KAMPONG CHHNANG 60 MW SOLAR POWER PROJECT

Project title	Kampong Chhnang 60 MW Solar Power Project
Project ID	4869
Monitoring period	11-November-2022 to 31-December-2023
Crediting period	11-November-2022 to 10-November-2029
Original date of issue	20-February-2024
Most recent date of issue	20-February-2024
Version	1.0
VCS Standard Version	VCS Standard, v4.5
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1 PROJECT DETAILS

1.1 Summary Description of the Project

The Kampong Chhnang 60 MW Solar Power Project, referred to as "the project," is a solar power plant developed by Prime Road Alternative (Cambodia) Co., Ltd., with a total capacity of 60 MWac. It serves as Phase 1 of the larger National Solar Park, with a combined capacity of 100 MWac. Located approximately 60 km northwest of Phnom Penh in the south of Kampong Chhnang province, Cambodia, the project can be accessed via provincial and rural roads.

Cambodia's energy landscape is primarily dominated by coal and hydropower. In the baseline scenario, the country faces challenges such as heavy reliance on imported fossil fuels, power outages, and environmental impacts from hydropower and coal-fired plants. The Kampong Chhnang project, a solar power initiative, contributes to the national grid by supplying an estimated annual average of 139,711 MWh of electricity. This helps reduce dependence on imports, fossil fuels, enhances resilience to climate change, and supports Cambodia in meeting its Nationally Determined Contributions (NDCs).

Without the project, the baseline scenario involves generating an equivalent amount of electricity from grid-connected fossil fuel-dominated power plants. Therefore, the electricity delivered to the grid by the project would otherwise have been generated by these fossil fuel plants or new generation sources.

Construction of the project commenced on 13 August 2021, and achieved Commercial Operation on 11 November 2022. The project owner has secured a long-term Power Purchase Agreement with Electricite Du Cambodge (EDC). On average, the project reduces approximately 101,136 tCO_2eq of GHG emissions annually. Over the first crediting period of seven years, the project results in an estimated emission reduction of 707,952 tCO_2eq.

For the current monitoring period from 11 November 2022, to 31 December 2023 (inclusive of first and last date), the project has supplied 156,367 MWh of electricity to the national grid, resulting in an emission reduction of 113,194 tCO_2eq.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Joint Validation and verification	11-11-2022--31-12-2023	VCS	4K Earth Science Private Limited	One year one month 20 days

1.3 Sectoral Scope and Project Type

Sectoral scope[1]	1 - Energy (renewable/non-renewable)
Project activity type	Renewable Energy Project

This project is not an AFOLU project and is not a grouped project.

Sectoral scope	NA
AFOLU project category[2]	NA
Project activity type	NA

1.4 Project Eligibility

1.4.1 General eligibility

The Project is a 60 MW grid connected electricity generation activity using solar power in Cambodia, which is a Least developed Country (LDC)[3] as designated by the United Nations. As per VCS Standard v4.5, section 2.1 -Table 1, grid connected solar power plants located in LDCs are within the VCS program scope, making this project eligible under VCS.

As per VCS Standard v4.5, section 3.8, the project start date is the date on which the project began generating GHG emission reductions. With commercial operation starting on November 11, 2022, and considering subsection 3.8.1, the project is eligible to undergo validation within two years of its Commercial Operation Date (COD), i.e., before November 10, 2024, meeting the validation deadline requirements.

Developed under the CDM-approved methodology ACM0002 – Grid-connected electricity generation from renewable sources – Version 21.0[4], this project aligns with VCS GHG program and methodology standards, qualifying it for participation in the VCS program.

1.4.2 AFOLU project eligibility

Not Applicable. This project is a solar power project which falls under the non-AFOLU project category.

1.4.3 Transfer project eligibility

Not Applicable as this project is not registered under any other GHG programs and is not seeking to transfer.

1.5 Project Design

[1] Projects, activities, or methodologies may be developed under any of the 16 VCS sectoral scopes: https://verra.org/programs/verified-carbon-standard/vcs-program-details/#sectoral-scopes

[2] See Appendix 1 of the VCS Standard

[3] https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/ldc_list.pdf

[4] https://cdm.unfccc.int/UserManagement/FileStorage/ZPFJL01OU2RYC6N3HASIXV7K84QBG9

☒ Single location or installation

☐ Multiple locations or project activity instances (but not a grouped project)

☐ Grouped project

Grouped Project Design

Not applicable as this project is not a grouped project

1.6 Project Proponent

Organization name	Prime Road Alternative (Cambodia) Co., Ltd.
Contact person	Mr. Rassa Herabat
Title	Head – Asset Management & Project Manager RE
Address	1 TP & T Tower, 22nd Floor, Soi Vibhavadi Rangsit 19, Vibhavadi Rangsit Road, Chatuchak, Chatuchak, Bangkok Thailand 10900
Telephone	+66 957936356
Email	rassa.h@primeroadgroup.com ; assetmanagement@primeroadgroup.com

1.7 Other Entities Involved in the Project

Organization name	Kosher Climate India Private Limited
Role in the project	Project Representative
Contact person	Vamsi Krishna M
Title	Director
Address	Zee Plaza, No.1678, 27th Main Rd, Near KLM Mall, Sector 2, HSR Layout, Bengaluru, Karnataka 560102, India
Telephone	+91 99453 43475
Email	vamsi@kosherclimate.com ; narendra@kosherclimate.com

1.8 Ownership

The project activity is being undertaken by Prime Road Alternative (Cambodia) Co., Ltd., owns all the legal rights and is the sole owner of the project activity. It has already obtained all the

necessary permits/consents from the various concerned government departments that are required to develop and operate a solar power project in the Cambodia. Further, the business license, project approval, equipment purchase contract and the power purchase agreements are the evidences for the ownership of the plant, equipment's and power generation.

1.9 Project Start Date

Project start date	11-November-2022
Justification	Project start date is the date on which project started its commercial operation and started generating electricity and hence began generating GHG emission reductions.

1.10 Project Crediting Period

Crediting period	☒ Seven years, twice renewable ☐ *Ten years, fixed* ☐ *Other (state the selected crediting period and justify how it conforms with the VCS Program requirements)*
Start and end date of first or fixed crediting period	11-November-2022 to 10-November-2029

1.11 Project Scale and Estimated GHG Emission Reductions or Removals

☒ < 300,000 tCO2e/year (project)

☐ ≥ 300,000 tCO2e/year (large project)

Calendar year of crediting period	Estimated GHG emission reductions or removals (tCO_2e)
11-Nov-2022 to 31-Dec-2022	14,131
01-Jan-2023 to 31-Dec-2023	101,136
01-Jan-2024 to 31-Dec-2024	101,136
01-Jan-2025 to 31-Dec-2025	101,136
01-Jan-2026 to 31-Dec-2026	101,136

01-Jan-2027 to 31-Dec-2027	101,136
01-Jan-2028 to 31-Dec-2028	101,136
01-Jan-2029 to 10-Nov-2029	87,005
Total estimated ERRs during the first or fixed crediting period	707,952
Total number of years	7
Average annual ERRs	101,136

1.12 Description of the Project Activity

The project is a new greenfield photovoltaic facility with an installed power capacity of 60 MW, which is derived from 77.006 MWp of its total installed DC power capacity connected to the Electricite du Cambodge (EDC) substation within the National Solar Park (NSP). The Project comprises 300 units of 200kVA (1500V) Huawei String inverters combined with 10 sets of box-transformers. The PV Modules are installed on single horizontal axis tracking system, consisting of 2 types of tracking row configuration. One type has 3 strings of PV modules and the another with 2 strings of PV Modules, all installed in one row portrait orientation. The average lifetime of the PV cell modules is 25 years as per the equipment supplier's specifications.

There are total of 10 sub-systems, 9 of which have 6.5MVA box-transformers and the other one has a 3.25MVA box-transformer, each one connected to 4 circuits of 22kV switchgear side of the 115kV Project substation.

Table I: Summary of the technical specifications for the key components of the Project

Technology	Type	Manufacturer	Model
Solar PV Module	Monocrystalline bifacial	Suntech	STP540S-C72/Pmh+ (540Wp)
Inverter	String Inverter	Huawei	SUN2000-215TL-H0
Transformer	Box Transformer	Huawei	3250kVA
	Box Transformer	Huawei	6500kVA
Monitoring Equipment			
- Pyranometer	Secondary standard	Kipp & Zonen	CMP10
- PV module temperature sensor	RTD sensor	OMEGA	SA2-RTD
- Temperature & Pressure sensor & Relative humidity	Weather transmitter	Vaisala	WXT536
Mounting Structure	Horizontal single axis tracker	Clenergy	EzTracker D1P

The objective of this facility is in line with the government's initiative to enhance power generation in the country, addressing the increasing demand and broadening the power sources. The solar photovoltaic facility is set to offer a clean and sustainable energy source, aiming to decrease the country's carbon footprint and support global endeavors against climate change. This initiative is a crucial stride toward achieving sustainable development in Cambodia, positively impacting the environment, economy, and society. The project seeks to replace the current annual anthropogenic emissions of greenhouse gases (GHGs), estimated at around 101,136 tCO_2e, by displacing approximately 139,711 MWh/year of electricity produced by thermal fossil fuel-based power plants. Beyond emission reduction and diversification of power sources, the project will generate employment opportunities, fostering the local economy. The installation of solar panels, inverters, transformers, and other essential equipment will involve the local workforce, contributing to the growth of the renewable energy sector in the country.

