ASCENT

Accelerating Sustainable and Clean Energy Access Transformation Program

Standard Environmental and Social Management Plan (ESMP)

Template for Solar Mini-Grid Projects

December 2025

INTRODUCTION TO THE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) TEMPLATE

Background

This Environmental and Social Management Plan (ESMP) template has been created for the purpose of facilitating the assessment of environmental and social impact factors and the development of adequate mitigation strategies for prospective mini-grid project developers and operators for new countries joining Accelerating Sustainable and Clean Energy Access Transformation (ASCENT) Multi Programmatic Approach (MPA). ASCENT is set to roll out across more than 20 countries over the coming three years. The initial phase will see implementation in Rwanda, Sao Tome and Principe, Somalia, and Tanzania. The second phase will expand to Kenya, Malawi, Namibia, Burundi, Zambia, Mozambique, and Ethiopia. The final phase will bring ASCENT to Comoros, Lesotho, Uganda, the Democratic Republic of the Congo (DRC), South Sudan, Angola, Madagascar, and Botswana.

ASCENT MPA will finance a wide array of activities and works that include solar home systems (SHS), hydro/solar-based mini-grids, small length of transmission lines (132kV) involving towers, distribution lines, Construction of distribution and grid substations, installation service drop cables and meters, Battery Energy Storage Systems (BESS), and improved cookstoves. Given that the specific activities and works to be carried out in each country joining ASCENT have not yet been identified, a framework approach is proposed to address potentially negative environmental and social impacts and risks and this ESMP Template provides "pragmatic good practice" standardized approach which should be tailored by each joining Country as part of their ASCENT Solar Mini-Grids Subprojects preparation and is designed to be user friendly and compatible with WB ESF requirements. The template format attempts to provide a simplified and uniform approach to preparation of the required ESMPs by the additional Countries joining ASCENT Program. The approval of ESMPs by the applicable respective regulatory authorities are a prerequisite to proceed with the construction of mini-grid projects.

It is worth noting that the scope of environmental and social mitigation strategies that National Environmental Agencies will demand from prospective project proponents are directly dependent on the regulatory, geographic and demographic context where the future project is to be implemented. Maximum and minimum threshold limits of, for instance, pollution levels, are not homogeneous across participating countries and thus each Proponent must be familiar with the regulatory context where the project is to be implemented. Nevertheless, clean energy mini-grids *per se,* regardless of where they are located, imply a similar set of environmental and social risks, thus enabling the development of this standardized ESMP template.

Instructions:

This template provides guidance for the preparation and implementation of Environmental and Social Management Plans. The prospective Project proponent is expected to become familiar with the National Regulatory Framework and integrate those parameters of relevance to the template.

For each missing field, kindly fill in the blank space according to the associated instruction (as specified in brackets). In some cases, this implies the name of an institution; in others, it implies the maximum/minimum permitted thresholds as per National Regulations.

[COUNTRY NAME]

[NAME OF MINISTRY/IMPLEMENTING AGENCY]

[LOGO OF MINISTRY]

[NAME OF PROJECT]

[PROJECT CODE]

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)
for Solar Mini-Grid Projects

[BORROWER APPROVAL AND DISCLOSURE DATE]

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List of Tables

Include a numbered list of the titles of the tables included in the ESMP.

Abbreviations and Acronyms

[Include an alphabetized list of all the abbreviations and acronyms used in the document].

Acronym	Acronym in Full
AC	Alternating current
AFD	Agence Francaise de Développement
AfDB	African Development Bank
AFE	Eastern and Southern Africa
ASCENT	Accelerating Sustainable and Clean energy Access Transformation
AIIB	Asian Infrastructure Investment Bank
BESS	Battery Energy Storage Systems
CdTe	Cadmium Telluride
C-ESMP	Contractor Environmental and Social Management Plan
CFL	Compact Fluorescent Lamp
CHS	Community Health and Safety
CoC	Code of Conduct
COMESA	Common Market for Eastern and Southern Africa
dB	Decibels
DC	Direct current
DRE	Distributed Renewable Energy
E&S	Environmental and Social
EHSGs	Environmental, Health and Safety Guidelines
EMF	Electric and Magnetic Fields
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESIRT	Environmental and Social Incident Reporting Toolkit
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESSs	Environmental and Social Standards
FI	Financial Intermediary
GBV	Gender-based Violence
GBVAP	Gender-based Violence Action Plan
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
HWMP	Hazardous Waste Management Plan
IDA	International Development Association
IFC	International Finance Corporation
IP/SSAHULTC	Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
LMP	Labour Management Procedures

LV	Low Voltage
MPA	Multi Programmatic Approach
MV	Medium Voltage
OHS	Occupational Health and Safety
PAD	Project Appraisal Document
PAP	Project Affected Person
PCR	Physical Cultural Resources
PIU	Project Implementation Unit
PPE	Personal Protective Equipment
PPP	Public Private Partnership
PUE	Productive Use of Energy
RAP	Resettlement Action Plan
RoW	Right of Way
RPF	Resettlement Policy Framework
SEA/SH	Sexual Exploitation and Abuse/ Sexual Harassment
SEP	Stakeholder Engagement Plan
SHS	Solar Home Systems (SHS)
SMP	Security Management Plan
SPV	Solar Photovoltaic
ToR	Terms of Reference
VAC	Violence Against Children
VRE	Variable Renewable Energy
WB	World Bank
WBG	World Bank Group
WHO	World Health Organization

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN FOR ASCENT ROLLOUT TO NEW COUNTRIES

1. Context

The Accelerating Sustainable and Clean Energy Access Transformation (ASCENT) Multi Programmatic Approach (MPA) aims to accelerate access to sustainable and clean energy in Eastern and Southern Africa (AFE). The project will establish an ASCENT Regional Acceleration Platform, managed by the Common Market for Eastern and Southern Africa (COMESA), which will drive implementation of Pillar 1 from the regional level, supported by additional actions and activities in participating countries. The Acceleration Platform will support both Phase 1 countries (for implementation of their projects), and to assist those countries still to enter the Multi Programmatic Approach (MPA) to prepare. In addition, the Platform will provide support to Distributed Renewable Energy (DRE) and clean cooking companies active in the region to accelerate their efforts and mobilize capital. Specifically, the Acceleration Platform will (i) support AFE countries in their adoption of digital platforms and tools facilitating management, financing, verification and monitoring of their energy access efforts, (ii) enact a digital monitoring, reporting and verification (D-MRV) platform at the regional level allowing aggregation from countries and the private sector and enabling the generation of carbon revenues and/or other climate/impact-related result-based financing; (iii) establish a Project Preparation Facility providing market intelligence and technical assistance both to Government agencies and the private sector, including for identification and enabling of cross-border electrification solutions; (iv) support planning processes and adoption of best practices and harmonization of policy and regulatory frameworks; (v) deliver energy access data and statistics, facilitating knowledge exchange and driving skill development, and (vi) provide support for monitoring and evaluation of the overall ASCENT program.

2. Project Objectives and Scope of Works:

[Project description, including identification of components and activities, from PCN, PAD, Energy Master Plan or elsewhere, concisely describes the proposed subproject and its geographic location, environmental, social, and temporal context, including any offsite investments that may be required, e.g. access roads, equipment yard, etc. Insert information on the names of locations of the Mini-Grids, their respective maps. voltage, number of kilometers, the engineering design, and site lay-out plans, expected activities and works, expected duration of works, if known supporting facilities, and any salient physical characteristics of the project site/s. Consider including information on any Associated Facilities as well as other projects that could lead to cumulative impacts.]

The objective of the ASCENT MPA in [insert name of formal sovereign borrower name] is [Project Development Objective, from Project Concept Note (PCN), Project Appraisal Document (PAD),

or other available documentation]. [Also, add project justification in line with Project Concept Note].

"A Mini-Grid is an aggregation of loads and one or more energy sources within a clearly defined boundary, operating as a single system providing electric power, either isolated and fully autonomous or connected to the main grid." A modern Solar Mini-Grid includes Solar based Decentralized Distributed Generation, energy storage (if required), control systems and the dedicated Power Distribution Network System for distribution of power from generation to consumers. Mini Grid can be modular and scalable (Option of Capacity enhancement of generation & distribution) so that additional generation capacity may be added in future to meet the growing electrical loads due to various reasons, without compromising the stable operation of the existing Mini-Grid system. This definition encompasses AC and DC based systems serving multiple customers through community-based power systems typically range up to MW size with dedicated distribution-level electrical interconnection.

