O&M required. A number of national experts consulted referred to solar panels previously installed now lying damaged and unused, which also makes facilities sceptical of re-engaging on the topic. Governments are also underestimating issues related to O&M and recycling of technologies. For example, in India the Jharkhand State Solar Policy 2015 covers the use of distributed renewable energy but does not mention long-term O&M of solar PV systems in remote regions (Ginoya et al. 2021a).

Long-term monitoring, reporting and verification of energy, emissions and other results is an additional cost. For low-carbon technologies, such as solar panels, energy monitoring systems need to be set up in the facility, which also requires a secure internet connection. In Nepal, for example, 45 percent of healthcare facilities currently do not have a computer with internet (Nepal Ministry of Health and Population 2022). In the carbon markets, accurate and audited data on energy and emissions is essential. In general, and particularly for measuring resiliency and health outcomes, facilities need to upgrade and digitalize their record keeping (e.g. data on outcomes for patients treated and damage to facilities during an extreme weather event).

There is little demand for low-carbon and resilient investments in healthcare facilities. The healthcare sector is highly regulated and public facilities in particular typically need a clear direction from the local/national government that these types of climate solutions are required. To different extents, governments in the region have recognized and are prioritizing climate-energy-health nexus issues. In many cases, climate change is still siloed from 'development' issues such as health and is considered an environmental problem. For example, health policies such as Nepal's 2014 National Health Policy and Nigeria's National Health Act do not reflect the latest discussions on national climate priorities and the importance of low-carbon and resilient healthcare facilities. In India, the government has made commitments to increase 24/7 health services, digitize healthcare and substantially increase the reach of telemedicine, but the impact that these actions will have on demand for electricity has not been factored in.

There is often an assumption on the part of governments and healthcare professionals that the extension of the grid and increase in generation capacity will ultimately fix the problem of a lack of supply of electricity for healthcare facilities. However, in India, while there has been major progress in household electrification over the last decade, in states like Assam, Jharkhand and Rajasthan this did not lead to any increase in electricity access for development services (Wood 2020). This is not just due to the unreliability of the electricity supplied from the grid, but also due to wider socio-economic factors that limit the demand for electricity (Ginoya et al. 2021b). The argument for off-grid renewable energy is further complicated in countries like Nepal, where hydropower dominates and grid-supplied electricity is considered relatively low carbon (even if not reliable).

In most countries in South Asia and Sub-Saharan Africa, there are also no regulations restricting the use of polluting and harmful technologies such as generators and kerosene lamps, and rarely incentives enabling alternative clean technologies.

The financial and economic benefits of low-carbon and clean technology solutions are affected by technology and fuel prices. The capital cost of many technologies, such as solar PV panels, is rapidly declining and this should improve the financial and economic parameters outlined in Section 1. However, in some locations these costs are likely higher than the estimates due to transport and shipping and import duties. The economic logic of these investments is also affected by fossil fuel subsidies that still exist in many countries, such as for kerosene in India. In many countries, recent global economic challenges have caused exchange rate fluctuations and spiralling inflation. This has an impact on the 'business case' for investing in mostly imported technologies. For example, the challenge with Nigeria's multiple exchange rates and fluctuating currency values means project developers are highly exposed to currency shocks/foreign exchange risks, which is a barrier to projects that involve payments in foreign currencies. An option is to explore local currency-based financing for projects, potentially through a blended finance approach with other sources of finance (pension funds, infrastructure funds and development finance) (PIDG n.d.).

Finance is required for not just low-carbon and climate-resilient investments in healthcare facilities, but much wider (and larger) investment in improving health outcomes. Climate finance by its nature requires a sharp focus on the very specific investment required for addressing either GHG emissions reductions or adaptation to climate change. In general, this means that any wider investments required by the healthcare sector, such as increasing the number of trained healthcare professions working in a facility, needs to be co-financed by another (non-climate finance) source. Often, climate finance projects do not sufficiently integrate wider non-climate objectives within their design, which further contributes to the siloing of climate change.

There are some shared barriers in accessing climate finance for climate proofing healthcare facilities

- Low potential GHG emissions savings for one healthcare facility to attract climate finance
- Limited capacity of healthcare facility professionals to design, manage and report on a project
- Unconsolidated national data on health facilities not including key energy and climate indicators
- More demand needed for low-carbon and resilient investments in healthcare facilities
- Financing OPEX and finding local service providers a challenge, risking sustainability
- Long-term monitoring, reporting and verification (MRV) of energy, emissions, etc. an added cost
- Financial and economic benefits of such solutions affected by technology and fuel prices
- Single source of climate finance unlikely to cover entire costs of the project
- Non-climate health objectives not sufficiently integrated into climate finance project design

4.2 Opportunities to mobilize climate finance for low-carbon and resilient healthcare facilities

There are opportunities to overcome each of the barriers highlighted in the previous section, based on the learnings of those who have successfully accessed and used climate finance for healthcare facilities but also in other related sectors. These do not include general actions to build the 'readiness' of countries to access climate finance more generally. This is well covered by a number of programmes, such as the World Bank's Partnership for Market Implementation (which provides technical support to governments to establish the regulatory and institutional setup required for carbon pricing and carbon markets under Article 6) and the GCF and Adaptation Fund's readiness funding, which is available for national governments to build their institutional capacity to understand, access and use their available financing. Table 8 therefore focuses on specific actions that national governments, and non-government partners looking to support these governments, could consider to mobilize climate finance for low-carbon and resilient healthcare facilities in South Asia and Sub-Saharan Africa.