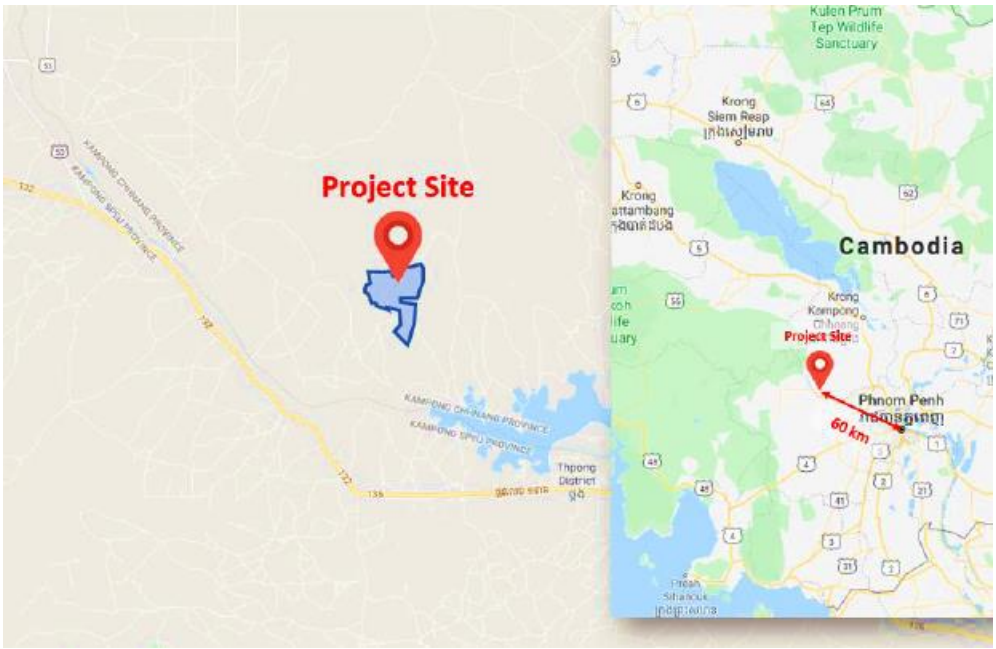
1.13 Project Location

The 60MW solar plant covers an area of 97 ha within the planned 250 ha NSP and is located in Tuek Phos district of Kampong Chhnang province, Cambodia

Table II: Location and description of site

Site Name	Longitude	Latitude	Size	Location
Kampong Chhnang	11° 47.638'N	104° 23.505'E	~97 hectares	Kampong Chhnang province, Tuek Phos, Kbal Tuek

Figure 1: Geographic Location of the project



1.14 Conditions Prior to Project Initiation

The project activity is the installation of a greenfield power plant and the baseline scenario is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

The conditions prior to the implementation of the project activity are same as that of the above-described baseline scenario. The project activity does not involve generation of GHG emissions for the purpose of their subsequent reduction, removal or destruction.

1.15 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project is adhering to the relevant legal and regulatory guidelines of the Cambodian Power Sector, governed by the Electricity Law[5] and the primary legislation overseeing Environmental Impact Assessment (EIA) in Cambodia, known as "The Law on Environmental Protection and Natural Resources Management[6]." This law outlines institutional responsibilities, mandates impact assessment criteria, and specifies procedures for conducting environmental assessments.

The 60 MW solar power project has obtained all required approvals for its development and initiation from the appropriate authorities, ensuring alignment with local laws and regulations. Further, the project is aligned with the direction from Ministry of Mines and Energy which is to encourage exploration and development of environmentally and socially acceptable energy resources needed to supply all sectors of Cambodian economy.

1.16 Double Counting and Participation under Other GHG Programs

1.16.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program?

☐ Yes ☒ No

1.16.2 Registration in Other GHG Programs

Is the project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

1.16.3 Projects Rejected by Other GHG Programs

Has the project been rejected by any other GHG programs?

☐ Yes ☒ No

[5] https://cdc.gov.kh/wp-content/uploads/2022/04/LAW-ON-ELECTRICITY_010202-.pdf

[6] https://cdc.gov.kh/wp-content/uploads/2022/04/Law-on-Environmental-Protection-and-Natural-Resource-Management_961224.pdf

1.17 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

1.17.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the *VCS Program Definitions* for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

1.17.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

☐ Yes ☒ No

1.17.3 Supply Chain (Scope 3) Emissions

Do the project activities specified in Section 1.12 affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

1.18 Sustainable Development Contributions

1.18.1 Sustainable Development Contributions Activity Description

The solar power project at hand plays a direct role in advancing Sustainable Development Goal (SDG) 7, specifically focusing on ensuring universal access to affordable, reliable, sustainable, and modern energy. This access to energy is pivotal for fostering sustainable economic growth and development, addressing climate action, promoting energy transformation, and enhancing equity and inclusiveness in a cohesive manner.

Table III: Contributions of the project activity to SDGs

	By generating an estimated annual output of 139,711 MWh of renewable energy, the project significantly contributes to the realization of SDG 7, which strives to ensure access to affordable, reliable, sustainable, and modern energy for all. This contribution aligns with the overarching goal of fostering a greener and more sustainable future.

	Throughout the construction and operational phases, the project has actively created numerous direct and indirect employment opportunities, predominantly benefitting the local population in the region. This proactive approach contributes to the fulfilment of SDG 8, which seeks to promote sustained, inclusive, and sustainable economic growth, along with full and productive employment and decent work for all.
	Through its efforts in emission reductions, the project aligns with the objectives of SDG 13, which calls for urgent action to combat climate change and its adverse impacts. By taking substantial measures to decrease greenhouse gas emissions, the project actively contributes to the global initiative of safeguarding the planet for the well-being of future generations.

1.18.2 Sustainable Development Contributions Activity Monitoring

The Kampong Chhnang solar power project generates electricity using renewable solar energy. With the average annual generation of 139,711 MWh of renewable energy, the project activity contributes to achieving SDG 7. Further, through emission reductions, this effort aligns with SDG 13 which calls for urgent action to combat climate change and it's impacts. During the current monitoring period, the project proponents have conducted 5 training sessions to educate and build capacity. 57 individuals have been successfully employed, contributing to the realization of SDG 8, which aims to promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.

Table 1: Sustainable Development Contributions

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current project contributions	Contributions over project lifetime
Sequential row number	*SDG Target number*	*Number and text of SDG indicator or, if no official SDG indicator is applicable, user-defined indicator*	*Indicate the project's contribution to the SDG Indicator (implemented activities to increase or decrease)*	*Brief description of the quantifiable impact of the project's activities related to the SDG indicator, during the monitoring period.*	*Brief description of the cumulative quantifiable impact of the project's activities related to the SDG indicator, over the project lifetime.*
1)	7.2	7.2.1 Renewable energy share in the total final energy consumption	Implemented activities to increase	In the reported monitoring period (11/11/22 to 31/12/23), the net renewable energy supplied to the grid is 156,367 MWh.	Until the end of the current monitoring period the project has generated 156,367 MWh of renewable energy and the project is expected to increase the share of renewable energy in the national grid by 3,909,175 MWh over its project lifetime

2)	8.5	8.5.1 Average hourly earnings of employees, by sex, age, occupation and persons with disabilities	Implemented activities to increase		Project activity supports creation of short-term and long-term job opportunities for men and women during the construction and operation of the project activity. During the current monitoring period (11/11/22 to 31/12/23), the project has created new employment and generates income for 57 people including men and women.	By the end of this monitoring period the project activity has resulted in generating job opportunities and income generation to 57 people.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to decrease		By generating 156,367 MWh of renewable electricity the project activity has avoided 113,194 tonnes of carbon emissions into the atmosphere during the current monitoring period.	Until the end of the current monitoring period the project has avoided 113,194 tonnes of carbon emissions and during the project lifetime it will avoid the release of 2,829,850 tonnes of carbon into the atmosphere

1.19 Additional Information Relevant to the Project

Leakage Management

Not applicable as the project activity is not an AFOLU project

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

Not applicable, as this project activity does not involve any additional information that may have a bearing on the eligibility of the project, the GHG emission reductions, or the quantification of the project's reductions.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

Stakeholder Identification	Stakeholders include various individuals, groups, and institutions who have an interest in, could be impacted by, possess the ability to significantly influence, or are crucial for achieving the desired project outcome. The list of relevant stakeholders identified through stakeholder mapping includes: • Local people, communities, and representatives expected to be directly or indirectly affected by or interested in the project. • Local policymakers and representatives of local authorities. • Local non-governmental organizations (NGOs) and Women Groups focusing on topics relevant to the project or collaborating with communities likely to be affected by the project.

Legal or customary tenure/access rights	This project is a component of Electricite du Cambodge's (EDC) National Solar Park (NSP) initiative. The project proponent has secured a 97-hectare lease for a 60 MW photovoltaic (PV) plant from EDC. EDC acquired the land through commercial negotiations, following a willing buyer-willing seller approach. As a result, the project site does not involve any territories or resources to which the stakeholders have customary rights or access.
Stakeholder diversity and changes over time	The plant is situated in Prey Chrov village in Kbal Toeuk Commune, a socio-economic survey was carried out in Kbal Toeuk commune and 2 other nearby communes – Chhean Loerng Commune and Prambei Mom commune to determine relevant demographic characteristics of the communities. Based on the socio-economic profile, stakeholder mapping was carried out to ensure that equitable, non-discriminatory and meaningful consultation was carried out. The stakeholder group exhibited notable diversity across social, economic and cultural dimensions. Socially, individuals from various backgrounds, including different age groups, ethnicities and socio-economic classes were present. It was ensured that women, disabled or elderly people, informal sector workers, poor communities and stakeholders with different financial capacities were represented and involved. The diverse stakeholder groups interacted in multifaceted ways, driven by their unique perspectives and interests to voice out their opinions. Overtime, the composition of these groups may undergo changes due to evolving circumstances or project related developments. New individuals or entities may join, a few might disengage. To monitor these changes and to ensure that the project continues to align with the diverse needs and expectations of its stakeholders, the project proponents will engage with the stakeholders every six months and has implemented a Grievance Redressal Mechanism (GRM).
Expected changes in well-being	The socio-economic survey revealed that in the baseline scenario there are no ethnic groups apart from Khmer and majority of the households in the project area practice farming while some households run small businesses. Livelihood generation and employment on plantations are reported to be temporary and seasonal. Agriculture is the main occupation with secondary income generating