For reference purpose, we can group Solar Mini-Grid system types into following categories:

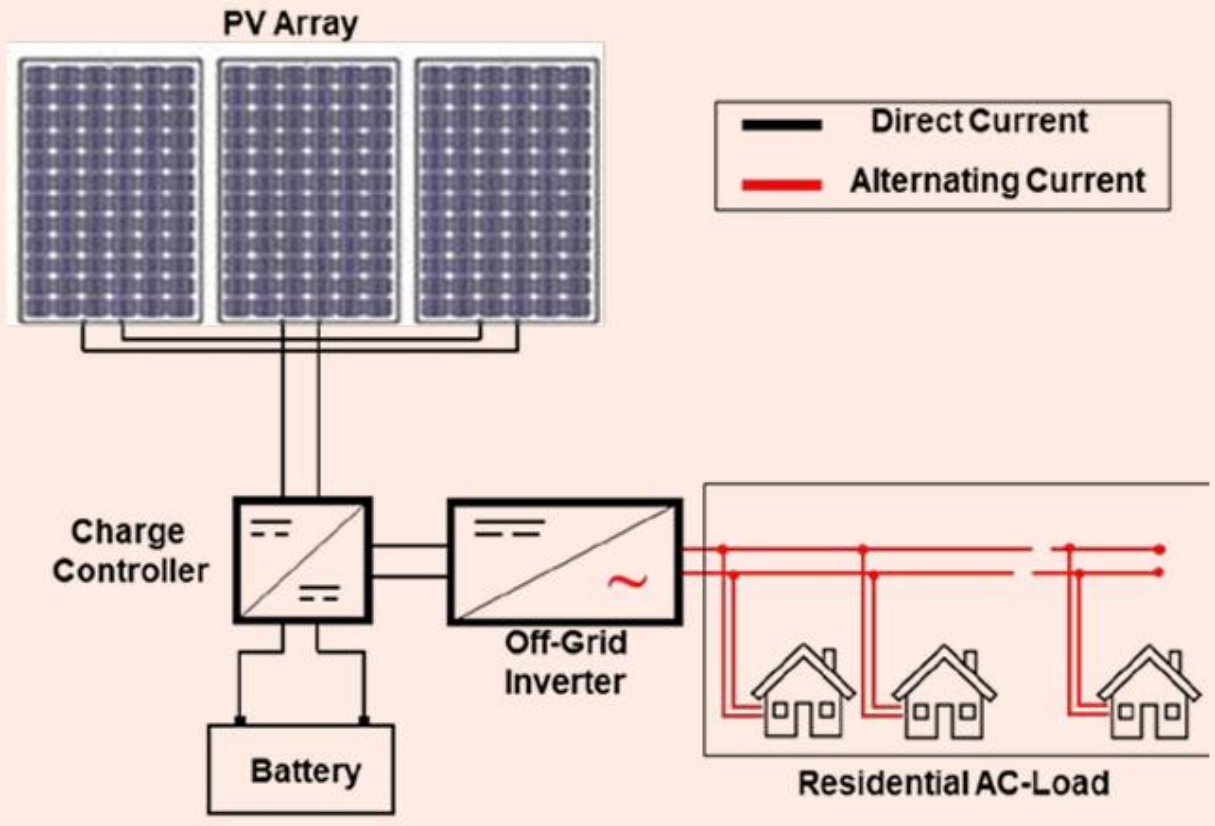

Figure 1: *Illustration of Standalone Mini-grid System*

The proposed Mini-Grid [provide name of subproject, proposed voltage] is/are located [provide name of location and GPS coordinates]. [include map showing location of the mini-grid, layout plan].

The project entails a series of activities which include among others, the following: [edit and add as appropriate]

- Installation of solar PV modules organized in arrays, battery banks (generally relying on lead-acid or lithium-ion batteries) and power electronic components such as inverters, charge controllers and combiner boxes.
- Installation of diesel or petrol generators to complement the renewable energy components, given the fluctuating nature of renewable resources such as solar and wind energy as well as overall loads.
- Installation of battery banks and inverters, combiner boxes and fuel gensets inside a power house.
- Construction of a power distribution network consisting of transformers, low voltage distribution cables, poles and energy meters.

The higher the renewable energy fraction of a Mini-Grid, the lower its environmental impact in terms of air and acoustic pollution during the operational phase; nevertheless, particular attention ought to be placed on the correct disposal of large battery banks after the Project's operational phase comes to an end.

Construction activities are anticipated to last for [provide estimated construction period] Months.

Please summarize any activities under operation and decommissioning

3. ESMP Objectives

It is a requisite of the World Bank that investments i it finances comply with the host country's national standards as well as other relevant international environmental and social policies. In addition to the relevant national legislation, the Project should address the applicable World Bank Environmental and Social Standards (ESS) regarding environmental and social issues. When the host country's regulations differ from the levels and measures presented in the World Bank ESF, projects will be required to achieve whichever is more stringent. This also applies if there are differences between National and Sub-National standards, the sterner standard must be followed.

If the analysis of the applicable legal and regulatory framework has been already done in another document (i.e., ESMF), then a brief summary and cross reference to that document would suffice

4. Legal And Regulatory Framework

It is a requisite of the World Bank that Investments which it finances comply with the host country's national standards as well as other relevant International environmental and social policies. In addition to the relevant national legislation, the Project should address the applicable World Bank Environmental and Social Standards (ESS) regarding environmental and social issues as it covers the requirements of many of the financing institutions. When the host country's regulations differ from the levels and measures presented in the World Bank ESF, projects will be required to achieve whichever is more stringent. This also applies if there are differences between National and Sub-National standards, the sterner standard must be followed.

National Legal Framework

The national environmental regulatory framework applicable to energy storage and distribution projects include the following regulations and guidelines [as applicable]:

[Insert a list of key relevant regulations and guidelines on assessing and managing impacts of installation of Mini-Grids. Keep descriptions of laws and regulations brief and only describe elements applicable to subproject activities.]

Table XXX. [Borrowing Country] Relevant Legal Framework

Law	Description and Relevance to Project Activities	Required Permit/ License/ Approval (as / if Applicable)
	National E&S Policies, Laws and Regulations	
[Example: The Constitution		*[Plz populate as appropriate].*
Environmental Protection]	Environmental and Social Impact Assessment/ Environmental and Social Management Plan	ESIA Certificate of Approval Waste Storage Permit
[Example: Occupational Health and Safety]	Occupational Health and Safety	Worksite/ Campsite Occupational Permit
[Example: Labor Law]	General provisions on Labor, against child labor, forced labor, trafficking, workers' associations and unions, and labor disputes.	Work Permits (Foreigners)
[Example: Anti-discrimination Law]		

Energy Sector Laws and Regulations	E&S requirements	Permit for storage and dispensing Hydrocarbons.

World Bank Environmental and Social Standards and EHS Guidelines

The ESF sets out the World Bank's commitment to sustainable development through a Bank Policy and a set of Environmental and Social Standards that are designed to protect people and the environment from adverse impacts of Bank-financed projects and to promote green, resilient, and inclusive sustainable development. The ESF offers broad and systematic coverage of environmental and social risks and makes important advances in areas such as transparency, non-discrimination, public participation, and accountability. This is achieved through the implementation of ten (10) Environmental and Social Standards which constitute the ESF, and which set out the requirements that apply to projects funded by the World Bank.

World Bank Group (WBG) Environmental, Health and Safety Guidelines (EHSGs), 2007 are technical reference documents that address the Bank's expectations regarding the EHS performance of projects. The information supports actions aimed at avoiding, minimizing, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHSGs serve as a technical reference source to support the implementation of the ESSs.

General EHSGs contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. The WBG General EHS Guidelines can be found in the following link: http://documents.worldbank.org/curated/en/157871484635724258

Table 1: ESS Objectives and Relevance to the Project.