TABLE 8 Role of non-government partners in accessing climate finance sources

BARRIERS	OPTIONS FOR OVERCOMING OR ADDRESSING THE BARRIER
The potential GHG emissions savings for a single healthcare facility are too small to attract climate finance on their own	• Carry out an in-depth survey of facilities including a bottom-up energy needs assessment, combined with top-down modelling of projected increases in demands, to get more accurate baseline data and estimates of potential GHG emissions savings. • Focus on both mitigation and adaptation benefits, potentially as part of a broader focus on addressing the climate impacts on health (beyond just facilities), which will increase the scale of benefits that funds such as GCF and Adaptation Fund can support. • Coordinate across multiple facilities to 'package' needs into a programmatic approach to the investments required. This will require collaboration across national and subnational levels of governance and potentially across the public and private sectors. It will be necessary to work with a type of 'aggregator' who can engage multiple healthcare facilities, which should include the government but could also be large healthcare non-profit organizations or even private hospitals that can 'partner' with public counterparts as part of their corporate social responsibility commitments.
Limited capacity of healthcare facility professionals to design, manage and report on a project	• Bring together local healthcare experts, low-carbon and resilient technology providers and those with experience accessing climate finance to collectively design a project and identify which sources of climate and non-climate finance will be targeted. • Utilize various international programmes and partners that regularly deliver trainings on climate finance to deliver targeted sessions for local healthcare professionals.
National data on healthcare facilities is not consolidated and does not cover key energy- and climate-related indicators	• Integrate key indicators related to energy consumption, GHG emissions and resilience within the regular health surveys carried out in many countries. At a minimum, this could use the common requirement for public facilities to report on expenditure including energy or fuel consumption, but add a requirement to provide a breakdown of expenditure on different sources of energy. • Aggregate data collected by facilities (see below) and regularly report on progress in climate proofing healthcare facilities. For example, this could be integrated within the existing Nepal Health Infrastructure Information System.
A single source of climate finance is unlikely to cover the entire costs associated with a project	• Bring together experts in a range of climate and non-climate financing instruments to consider what source is appropriate (including blended and hybrid options) for the different costs and investment needs of the facilities and develop a single integrated long-term financing plan.
Financing OPEX and finding local service providers is a risk for long-term sustainabil-ity of investments	• Develop the long-term financing plan for each facility-level investment before exploring potential sources of climate finance, which should include OPEX but also future projections of growth in demand for energy. • Provide start-up financing and business support to local companies to ensure sustained provision of O&M services. • Add a condition to any contract for installation and maintenance of technology, such as solar systems, to train and support local businesses and community members to carry out O&M as part of a long-term effort to build a local ecosystem of service providers. • Consider carbon markets as a potential source of finance to specifically cover O&M costs.
Digital monitoring, reporting and verifica-tion of energy, emis-sions and other re-sults is an additional cost	• Support the design, piloting and roll-out of standardized digital systems for facilities to monitor and report on energy, emissions and resilience indicators, and factor the additional infrastructure- and capacity building-related costs into the long-term financing plan for the facility. • Build on the efforts of various governments in the region to digitalize healthcare facilities (e.g. India's National Digital Health Mission), and ensure core climate indicators are incorporated into any system.
Demand for low-carbon and resilient investments in healthcare facilities needs to be mobilized	• Clear policy direction needs to be provided on the need for facilities to adopt low-carbon and climate-resilient solutions, particularly within healthcare policy and regulation. • Screening of healthcare programmes and schemes to understand their impacts on energy demand, emissions and resilience, as well as to identify opportunities to support the adoption of climate solutions. • Strengthen the engagement of Ministries of Health and other healthcare agencies within policy discussion on climate change, and quantify the role and contribution of the healthcare sector in achieving net-zero emissions.

BARRIERS	OPTIONS FOR OVERCOMING OR ADDRESSING THE BARRIER
Financial and economic benefits of low-carbon and clean technology solutions are affected by technology and fuel prices	• Introduce fiscal, policy and other types of incentives to make low-carbon and resilient investments more financially viable, which includes reducing any fossil fuel subsidies. • Explore local currency-based financing for projects, potentially through a blended finance approach with other sources of finance (pension funds, green bonds, infrastructure funds and development finance).
The need for a low-carbon and climate-resilient healthcare sector cannot be separated from improving health outcomes	• Design projects that mobilize both climate and non-climate sources of finance, such as combining VCM credits or RECs with tradable credits for verified social impact. • Climate proof existing public healthcare programmes to identify direct and indirect opportunities to reduce GHG emissions and strengthen resilience, such as Nigeria's Basic Healthcare Provision Fund, to ensure an integrated approach. The 'additional' costs of these investments could still be separately funded by climate finance.