	activities being livestock rearing, fishery and working in factories, where both men and women are involved. Poverty is a concern in the survey area due to limited job opportunities. This project activity will employ local populace resulting in economic and livelihood generation opportunities during the construction and operation phase. Further, there are no protected areas or habitats of particular biodiversity value within the project area of influence. The solar plant site is located in modified environment (disturbed by human activity) dominated by scrubland with scattered trees and paddy fields hence no changes to the ecosystem services important to the stakeholders have been identified.
Location of stakeholders	The locations of the stakeholders are – Kbal Toeuk commune in Toeuk Phos district, Chhean Loerng commune in Samaki Meanchey district, Kampong Chhnang province and Prambei Mom commune in Kampong Speu province. The solar plant is situated within the administrative are of Prey Chrov Village in Kball Toeuk Commune, where the population is located around 18km from the commune where most of the stakeholders live and is unlikely to experience any direct or indirect impacts from the project activity. Further, there are no habitations/settlements within the 60 MW solar plant or private ownership with formal land titles or traditional land holding. The project's transportation is partly through Prambei Mom commune, the closest human receptors that will be likely affected due to transportation are those living along the existing access road. Potential impacts due to transportation issues such as dust and noise have been assessed based on Cambodian and International environmental standards and mitigation measures were developed to help minimize any direct or indirect adverse effects associated. Also, the transportation need of the project was minimal since the total planned construction was only 18 months and the needs of transporting materials in and out of the project site were not on a regular basis.

Location of resources	There are no habitations/settlements within the project site. This site was previously used for cassava plantations and was later reportedly abandoned. The site assessment conducted by the project proponent for 197 ha identified the site as mainly scrubland and paddy fields. The site surrounding the project, is now a grass-field and a grazing area for local villagers. This is a kind of opportunistic grazing by villagers. There are no territories or resources in the project site which are owned by the stakeholders or have customary access to.

2.1.2 Stakeholder Consultation and Ongoing Communication

Date of stakeholder consultation	27-September-2020, during the preparation of the ESIA report and subsequently during the construction phase, the project proponent engaged in stakeholder consultation on 21-July-2022. The purpose was to provide an update on the project's progress and gather insights into any concerns stakeholders might have.
Stakeholder engagement process	Key stakeholders were identified by stakeholder mapping considering social, cultural and gender-specific factors that might influence their engagement. Representation and participation from diverse groups such as local communities, local governments, national & local NGOs, private sector entities comprising women, men, elderly, girls and boys etc. was sought by inviting them to attend the meeting through different means such as: • Personal face to face invitations to government officer/NGOs • Invitation letter posted on the village bulletin board Local people were invited to the meeting via personal face to face invitations and posters. Local government officers were invited to the meeting via face-to-face invitations and invitation letter. The meeting announcements were made well in advance after consulting with the commune and village representatives. The agenda of the meeting, the Project Information Booklet (PIB) and guide questionnaires

	for Focus Group Discussions (FGDs) with men and women in Khmer language were distributed well in advance. The consultation was undertaken in both village and provincial levels. It was a two-way information sharing channel where participants provided their comments and feedbacks. The results of the consultations; concerns raised & recommendations made have been addressed in the ESIA & ESMP of this project activity. Furthermore, the project proponents have established a Grievance Redressal Mechanism (GRM) which provides an accessible platform for receiving and facilitating resolution of grievances from affected stakeholders.
Consultation outcome	Initial consultations with relevant stakeholders potentially affected by the project were conducted in May and July 2018 by EDC before the commencement of any project activity to inform them of the proposed project, potential temporary impacts and project benefits. Two village consultations were held on 27 September 2020 to disseminate information about this 60 MW solar plant project and to discuss the concerns and suggestions of potentially affected peoples followed by subsequent consultations during the construction phase. Public participation as part of the consultation included information disclosure via distribution of project information booklets (PIB) in affected communes during consultations, public meetings at district, and village level and focus group discussions (FGDs) with both women and men of the affected communes. Furthermore, the project proponent has ensured consistency in social and environmental monitoring in compliance with the local laws, ADB safeguard policy statement (SPS)and IFC Performance Standard requirements. As required by the Cambodian regulation, the project proponent will be contributing USD 1,000/Year towards environmental and social fund. All of participants supported the project. Main environmental concerns expressed by the participants were related to increase in dust in the dry season, construction debris dumping during construction and the

	operation stage. Measures to address these concerns have been integrated in the design and ESMP.
Ongoing communication	The Project Management Office (PMO) has established a Social and Environmental Compliance Unit (SECU) for handling complaints/grievances attributed to social or environmental issues based on several discussions and meetings with ADB/IFC. Further, there is a Grievance Redress Mechanism (GRM) to receive and facilitate resolution of project affected persons' concerns, complaints, and grievances about the project's environmental and social performance. GRM involves a Grievance Redress Committee (GRC), which comprises of the relevant commune and/or village chiefs, provincial officers or their nominee, District Officer from the Cadastral office or their nominee, Contractor and a witness of the affected person; at least one person in the GRC will be female. The GRC is expected to: (i) resolve issues on land acquisition (if any), (ii) resolve issues on dust, noise, vibration, construction related nuisances to public, etc.; (iii) convene once a month to review complaints lodged (if any); (iv) record the grievances and resolve the issues within 30 days from the date the grievance was filed with the SECU; and (v) report to the complainant(s)/affected persons the status of grievance resolution and the decisions made or action taken. GRC has be established at provincial level ("Provincial GRC") with representation from commune councils across the project area of influence where the project components will be implemented. The key contacts for the GRC have been posted at project office sites, and public notice boards in affected communes in Khmer language.
Stakeholder input	During the consultation, the project proponents updated stakeholders on the project's progress, discussed potential

	impacts, and gave stakeholders the chance to express concerns and suggestions for improvement. Stakeholders expressed satisfaction with the project outcomes but requested more job opportunities due to their involvement in seasonal agricultural activities. The project proponents assured them of future employment announcements for local hiring. Concerns about transportation-related issues, including dust, noise, and potential accidents, were addressed. The project team emphasized their commitment to safety, highlighted the absence of transportation accidents, and assured continuous monitoring of noise and air pollution, which remained below harmful levels. Stakeholder comments mainly sought clarification, and as sufficient information was provided during the meeting, no changes to the project design are deemed necessary.

2.1.3 Free Prior and Informed Consent

Obtaining consent	Consent for implementing project activities involved engaging with stakeholders since July 2018, when EDC initiated consultations before acquiring the land. All leased land was obtained through commercial terms, following a willing seller-willing buyer approach. The project proponents fostered open dialogues, providing stakeholders ample opportunities to express concerns, ask questions, and share input. All raised concerns and inputs have been documented, and a grievance resolution mechanism is in place to address ongoing conflicts, demonstrating the project's commitment to prioritizing resolution and community harmony. Regular stakeholder engagement will persist throughout the project lifecycle to address evolving concerns and ensure ongoing support. Through this comprehensive process, the project not only obtained consent but also built a foundation of trust and cooperation with stakeholders, resulting in no ongoing or unresolved conflicts.

Outcome of FPIC	The result of the FPIC and stakeholder consultation is positive, with stakeholders expressing their support for the project. Additionally, a third-party assessment was conducted to confirm that the land acquisition adhered to the ADB SPS (2009) requirements. The verification affirmed that EDC acquired the land through commercial transactions, ensuring that the project did not encroach on land, relocate people without consent, or cause forced physical or economic displacement.

2.1.4 Grievance Redress Procedure

Development process	Grievance Redress Mechanism (GRM) has been established in a systematic and culturally sensitive manner to address concerns raised by stakeholders. This involves a Grievance Redress Committee (GRC), consisting of relevant commune and/or village chiefs, provincial officers or their nominees, a District Officer from the Cadastral office or their nominee, the Contractor, and a witness of the affected person, with at least one female member. The GRC is tasked with (i) resolving land acquisition issues (if any), (ii) addressing concerns related to dust, noise, vibration, and construction-related nuisances to the public, (iii) convening monthly to review lodged complaints (if any), (iv) recording grievances and resolving them within 30 days from filing, and (v) reporting the status of grievance resolution and decisions/actions taken to the complainant(s)/affected persons. The Provincial GRC, established at the provincial level, includes representation from commune councils across the project area of influence where project components will be implemented. Key contacts for the GRC have been prominently displayed at project office sites and public notice boards in affected communes, in Khmer language, to ensure accessibility and awareness.

Grievance redress procedure	The Grievance Redress Mechanism (GRM) comprises the following conflict resolution procedure: Step 1: Affected persons/complainants can present complaints to the commune council through the village or commune chief, either verbally or in writing. The chief will provide an immediate written receipt and forward the complaint to the Social and Environmental Compliance Unit (SECU) of the project. The SECU will resolve the issue within one week through negotiation. Records of complaints and resolutions will be submitted to the Project Management Office (PMO) as part of monthly progress reports. Step 2: If the complainant is dissatisfied with the contractor's action or decision, they will take the issue to the PMO via the commune council. Grievances will be recorded in writing and forwarded to the SECU. The project proponent has 15 days to resolve the complaint through negotiation. If unresolved within 15 days or if the complainant remains dissatisfied, they can escalate the issue to the District office. Step 3: The District office has 15 days to negotiate the complaint and attempt resolution. If satisfactory resolution is not achieved, the District office will refer the issue to the Provincial Grievance Redress Committee (GRC). Step 4: The Provincial GRC will meet the complainant and attempt to resolve the issue. Within 30 days of complaint submission, the GRC must make a decision and inform both the complainant and SECU in writing. Step 5: If dissatisfied with the Provincial GRC or its decision, the complainant can bring the case to the Provincial Court. The Court's written decision will be submitted to executing and implementing agencies. If still unsatisfied, the complainant can escalate the case to a higher-level court. Step 6: If disputes remain unresolved or unsatisfactory, affected persons can directly discuss concerns with ADB's Energy Division, Southeast Asia Department, or through ADB Cambodia Resident Mission (CARM) and IFC's

	ombudsman office. If still dissatisfied, they can contact the ADB Office of the Special Project Facilitator through the accountability mechanism. Recordkeeping and Reporting: The SECU will maintain records of grievances, including complainant details, complaint date, nature of grievance, corrective actions, and resolution dates. Summaries of filed and resolved grievances will be reported in quarterly project progress reports and semi-annual safeguard reports. The outcomes will be displayed/disclosed in project field offices, Commune council offices, and the Provincial Office if required.