Environment and Social Standards	Objectives	Relevance to Project
Environmental and Social Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;	To identify, evaluate and manage the environment and social risks and impacts of the project in a manner consistent with the ESSs To adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable, and they are not disadvantaged in sharing development benefits and opportunities resulting from the project. To utilize national environmental and social institutions, systems, laws, regulations and procedures in the assessment, development and implementation of projects, whenever appropriate. To promote improved environmental and social performance, in ways which recognize and enhance Borrower capacity.	ESS1 is relevant for the project because project activities are expected to pose moderate environmental and social risks such as …… terrestrial habitat alteration, aquatic habitat alteration, creation of hazardous materials. From a social perspective risks and impacts could include changes in land use presence of a limited external workforce with associated risks for disease transmission, SEA/SH or other community issues.
Environmental and Social Standard 2: Labor and Working Conditions	To promote safety and health at work. To promote the fair treatment, non-discrimination and equal opportunity of project workers. To protect project workers, including vulnerable workers such as women, persons with disabilities, children (of working age, in accordance with this ESS) and migrant workers, contracted workers, community	The installation of the Mini-Grid is likely to engage direct and contracted project workers, who could be exposed to different types of OHS risks from project activities. The number of project workers is estimated to be XX [insert the estimated number of workers involved in the installation and operation of the Mini-Grids]. However, no large-scale labor influx is expected given the limited scope of the installation of the Mini-Grid.

	workers and primary supply workers, as appropriate. To prevent the use of all forms of forced labor and child labor. To support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law. To provide project workers with accessible means to raise workplace concerns	This standard requires implementation of supply chain measures which should be considered and handled as follows: • Companies should undertake due diligence to avoid using companies where there is risk of child labor, forced labor or serious safety issues. • Include the WB IPF Solar Procurement Bidder Declaration - Forced Labor in the solar panels and components procurement document.
ESS3 - Resource Efficiency and Pollution Prevention and Management	To promote the sustainable use of resources, including energy, water and raw materials. To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. To avoid or minimize project-related emissions of short and long-lived climate pollutants. To avoid or minimize generation of hazardous and non-hazardous waste. To minimize and manage the risks and impacts associated with pesticide use.	This standard is relevant due to the construction activities which can result in low to moderate levels of pollution, including disposal of hazardous and non- hazardous wastes and pollution to air, water, etc. Particular attention ought to be placed on the correct disposal of large battery banks and solar PV cells after the Project's operational phase comes to an end. Materials for Mini-Grid installation may come from illegal gravel and sand mines, or wood from illegal logging contributing to secondary negative impacts in these areas.
Environmental and Social Standard 4: Community Health and Safety	To anticipate and avoid adverse impacts on the health and safety of project-affected communities during the project life cycle from both routine and non-routine circumstances. To promote quality and safety, and considerations relating to climate change, in	During the Mini-Gird construction and installation activities, the public is at risk of accidents from the equipment, vehicles, improperly placed or stored materials, and unprotected work sites. Works could generate noise, dust, and pollution that could impact the health of communities. Since heavy-duty equipment and vehicles may have to work and traverse the road during construction, the safety of other road users could be jeopardized. Waste

	the design and construction of infrastructure, including dams. To avoid or minimize community exposure to project-related traffic and road safety risks, diseases and hazardous materials. To have in place effective measures to address emergency events. To ensure that the safeguarding of personnel and property is carried out in a manner that avoids or minimizes risks to the project-affected communities.	left on site can also be a health and safety hazard to the communities. The influx of workers, goods, and services to a project area can have negative social consequences for the local community.
Environmental and Social Standard 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	To avoid involuntary resettlement or, when unavoidable, minimize involuntary resettlement by exploring project design alternatives. To avoid forced eviction. To mitigate unavoidable adverse social and economic impacts from land acquisition or restrictions on land use by: (a) providing timely (prior to displacement) in full compensation for loss of assets at replacement cost and (b) assisting displaced persons in their efforts to improve, or at least restore, their livelihoods and living standards, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. To improve living conditions of poor or vulnerable persons who are physically displaced, through provision of adequate	While the footprint of Mini-grid infrastructure is small, it may cause the partial loss, loss of access to or modifications of land or assets. The interventions are expected to have minimal impact and the E&S screening undertaken during selection of solar mini-grid subprojects should have resulted in the avoidance of physical displacement for mini-grids and significant economic displacement, in line with the Exclusion list provided in the ESMF. .

	housing, access to services and facilities, and security of tenure. To conceive and execute resettlement activities as sustainable development programs, providing sufficient investment resources to enable displaced persons to benefit directly from the project, as the nature of the project may warrant. To ensure that resettlement activities are planned and implemented with appropriate disclosure of information, meaningful consultation, and the informed participation of those affected.	
Environmental and Social Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	To protect and conserve biodiversity and habitats. To apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity. To promote the sustainable management of living natural resources. To support livelihoods of local communities, including Indigenous Peoples, and inclusive economic development, through the adoption of practices that integrate conservation needs and development priorities.	[Analyze if the Mini-Grid installation will impact non-critical natural habitats. The following text can be adapted if the works impact non-critical habitats. If this is not the case, the standard can be considered non-relevant]. Sub-project screening included exclusionary criteria prohibiting activities that would adversely impact critical habitat or protected areas. However, works may affect modified and natural habitats such as forests and wetlands. Such areas should be avoided as much as possible. Avoiding clearing in riparian areas and avoiding use of machinery in the vicinity of watercourses.
Environmental and Social Standard 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	To ensure that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource based livelihoods of Indigenous Peoples/ Sub-Saharan African	[Analyze if the footprint of the Mini-Grid site and related infrastructure will impact indigenous peoples. If so, the following text can be adapted. If this is not the case, the standard can be considered non-relevant].

	Historically Underserved Traditional Local Communities. To avoid adverse impacts of projects on Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities, or when avoidance is not possible, to minimize, mitigate and/or compensate for such impacts. To promote sustainable development benefits and opportunities for Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities in a manner that is accessible, culturally appropriate and inclusive. To improve project design and promote local support by establishing and maintaining an ongoing relationship based on meaningful consultation with the Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities affected by a project throughout the project's life cycle. To obtain the Free, Prior, and Informed Consent (FPIC) of affected Indigenous Peoples/ Sub-Saharan African Historically Underserved Traditional Local Communities in the three circumstances described in this ESS. To recognize, respect and preserve the culture, knowledge, and practices of Indigenous Peoples/Sub-Saharan African	This standard is relevant as the Mini-Grid and related infrastructure may impact indigenous communities. Where applicable, these activities will be guided by an IPP to be developed during implementation following the guidance of the IPPF being prepared. The IPP will include measures to mitigate any potential project impacts on IPs. The project SEP ensures that Indigenous communities are appropriately informed in an inclusive and culturally appropriate manner.

	Historically Underserved Traditional Local Communities, and to provide them with an opportunity to adapt to changing conditions in a manner and in a timeframe acceptable to them.	
Environmental and Social Standard 8: Cultural Heritage	To protect cultural heritage from the adverse impacts of project activities and support its preservation. To address cultural heritage as an integral aspect of sustainable development. To promote meaningful consultation with stakeholders regarding cultural heritage. To promote the equitable sharing of benefits from the use of cultural heritage.	This standard is not considered relevant. Sub-project screening excluded activities that could impact cultural heritage.
Environmental and Social Standard 10: Stakeholder Engagement and Information Disclosure.	To establish a systematic approach to stakeholder engagement that will help Borrowers identify stakeholders and build and maintain a constructive relationship with them, in particular project-affected parties. To assess the level of stakeholder interest and support for the project and to enable stakeholders' views to be taken into account in project design and environmental and social performance. To promote and provide means for effective and inclusive engagement with project-affected parties throughout the project life cycle on issues that could potentially affect them. To ensure that appropriate project information on environmental and social risks and impacts is disclosed to stakeholders in a timely,	This standard applies to all projects funded by the Bank. A Stakeholder Engagement Plan (SEP) was developed, disclosed, and consulted on. The SEP identified and mapped the relevant stakeholders including beneficiaries and project affected people, and discussed the actions and consultation plans for each group. In addition, the SEP established a complaints and grievance redress mechanism (GRM) for stakeholders. The GRM included SEA/SH-sensitive measures, including multiple channels to initiate a complaint and specific procedures for SEA/SH, such as confidential and/or anonymous reporting with safe and ethical documenting of SEA/SH, and ensures that all project-level complaints are received and resolved in a timely manner.

	understandable, accessible and appropriate manner and format. To provide project-affected parties with accessible and inclusive means to raise issues and grievances, and allow Borrowers to respond to and manage such grievances	

The World Bank Environmental and Social Standards including guidance notes can be accessed through the following link: https://www.worldbank.org/en/projects-operations/environmental-and-social-framework

5. Environmental and Social Baseline

[This section highlights observed findings of the Mini-grid installation and associated infrastructure sites during environmental and social field assessment visits].