Priority actions: Cutting across these specific ideas for how to access and effectively use climate finance for low-carbon and climate-resilient healthcare facilities are a clear set of priority actions, which include the following:

- ***Identify facility-level climate and health needs:*** The starting point for any investment in low-carbon and resilient healthcare facilities would ideally be a bottom-up assessment for each facility of its current and projected future energy and carbon footprint and vulnerability to climate impacts. It should also consider the wider infrastructure, personnel and technology needs required for the healthcare facility to provide high-quality health services under current and future scenarios. For example, modular systems of renewable energy will make it easier to add capacity if more is required in the future. This should also identify the specific climate and non-climate benefits, including financial savings, from the measures and technologies proposed. In reality, an individual assessment and bespoke design of a set of climate solutions for each healthcare facility is not feasible at the scale needed. Some degree of aggregation of different types of facilities will likely be needed and standardization of solutions based on estimated needs.
- ***Develop a long-term facility-level and national financing plan to focus on the sustainability of investments:*** A fully costed plan for delivering the technology and measures identified in the assessment should be multi-year and consider both CAPEX and OPEX. This will help identify appropriate sources of finance, and the role that climate finance could play (including to catalyse the additional finance required).
- ***Create space for more collaboration between healthcare, energy and climate finance experts:*** These are typically three different sets of experts, and each set of capabilities is required to engage facilities, design a programme and support facilities in an integrated manner. These experts are likely to come from a combination of government, the private and finance sector and non-profit organizations.
- ***Adopt a programmatic approach to help deliver economies of scale and strengthen the wider enabling environment:*** A relatively large number of healthcare facilities will need to aggregate their energy savings, avoided/reduced emissions and resilience benefits in order to demonstrate sufficient scale to climate finance providers. The government or a large external organization will therefore need to bring on board the healthcare facilities, build their capacity and support the entire delivery process. At the same time, the programme can help ensure its sustainability and scale-up by establishing policy and regulatory enablers and creating an ecosystem of local private service providers for O&M.
- ***Digitalize healthcare facilities, including monitoring emissions and energy consumption:*** Climate finance sources, to different degrees, need accurate and often verified reporting of emissions and/or energy use. The benefits of upgrading the bookkeeping practices of healthcare facilities will likely extend far beyond accessing climate finance and in general increase the efficiency and effectiveness of services.

Priority actions to mobilize climate finance for low-carbon and resilient healthcare facilities

Identify facility-level climate and health needs

Create a long-term financing plan at the facility and national levels ensuring sustainability

Improve collaboration with healthcare, energy and climate finance experts

Adopt a programmatic approach for economies of scale and a stronger enabling environment

Digitize healthcare facilities including monitoring emissions and energy consumption

These priority actions can be used to guide any organization or programme, such as SEforALL and its partners, looking to support countries in their efforts to mobilize climate finance for low-carbon and resilient healthcare facilities. However, one additional challenge may be knowing where to focus efforts. The following is a list of suggested criteria for prioritizing particular countries for support in accessing climate finance for healthcare facilities:

Need: Most low- and lower-middle-income countries in South Asia and Sub-Saharan Africa have a significant proportion of healthcare facilities with unreliable supplies of electricity and which are vulnerable to the impacts of climate change. Selecting those with the highest need, relative to others, would help make a strong case to some climate funds. This includes having a sufficient number and scale of facilities so that an aggregation of impact is feasible. There must also be a clear need for climate finance to make the investment viable, meaning that without this additional finance it would not happen. There should also not be any duplication with any similar (large-scale) programme underway, so a mapping of existing efforts is required. Specific criteria could include:

- The proportion, and absolute number, of healthcare facilities with an unreliable supply of electricity;
- The degree of vulnerability to natural disasters and other climate impacts, demonstrated by historical loss and damage within the health sector;
- The degree of financial (and other) barriers to investing in low-carbon and climate-resilient solutions; and
- The level of climate finance currently invested in the healthcare sector.

Feasibility: Although there needs to be a clear gap in financing and need for support, there must also be evidence that climate finance will deliver the expected results. The country should have some prior experience with accessing climate finance, and for the GCF and Adaptation Fund, it should have national or international organizations (with a mandate and experience to work in the healthcare sector) that are accredited and able to deliver finance in the country. More generally, there should be established organizations and partnerships at the local level that have the capacity to successfully implement project activities. Feasibility also relates to there being a functional healthcare facility and sufficient law and order and security for a programme to be implemented successfully. Ideally, there would be some pilots that have already demonstrated the feasibility and results of the specific technologies and measures being proposed. Specific criteria could include:

- Strength of organizational capacity and partnerships to access and effectively deliver climate finance; and
- Strength of evidence that the technology and measures are locally viable, ideally demonstrated through successful pilots.

Demand: This primarily relates to the recipient country, and to what extent there is already interest from the government to deliver such a programme. Ideally, there would be a clear policy framework guiding the project, such as a climate strategy for the healthcare sector. For the GCF, countries have already articulated their priorities for financing in their Country Programmes, although these are not binding documents. However, donor countries and climate funds also have their own explicit or implicit 'priority' countries, which could be informed by diplomatic relations or the need to balance their portfolio. This can usually be established through conversation with the relevant official. Specific criteria could include:

- Strength of ownership by the national government on the need for low-carbon and climate-resilient healthcare investments and interest in accessing climate finance.
- The degree of alignment with funders' priority countries.

