

**FORMULATING A NATIONAL
ELECTRICITY GRID CODE AND
DEVELOPMENT OF A NET
METERING POLICY IN TIMOR-
LESTE**

CASE REF: 3100005838

Detailed Work Plan

04 JUNE 2024



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1 Introduction

Timor Leste has requested technical assistance to develop a net metering policy and grid code that will encourage the use of distributed energy resources (DERs) and facilitate grid integration. The country's power system has a high reliance on generation from diesel fuel, which results in high electricity prices. The solar resource assessment, net metering policy, and grid code design will support the development of DERs, which could reduce the reliance on diesel generation and lower electricity prices.

1.1 Project Background

1.1.1 Timor-Leste's Transition to Renewables

Timor Leste is an island nation with an area of approximately 14,874 km². The population of the island is 1.37 million (2023), with the main population centres being Dili, Baucau and Maliana.

Timor-Leste's power system with a total installed capacity of 287 MW is almost entirely reliant on diesel powered generation sources. Effectively, 99.9% of power generation is from diesel-fired plants with a negligible amount coming from solar resources. As the Government of Timor-Leste (GoTL) has made a policy commitment under the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement (PA) to scale up the share of renewable energy (RE) generation. This poses a major medium-term challenge for Eletricidade de Timor-Leste (EDTL), the State-Owned Enterprise (SOE) utility, to implement its updated Nationally Determined Contributions (NDC) 2022-2030.

The strategy for achieving the NDC goal by 2030 involves a combination of switching from the use of diesel to the use of gas for fuel, while developing renewables to meet up to 50% of the energy generation mix. Timor-Leste is endowed with robust potential of both wind and solar PV, and these are seen as the most feasible RE technologies over this timeframe. Other resources that have been previously considered include hydro and biomass.

A further challenge to transitioning their power system towards higher RE is that with peak demand at 70 MW, there is a significant amount of surplus / underutilised capacity in the system, which has two significant diesel power stations, Hera (120 MW) and Betano (136 MW), operating at low utilisation rates. Investigation into the use of these power stations in a backup reserve mode is understood to be under consideration.

1.1.1 Timor-Leste's Power Grid

Timor Leste has a 150 kV transmission loop for the bulk power system network, comprising 603 circuit kms, with mostly single circuit lines, except for the Dili-Hera-Manatuto section, which is double circuit line (50.8 kms). There is a 20 kV ring representing the distribution voltage network.

The electricity grid does not feature any sub-transmission circuits or trunk feeders as one would see in larger and more densely populated nations. Consequently, Timor-Leste's electricity grid is largely radial in nature with limited ability to interconnect or mesh networks to provide multiple transmission routes to key customers or core areas of service.

Given the demographics of Timor-Leste, distributed energy resources (DER) are potentially high value, notwithstanding the technical challenges involved in providing capacity and reliable



operation. Electricidade de Timor-Leste Empresa Pública (EDTL, E.P.) is Timor-Leste's State-Owned Company in Electricity and Energy Sector, providing generation, transmission, and distribution services. EDTL is a key stakeholder for this assignment.

Considering the relatively small size of the electricity grid, it is sensible that a combined grid code could be an economic solution for the country, providing a single point of reference for DER resources seeking connection to EDTL's transmission and distribution networks.

1.2 Project Objectives

The objective of the study is to support the wider initiative in transitioning Timor Leste towards supporting a higher share of renewables by providing technical assistance across a range of important areas:

- Carrying out a solar resource assessment,
- Development of net metering policy, and
- Formulation of a Grid Code for Distributed Energy Resources (DERs) and Inverter Based Resources (IBRs).

In doing so, also providing capacity building, and developing numerous documents as key deliverables.

1.3 Report Purpose

This is the detailed work plan report for the project. This outlines the scope of work and the approach and methodologies to accomplish the tasks. It has been structured as follows:

- Section 2 sets out the scope of work,
- Section 3 is the consultant's approach and methodology, and
- Section 4 provides information on the confirmed project team.