[Develop sub-sections describing the project location, land use/economic activities, vegetation/fauna, wetlands & river crossings, settlement patterns, encroachment of the ROW, and access to energy provider facilities. This should be done for individual Mini-grids or preferably for groups of similar sites with an explanation of the grouping carried out].

[Insert pictures of the installation site and ROW to illustrate settlement patterns, encroachment, wetlands and river crossings, vegetation, and any salient characteristics that could impact the infrastructure].

[The baseline should focus on the project footprint and surrounds. District and national data should not be included.]

6. Assessment of Potential Impacts and Mitigation Measures

The likely impacts will be predicted and their significance assessed based on the interaction between the biophysical and socioeconomic environments of the Project and the characteristics of the environment receiving the impact. The following section further discusses the identified significant impacts and recommends measures to improve the positive impacts whilst the negative impacts are addressed using the mitigation hierarchy from prevention, reduction, restoration, and compensation.

[Applicable national, regional or local legal & regulatory requirements as well as any World Bank or other international guidance or requirements should be referenced as necessary].

The key power generation components of clean energy mini-grids are solar PV modules organized in arrays, battery banks (generally relying on lead-acid or lithium-ion batteries) and power electronic components such as inverters, charge controllers and combiner boxes. Often diesel or petrol generators are installed to complement the renewable energy components, given the fluctuating nature of renewable resources such as solar and wind energy as well as overall loads. Battery banks and inverters, combiner boxes and fuel gensets are located inside a powerhouse. Transformers, low voltage distribution cables, poles and energy meters compose the power distribution network of a Mini-Grid Project. The higher the renewable energy fraction of a Mini-Grid, the lower its environmental impact in terms of air and acoustic pollution during the operational phase; nevertheless, particular attention ought to be placed on the correct disposal of large battery banks after the Project's operational phase comes to an end.

Thus, key environmental impacts to be considered during the ESMP process of a clean energy mini-grid and their corresponding risk assessment are:

Table xxx Summary of Environmental impacts during life-cycle of a clean energy mini-grid

Impact	Relevant Mini-grid Component
Construction Phase	
Acoustic & air pollution from operating machinery (high probability/low impact).	Excavation works for powerhouse foundation and distribution network poles as well as earth works for protection of power generation components.
Soil erosion & sedimentation (medium probability/high impact).	
Water/ground pollution (low probability/low impact).	Improperly used or disposed paint, chemicals, sealants relied upon during construction process. Improper closure of construction phase leading to unremoved construction materials (spare cables, connectors, etc.).
Solid waste generation (high probability/medium impact).	Packaging materials of PV panels, battery banks, combiner boxes, etc.
Oil/fuel spills (low probability/high impact).	Transport of equipment to remote site and operation of construction machinery.
Loss of natural assets (medium probability/low impact).	Need for tree cutting to construct the distribution network/power generation assets.
Operation Phase	
Water/ground pollution from spillovers (medium probability/high impact).	Improperly transported and stored fuel for genset operation. Acid spillage (applicable for lead-acid battery banks relying on liquid sulphuric acid as electrolyte).
Acoustic pollution (low probability/medium impact).	Gensets strongly contribute to acoustic pollution. Power houses (where gensets are stored) should be built at sufficient distance from inhabitants' houses.
Air pollution (low-medium probability/medium impact).	Old genset filters prevent proper cleaning of exhaust air. Gensets' air and fuel filters have to be replaced frequently as part of generator servicing. Schemes are determined by genset's manufacturers. Expulsion of toxic gas (thermal runaway) of improperly maintained or physically damaged lithium-ion batteries.
Fire/explosion (low probability/high impact).	Vegetation/trees falling on distribution network cables. Applicable in case of large mini-grid systems with high current and voltage levels (inverters can be source of high magnetic fields). Consequence of improperly

	stored/handled fuel. Overheating of battery banks.
Prevention of air/noise pollution and fires/explosions.	Positive environmental impact associated with the reduction in genset use in favour of solar energy from PV arrays (applicable only where a solar mini-grid is deployed as a complement or replacement of an existing fuel generator). Positive impact associated with use of electricity instead of kerosene for household lighting purposes.
Loss of physical assets (low probability/high impact).	Thunderstorms, floods and strong winds can lead to poles falling on community buildings (if not properly constructed) and short circuits.
Closure/Disposal Phase	
Water/ground pollution (low probability/high impact).	Leachate generated on landfills of CdTe thin film PV solar panels. Battery banks have to be properly disposed of due to their composition/use of chemicals and heavy metals (especially lead-acid and nickel cadmium batteries) Refrigerants in air-conditioner units installed inside of power houses as part of battery coolant systems.
Landfill waste (medium probability/medium impact).	Increased amounts of PV panel deployment worldwide. Priority for recycling.
Impact on landscape (low probability/low impact).	Concrete foundations of powerhouse or PV panel arrays should be removed after Project life-time.

Key social impacts to be considered during the ESMP process of a clean energy mini-grid and their corresponding risk assessment are:

Table xxxxx. Social impacts during life-cycle of a clean energy mini-grid

Impact	Relevant Mini-grid Component
Construction Phase	
Temporary /permanent access restrictions to properties/community buildings (high probability/low impact).	Installation of infrastructure including poles and cables
Positive economic impact.	Potential employment of local labour during the construction phase.
Operation Phase	
Risk of burns/fire (low probability/medium impact)	Fuel spill overs during refilling if proper systems are not used.
Negative health impact (low	Associated with genset fuel and battery bank acid leakages

probability/high impact).	(for Lead-acid batteries). Nickel-Cadmium & Lead-acid batteries are partially composed of heavy metals, exposure to which can lead to headaches, brain and kidney damage, abdominal discomfort affect children's growth, cause sleep problems and in severe cases lead to comas.
Possible social exclusion (medium probability/medium impact)	In case community interest to connect to the mini-grid is larger than the mini-grid size allows.
Closure/ Disposal Phase	
Negative health impact (low probability/high impact)	Improper disposal of batteries after their life-time can potentially lead to health risks as described above.

6.1 Potential Environmental and Social Impacts with Corresponding Mitigation Measures

The environmental and social impact of a Mini-Grid Project will depend to a large extent on the project's size (in kW of delivered power), on the project location in relation to its environmental and demographic context and the mini-grid's renewable energy fraction.

In defining the E&S parameters, it is expected that the Proponent will consider the environmental aspects emanating from the following minimum project activities:

i. Quantities and types of material needed during the construction and operation of the Mini-Grid Project;
ii. Characteristics of the operational process;
iii. Physical presence and appearance of completed development within the receiving environment
iv. Geographical setting and use of the land for proposed development;
v. Estimated duration of the construction phase, operational phase and where appropriate, decommissioning phase;
vi. Estimated numbers of workers and/or visitors entering the site during construction and operation and worker camps and/or transportation and access routes;
vii. Power evacuation means;
viii. Estimates, by type and quantity, of expected residues and emissions (heat, noise, vibration, light, radiation, air, water, and soil contaminants, etc.) during construction, operation and decommissioning phases of the proposed Mini-Grid Project;

6.1.1 Potential Positive Impacts

Mini-Grids play a critical role in providing electricity to remote places, small islands, rural communities where electricity from conventional grid is either not existing or sparsely available and in helping to connect millions of people worldwide. Minigrids offer numerous positive impacts, including enhanced energy reliability, cost savings, and environmental benefits. They improve grid resilience by allowing local energy generation and management, reducing reliance

on centralized power sources. Minigrids can also facilitate the integration of renewable energy sources, contributing to a cleaner energy system. Specifically, the benefits of the Mini-grids include:

i. Enhanced Reliability and Resilience:

- Minigrids can operate independently of the main grid, providing a continuous power supply during outages or grid failures.
- They can quickly recover from disruptions, minimizing downtime and economic losses, especially for critical infrastructure like hospitals, data centers, and emergency services.
- By islanding from the grid during outages, Minigrids can avert significant economic losses for businesses.

ii. Cost Savings:

- Minigrids can combine different energy sources, including renewable resources and energy storage, to reduce energy costs.
- Efficient energy management within a Minigrid can lead to lower energy bills and better budgeting for consumers.
- Cost savings can also be achieved by reducing distribution losses associated with long-distance power delivery.
- Operation and Maintenance can be managed by local Manpower: For optimum sustainability of SMG, planned Operation & Maintenance (O&M) activities plays an important role. Through capacity building and appropriate technical support to the local manpower the O&M task can be well managed by local manpower with sufficient spares and toolkits in place.

iii. Environmental Benefits:

- Minigrids can integrate various renewable energy technologies like solar, wind, and fuel cells, promoting cleaner energy sources.
- By reducing reliance on fossil fuels, Minigrids help decrease carbon emissions and mitigate climate change.
- They can improve local air quality by reducing reliance on polluting energy sources.

iv. Economic Development:

- Minigrids can attract businesses and industries seeking reliable and clean energy sources, fostering local economic growth.
- The construction and operation of Minigrids create local jobs and stimulate economic activity within the community.
- Communities with Minigrids become more attractive to businesses, leading to increased investment and job creation.