CHAPTER FIVE

Conclusion

There is a clear climate rationale for investment in low-carbon and climate-resilient technologies in healthcare facilities in South Asia and Sub-Saharan Africa. For partners such as SEforALL, with an interest to mobilize finance and support investments in these solutions, there are three areas of potential action.

Firstly, raise awareness and increase demand for climate finance for healthcare facilities by national stakeholders. The adoption of solar PV systems in healthcare facilities has so far received the most government and funder attention, driven primarily by the need to increase the supply of reliable energy. However, to maximize the climate benefits, it would be efficient to incorporate a wider set of low-carbon and resilience-building measures, such as energy efficiency and resilient building design. This may require a slight pivot away from looking at this issue as purely about energy access, to also incorporate a climate change dimension. For example, the policy entry-point may be health and/or environment policymakers who are developing a strategy or policy to climate proof the healthcare sector, under which healthcare facility infrastructure is just one aspect.

Secondly, bring together varied health, energy, and climate (and climate finance) professionals at the national and international level. There is a need to bring together the growing set of stakeholders looking at the intersection of health, energy, and climate, in particular those exploring the impact of climate change on health and those supporting healthcare facilities to secure a reliable supply of clean energy. Currently, these experts are typically working in silos addressing either the issue of vulnerability to climate change or energy access. In addition, there is usually a separate set of organizations with expertise in designing finance models to make the low-carbon and climate-resilient solutions being proposed sustainable in the long term and scalable. Lastly, there are organizations with experience in one or more sources of climate finance but few that have first-hand experience of all domains. Bringing together this varied group of organizations to strategize on the best approach for a particular country to access climate finance is a necessary early step.

Thirdly, design a project that is delivering climate benefits at scale. The process of developing a project on low-carbon and climate-resilient healthcare facilities and, targeting one or more sources of climate finance, will help to unearth and address many of the real-life challenges in a particular location. The design process would require having strong ownership on the part of the government and the involvement of a diverse set of stakeholders (see above). The project should crucially be aiming for the adoption of low-carbon and climate-resilient measures at scale, for example nationwide. It will therefore have to aggregate facilities while also factoring in the localized context and specific needs of individual facilities. It should ideally integrate climate finance with public (or private) financing for wider health sector investments so that enhanced climate and health outcomes go hand in hand.

These three actions should help advance discussion, partnerships, and action toward mobilizing climate finance for low-carbon and climate-resilient healthcare facilities. Within five years it is feasible to imagine that climate finance, used in combination with other sources of development finance, could be supporting a large proportion of healthcare facilities across a handful of countries to reduce their carbon footprint and adapt to the impacts of climate change. In this sense, the viability and costs and benefits will have been demonstrated at scale and this should catalyse even greater sources of financing. Experience to date suggests that a combination of climate finance sources is required, and therefore that targeting grants and/or concessional loans from the GCF or bilateral sources in combination with D-RECs or VCMs for O&M costs, and using this to attract greater volumes of domestic public and private finance, would be the most strategic option. As carbon and REC markets look likely to grow considerably in the future, there is an opportunity to try and direct some of this finance to healthcare facilities. Green bonds are also increasing at a rapid pace, and some experimentation of their potential for healthcare sector financing is required. Grant-based financing via bilateral, multilateral or private foundations can be used to catalyse this and other types of innovative financing.

At the UNFCCC 28th Conference of Parties (COP) in 2023 there will be the first ever 'Day of Health' to underscore that the climate crisis is, unequivocally, a health crisis. This is an opportunity to kick-start a wider discussion on how to mobilize greater volumes of climate finance for advancing action on the health-energy-climate nexus.

Annex 1: Nepal survey of healthcare facilities

The following data sources and assumptions were used to inform the case study of the current energy consumption and carbon footprint of Nepal's healthcare facilities.

TABLE 9 Calculation of the carbon footprint of fuel consumed by healthcare facilities in Nepal

LEVEL	ANNUAL EXPENDITURE ON 'OTHER' FUELS (NET PRIMARY REVENUE)	AVERAGE COST OF FUELS (NET PRIMARY REVENUE)	AVERAGE FUEL CONSUMED (LTRS)	AVERAGE EMISSIONS FACTOR FOR 1 LITRE OF FUEL (KG CO_2E)	ESTIMATED EMISSIONS IN TONNES OF CO_2E
Federal	1,482,919	110.00	13,481	2.483	33.47
Province	2,228,738	140.00	15,920	2.483	39.53
Local	1,150,359	120.00	9,586	2.483	23.80
TOTAL					**97**

TABLE 10 Sample of projects in Nepal installing solar panels on healthcare facilities

PROJECT	UNITS OF SOLAR SYSTEMS INSTALLED	INSTALLED POWER	FUNDING SOURCE	TYPE OF FACILITIES
Renewable Energy for Rural Livelihood Project implemented by UNDP for the AEPC	168	98280 KwP	GEF, UNDP and Japan Supplementary Budget	Health posts, birthing centres, district hospitals, district public health offices, health cooperatives, community health centres, snake bite centres, health centres
Nepal Renewable Energy Project for the AEPC	4	695.12 KwP	UK Foreign, Commonwealth and Development Office	Private hospitals, herbaceutical centres, provincial hospitals
Sun Bridge	6	574.84 KwP	Givepower	Health posts, private hospitals, government hospitals
PEEDA	1	2 KwP	WISIONS Germany	Health posts
Navya Health	13	27.3 KwP	Various	Health posts
GIZ	148	2960 KwP	KfW start-up fund	Health posts and telemedicine
ANMF	13	13000 KwP	ANMF seed fund	Health posts and district hospitals