Grievances received	Resolution and outcome
NA	No grievance has been raised during the current monitoring period. The key contacts for the Grievance Redress Committee have been displayed at the project site and public notice boards of nearby communes in Khmer language so that the platform is easily accessible for the stakeholders to raise their concerns or suggestions if any during the course of the project activity.

2.1.5 Public Comments

Comments received will be summarized in the table below once the project opens for public comments

Comments received	Actions taken

2.2 Risks to Stakeholders and the Environment

	Risks identified	Mitigation or preventative measure taken

Risks to stakeholder participation	No risk identified	No risks to stakeholder participation were identified during the preparation for stakeholder consultation. The project developer analyzed relevant stakeholders, risks, opportunities, and strategies for conducting the most effective consultation. To ensure inclusivity, the consultation venues were chosen centrally and made accessible to people of all castes, creeds, and sects in the society, ensuring that the location was considered safe by everyone in the community. Focus Group Discussions were conducted specifically to provide women and marginalized groups with an opportunity to express their opinions.
Working conditions	No risk identified	Occupational Health and Safety will be prioritized at every stage of the project. Employees will receive regular training to ensure their health and safety in the workplace. Measures will also be implemented to safeguard the health of the community near the project area. The project is committed to complying with national Occupational Health and Safety Standards, national labour standards, IFC PS2 and International Labour Organization Labor Standards, following all guidelines and standards.
Safety of women and girls	No risk identified	The project promotes safe and secure environments for all stakeholders including women and girls.

		The proposed project is a renewable energy grid connected power project and therefore it's not gender sensitive and does not adversely impact the safety of women and girls
Safety of minority and marginalized groups, including children	No risk identified	The project promotes safe and secure environments for all stakeholders including minority, marginalized groups and children
Pollutants (air, noise, discharges to water, generation of waste, release of hazardous materials)	No risk identified	The project is a solar energy project, hence will not result in release of pollutants to the environment. The project will have a temporary impact on the environment only during the construction phase due to soil disruption, particulate dust generation and noise associated with vehicles, respective measures have been taken to minimize the impact. All waste from land clearing, building activities, and accommodation were collected, stored and disposed of safely in a manner that prevents any release of leachate

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

Discrimination and sexual harassment	The project is committed to ensuring a work environment free from discrimination and sexual harassment. The project developer has an Anti-sexual harassment policy in place to prohibit any form of discrimination or harassment based on factors such as race, gender, age, religion, or any other protected characteristic. All employees are made aware of these policies through training programs, and clear reporting mechanisms are in place to address any concerns or incidents promptly

Management experience	Prime Road Group, the project developer, brings extensive experience to the table with a track record of successfully managing various regional and international solar development projects. This includes 9 projects in Thailand, 5 in Japan, and 1 in Taiwan. These projects highlight the management team's proficiency in promoting renewable energy development and contributing to the sustainable development of local communities.
Gender equity in labor and work	The project developer has a Non-Discrimination and Equal Opportunity Policy in place, promoting equal opportunities, non-discrimination, and fair treatment of workers. The project is committed to eliminating gender-based discrimination and ensuring that everyone, regardless of gender, has equal access to employment, training, and advancement opportunities. Moreover, the project follows transparent and non-discriminatory hiring practices and has set up a fair compensation structure based on principles of pay equity, ensuring that individuals receive equal pay for equal work.
Human trafficking, forced labor, and child labor	Prime Road Alternative (Cambodia) Co., Ltd and its sub-contractors strictly adhere to all national and international laws related to child labor, forced labor, and human trafficking. The project unequivocally affirms that it does not and will not use victims of human trafficking, forced labor, or child labor in any aspect of its operations. This commitment aligns with the project's dedication to upholding ethical and legal standards in its workforce practices.

2.3.2 Human Rights

The project avoids any activities that could violate the economic, social, and cultural well-being of local communities. Consequently, the project developer and the project itself commit to respecting internationally proclaimed human rights. They will not be complicit in any form of violence or human rights abuses, as defined in the Universal Declaration of Human Rights. This commitment reflects the project's dedication to upholding ethical standards and safeguarding the well-being of the communities involved.

2.3.3 Indigenous Peoples and Cultural Heritage

The Project will not directly or indirectly affect the dignity, human rights, livelihood systems, or culture of Indigenous Peoples (IPs), neither will it affect the territories or natural or cultural resources that IPs own, use, occupy, or claim as their ancestral domain.

2.3.4 Property Rights

Rights to territories and resources	This project is a component of Electricite du Cambodge's (EDC) National Solar Park (NSP) initiative. The project proponent has secured a 97-hectare lease for a 60 MW photovoltaic (PV) plant from EDC. EDC acquired the land through commercial negotiations, following a willing buyer-willing seller approach. As a result, the project site does not involve any territories or resources to which the stakeholders have customary rights or access.
Respect for property rights	Not applicable as the project does not involve any any territories or resources to which the stakeholders have customary rights or access.

2.3.5 Benefit Sharing

As described in section 2.3.4 above, the project developer has leased the land from EDC, which, in turn, acquired the land through commercial negotiations and holds all rights to the land on which the project has been developed. Further, the project does not involve any territories to which the stakeholders have customary rights and therefore benefit sharing is not applicable and hence no benefit sharing plan has been designed.

Process used to design the benefit sharing plan	NA
Summary of the benefit sharing plan	NA
Approval and dissemination of benefit sharing plan	NA
Benefit sharing during the monitoring period	NA

2.4 Ecosystem Health

	Risks identified	Mitigation or preventative measure taken
Impacts on biodiversity and ecosystems	No risk identified	ESIA has confirmed that the projected area is the not located in sensitive ecological zones, biodiversity conservation areas, and there are no rare and valuable plant and animal species.
Soil degradation and soil erosion	Risk of soil erosion during construction	The project might lead to soil erosion during the construction phase. However, mitigation measures will be implemented, such as recovering topsoil stripped during clearing and construction. Land clearing will be confined to the specific project site needed for development, minimizing the impact. Activities involving chemicals or hydrocarbons, including the storage of broken or redundant solar panels, will be limited to designated areas with proper bunding, a concrete or compacted earth base, and complete containment by drainage controls. Furthermore, soil quality monitoring will be carried out every six months.
Water consumption and stress	No risk identified	The project will not contaminate or impede the natural flow of any surface or sub-surface water sources. Moreover, the project developers have implemented a Water Management Plan. This plan assesses and manages any future groundwater extraction needs. Additionally, the project incorporates a water harvesting procedure to collect stormwater runoff, minimizing water usage. The project also includes measures to recycle water used in panel cleaning.
Usage of fertilizers	No risk identified	The project harnesses solar energy to generate electricity and therefore, will not involve

		application of fertilizers, pesticides or herbicides

2.4.1 Rare, Threatened, and Endangered species

Is the project located in or adjacent to habitats for rare, threatened, or endangered species?

☐ Yes ☒ No

Species and habitat	NA

2.4.2 Introduction of species

This is not a AFOLU project and doesn't involve introduction of any species into the project area, hence this section is Not Applicable

Species introduced	Classification	Justification for use	Adverse effects and mitigation
NA	NA	NA	NA

Existing invasive species	Mitigation measures to prevent spread or continued existence of invasive species
NA	NA

2.4.3 Ecosystem conversion

The project activity has not resulted in conversion or clearing of the existing ecosystem

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
Methodology	ACM0002	Grid-connected electricity generation from renewable sources	21.0
Tool	TOOL07	Tool to calculate the emission factor for an electricity system	7.0

Tool	TOOL01	Tool for the demonstration and assessment of additionality	7.0.0
Tool	TOOL27	Investment analysis	13.0
Tool	TOOL24	Common Practice	03.1

3.2 Applicability of Methodology

This project is a large-scale grid-connected Greenfield renewable energy power plant. Large-scale Approved Consolidated Methodology ACM0002: Grid-connected electricity generation from renewable sources --- Version 21.0[7] is applicable for the proposed project as per the scope defined in the methodology. A detailed discussion regarding applicability of ACM0002 methodology, Version 21.0 given in table below.