[Add any additional potential positive environmental and economic impacts of the installation of Mini-grids].

6.1.2 Potential Negative Impacts of Mini-Grid Powerhouse, Distribution Network and Overall Site Construction and Operation

Civil works of mini-grids involve mainly the construction of a powerhouse for the storage of the battery banks, genset, battery inverters and combiner boxes as well as the erection of poles as part of the power distribution network. Power houses are constructed on-site next to the PV arrays, all of which must be gated to prevent theft of any of the components. For small-scale systems of up to 100 kW, power houses are usually not larger than 20 ft. containers, constructed on concrete foundations and usually covered with metal sheet roofs. In particularly warm climates, power houses may be equipped with air conditioners that serve as a cooling mechanism for the battery room.

A small-scale mini-grid requires the excavation and erection of several tens or hundreds of poles to connect all customers to the distribution network. Poles are often made of wood but can also be made of steel or concrete. The proper excavation of holes for pole erection is of fundamental importance to prevent the risk from poles falling on household structures or other buildings when subject to strong winds or floods. Furthermore, wooden poles are treated with chemicals during manufacturing, which can lead to leaching and the formation of surface residues at the right-of-way, for which proper mitigation measures ought to be taken.

Negative impacts of construction and operation of Mini-grids are described with corresponding mitigation measures. [The content of each session is not exhaustive. Please correct or add information on the different kinds of impacts, based on the technology of the proposed sub-project].

6.1.2.1 Negative Impacts on the Physical Environment

This section discusses the most significant potential impacts to environmental resources including soils, water resources, ambient noise levels and ambient air quality. Generally, potential environmental impacts are expected to occur during the construction phase of the project although negligible to minor impacts may also be associated with operations.

a: Negative Impacts on Landscapes

During the construction phase, the existing topography may change due to excavation and leveling, in addition, the excavated overburden materials and construction materials left over inside the site and surrounding area may create visual impacts. However, small-scale projects, PV panels are easily integrated into the environment without fundamentally changing the landscape.

b: Negative Impacts on Soils

During construction work, a considerable volume of soil will be excavated for leveling site and solar mounting foundation. In the construction area, soils will be impacted due to the clearing of vegetation, mounting of the PV modules, construction of internal roads, etc. Exposure to the ground and removal of vegetation cover will make the soil vulnerable to erosion by wind and running water. Soil disturbing activities may increase risks of erosion particularly in regions where the prevailing soil types have high erosion potential. Soils may be accidentally or intentionally become contaminated by the improper management of wastes and other materials during project construction.

c: Noise Pollution

During the construction phase, some noises could be generated from construction machinery (like excavators, loaders, bulldozers, mixers, dump trucks, compactors, generators, etc) movements. This may disturb the workers of the project and the nearby villagers to some extent. Noise by nature is a nuisance and may bring about annoyance, sleep disturbance, and interference with communication and cause ear disease if the level is beyond the acceptable limit (WHO prescribes 55dB for residential areas). However, the construction noise will last for a short period and is not expected to cause a significant nuisance to the public, at least not with standard mitigation measures in place.

d: Air Pollution

The main impact to air quality during construction will be from increased dust levels arising from the movement of vehicles and construction machinery, land clearing and leveling, cement mixing (fugitive dust, Pm2.5 microgram per litter), internal road construction, etc. In addition to emissions of particles, there will be minor emissions of CO from construction machinery, vehicles, and diesel power generators.

e: Generation of waste

[Refer to Annex-1 for detailed Waste Management Plan]

Installation of Mini-Grids may result in generation of waste arising from site clearance and operations, packaging materials, residual materials, etc. Wastes generated by construction activities will comprise primarily general solid wastes including food wastes, plastics, paper, cardboards and construction waste. Liquid waste will include black water and grey water generated on-site by construction workers. Furthermore, derelict infrastructure or those in good condition but not used for whatever reason pose a risk to the public and environment. No significant impact to soil is anticipated post construction.

f: Hazardous Materials Management

Silicon-based PV panels present little concern during disposal. However, thin-film PV modules need to be handled carefully. Exposure to heavy metals such as Lead and Cadmium is a growing problem throughout the world. While the combination of Cadmium and Tellurium found in some thin-film PV panels reduce the toxicity of the former (with a concentration of only 0.04% on the entire panel), it is of paramount importance to develop a proper disposal plan of modules after the end of Project's lifetime.

6.1.2.2 Negative Impacts on the Biological Environment

g: Negative Impacts on Forests and Vegetation

While the footprint of Mini-Grids is limited, the site selected could impact ecologically sensitive areas and require the cutting of trees and vegetation.

6.2.2.3 Occupational and Community Health and Safety

h: Negative Impacts on Community Health and Safety

During the construction of the Mini-Grid the public is at risk of accidents from the equipment, vehicles, improperly placed or stored materials, and unprotected work sites. Since heavy-duty equipment and vehicles may have to work and traverse the road during construction, the safety of other road users could be jeopardized. Construction traffic, particularly heavy vehicles such as low beds and loaded trucks, are also expected to contribute to increased road traffic. Waste left on site can also be a health and safety hazard to the communities.

Although the footprint of Mini-Grids sites is small and temporary, the influx of workers, goods, and services to a project area can have negative social consequences for the local community. There could be an increase in the risk of transmission of sexual diseases with the migration of workers into the communities who will have purchasing power and can use that power to influence persons to engage in unsafe sexual practices. This can include the spread of HIV/AIDS and other sexually transmitted infections. Women may experience harassment, fear of violence, and other threats when using roadways, especially after dark. Non-local workers could also lead to bad relations, particularly between the male workers when the females are shown increased attention that is unwanted. Interpersonal relationships with married persons could lead to the breakup of families thereby disrupting the community dynamic. There could also be cases of unwanted pregnancies particularly affecting the younger women of the community. The abuse of alcohol and other drugs can be detrimental to the community, especially to vulnerable groups when introduced and encouraged by non-local workers. In addition, the presence of a non-local construction crew to the area can create security fears among local residents. There is also the risk of Inadequate stakeholder engagement, leading to exclusion of vulnerable groups, especially at the social and health infrastructure.

i: Occupational Health and Safety

Health and safety are a key concern at any construction site. Workers are usually exposed to situations which can result in serious accidents, some of which can be fatal, if established guidelines and practices are not properly communicated or complied with by workers and supervised/enforced accordingly. Risks can result from the improper use of construction methods, machines and equipment or accidents on the work sites. The health and safety of workers are therefore major concerns during the construction period. While training and monitoring should be conducted and can reduce the risk of any serious incidents, accidents can still occur. Risks may include accidents during site preparations, transporting and offloading of construction materials, improper use of equipment, slip or trip while traversing the work sites, etc. In such cases, these exposures can result in physical injuries such as cuts, bruises, loss of limbs or can even be fatal.

The following are therefore possible health and safety risks which are likely to be encountered at the construction site:

- Live power lines.
- Exposure to chemicals.
- Sickness caused by the consumption of untreated water.
- Injuries or death from vehicular collisions.
- Injuries from slips, trips and falls.
- Injuries from falling onto unprotected excavations and other open trenches or areas.
- Ill health caused by insect bites/stings from hostile fauna.
- Injuries or death caused by snake bites.
- Injuries or ill health caused by heat-related illnesses such as sunburn, heat stress, heat exhaustion or heat stroke as a result of working under extremely hot conditions.