Annex 2: Data and assumptions for the calculation of climate benefits

This annex provides the breakdown of data used to estimate the climate and financial benefits from a sample of clean technologies. The first table provides the complete set of estimated results for each country. The economic and financial analysis assumes a discount rate of 10 percent. The second table provides sensitivity analysis of the Net Present Value of the investments in sample climate solutions for different discount rates.

TABLE 11 Breakdown of environmental and financial benefits for sample of climate solutions across three countries

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
On-grid 'low' scenario: On-grid healthcare facility receiving 30 KwH of electricity from the grid per day with a 2.5 kVA diesel/ petrol generator as a back-up electricity source (consuming 1.5 litres of fuel per day). The use of the back-up generator is replaced by a 2kWP stand-alone solar PV system	CO_2 emissions savings (tonnes CO_2/ per year/ per facility)	1.5	1.3	1.5	**1.4**		
	Number of healthcare facilities	131,029	10,445	3,254		57,715	150,566
	Total CAPEX over five years (USD/ all facilities)	786,174,000	62,670,000	19,524,000			
	Total CAPEX over 25 years (USD/ all facilities)	786,174,000	62,670,000	19,524,000			
	Total CO_2 emissions savings (tonnes CO_2/ per year/ all facilities)	190,321	13,130	4,726		80,072	208,890
	Per facility OPEX savings (USD/ per year/ per facility)	673	501	717	**630**		
	Total OPEX savings (USD/ per year/ all facilities)	88,208,723	5,899,833	2,333,118		36,378,486	94,903,632

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
	Financial rate of return over five years (factoring cost savings only)	-23 percent	-31 percent	-21 percent	**-25 percent**		
	Financial rate of return over 25 years (factoring cost savings only)	12 percent	8 percent	13 percent	**11 percent**		
	Economic rate of return over five years (factoring cost savings and social cost of GHG emissions savings)	-19 percent	-28 percent	-17 percent	**-21 percent**		
	Economic rate of return over 25 years (factoring cost savings and social cost of GHG emissions savings)	14 percent	9 percent	15 percent	**12 percent**		
On-grid 'high' scenario: On-grid healthcare facility receiving 15 KwH of electricity from the grid per day with a 2.5 kVA diesel/ petrol generator as a back-up electricity source (consuming 3 litres of fuel per day). The use of the back-up generator is replaced by a 5kWp stand-alone solar PV system	CO_2 emissions savings (tonnes CO_2/ per year/ per facility)	3	3	3	**3**		
	Number of healthcare facilities	131,029	10,445	3,254		57,715	150,566
	Total CAPEX over five years (USD/ all facilities)	1,965,435,000	156,675,000	48,810,000			
	Total CAPEX over 25 years (USD/ all facilities)	1,965,435,000	156,675,000	48,810,000			
	Total CO_2 emissions savings (tonnes CO_2/ per year/ all facilities)	380,644	26,260	9,453		160,144	417,780
	Per facility OPEX savings (USD/ per year/ per facility)	1,151	806	1,239	**1,066**		
	Total OPEX savings (USD/ per year/ all facilities)	170,279,626	8,423,631	4,513,808		61,502,547	160,446,894

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
	Financial rate of return over five years (factoring cost savings only)	-33 percent	-41 percent	-31 percent	**-35 percent**		
	Financial rate of return over 25 years (factoring cost savings only)	6 percent	3 percent	7 percent	**5 percent**		
	Economic rate of return over five years (factoring cost savings and social cost of GHG emissions savings)	-30 percent	-38 percent	-28 percent	**-32 percent**		
	Economic rate of return over 25 years (factoring cost savings and social cost of GHG emissions savings)	8 percent	4 percent	9 percent	**7 percent**		
Off-grid scenario: Unelectrified facility is using a 2.5 kVA diesel/ petrol generator as the sole source of electricity (consuming 4.5 litres of fuel per day). The use of the generator is replaced by a 10 kWp stand-alone solar PV system	CO_2 emissions savings (tonnes CO_2/ per year/ per facility)	4.4	3.8	4.4	**4.2**		
	Number of healthcare facilities	21,072	27,277	359		65,413	28,973
	Total CAPEX over five years (USD/ all facilities)	632,160,000	818,310,000	10,770,000			
	Total CAPEX over 25 years (USD/ all facilities)	632,160,000	818,310,000	10,770,000			
	Total CO_2 emissions savings (tonnes CO_2/ per year/ all facilities)	91,822	102,866	1,564		272,255	120,588
	Per facility OPEX savings (USD/ per year/ per facility)	1,540	1,022	1,671	**1,411**		