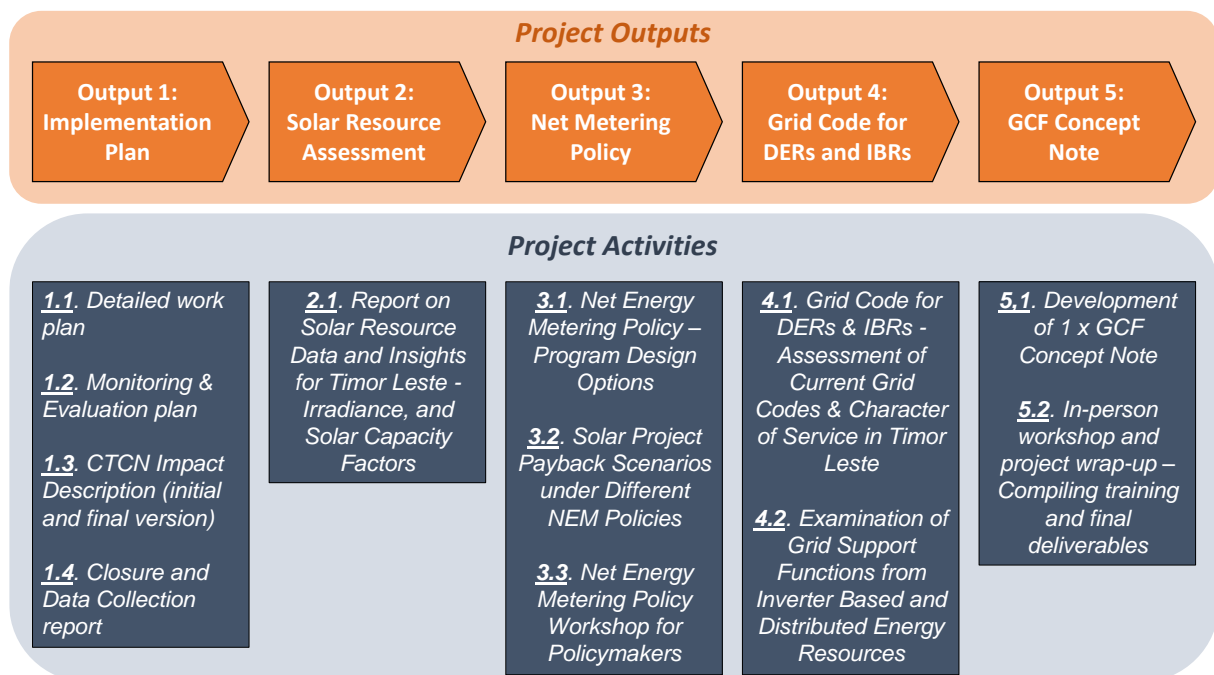
2 Scope of Work

This section sets out the scope of work as defined in the Terms of Reference (TOR) document. Section 3 discusses the approach to meet the project objectives.

2.1 Scope of Work & Tasks

The TOR document defines 5 outputs, each having a number of activities associated with it. This is illustrated in Figure 1. The sections below further describes the project activities relating to each project output.

Figure 1 Project Outputs and Activities



2.2 Activity 1: Development of implementation planning and communication documents

The objective of activity 1 is to develop an implementation plan and communication documents, with activities to occur at the beginning and at the end of the CTCN technical assistance including:

- Detailed work plan of all activities, deliveries, outputs, deadlines, and responsible person/organisations and a detailed budget to implement the Response Plan. The detailed work plan and budget must be based directly on this Response Plan.
- Based on the work plan, a monitoring and evaluation plan with specific, measurable, achievable, relevant and time-bound indicators should be developed to monitor and evaluate the timeliness and appropriateness of the implementation. The monitoring and evaluation plan should apply selected indicators from the Closure and Data Collection report template and enable the lead implementer to complete the CTCN Closure and Data collection report at the end of the assignment.



- A two-page CTCN Impact Description formulated at the beginning of the technical assistance and updated/revised once the technical assistance is fully delivered (a template will be provided).
- A Closure and Data Collection report completed at the end of the technical assistance (a template will be provided).