6.1.2.4 Negative Impacts on the Socio-economic Environment

j: Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH)

The presence of non-local project workers during the construction could result in increased risk of SEA/SH both within communities and the workforce with women being most at risk.

k: Inadequate stakeholder engagement and potential exclusion of vulnerable groups

In cases of inadequate stakeholder engagement, vulnerable groups can be underrepresented or excluded in project related engagements and planning. Women, people living with disabilities, the elderly etc may not be involved in decision making if differentiated engagement (focus groups) and timing of engagement is not considered. When employed, women may be offered lower compensation than their male counterparts.

l: Impact on Public Services and Property

Short-term, localized road traffic interruption will be experienced during the process of material transportation and potentially at site access points. There is a likelihood of loss of physical assets (low probability/high impact) due to Thunderstorms, floods and strong winds from poles falling on community buildings (if not properly constructed) and short circuits.

m: Land Acquisition, Land Use and Livelihoods

[Identify impacts of land acquisition, land use, and economic resettlement based on the nature of works, the existing land uses and ownership, how the land will be acquired and any changes in access as a result of the project].

n. Indigenous peoples

[If relevant, include an analysis of potential impacts of the installation of Mini-Grids to indigenous peoples – including if they will benefit equally, ownership of the land being used etc.]

6.1.3Potential Negative Impacts of Major Mini-Grids Components

6.1.3.1 PV Panels

Solar modules are the source of conversion from solar energy to renewable electricity. They produce DC power, which is in turn fed into batteries through charge controllers or fed into the grid after being converted from DC to AC by inverters. PV panels are made of silicon, metal and glass. The key components of a PV module are the solar cells (heart of the component), a metal frame (typically aluminium), glass sheets for casing, wires and steel screws. PV panels are classified as monocrystalline, polycrystalline or amorphous thin-film modules. Solar panels are known for being an environmentally-friendly technology, free from noise and air pollution throughout their operational phase. For small-scale projects, PV panels are easily integrated into the environment without fundamentally changing the landscape.

90% of the modules in the market are made of silicon as a semiconductor material. Nevertheless, some thin-film PV modules use Cadmium Telluride (CdTe). Cadmium is a dangerous and highly poisonous heavy metal when inhaled or ingested, both for animals and humans, and should be properly disposed after the Project's lifetime. Furthermore, the PV manufacturing process is an energy-intensive one, and priority ought to be given to manufacturers implementing environmental and social mitigation measures in their processes. Other than the need to properly dispose PV panels as well as rely on environmentally-conscious PV panel suppliers, no other environmental requirements have to be fulfilled.

To minimize water requirements for cleaning solar panels, it is recommended to mount the panels at a tilted angle. Tilted solar panels don't require cleaning as much as flat panels, a minimum five-degree angle helps debris to slide off the panels. In order to reduce water stress on community water sources, it is recommended that: (i) solar powered wells be drilled at the project site to supply

water for cleaning and (ii) rain water harvesting infrastructure be incorporated in the project design to supplement to the existing water sources. Dry cleaning is recommended to be used most times, and when need arises, use the wet cleaning method. For the most part, solar panels are self-cleaning.

6.1.3.2 Battery Banks

In combination with the PV arrays, properly sized battery banks allow for a minimization of the dependence on fuel generators for power supply in Mini-Grid Projects. Mini-Grid batteries are operational daily and subject to varying states of charge. For this reason, deep-cycle industrial batteries are required for off-grid/mini-grid applications, given their high reliability and lower life-cycle cost to users. While Lead-acid batteries are the most used technology (mainly due to economic reasons and proven in their application), Lithium-ion batteries are gaining traction in the market. Although less commonly used, other Nickel-based battery types, such as Nickel-Cadmium (NiCd) and Nickel-Metal Hydride (NiMH) batteries, are suitable for remote contexts with extreme environmental conditions (e.g. high temperatures), given their robustness and long use life.

6.1.3.3 Fuel Generators

The reliance on properly functioning diesel/petrol generators ensures mini-grid up-time throughout the day regardless of solar patterns (especially at night and during rainy seasons) while allowing to reduce initial capital investment in large battery banks and PV arrays. However, these components are the key contributor to negative environmental and social impacts throughout a Mini-Grid Project's operational phase. Gensets contribute to acoustic and air pollution during their operational hours. Furthermore, the transport of fuel and lubricant oil to remote locations poses in itself an environmental risk, given their highly hazardous nature. Fuel and oil leakages can significantly affect wildlife and ecosystems by polluting drinking water as well as cause injuries and diseases to animals and human beings.

6.1.3.4 Power Electronic Components

Power electronic components comprise those parts of the system controlling the flow of power as well as converting electricity from one form to another, such as inverters, charge controllers, circuit breakers, etc. While they imply no significant risk during the construction and operational phase, heavy metals may be present on their structures and thus disposal on adequately managed landfills/recycling points is required. If the electronic components are installed as per manufacturers' recommendations and international standards, these imply very low environmental and social risk, especially for smaller systems in the range of several kW.

7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

]The identified critical impacts of Mini-Grid installation and proposed mitigation measures under Section 6 above are extracted into Table 3 for ease of implementation. Please complete Section 6.2 and adapt it to your Mini-Grid subproject, as appropriate, and accordingly complete the Mitigation Tables Template provided below].

Table 3: Environmental and Social Risks and Mitigation Measures

Activities	**Potential E&S Risks and Impacts**	**Proposed Mitigation Measures**	**Responsibilities**	**Timeline**
Installation of Mini-Grids ***- Impacts on Physical Environment.***	- Impacts on Landscapes	- Careful site selection including consultation with local communities. - Restrict vegetation clearance to the project host site only. - Use the excavated soil for backfill during site restoration phase and properly store and finally clear construction leftover materials. - During decommissioning, concrete foundations must be removed and the landscape must be returned as close as possible to its pre-project state.	Design Engineer Contractors [Select monitoring entity. i.e. supervision firm, PIU, public utility company]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
	- Impacts on Soil	- Avoid excavation during the rainy season. Drainage measures shall be provided, prior to construction works, to reduce storm water run-off and flash floods. - During construction, dug plots/holes must be re-filled after excavation. - All excess materials and waste produced during installation of Mini-Grids or maintenance must be collected for proper disposal and this must be included in contracts. - Old or disused equipment must be safely decommissioned and cleared. - Exposure of Cadmium on panels to rain water on landfills can lead to the formation of leachate in the mid-term. The landfill where PV panels would eventually be disposed of must ensure the treatment of its effluent. …… *(kindly state name of country)* environmental regulations set a Cadmium concentration limit on effluents of less than …… *(kindly state maximum level of cadmium*	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		concentration levels on effluents as per national regulations) mg/liter as per …… *(kindly state source of applicable national environmental regulation)*. Minimization of exposure to water of the modules would - significantly reduce the formation of leachate, and thus minimize the negative environmental impact in terms of direct soil and water pollution. - -		
	- <u>Noise Pollution</u>	- Noisy activities shall be scheduled to daytime hours. - Construction works must be undertaken in a way to minimize generation of unnecessary noise levels and this must remain below …… [*kindly state maximum limit of noise pollution levels as per national regulations during day-time]* dB (day-time2) and …… [*kindly state maximum limit of noise pollution*	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	During construction phase