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
	Total OPEX savings (USD/ per year/ all facilities)	37,125,391	27,882,890	599,889		272,255	40,879,092
	Financial rate of return over five years (factoring cost savings only)	-42 percent	-49 percent	-40 percent	**-44 percent**		
	Financial rate of return over 25 years (factoring cost savings only)	2 percent	-1 percent	3 percent	**1 percent**		
	Economic rate of return over five years (factoring cost savings and social cost of GHG emissions savings)	-39 percent	-46 percent	-38 percent	**-41 percent**		
	Economic rate of return over 25 years (factoring cost savings and social cost of GHG emissions savings)	4 percent	0 percent	4 percent	**3 percent**		
Solar lanterns 'low' scenario: Unelectrified facility is using six kerosene ('hurricane') lamps (consuming 263 litres of kerosene per day). These lamps are replaced by seven solar lanterns.	CO_2 emissions savings (tonnes CO_2/ per year/ per facility)	0.66	0.66	0.7	**0.7**		
	Black carbon emissions savings (tonnes black carbon/ per year/ per facility)	0.3	0.3	0.3			
	Number of healthcare facilities	21,072	27,277	359		65,413	28,973
	Total CAPEX over five years (USD/ all facilities)	36,918,144	47,789,304	628,968			
	Total CAPEX over 25 years (USD/ all facilities)	159,978,624	207,086,984	2,725,528			

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
	Total CO_2 emissions savings (tonnes CO_2/ per year/ all facilities)	13,844	17,921	236		42976	19035
	Total black carbon emissions (tonnes black carbon/ per year/ all facilities)	6,280	8,129	107			
	Per facility OPEX savings (USD/ per year/ per facility)	150	420	315	**295**		
	Total OPEX savings (USD/ per year/ all facilities)	3,156,501	11,469,433	113,214		19,310,703	8,553,177
	Financial rate of return over two years (factoring cost savings only)	-66 percent	157 percent	17 percent			
	Economic rate of return over two years (factoring cost savings and social cost of GHG emissions savings)	-49 percent	309 percent	66 percent			
Solar lanterns 'high' scenario: Unelectrified facility is using 12 kerosene ('hurricane') lamps (consuming 526 litres of kerosene per day). These lamps are replaced by 15 solar lanterns.	CO_2 emissions savings (tonnes CO_2/ per year/ per facility)	1.3	1.3	1.3	**1.3**		
	Black carbon emissions savings (tonnes black carbon/ per year/ per facility)	0.6	0.6	0.6			
	Number of healthcare facilities	21,072	27,277	359		65,413	28,973
	Total CAPEX over five years (USD/ all facilities)	73,836,288	95,578,608	1,257,936			
	Total CAPEX over 25 years (USD/ all facilities)	319,957,248	414,173,968	419,312			

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
	Total CO_2 emissions (tonnes CO_2/ per year/ all facilities)	27,689	35,842	472		85,953	38,071
	Total black carbon emissions (tonnes black carbon/ per year/ all facilities)	12,560	16,258	214			
	Per facility OPEX savings (USD/ per year/ per facility)	300	841	631	**590**		
	Total OPEX savings (USD/ per year/ all facilities)	6,313,003	22,938,866	226,428		38,621,405	17,106,355
	Financial rate of return over two years (factoring cost savings only)	-66 percent	157 percent	17 percent			
	Economic rate of return over two years (factoring cost savings and social cost of GHG emissions savings)	-49 percent	309 percent	66 percent			
TOTAL	**Total GHG emissions of both solutions ('high' and off-grid scenarios) (tonnes CO_2/per year/ all facilities)**	500,155	164,968	11,489		518,351	576,439
	Total GHG emissions of both solutions ('low' and off-grid scenarios) (tonnes CO_2/per year/ all facilities)	295,989	133,917	6,527		395,303	348,514
	Total economy-wide national net emissions (tonnes CO_2/ per year/ all facilities)	2,838,000,000	673,641,000	281,66,000			

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
	Total OPEX of both solutions ('high' and off-grid scenarios) (USD/per year/ all facilities)	213,718,019	59,245,388	5,340,126		100,396,207	218,432,340
	Total OPEX of both solutions ('low' and off-grid scenarios) (USD/ per year/ all facilities)	128,490,615	45,252,156	3,046,221		55,961,444	144,335,901
	Total number of energy-deficient healthcare (non-hospital) facilities	152,101	37,722	3,613		123,128	179,539
	Total number of healthcare (non-hospital) facilities in country	194,349	47,603	8,176		171,347	239,442
	Total OPEX of solar PV solution ('high' and off-grid scenarios) (USD/ per year/ all facilities)	207,405,017	36,306,522	5,113,697		61,774,802	201,325,986
	Total OPEX solar PV solution ('low' and off-grid scenarios) (USD/ per year/ all facilities)	125,334,114	33,782,723	2,933,007		36,650,741	135,782,724
	Total GHG emissions of solar PV solution ('high' and off-grid scenarios) (tonnes CO_2/ per year/ all facilities)	472,466	129,126	11,017		432,399	538,368
	Total GHG emissions of solar PV solution ('low' and off-grid scenarios) (tonnes CO_2/ per year/ all facilities)	282,144	115,996	6,291		352,327	329,478

SCENARIO	INDICATOR	COUNTRY/REGION					
		INDIA	NIGERIA	NEPAL	AVERAGE	SUB-SAHARAN AFRICA	SOUTH ASIA
	Total CAPEX of solar PV solution ('high' and off-grid scenarios) (USD/ per 25 years/ all facilities)	2,597,595,000	974,985,000	59,580,000			
	Total CAPEX of solar PV solution ('low' and off-grid scenarios) (USD/ per year/ all facilities)	1,418,334,000	880,980,000	30,294,000			

TABLE 12 Sensitivity analysis for changes in discount rate for net present value of combined OPEX savings and social cost of GHG emissions savings per facility over 25 years (USD/ per facility/ 25 years).