Methodology ID	Applicability condition	Justification of compliance
ACM0002	4. This methodology is applicable to grid-connected renewable energy power generation project activities that: (a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operating plant(s)/unit(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s).	The project activity is a Greenfield solar power plant and hence the project meets the applicability condition (a).
	5. In case the project activity involves the integration of a BESS, the methodology is applicable to grid-connected renewable	Not Applicable as the project doesn't involve integration of BESS

[7] https://cdm.unfccc.int/UserManagement/FileStorage/ZPFJL01OU2RYC6N3HASIXV7K84QBG9

	energy power generation project activities that: (a) Integrate BESS with a Greenfield power plant; (b) Integrate a BESS together with implementing a capacity addition to (an) existing solar photovoltaic1 or wind power plant(s)/unit(s); (c) Integrate a BESS to (an) existing solar photovoltaic or wind power plant(s)/unit(s) without implementing any other changes to the existing plant(s); (d) Integrate a BESS together with implementing a retrofit of (an) existing solar photovoltaic or wind power plant(s)/unit(s).	
	6. The methodology is applicable under the following conditions: (a) Hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit; (b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects) the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity; (c) In case of Greenfield project activities applicable under paragraph 5 (a) above, the project participants shall demonstrate	The project involves installation of a solar power plant and is applicable under the condition (a)

	that the BESS was an integral part of the design of the renewable energy project activity (e.g. by referring to feasibility studies or investment decision documents); (d) The BESS should be charged with electricity generated from the associated renewable energy power plant(s). Only during exigencies 2 may the BESS be charged with electricity from the grid or a fossil fuel electricity generator. In such cases, the corresponding GHG emissions shall be accounted for as project emissions following the requirements under section 5.4.4 below. The charging using the grid or using fossil fuel electricity generator should not amount to more than 2 per cent of the electricity generated by the project renewable energy plant during a monitoring period. During the time periods (e.g. week(s), months(s)) when the BESS consumes more than 2 per cent of the electricity for charging, the project participant shall not be entitled to issuance of the certified emission reductions for the concerned periods of the monitoring period.	
	7. In case of hydro power plants, one of the following conditions shall apply: (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density, calculated using equation (7), is greater than 4 W/m2 ; or (c) The project activity results in new single or multiple reservoirs and the power	Not applicable as this project is a solar power plant

	density, calculated using equation (7), is greater than 4 W/m2 ; or (d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (7), is lower than or equal to 4 W/m2 , all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (8), is greater than 4 W/m2 ; (ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; (iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m2 shall be: a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.	
	8. In the case of integrated hydro power projects, project participants shall: (a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or (b) Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water	It's not applicable as the proposed project is a solar power project

	availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum of five years prior to the implementation of the CDM project activity.	
	9. The methodology is not applicable to: (a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; (b) Biomass fired power plants/units.	The proposed project is neither fuel switch nor biomass plant as it is a solar power plant. Hence, the methodology is applicable for the project activity.
	10. In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance"	This condition is not applicable as the project doesn't involve any retrofits, capacity addition rehabilitations or replacements in the existing plant/unit.
In addition to satisfying the applicability criteria of the methodology ACM0002, the project also meets the applicability conditions of the tools applied as below:		
TOOL01	9. The use of the "Tool for the demonstration and assessment of additionality" is not mandatory for project participants when proposing new methodologies. Project participants may propose alternative methods to demonstrate additionality for consideration by the Executive Board. They may also submit revisions to approved methodologies using the additionality tool.	Applicable The project participant is not using any new methodology, this tool has been applied to demonstrate additionality.

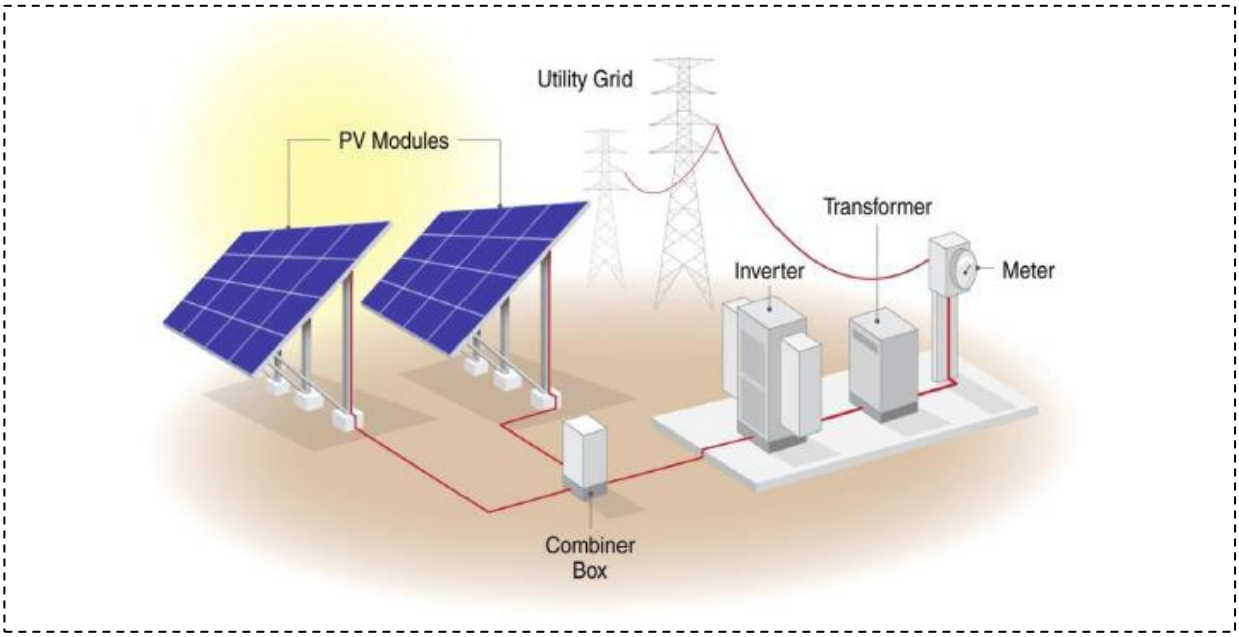
	10. Once the additionally tool is included in an approved methodology, its application by project participants using this methodology is mandatory.	Applicable as the methodology used by the project requires the use of this tool.
TOOL07	3. This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	Applicable as this project is a greenfield solar power project which supplies renewable energy to the grid and this tool is used to calculate the OM, BM & CM of the project activity.
	4. Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Applicable, since the project activity is grid connected, this condition is applicable and the emission factor has been calculated accordingly.

	5. In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	Not Applicable, the project is located in Cambodia, a non-Annex I country.
	6. Under this tool, the value applied to the CO2 emission factor of biofuels is zero.	Not Applicable as the project is a solar power plant.
TOOL27	2. This methodological tool is applicable to project activities that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", the guidelines "Non-binding best practice examples to demonstrate additionality for SSC project activities", or baseline and monitoring methodologies that use the investment analysis for the demonstration of additionality and/or the identification of the baseline scenario.	Applicable as this project activity applies the methodological tool, "Tool for the demonstration and assessment of additionality."
	3. In case the applied approved baseline and monitoring methodology contains requirements for the investment analysis that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	The applied methodology, ACM0002 Version 21.0 requires the use of this tool to demonstrate investment analysis of this project.
TOOL24	3. This methodological tool is applicable to project activities that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", or baseline and monitoring methodologies that use the common practice test for the demonstration of additionality.	Applicable as this project activity applies the methodological tool, "Tool for the demonstration and assessment of additionality."

	4. In case the applied approved baseline and monitoring methodology defines approaches for the conduction of the common practice test that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	The applied methodology, ACM0002 Version 21.0 requires the use of this tool to demonstrate the common practice of this project.

3.3 Project Boundary

According to the methodology, the spatial extent of the project boundary includes the project power plant/unit and all power plants/units connected physically to the electricity system that the project power plant is connected to. Hence, the project boundary includes the project site where the power plant has been installed, associated power evacuation infrastructure, energy metering points, switch yards and the connected EDC grid.



Source: NREL

Figure 2: Project Boundary

The table below provides an overview of the emissions sources included or excluded from the project boundary for determination of baseline and project emissions:

Source		Gas	Included?	Justification/Explanation
Baseline	Source 1: CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main source of emission in the baseline
		CH_4	No	Minor source of emission
		N_2O	No	Minor source of emission
		Other	No	Minor source of emission
Project	Source 1	CO_2	No	As per ACM0002, for renewable energy power generation project emissions are $PE_Y = 0$
		CH_4	No	
		N_2O	No	
		Other	No	

3.4 Baseline Scenario

According to ACM0002 - Version 21.0, if the project involves installing a Greenfield power plant, the baseline scenario is the electricity delivered to the grid by the project activity. This electricity would have otherwise been generated by the operation of grid-connected power plants and the addition of new generation sources, as outlined in the combined margin (CM) calculations described in "TOOL07: to calculate the emission factor for an electricity system[8]."

The combined margin ($EF_{grid,CM,y}$) represents a weighted average of two emission factors related to the electricity system: the operating margin (OM) and build margin (BM). The calculation of the combined margin must be based on data from an official source, where available, and made publicly accessible. The document published by the Institute for Global Environmental Strategies (IGES)[9], which utilizes data from the Electricity Authority of Cambodia (EAC), is the latest available data at the time of PDMR submission to VVB for validation. Therefore, it is considered for emission factor calculations.

The combined margin of the grid used for the project activity is as follows:

Parameter	Value (tCO_2/MWh)	Description	Source
$EF_{grid,CM,y}$	0.7239	Combined margin CO_2 emission factor for the project electricity system in year y	Calculated using the simple CM method, the data is sourced from the document published by IGES based on information from the Electricity Authority of Cambodia.

[8] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

[9] https://portal.gms-eoc.org/uploads/resources/1904/attachment/GEF-Cambodia_2010-2012.pdf

$EF_{grid,OM,y}$	0.7239	Operating margin CO_2 emission factor for the project electricity system in year y	Calculated as a 3-year (2010, 2011, and 2012) generation-weighted average, the data is sourced from the document published by IGES based on information from the Electricity Authority of Cambodia.

3.5 Additionality

3.5.1 Regulatory Surplus

Is the project registered or seeking registration in an UNFCCC Annex 1 or Non-Annex 1 country?

☐ Annex 1 country ☒ Non-Annex 1 country

Are the project activities mandated by any law, statute, or other regulatory framework?

☐ Yes ☒ No

If the project is located inside a Non-Annex 1 country and the project activities are mandated by a law, statute, or other regulatory framework, are such laws, statutes, or regulatory frameworks systematically enforced?

☐ Yes ☐ No

Not Applicable since the project activity is not mandated by any law or regulations and is entirely voluntary in nature.