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		levels as per national regulations during night-time] dB (night-time) as per …… [*kindly state name and source of applicable regulation].* - Noise disturbance and impact can be reduced by also administration and management decision to work on a shift basis, work rotation and work time reduction for workers to reduce their exposure to noise, moving away the workers from the source of noise by restricting area and shutting or turning off noisy equipment or machineries when not needed. - Noise levels at sensitive receptors shall be measured regularly and whenever complaints ariseIn instances where workers will be exposed to elevated sound levels, personal protective equipment (PPE) such as ear mufflers/plugs should be used.		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
	- Air Pollution	- Generators have to be regularly and properly maintained/serviced as per manufacturer's guidelines to ensure genset emissions are under national emission standards. - Workers assigned in the construction machinery operation should wear a dust mask. - Construction works must be undertaken in a way to minimize generation of unnecessary amounts of dust.	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	During construction phase
	- Waste Management	- Follow the mitigation hierarchy by avoiding generation of waste through product substitution, minimizing generation of waste by buying just enough materials to be used and ensuring efficiency. - During construction and operation, adequate litter bins must be provided on-site as per …… *(kindly state name and source of applicable waste control national regulation)*	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		- Segregating generated waste and disposing it off according to waste types and characteristics. Sensitize workers on waste management to ensure good housekeeping practices and general waste handling. - Collect and transfer recyclable waste to recycling facilities. This includes metal, paper, plastic, and wood. - Engage registered waste management companies to handle hazardous waste. - Organic waste shall be disposed of at the municipal landfill of the project area. - Put an impervious layer below the pole stacks so that the creosote is prevented from infiltrating to the soil. - Require Contractors to develop and implement a waste management plan to manage different waste streams (Plastics, hazardous, Bio-degradable and non-biodegradable) in accordance with The National Environment/Waste Management Regulations. - Minimize potential negative environmental and social impacts of		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		the entire PV panel value chain from a life-cycle perspective, proper mitigation measures through procurement provisions from suppliers regarding recycling and appropriate precaution practices throughout the manufacturing process. Operators and developers of mini-grid systems must subscribe to …… [*Kindly state, if applicable, name of national program regulating end-of-lifecycle equipment disposal].* - During disposal, Lead-acid batteries should be transported to specialized collecting points, given the highly pollutant nature of Lead and as per …… [*kindly state name of country]* environmental regulations, which set a Lead concentration limit on effluents of less than …… [*kindly state lead concentration limit on effluents as per national regulations]* mg/liter as per …… [*kindly state source of applicable regulation].* - Existence/availability of battery recycling points must be ensured. Mini-grid operators shall subscribe to the ……		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		(Kindly state, if applicable, name of national program regulating end-of-lifecycle equipment disposal). -		
	- Hazardous Materials Management	- To minimize potential negative environmental and social impacts of the entire PV panel value chain from a life-cycle perspective, proper mitigation measures would include procurement provisions from suppliers regarding recycling and appropriate precaution practices throughout the manufacturing process. - Adhering to IEC's international safety standards for the selection of Lithium-ion battery banks. - Hazardous substances used during construction (such as paint and other chemicals) much be properly disposed. - During operation, wooden electric poles must be treated to ensure chemical fixation and prevent leaching as per …… [*kindly state name and source of applicable national environmental regulation of*	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		the energy sector]. - Careful disposal of air conditioner units (if available) must be guaranteed, to prevent leakage of hazardous refrigerants on the surrounding environment. - Develop and implement a proper disposal plan of modules after the end of Project's lifetime. Proponent must adhere to …… [*Kindly state, if applicable, name of national program regulating end-of-lifecycle equipment disposal].* - Fuel is an extremely hazardous and flammable material. It must be stored in properly sealed tanks on-site, at a sufficient distance and separate room from the battery banks. Fire extinguishers must be available on-site and regularly maintained. - -		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
Installation of Mini-Grids ***- Impacts on the Biological Environment***	- Impacts on natural habitats, ecological resources and biodiversity including Forests and Vegetation.	- The selection of project sites will need to screen out ecologically sensitive areas. - As much as possible consideration shall be given to alternative design to avoid trees. - Every tree felled for the purpose of the Mini-Grid Project must be in conformity with the …… *(kindly state name and source of relevant environmental regulations, if applicable.* - If there is need for a new tree to be planted, the relevant authorities such as the [insert name of relevant authority] shall be consulted in the identification of species and siting of replacement trees. - Revegetation of disturbed areas with native plant species. - Removal of invasive plant species during routine vegetation maintenance.	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
Installation of Mini-Grids ***- Impacts on Socio-economic environment.***	- Community Health and Safety	- Access to the sites during works must be restricted to avoid accidents and theft incidents. - Safety signs, symbols and barriers will be used at sensitive work locations. - Contractors will be required to implement a Code of Conduct (extracted from the project ESMF) for construction workers which will include measures relating to SEA/SH, and expectations regarding the behavior of workers as well as reference to disciplinary actions that may be taken. - Clear all waste and excess materials immediately after pole erection and clear derelict poles. - Use well-kept heavy vehicles and equipment to reduce exhaust emissions. - Compacting dirt access roads, spraying access roads with water periodically, and keeping down the speed of sub-project vehicles using speed control structures.	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		- Regular toolbox talks should be conducted for drivers and include issues related to traffic management in addition to enforcing speed limits of up to 20 kph within the project areas. - Store material away from easy public access. - Segregate and restrict work site from public access and use safety signage and symbols. - Setting up and operationalizing Community Grievance Redress Mechanism and Committees at Local Level. - Put in place Emergency Response Plan, Measures and Procedures, popularized to the public and workers to handle project related incidents and accidents. - Fire alarm systems must be set in place in case of an outbreak of fire due to the battery banks. - Develop and implement a Site Security Management Plan guided by security risk assessment (where Security Personnel are used),		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		undertaking due diligence background check on conduct of personnel deployed, ensuring their regular training on code of conduct and use of proportionate force when handling riots.		
	- SEA/SH	- A SEA/SH Action Plan is prepared for the project and will be implemented. - The contractors will be required to implement a Code of Conduct (extracted from the project ESMF) for construction workers which will include measures relating to SH/SEA, and to monitor the behavior of workers. - Locals will be sensitized and encouraged to report any such behavior or incidents through specific measures included in the project GRM for SEA/SH. - Educate workers on risks and prevention of sexually transmitted infections. - Use local labor as much as possible, of both skilled and unskilled to minimize	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	During installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		labor influx. - Sensitize workers on appropriate behavior and ensure the Code of Conduct is signed by all workers.		
	- Inadequate stakeholder engagement and exclusion of vulnerable groups	- Include women and other vulnerable groups in all stakeholder engagement. - Take into consideration the feedback from these groups in the project design and implementation. - Design GRM to make special provisions for addressing grievances from vulnerable groups. - Encourage employment of women, where possible with fair compensation.	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure
	- Occupational Health and Safety	- During construction of battery banks, special precaution in the transport and filling of the sulphuric acid serving as battery electrolyte has to be taken, given its highly corrosive nature. Personnel dealing with batteries should always wear protective personal equipment such as protective eyewear and gloves.	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		- Only allowing trained and certified workers to install, maintain, or repair electrical equipment; - Ensuring that live-wire work is conducted by trained workers with strict adherence to specific safety and insulation standards. - Workers should not approach an exposed energized or conductive part even if properly trained unless: o The worker is properly insulated from the energized part with gloves or other approved insulation; or, o The energized part is properly insulated from the worker and any other conductive object; or, o The worker is properly isolated and insulated from any other conductive object (live-line work). - The contractors will be required to prepare a plan to address Occupation Health and Safety, which is expected		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		to address induction and training of workers, conduct of tool box sessions, provision of personal protective equipment, provision of first aid kits, etc. - Institutes emergency response procedures to handle any emergency incidents. - Incident/accident reporting through keeping log of incidents/accidents and remedial actions (in the event of an accident). - Provide personal protective equipment and first aid kits. - Setting up Workers' Grievance Redress Committees to handle and process workers' complaints. - Providing workers with Contracts, with clear Terms of Employment and working conditions in accordance with the National Employment and Labour Laws. - Provide workers with gender segregated sanitation facilities (mobile toilets), with maintained hygiene.		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		- Any genset is to be located on a separate and well-ventilated room in relation to the battery banks. Exhaust pipes should be directed far from PV panel arrays as well as other electronic equipment. - Genset servicing must be undertaken by certified professionals wearing adequate PPE. - If improperly maintained (not kept cooled and regularly exposed to complete discharging) or are physically damaged, Lithium-ion batteries can be subject to thermal runaway risk, which involves the rapid expulsion of a toxic gas that can eventually explode if ignited. It is thus of fundamental importance to keep the battery banks cool and operational as per manufacturer's guidelines.		
	- Impacts on Public Social Services, Utilities and Property, including	- Control road traffic. - Avoid peak times and days such as market days. - The construction or installation activities must not interfere with the use of public space, land and airport facilities.	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
	water resources	- During operation, right-of-way maintenance has to be undertaken to ensure events of trees and other vegetation falling on distribution cables do not take place. - Water requirements for regular PV panel cleaning should be taken into consideration when siting the installation, preferably near a water body. While water access should be ensured, it must also be properly communicated to the recipient community during early stages of project design (especially in areas with water scarcity issues). - To minimize water requirements for cleaning solar panels, it is recommended to mount the panels at a tilted angle. Tilted solar panels don't require cleaning as much as flat panels, a minimum five-degree angle helps debris to slide off the panels. - In order to reduce water stress on community water sources, it is recommended that: (i) solar powered		