SOLUTION	DISCOUNT RATE	COUNTRY		
		INDIA	NIGERIA	NEPAL
Solar PV systems as replacement back-up for on-grid facilities ('high' scenario)	5 percent	-1,840	-1,112	5,265
	10 percent	4,030	-5,152	-1,045
	15 percent	-1,840	-7,001	-4,077
Solar PV systems as replacement back-up for on-grid facilities ('low' scenario)	5 percent	4,818	2,247	5,435
	10 percent	1,329	-327	1,726
	15 percent	-387	-1,566	-104
Solar PV system as replacement sole source of electricity for off-grid facilities	5 percent	-3,740	-11,454	-1,888
	10 percent	-11,280	-16,248	-10,088
	15 percent	-14,698	-18,236	-13,849
Solar lantern as replacement for kerosene lamps for off-grid facilities ('high' scenario)	5 percent	39,424	39,424	39,424
	10 percent	18,222	18,222	18,222
	15 percent	7,591	7,591	7,591
Solar lantern as replacement for kerosene lamps for off-grid facilities ('low' scenario)	5 percent	39,424	39,424	39,424
	10 percent	18,222	18,222	18,222
	15 percent	7,591	7,591	7,591

TABLE 13 Data sources and assumptions

ASSUMPTION	COUNTRY		
	INDIA	NIGERIA	NEPAL
Discount rate	**10 percent**	**10 percent**	**10 percent**
Date source/notes: This was an approximate mid-point of discount rates typically used by the World Bank in economic and financial analysis for these countries. Sensitivity analysis (see above) was used to model different higher and lower discount rates			
Baseline average daily deficit of grid-supplied electricity for electrified healthcare facilities (KwH)	**10 KwH (high scenario) and 5 KwH (low scenario) and 0 KwH (off-grid)**		
Date source/notes: In the high scenario, it is assumed that 15 KwH is supplied from the grid, and in the low scenario 30 KwH. This is based on research studies from each country and expert consultations. For unelectrified facilities, there is 0 KwH supplied from the grid			
Baseline average size of diesel generator (kVA)	**2.5 kVA**	**2.5 kVA**	**2.5 kVA**
Date source/notes: Estimated based on research studies from each country and expert consultations. This assumes that the same size of generator is used (and volume of diesel consumed) under on-grid and off-grid baseline scenarios. The difference in these baseline scenarios would therefore be the relative size of the energy deficit			
Baseline capital cost of 2.5 kVA generator with 10-year lifespan (USD/ per system)	**USD 1,500**	**USD 1,500**	**USD 1,500**
Date source/notes: Estimated based on review of retail price of generators in the three countries			