3.5.2 Additionality Methods

As per ACM0002 – Version 21.0, the additionality of a project activity shall be demonstrated and assessed using the "TOOL01 - Tool for the demonstration and assessment of additionality[10]."

The tool provides a step-wise approach to demonstrate additionality as described below:

Step 0: Demonstration whether the proposed project activity is the first-of its kind

This step is not applied to the project activity since it is not first-of-its-kind, hence the additionality of the project will be demonstrated in next steps below.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

As per the applied methodology ACM0002 – Version 21.0, as stated in Paragraph 24, "If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of a grid-connected power plant and by the addition of new generation sources." Since the baseline scenario is defined by the applied methodology, no further analysis is conducted to identify alternatives.

[10] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

Step 2: Investment analysis

As per paragraph 29 of "Tool for the demonstration and assessment of additionality" version 7.0.0, it is determined that the proposed project activity is not an economically or financially feasible option. Referring to TOOL27 - Investment analysis, version 13.0 (EB 120 annex 3)[11] for the investment analysis, the financial analysis of the project considers three options, as outlined in "Tool for the demonstration and assessment of additionality" (version 07.0.0):

Option I: Simple Cost Analysis
Option II: Investment Comparison Analysis
Option III: Benchmark Analysis

Since the project generates revenues from the sale of electricity, Option I is not applicable. Option II is also not applicable because there is no comparable investment alternative available to the project participant. Therefore, the most appropriate financial analysis method is Option III: the benchmark analysis, comparing returns on investment in the project activity to benchmark returns available to any investors in the country.

Sub-step 2b: Option III. Apply benchmark analysis

The project proponents have taken into account the Post-Tax Equity IRR for investment analysis during decision-making. The project proponent focuses on the returns generated on the portion of investment costs financed by them in the form of equity. According to Para 15 of TOOL 27: Investment analysis, Version 13.0, Required/expected returns on equity are suitable benchmarks for an equity IRR. Hence, the Expected return on equity is considered an appropriate benchmark. Consequently, the post-tax Equity IRR is regarded as the relevant financial indicator for Investment Analysis.

Default Value Benchmark

According to paragraph 19 of TOOL 27: Investment analysis, Version 13.0, the cost of equity is determined by choosing values provided in the Appendix. Default values for the cost of equity (expected return on equity) are presented below:

The Required return on equity (benchmark) was computed in the following manner:

Nominal Benchmark = {(1+Real Benchmark) * (1+Inflation rate)} - 1

Where:

– Default value for Real Benchmark is the default value of expected return on equity in real terms for Energy Industries (Group 1) in Cambodia as provided in the Appendix

– Average forecasted inflation rate for the host country published by the IMF for the next five years after the start of the project activity

Benchmark estimation

The Cost of Equity has been determined using the "Methodological tool: Investment analysis" available at the time of decision-making, as well as the latest available value. As a conservative

[11] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v13.pdf

approach, the minimum value of the benchmark has been considered, calculated using these two approaches.

Default Value at the time of investment decision:

Appendix, Investment Analysis, EB105, Annex 06[12] specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in Cambodia = 15.24%

Default Value as per latest version of Investment Analysis Tool version 13.0:
Table under EB 120 annex 3 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in Cambodia = 14.15%

Thus, minimum Default Value considered for calculation of Benchmark = 14.15%

As per Para 16 of TOOL 27: Investment analysis, Version 13.0, the average forecasted inflation rate for Cambodia published by the IMF (International Monetary Fund, World Economic Outlook) for the next five years after the start of the project activity has been used.

The five-year inflation forecast for Cambodia as published by IMF in its World Economic Outlook Database and the corresponding benchmark value is 2.95%

Average forecasted inflation rate for 5 years	Source
2.95%	IMF, World Economic Outlook Database[13]

The nominal benchmark has been calculated as; {(1+14.15) *(1+2.95)} – 1 = 17.52%

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III):

Input values used in the investment analysis:

Particulars	Value	Unit	Source/Remarks
Capacity of the project	60	MW	DPR
Annual Net generation	139711.456	MWh	DPR
Project cost	43564.51	k USD	DPR
Debt	69.70%	%	Calculated
Equity	30.30%	%	DPR
Debt	30364.46	Mn USD	Calculated
Equity	13200.05	Mn USD	Calculated
Interest rate	6.40%	%	DPR
Debt Repayment tenure	17	years	DPR
Moratorium	0	year	DPR
O&M Cost	304.0510	k USD	DPR
Tax on O&M Cost	15.0%		DPR
Insurance & Overheads	79.0	K USD	DPR
1st Year tariff	0.03877	USD/kWh	DPR

[12] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v10.0.pdf

[13] IMF, World Economic Outlook Database

Escalation in expense	4%	%	DPR
Depreciation Rate (Book)	4.00%	%	DPR
Salvage Value	10%	%	DPR
Tax holiday	9	Years	DPR
Income tax rate from 10th year onwards	20%	%	DPR

Considering the input values, Equity IRR is calculated as 5.37% against the benchmark of 17.52%. Hence, the project activity cannot be considered as financially attractive as the equity IRR for the project activity is less than the Benchmark.

Sub-step 2d: Sensitivity Analysis

In line with paragraphs 27 and 28 of TOOL 27: Investment analysis, Version 13.0, the following factors have been subjected to sensitivity analysis: 1. Tariff, 2. Generation, 3. Project Cost, and 4. O&M Cost. The rationale for sensitivity analysis is to determine the likelihood of the occurrence of a scenario other than the one presented, providing a cross-check on the suitability of the assumptions used in the development of the investment analysis.

The results of the sensitivity analysis are as follows:

Variation %	-10%	Normal	10%	Variation required to reach benchmark	Value required to reach benchmark	
Tariff	3.62%	5.37%	7.10%	70.70%	0.066	USD/kWh
Generation	3.62%	5.37%	7.10%	70.70%	238487	MWh
Project Cost	7.08%	5.37%	3.97%	-43.94%	24422.26	k USD
O&M Cost	5.54%	5.37%	5.21%	NA	NA	k USD

The analysis reveals that even with a variation of +10% and -10% in project cost, O&M cost, generation and tariff rate, Equity IRR is significantly lower than the benchmark. As evident from the results above, the project remains additional even under the most favorable conditions.

Parameters	Probability of breaching the benchmark
Tariff	The tariff considered for the sensitivity analysis is in line with the signed PPA and as per the +10% to -10% sensitivity analysis the calculated IRR is exceeding the benchmark when the tariff changes by 70% which unlikely throughout the PPA of 20 years.
Generation	In the first year of operation the project has generated 138,905 MWh of electricity which is in line with the maximum power generation in the first year of operation as per the energy yield assessment done by the technical advisor AFRY (Thailand). Hence, it is highly unlikely that the generation will breach the benchmark value.
Project Cost	The project is already commissioned and any reduction in project cost is impossible.
O&M Cost	The sensitivity analysis reveals that O&M will breach the benchmark at a negative value and is a hypothetical case. Hence, the O&M costs associated with the project has no impact on the financial returns of the equity.

Outcome of Step 2:

This confirms that the investment is not financially attractive (Equity IRR for the project activity is less than the Benchmark Equity IRR). Thus, it can be easily concluded that the project activity is additional and is not a business-as-usual scenario.

Step 3: Barrier analysis

Barrier analysis has not been applied

Step 4: Common practice analysis

Stepwise approach for common practice analysis has been carried out as per Methodological tool "Common Practice", version 03.1 EB84, Annex 7[14]:

Definitions as per methodological tool	Justification
Step 1: calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.	+50% of project's installed capacity: 90 MW Installed capacity of the project activity: 60 MW -50% of project's installed capacity: 30 MW
Step 2: identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions: (a) The projects are located in the applicable geographical area; (b) The projects apply the same measure as the proposed project activity; (c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity; (d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;	(a)The project is located in Kampong Chhnang province, Cambodia (b)The proposed project activity uses renewable energy to generate power. Therefore, all renewable energy projects located in Cambodia are considered. (c)The energy source used by the project activity is Solar. Hence, only solar energy projects have been considered. (d) The project activity produces electricity; therefore, all solar power plants are considered.

[14] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf

(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1; (f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.	(e) The capacity range of the projects is within the applicable capacity range from 30 to 90 MW (f) The project was started on 13th August 2021 as it is a start date of proposed project activity. As Kyoto Protocol was ratified by Cambodia on 4th July 2002, solar projects which had started commercial operation between 4th July 2002, 13th August 2021 have been identified. Numbers of Similar projects (CDM and non-CDM) identified, which fulfil above-mentioned conditioned are 5 i.e. N_{solar} = 5
Step 3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}	Within the 5 projects identified in Step 2, 2 projects are registered under the International Renewable Energy Certificates (I-RECs) mechanism. Therefore N_{all} = 3
Step 4: within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff}	The identified projects in Step 3 do not apply technologies other than solar. Hence, N_{diff} = 0
Step 5: calculate factor $F=1-N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.	F=1-Ndiff/Nall F = 1- 0/3 = 1 – 0 Hence, F is 1
As per paragraph 18, The proposed project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all}-N_{diff}$ is greater than 3.	From the above, F = 1 which is greater than 0.2 $N_{all}-N_{diff}$ = 3 which is equal to 3. Hence, the project activity is not a “common practice” in the applicable geographical area.

Outcome of Step 4:

The above explanation/justification clearly shows that the proposed project activity is unlikely to be financially attractive as well as not a common practice in the host country; hence the project activity is additional.

3.6 Methodology Deviations

There is no methodology deviation

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The current status of project implementation includes the following key points:

Operation during Monitoring Period:

The project commenced its commercial operation on November 11, 2022, and has been consistently operational throughout the monitoring period. Monthly net electricity supplied to the grid, crucial for emission reduction calculation, is extracted from the Joint Meter Reading (JMR) reports. No significant issues affecting emission reductions or removals have been identified during this period.