Activities	Potential E&S Risks and Impacts	Proposed Mitigation Measures	Responsibilities	Timeline
		wells be drilled at the project site to supply water for cleaning and (ii) rain water harvesting infrastructure be incorporated in the project design to supplement to the existing water sources. - Dry cleaning is recommended to be used most times, and when need arises, use the wet cleaning method. For the most part, solar panels are self-cleaning		
	- Land Acquisition, Land Use and Livelihoods	A Resettlement Policy Framework has been drafted during project preparation to guide the elaboration and implementation of a Resettlement Action Plan (RAP). The RAP will guide the compensation process for the different kinds of involuntary resettlement.	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure
	- Impacts on Indigenous Peoples	[List mitigation measures set out by IPPF/IPP]	[Select an appropriate monitoring entity. i.e. supervision firm, PIU, public utility company, Contractor, etc]	Prior to, and during installation of Mini-Grid infrastructure

8. CONSULTATIONS AND PUBLIC PARTICIPATION

8.1 Objectives of The Stakeholder Consultations

It is important that affected communities are given the opportunity to participate in the environmental and assessment process, particularly in the provision of information specific to the sites. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

8.2 Summary of Issues During the Stakeholder Consultations

[Include a summary or the stakeholder engagement process carried out for the specific works at hand. This should include a brief analysis of project-affected parties, other interested parties, and vulnerable groups engaged, the efforts and instances of engagement, the project environmental and social aspects discussed, the questions and concerns expressed by stakeholders, and the feedback absorbed by project design].

[Include a table summarizing the comments and concerns raised during consultations with stakeholders. Remember to blur the first two columns *(containing personal information)* in the disclosure version of the ESMP in line with WB Policy on information disclosure]

Table 5: Summary of Comments received from stakeholders consulted

Name	Designation & Contact Information	Location	Comments and concerns/issues	Response and proposed mitigation measure to address raised issues

9. IMPLEMENTATION AND MONITORING ARRANGEMENTS FOR THIS ESMP

9.1 Implementation Arrangements, Roles and Responsibilities

[This section describes the institutional arrangements to implement the ESMP in relation to the assessment and identification of mitigation measures for subprojects, review, clearance and disclosure of the ESMP, carrying out the mitigation and monitoring measures, (for operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting and

staff training). A clear delineation of responsibilities must be spelled out under this section. This should consider and describe functions and roles encompassing planning and design, and construction stage, an institutional arrangement for the authorities, project proponent, consultants, contractors and supervision engineers. For suggestions in relation to this, see the institutional arrangements provided in the project ESMF, and adapt accordingly. The text below can serve as a guide].

The Project Implementation Unit (PIU) under [fill in the name of the Ministry of Public Works authority housing the PIU] is responsible for the overall implementation of the Project and its ESMP. The E&S Specialists/Unit/Department [use whichever is applicable] will ensure the respective roles of each party are carried out on time. The PIU will ensure that the environmental and social requirements as detailed in the ESMP are part of the bidding and contract negotiation phase and part of the works contracts. The [include the names of the ministries, public utility companies, or institutions with oversight capacities], with their oversight responsibilities, shall liaise with the [Ministry or Public Utility company], housing the PIU, to ensure the Project is in line with legal requirements.

[Include mention of the national and local laws and regulations on Environmental and Social Impact Assessment (ESIA) and the stated arrangements and obligations set out to monitor, supervise and audit the ESMP implementation].

The table below summarizes the roles and responsibilities regarding the implementation arrangements for **environmental and social management.** Complete table below and adapt as relevant for project.

Table 6: Implementation Arrangements – [template]

Level/ Responsible Party	*Roles and Responsibilities*
[National/ Regional, PIU	
Regional/local field staff	
Supervision Engineer	
Local contractors]	

9.2 Institutional Training and Sensitization

Contractors shall include in their work plans and carry out training of workers on the required E&S

risk management measures they are expected to implement as part of the daily activities.

9.3 Monitoring of the ESMP

[Describe monitoring arrangements for environmental and social impacts as set out in national legislation and regulations, and implementation arrangements specific to the project. Institutions in charge of monitoring can include supervision firms, the PIU, national EIA authority, amongst other.]

Table 7: ESMP Monitoring Program [this is an example]

Institution	Monitoring activity	Timeline	Recommended frequency	Requirements	Proposed budget (USD)
Supervision Firm	Monitoring and evaluation of measures implemented by contractors	Whole Project Duration, especially during the installation of the Mini-Grids.	Daily	Logistics for monitoring field work	$XX,XXX
PIU	Monitoring and evaluation of measures set out by ESMP	Whole Project Duration, especially during the installation of the Mini-Grids.	Weekly	Logistics for monitoring field work	$XX,XXX
EIA Authority	Monitoring and evaluation of measures set out by national legislation	Whole Project Duration, especially during the installation of the Mini-Grids.	Bi-weekly. Monthly	Logistics for monitoring field work	$XX,XXX
				TOTAL	$XX,XXX

The Environmental and social monitoring activities shall be based on direct or indirect indicators of complaints, noise, laboratory tests, and resource use, as applicable to the project.

The responsibility for the environmental and social monitoring will largely lie with the PIU. The involvement of other stakeholders in monitoring compliance of the project with other aspects is not much anticipated due to short term nature of the construction phase of the Mini-Grids.

Some of the key monitoring indicators of focus will include the following amongst others:

a) Indicators of emissions, effluents, and resource use applicable to the particular project;
b) Accident and Fatality Rates: Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities;
c) Traffic control measures put in place during construction phase of the project;
d) Number of trees planted;
e) Number of sensitization meetings held for the community on aspects of the project etc.; and
f) Safety aspects on the project i.e. provision of PPEs for the workers, OSH trainings, Toolbox meetings,
g) PV panel suppliers ought to be required to provide information on the source/origin of used raw materials.
h) The genset and fuel tank room must be kept clean of oil and fuel leakages at all times to prevent risk of fire.
i) The genset's operating hours must be constantly tracked to properly and timely plan servicing schedules. Emissions of SO2, NO2 and particulates must be kept below …… *(kindly stated maximum limit of emitted SO2 as per national regulations)* ppm, …… *(kindly stated maximum limit of emitted NO2 as per national regulations)* ppm and …… *(kindly stated maximum limit of emitted particulates as per national regulations)* mg/m3, respectively, as per national emission standards …… *(kindly state source of applicable regulation).* Emissions must be quantified and reported to …… *(kindly state name of national environmental regulator, if applicable).*
j) Genset exhaust gas must be colourless.
k) Nearby water bodies ought to be tested periodically to ensure there is no contamination due to coolants/fuel.
l) Cameras or guards must be based on-site to prevent fuel theft.
m) Measurements on noise levels (both inside the facility as well as within the ambient environment) must be undertaken periodically with noise level meters and reported to …… *(kindly state name of national environmental regulator, if applicable).*
n) Resolution of grievances within agreed timelines

During the construction period, the monitoring activities will focus on ensuring that environmental mitigation measures are implemented, and some performance indicators will be monitored to record environmental performance and to guide any remedial action to address unexpected impacts.

9.4 Reporting

Effective communication between contractors, the engineering supervision firm, the PIU, and the Environmental Authority is essential. Monthly reporting of monitoring and evaluation results from the contractors and supervision firm to the PIU is recommended. The PIU will report to the EIA Authority in accordance with national legislation and regulations.

9.5 Environmental and Social Auditing

Environmental and social auditing will be carried out after the completion of project activities.

9.6 ESMP Implementation Budget

Table 8: ESMP Implementation Budget [Adopt and complete the Budget Table below]

S.No.	Cost Item/ Activity	Unit Cost (USD)	Quantity	Total (USD)
	Hiring E&S Staff as part of the Operator/ Contractor and/RE team - (Environmental Specialist, Social Development Specialist)	xx	xx	xx
	E&S Supervision and Monitoring by the Operator/ Contractor & RE (At-least Once per Month).	xx	xx	xx
	Periodic (Annual) Environmental and Social Audit.	xx	xx	xx
	E&S Office Equipment (Laptops), E&S Monitoring Equipment (Air-Quality, Noise Meter, GPS, Vehicle).	xx	xx	xx

	……etc……			
	TOTAL Budget			

10. REFERENCES

[Kindly list all relevant national environmental regulations]