ASSUMPTION	COUNTRY		
	INDIA	NIGERIA	NEPAL
Baseline annual O&M cost of 2.5 kVA generator (USD/ per year)	**USD 150**	**USD 150**	**USD 150**
Date source/notes: Assumed to be 10 percent of capital cost of system as per WHO (2023) Web Annexes			
Baseline average annual fuel consumption of generator (litre/ per facility/ per year)	**1,095 (high scenario) and 547.5 (low scenario) and 1,642.5 (off-grid scenario)**		
Date source/notes: This is calculated based on the assumption that 0.3 litres of fuel is required to generate 1kwH electricity using a generator (www.eia.gov/tools/faqs/faq.php?id=667&t=6), which is multiplied by the assumed average daily deficit of grid-supplied electricity. The deficit is calculated using an assumption in WHO (2023) that 45 kwH is required on average per day to operate a healthcare facility ('non-hospital') at full capacity, but only 30 percent of the deficit is met through a generator (the remainder is unmet demand). It assumes that healthcare facilities operate and run their generators 365 days a year. This assumes that the same size of generator is used (and volume of diesel consumed) under on-grid and off-grid baseline scenarios. The difference in these baseline scenarios would therefore be the relative size of the energy deficit			
Baseline generator fuel price (USD/ litre)	**1,12 (diesel)**	**0.805 (petrol)**	**1.2 (diesel)**
Date source/notes: www.globalpetrolprices.com using an estimate for the most common fuel source in each country			
Baseline per unit price of grid-supplied electricity (USD/ KwH)	**0.078**	**0.03**	**0.04**
Date source/notes: www.globalpetrolprices.com using an estimate for the household price of electricity			
Baseline average number of 'hurricane' style kerosene lamps per facility, with lifespans of three years	**12 (high scenario) and 6 (low scenario)**		
Date source/notes: Estimated based on lighting needs of facility			
Baseline capital cost of one hurricane style kerosene lamp	**10**	**10**	**10**
Date source/notes: Estimated based on review of retail prices in the three countries			
Baseline average annual kerosene consumption for lighting per facility (litre/ per facility/ per year)	**525.6 (high scenario) and 262.8 (low scenario)**		
Date source/notes: This is calculated based on the assumption of 0.03 litres/hr for four hours per day/ 365 days per year. www.seforall.org/system/files/2021-08/SEforALL_Carbon-emissions-methodology-note.pdf			
Baseline kerosene fuel price (USD/ litre)	**0.57**	**1.6**	**1.2**
Date source/notes: www.globalpetrolprices.com			
Emissions factor for diesel consumed by generator (kg of CO_2 per litre)	**2.296**	**2.296**	**2.296**
Date source/notes: https://ghgprotocol.org/calculation-tools-and-guidance			
Emissions factors for kerosene used by lamp: kg of CO_2 per litre and kg of black carbon per litre	**2.5 kg of CO_2 and 1.134 kg of black carbon**		
Date source/notes: www.seforall.org/system/files/2021-08/SEforALL_Carbon-emissions-methodology-note.pdf and www.ncbi.nlm.nih.gov/pmc/articles/PMC3531557/#:~:text=BC%20emission%20rates&text=A%20value%20of%20EFBC,lamp%20(0.95%20%C2%B1%200.03).			
Social cost of CO_2 and black carbon (USD per tonne)	**51**	**51**	**51**
Date source/notes: Based on current estimate of US Environment Protection Agency. www.brookings.edu/articles/what-is-the-social-cost-of-carbon/			
Emissions factor for grid-supplied electricity (kg of CO_2 per kWh)	**0.85**	**0.57**	**0.35**
Date source/notes: Based on country-specific estimates: www.adb.org/sites/default/files/linked-documents/49086-001-crf.pdf; https://cea.nic.in/wp-content/uploads/baseline/2020/07/user_guide_ver14.pdf; www.iges.or.jp/en/pub/list-grid-emission-factor/en			

ASSUMPTION	COUNTRY		
	INDIA	NIGERIA	NEPAL
Average size of stand-alone SPV system required for back-up system	**2kWp ('low' on-grid scenario) and 5kWp ('high' on-grid scenario) and 10kWp (off-grid scenario)**		
Date source/notes: Calculated based on the estimated average energy deficit (see above)			
Capital cost of stand-alone SPV system with 25-year lifespan (USD/ per KwP/ per system)	**USD 3,000**	**USD 3,000**	**USD 3,000**
Date source/notes: Estimated based on proxy cost used for WHO (2023) study modelling costs across the regions. This includes cost of panels, batteries and inverter costs. A premium is added to cover cost of transportation, permitting, design, installation etc.			
Annual O&M cost of stand-alone SPV system (percent of CAPEX/ per year)	**1.5 percent**	**1.5 percent**	**1.5 percent**
Date source/notes: Assumed to be 1.5 percent of capital cost of system as per WHO (2023) Web Annexes. Includes battery replacement			
Average number of high-end solar lanterns per facility	**7.3 (low scenario) and 14.6 (high scenario)**		
Date source/notes: Estimated based on assumption that one high-end lantern replaces the need for 3 litres of kerosene per month. www.iisd.org/system/files/publications/kerosene-in-india-staus-quo-path-to-reform.pdf			
Capital cost of one high-end solar lantern with assumed two-year lifespan (USD/ per system)	**USD 80**	**USD 80**	**USD 80**
Date source/notes: Estimated based on review of retail prices in the three countries			
Number of facilities installing back-up solar systems	**131,029**	**10,445**	**3,254**
Date source/notes: Assumes that all 'non-hospital' facilities that were identified in WHO (2023) Web Annexes as requiring a back-up supply of electricity install the solar system			
Number of facilities installing solar system as sole off-grid supply of electricity	**21,072**	**27,277**	**359**
Date source/notes: Assumes that all 'non-hospital' facilities that were identified in WHO (2023) Web Annexes as requiring a new electricity connection adopt the solar system			
Number of facilities switching from kerosene lamps to solar lanterns	**21,072**	**27,277**	**359**
Date source/notes: Assumes that 25 percent of facilities that were identified in WHO (2023) Web Annexes as requiring a new electricity connection install solar lanterns			
Total national net GHG emissions from latest UNFCCC Biannual Update Report	**2,838,000 Gg CO_2e in 2016**	**673,641 Gg CO_2e in 2017**	**28,166 Gg CO_2e in 2010/11**
Date source/notes:	Ministry of Environment, Forest and Climate Change 2022	Federal Republic of Nigeria 2021	Ministry of Forests and Environment 2021

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SUSTAINABLE ENERGY FOR ALL

ABOUT SEforALL

Sustainable Energy for All (SEforALL) is an independent international organization that works in partnership with the United Nations and leaders in government, the private sector, financial institutions, civil society and philanthropies to drive faster action on Sustainable Development Goal 7 (SDG7) – access to affordable, reliable, sustainable and modern energy for all by 2030 – in line with the Paris Agreement on climate change.

SEforALL works to ensure a clean energy transition that leaves no one behind and brings new opportunities for everyone to fulfil their potential. Learn more about our work at www.SEforALL.org.