Changes to Project Proponent or Other Entities:

There have been no alterations to the project proponent or other essential entities associated with the project. The original project proponent continues to lead and oversee the project's implementation.

5 QUANTIFICATION OF ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology ACM0002 – Ver21.0, assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants.

The baseline emissions are to be calculated as follows:

$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$

Where:

BE_y = Baseline emissions in year y (t CO_2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y is calculated using TOOL07 – Tool to calculate the emission factor for an electricity system, Version 07.0 (t CO_2/MWh)

Baseline emission factor is calculated as combined margin, consisting of a combination of operating margin and build margin factors according to the procedures prescribed in the latest "tool for calculating the emission factor for an electricity system", version 07.0.

The steps of calculation are as follows:

(a) Step 1: Identify the relevant electricity systems;
(b) Step 2: Choose whether to include off-grid power plants in the project electricity system (optional);
(c) Step 3: Select a method to determine the operating margin (OM);
(d) Step 4: Calculate the operating margin emission factor according to the selected method;
(e) Step 5: Calculate the build margin (BM) emission factor;
(f) Step 6: Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity systems

As described in tool "For determining the electricity emission factors, identify the relevant project electricity system. Similarly, identify any connected electricity systems". It also states that "If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used". Keeping this into consideration, the Electricity Authority of Cambodia (EAC), defines the gird systems as follows:

a) High voltage grid systems:

In 2011, two separate High Voltage Grid System (i) the National Grid and (ii) the Banteay Meanchey Grid operated in Cambodia. The National Grid received electricity from import from Vietnam, Hydropower plants at Kirirom 1&3, and Kamchay and other generation sources in Phnom Penh. The Banteay Meanchey Grid comprised of Substations at Banteay Meanchey, Battambang and Siemreap and received electricity from import from Thailand. In 2012 the Phnom Penh-Battambang 230 kV double circuit line with substations at Kampong Chhanang, Pursat and Battambang was commissioned. This provided a link to connect the National Grid with Banteay Meanchey Grid and the whole system is termed as National Grid. As it was not possible to run the supply from Vietnam with Supply from Thailand, the two systems were not operated in parallel, but many areas received supply from either source at different times. With increased generation from Kamchay and commissioning of Kirirom 3, the availability of supply improved in rainy season and supply from Phnom Penh area was extended upto Siemreap substation for some time during rainy season. Similarly, during dry season supply from Thailand was extended up to part of Phnom Penh system. The supply from National Grid covered areas in the provinces of Takeo, Phnom Penh, Kandal, Kampong Speu, Kampong Chhanang, Pursat, Battambang, Banteay Meanchey and Siem Reap.

b) Medium voltage grid systems:

1. Kampot-Sihanoukville MV Grid: This MV grid gets supply from Vietnam at 22 kV, generation from Kamchay Hydropower plant at MV, supply from National Grid through Kampot Substation and Generation plant of Colben Energy (Cambodia) Ltd and of EDC at Kampot and Sihanoukville. By end of 2012, EDC Kampot, EDC Sihanoukville and nine other licensees in Kampot and Sihanoukville provinces are connected to this grid.

2. Kampong Cham MV Grid: This MV grid consists of Generation plant of G.T.S. Power Ltd at Kampong Cham and the connected 22 kV system in Kampong Cham and Kampong Thom provinces connected to it. By end of 2012, this grid supplied electricity to EDC and 27 other licensees in the provinces of Kampong Cham and Kampong Thom. 6 3. MV Grid connected to Vietnam system: Cambodia imports electricity from Vietnam through 22 kV connections at 17 locations in the provinces of Kampong Cham, Svay Rieng, Kampot, Mondulkiri, Kandal, Takeo, Kratie, Prey Veng and Ratanakiri.

The calculation target grid systems here is Kampong Cham MV Grid as the project is connected to the same.

Table 1: Electricity generations and imports in Kampong Cham MV Grid

Name of Power Plant/ country	Start year of supplying electricity to a grid	Electricity output (MWh)			Main Fuel Type	Main Fuel Consumption (t)			Secondary Fuel Type	Secondary Fuel Consumption (t)		
		2010	2011	2012		2010	2011	2012		2010	2011	2012
GTS Power Ltd	2008	31,388.4	25,684.4	37,753.9	Residual Fuel Oil	7,583.50	6,269.90	9,057.00	Diesel Oil		39.0	61.0
Small diesel power plants		74.1	1,535.6	3,833.2	Diesel Oil							

Source: EAC 2013,2012 and 2011, and EDC

The tool provides calculation options to determine the CO_2 emission factors for net electricity imports from a connected electricity system as follows;

(a) 0 t CO_2/MWh; or

(b) The simple OM emission rate of the exporting grid

(c) The simple adjusted OM emission rate of the exporting grid

(d) The weighted average OM emission rate of the exporting grid

As there is no import involved in this Kampong Cham MV Grid, no import is considered for the calculation.

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).

Option I: 'Only grid power plants are included in the calculation', is chosen.

STEP 3. Select the method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM

The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in:
1) average of the five most recent years, or
2) based on long-term averages for hydroelectricity production.

As there are no power plants of low cost must run resources in Kampong Cham MV Grid, the simple OM method is applicable for the calculations of this grid.

For the simple OM, the emissions factor can be calculated using either of the two data vintages: Ex ante option or Ex post option. The Ex-ante option is chosen.

Ex ante option: If the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation

Step 4: Calculate the operating margin emission factor ($EF_{grid,OM\ Simple,y}$) according to the selected method

(a) Simple OM:

The simple OM may be calculated:

Option A: Based on the net electricity generation and CO_2 emission factor of each power unit; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Since required date is available, option A is chosen.

Option A - Calculation based on average efficiency and electricity generation of each plant

Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot FE_{EL,m,y}}{\sum_m EG_{m,y}}$$

where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year *y* (t-CO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (t-CO_2/MWh)

m = All power units serving the grid in year *y* except low-cost / must-run power units

y = The relevant year as per the data vintage chosen in Step 3

Determination of $EF_{EL,m,y}$

The emission factor of each power unit m should be determined as follows:

Option A1: If for a power unit m data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO_2,i,y}}{EG_{m,y}}$$

where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (t-CO_2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type i in year y (t-CO_2/GJ)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

m = All power units serving the grid in year y except low-cost/must-run power units i = All fossil fuel types combusted in power unit m in year y

y = The relevant year as per the data vintage chosen in Step 3

Option A2: If for a power unit m only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO_2,i,y} \cdot 3.6}{\eta_{m,y}}$$

where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (t-CO_2/MWh)

$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type i used in power unit m in year y(t-CO_2/GJ)

$\eta_{m,y}$ = Average net energy conversion efficiency of power unit m in year y (ratio)

m = All power units serving the grid in year y except low-cost/must-run power units

y = The relevant year as per the data vintage chosen in Step 3

There are many small diesel power plants whose diesel consumption data is not available, but data for capacity of them is available. For those power plants, the heat efficiency is taken from the default values provided by the CDM guideline of "Toot to calculate the emission factor for electricity system".

Option A3: If for a power unit m only data on electricity generation is available, an emission factor of 0 t-CO_2/MWh can be assumed as a simple and conservative approach.

Table 2: Calculation of the operating margin of Kampong Cham MV Grid

Name of Power Unit	2010		2011		2012	
	Net Electricity Generation	CO_2 Emission Factor	Net Electricity Generation	CO_2 Emission Factor	Net Electricity Generation	CO_2 Emission Factor
	MWh	t-CO_2 /MWh	MWh	t-CO_2 /MWh	MWh	t-CO_2 /MWh
GTS Power Ltd	31,388	0.726	25,684	0.7381	37,754	0.7257
Small diesel power plants 50<CAP≤100kW	0	-	0	-	105	0.7467
Small diesel power plants 100<CAP≤200kW	0	-	57	0.7064	343	0.7064
Small diesel power plants 200<CAP≤400kW	0	-	0	-	1,056	0.6702
Small diesel power plants 400<CAP≤1000kW	74	0.6223	1,478	0.6223	1,406	0.6223

Small diesel power plants CAP>1000kW	0	-	0	-	923	0.5808
Annual Electricity Generation in Total	31,462		27,220		41,587	
Simple Operating Margin CO2 Emission Factor	$EF_{grid, OMsimple,y1}$	0.7257	$EF_{grid, OMsimple,y2}$	0.7317	$EF_{grid, OMsimple,y3}$	0.7175
Operating Margin Emission Factor (t-CO_2 /MWh)					**0.7239**	

STEP 5: Identify the group of power units to be included in the build margin

In terms of vintage of data, project participants can choose between one of the following two options:

(a) Option 1 - for the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of CDM PDD submission to the DOE for validation.

(b) Option 2 - For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available.

Option 1 is chosen.

Option 1 as described above is chosen to calculate the build margin emission factor for the project activity. BM is calculated ex-ante based on the most recent information available at the time of submission of PDD and is fixed for the entire crediting period.

The build margin emissions factor is the generation-weighted average emission factor (t-CO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times FE_{EL,m,y}}{\sum_m EG_{m,y}}$$

where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t-CO_2/MWh)

$E_{Gm,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$E_{FEL,m,y}$ = CO_2 emission factor of power unit m in year y (t-CO_2/MWh)

m = Power units included in the build margin

y = Most recent historical year for which power generation data is available

In Kampong Cham MV Grid, there are only one large power plant (GTS Power Ltd) and some small diesel engine power plants which do not enough data for calculate build margin.

STEP 6: Calculate the combined margin (CM) emissions factor

The calculation of the combined margin emission factor is based on one of the following methods;

(a) Weighted average CM

(b) Simplified CM

The simplified CM method can only be used if:
(a) The project activity is located in: (i) a Least Developed Country (LDC); or in (ii) a country with less than 10 registered CDM projects at the starting date of validation; or (iii) a Small Island Developing States (SIDS); and

(b) The data requirements for the application of Step 5 above cannot be met.

The data of power plants in Kampong Cham MV Grid is not able to satisfy the requirement for calculating build margin and Cambodia is an LDC. Thus, simplified CM is selected for Kampong Cham MV Grid

The combined margin emissions factor is calculated as follows;

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

where:

$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year y (t-CO_2/MWh)

$EF_{grid,OM,y}$ = Operating margin CO2 emission factor in year y (t-CO_2/MWh)

w_{OM} = Weighting of operating margin emissions factor (%)

w_{BM} = Weighting of build margin emissions factor (%)

The following default values should be used for w_{OM} and w_{BM} for Simplified CM:

w_{BM}=0,

w_{OM}=1

$EF_{OM,y}$ calculated as described in Steps 3 & 4 above (t-CO_2/MWh)

$EF_{BM,y}$ calculated as described in Steps 5 above (t-CO_2/MWh)

Baseline Emission factor (Kampong Cham MV Grid) = 0.7239* 1+ 0 = 0.7239 t-CO_2/MWh

The baseline emission factor is ex-ante parameter and will remain constant throughout the crediting period.

EF_{grid} = Combined Margin Grid Emission Factor = 0.7239 tCO_2/MWh

5.2 Project Emissions

As per the ACM0002 ver-21.0, Project Emission for most renewable energy power generation project activities, PE_y = 0. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$

Where:

PE_y = Project emissions in year y (tCO_2e/yr)
$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (tCO_2e /yr)
$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y (tCO_2e /yr)
$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (tCO_2e /yr)

The project activity involves the generation of electricity from the installation of solar projects. Hence, as per ACM0002, ver-21.0, there is no project emission for solar projects. Therefore, project emissions are zero.

5.3 Leakage Emissions

The project activity does not account for any leakage emissions. In the context of electric sector projects, potential emissions contributing to leakage, such as those from power plant construction and upstream fossil fuel use (including extraction, processing, and transport), are deemed negligible due to their limited scale and are therefore not considered in the assessment.

5.4 Estimated GHG Emission Reductions and Carbon Dioxide Removals

The ex-ante emission reductions (ERy) for the project activity are calculated as follows:

$ER_y = BE_y - PE_y - LE_y$

Where:
ER_y = Emission Reduction in year y (tCO_2)
BE_y = Baseline emission in year y (tCO_2)
PE_y = Project emissions in year y (tCO_2)
LE_y = Leakage Emissions in year y (tCO_2)
Since PE_y = 0 and LE_y = 0

$ER_y = BE_y$

In first crediting period, the total estimated emission reduction of the project is 707,952 tCO_2e, with average annual emission reductions of 101,136 tCO_2e.

Vintage period	Estimated baseline emissions (tCO_2e)	Estimated project emissions (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated reduction VCUs (tCO_2e)	Estimated removal VCUs (tCO_2e)	Estimated total VCUs (tCO_2e)

11-Nov-2022 to 31-Dec-2022	14,131	0	0	14,131	NA	14,131
01-Jan-2023 to 31-Dec-2023	101,136	0	0	101,136	NA	101,136
01-Jan-2024 to 31-Dec-2024	101,136	0	0	101,136	NA	101,136
01-Jan-2025 to 31-Dec-2025	101,136	0	0	101,136	NA	101,136
01-Jan-2026 to 31-Dec-2026	101,136	0	0	101,136	NA	101,136
01-Jan-2027 to 31-Dec-2027	101,136	0	0	101,136	NA	101,136
01-Jan-2028 to 31-Dec-2028	101,136	0	0	101,136	NA	101,136
01-Jan-2029 to 10-Nov-2029	87,005	0	0	87,005	NA	87,005
Total	**707,952**	**0**	**0**	**707,952**	**NA**	**707,952**

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	Operating Margin CO_2 emission factor in year y
Source of data	The document published by Institute for Global Environmental Strategies (IGES) based on the data from Electricity Authority of Cambodia (EAC)
Value applied:	0.7239
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07" as 3-year generation weighted average using data for the years 2010, 2011 & 2012. The data are obtained from electricity authority of Cambodia.
Purpose of data	Calculation of baseline emissions
Comments	This parameter is fixed ex-ante for the entire crediting period

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined Margin CO_2 emission factor in year y
Source of data	The document published by Institute for Global Environmental Strategies (IGES) based on the data from Electricity Authority of Cambodia (EAC)
Value applied:	0.7239
Justification of choice of data or description of	The simple combined margin emissions factor is calculated as follows where: $EF_{grid,CM,y} = EF_{grid,OM,y}$

measurement methods and procedures applied	
Purpose of data	Calculation of baseline emissions
Comments	This parameter is fixed ex-ante for the entire crediting period

6.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh/year
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y in MWh
Source of data	Monthly joint meter reading reports
Description of measurement methods and procedures applied	The monthly net electricity supplied to the grid by the project activity is determined by subtracting the final value of exports from imports. This same value will be utilized for emission reduction calculations.
Frequency of monitoring/recording	Continuous monitoring & monthly recording
Value applied:	139,711
Monitoring equipment	Electricity meters, the details of which are as below:
QA/QC procedures applied	The State Utility has approved, tested, and sealed the meters, keeping them in its custody. The meters undergo calibration once every five years. The monthly electricity supplied or exported by the project activity, as reported in the Joint Meter Reading (JMR) report, is cross-checked with the monthly sales invoices. In case

Feeder	Main Meter Number	Backup Meter Number	Accuracy	Make
1	55548513	55548515	0.5s	Landis+Gyr E650
2	55548514	55580597		
6	55548500	55580600		
7	55548498	55548501		

	of meter calibration absence or delay, appropriate guidelines will be applied to confirm the conservatism of metering. The metering arrangement, accuracy class of meters, and calibration frequency are under the control of the EDC, and the project proponent (PP) has no authority over them. The PP receives the value of net electricity supplied to the grid, which serves as the monitoring parameter, while billing is raised based on substation meters.
Purpose of data	Calculation of baseline emissions
Calculation method	Net electricity supplied to the grid by the project plant in a given month = Export(kWh)– Import (kWh).
Comments	Data will be archived in both paper and electronic forms for two years after the end of the crediting period or the last issuance of Verified Emission Reductions (VERs) for this project activity, whichever occurs later.

6.3 Monitoring Plan

The monitoring plan aims to make sure the project accurately measures emission reductions during its crediting period. The project owner, with support from EDC, will carry out this plan. It ensures that actual, measurable, and long-term reductions in greenhouse gas (GHG) emissions are well-tracked and reported, playing a vital role in determining the project's overall emission reductions. The project owner will put this monitoring plan into action during the project's operation, and the details of the same as below:

Monitoring organization

The overall responsibility for monitoring, recording and reporting of the data is with the plant in charge/site manager. The plant in-charge/site manager will be assisted by a team with experience in plant operations & management of project.

Monitoring practices

There are two sets of meters installed, one set at the project location and another at the grid substation to record export and import of power from the project. The accuracy of electricity meters installed are not less than 0.5s and regular calibration will be carried out. Meters installed at the substation will be considered for the monthly energy measurement.

QA/QC procedures

When the Main Meter and/or the Check Meter and/or any component thereof is found to be outside the acceptable limit of accuracy or otherwise not functioning properly, energy meters will be repaired, re-calibrated or replaced as soon as possible.

Data storage and archiving

All the data items monitored will be kept for two years after the end of crediting period or till the last issuance of VERs for this project activity whichever occurs later. The monitored data will be presented for future verifications.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh/y
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y in MWh.
Value applied:	156,367
Comments	Data will be archived in both paper and electronic forms for two years after the end of the crediting period or the last issuance of Verified Emission Reductions (VERs) for this project activity, whichever occurs later.

7.2 Baseline Emissions

$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$

Where:

BE_y = Baseline emissions in year y (tCO_2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the VCS project activity in year y (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of "TOOL07: Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

Monitoring Period	$EG_{PJ,y}$ (MWh)	$EF_{grid,CM,y}$ (tCO_2/MWh)	BE_y (tCO_2/year)
11-Nov-2022 to 31-Dec-2022	17,463	0.7239	12,641
01-Jan-2023 to 31-Dec-2023	138,904	0.7239	100,553
Total	**156,367**	**0.7239**	**113,194**

7.3 Project Emissions

Not Applicable, since emissions from the project activity is zero.

7.4 Leakage Emissions

Not Applicable, since emissions from the project activity is zero.

7.5 GHG Emission Reductions and Carbon Dioxide Removals

Vintage period	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Reduction VCUs (tCO_2e)	Removal VCUs (tCO_2e)	Total VCUs (tCO_2e)
11-Nov-2022 to 31-Dec-2022	12,641	0	0	12,641	NA	12,641
01-Jan-2023 to 31-Dec-2023	100,553	0	0	100,553	NA	100,553
Total	**113,194**	**0**	**0**	**113,194**	**NA**	**113,194**

For all projects, state the estimated ex-ante GHG emission reductions and carbon dioxide removals and the achieved reductions and removals for the monitoring period. Report the percentage difference and explain any difference. The quantities of reductions and removals are the total quantities before any deductions for buffer credits.

Vintage period	Ex-ante estimated reductions/ removals	Achieved reductions/ removals	Percent difference	Explanation for the difference
11-Nov-2022 to 31-Dec-2022	14,131	12,641	-11.13%	The achieved emission reductions are lower than the estimated reductions. As the project is a solar project, the electrical power output is directly influenced by solar irradiance. A decrease in this factor results in lower generation, impacting the emission reductions.
01-Jan-2023 to 31-Dec-2023	101,136	100,553	-0.57%	
11-Nov-2022 to 31-Dec-2023	115,267	113,194	-11.70%	
Total	**115,267**	**113,194**	**-11.70%**	

APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION

Section	Information	Justification
NA	NA	NA