2.3 Activity 2: Solar Resource Data and Insights for Timor Leste

The Implementing Partner will examine solar resource data for Timor Leste to provide insights into the renewable energy potential for the country. Leveraging solar resource datasets (e.g., National Solar Resource Database, Renewable Energy Data Explorer, etc.), the Implementing Partner will calculate solar PV capacity factors for the country for different solar configurations (e.g., fixed, 1-axis tracking, etc.). The Implementing Partner will examine using topographical data for land exclusions for developable areas and work with partners in Timor Leste to investigate whether land-use geographical information system (GIS) data is available for further exclusions (e.g., forested areas, private land, protected areas, etc.). Using land-use GIS data to refine the analysis is not guaranteed and will be included if the data is available and of sufficient quality to easily utilise.

2.4 Activity 3: Net Energy Metering Policy for Timor Leste

2.4.1 Activity 3.1: Program Design Options

The Implementing Partner will develop a net metering policy for Timor Leste and explore program design options, including; type of NEM (full retail rate, feed-in tariff, no compensation for export, time-based export), technology eligibility, program and system size limits, and the type of eligible customers. The Implementing Partner will assist Timor Leste in understanding how NEM policies have evolved across utilities internationally and the metering infrastructure required to roll out a NEM program.

2.4.2 Solar Project Payback Scenarios under Different NEM

The Implementing Partner will examine solar payback scenarios under different NEM structures (e.g., full retail rate, feed-in tariff, no compensation for export, etc.). Additionally, the Implementing Partner will include solar plus storage scenarios for NEM structures where the full retail rate is not used in remunerating export. This activity will utilise the solar resource data developed in activity 2.1. The payback scenarios will help Timor Leste policy makers understand how each NEM structures financially motivates solar adoption.

2.4.3 Workshop for Policymakers

The Implementing Partner will organise a workshop for policymakers and disseminate information on program design options, solar project payback scenarios based on different NEM structures and other findings related to NEM.

2.5 Activity 4: Grid Code for DERs and IBRs in Timor Leste

2.5.1 Activity 4.1: Assessment of Current Grid Codes and Character of Service

The Implementing Partner will examine existing grid codes, both for transmission and distribution, examining frequency

and voltage bounds, trip settings, and regulation services. The Implementing Partner will request EDTL for operational data (voltage and frequency for bulk and distribution), where available, to help understand the existing power quality that may inform grid code design. The Implementing Partner will also request current interconnection regulations and guidelines, if they exist, for distributed generation.

2.5.2 Activity 4.2: Examination of Grid Support Functions from Inverter

The Implementing Partner will develop the grid code by examining elements of IEEE 2800 and IEEE 1547-2018 that may help safely integrate inverter-based resources. These will include; voltage and frequency trip and ride-through capabilities along with voltage and frequency regulation services. These services will be examined in the context of EDTL's grid operation, the level of DER adoption anticipated, and the current state of power quality for the Timor Leste power system.

2.6 Activity 5: GCF concept note and In-person workshop

2.6.1 Activity 5.1: Development of 1 GCF Concept Note

As per standard requirements, the GCF concept note will include a project summary, detailed project information, indicative financing/cost information and supporting documents that may include a theory of change, economic and financial models, pre-feasibility studies, evaluation reports from previous projects, and/or results of environmental and social risk screening.

2.6.2 Activity 5.2 In-person workshop and project wrap-up

The Implementing Partner will prepare presentation materials and compile previous deliverable reports into a final and publicly available report for Timor Leste. The Implementing Partner will travel to deliver the final project presentation and material dissemination.



3 Approach & Methodology

3.1 Approach to Output 1: Implementation Plan

The objective of Output 1 is to formulate the implementation plan and communication documents. It is understood that some of the activities need to be carried out upon project start while some other activities are to be carried out prior to the project's conclusion.

The four activities under Output 1 are:

- 1.1: Detailed work plan
- 1.2: Monitoring and evaluation plan
- 1.3: CTCN Impact Description (initial and final version)
- 1.4: Closure and Data Collection report

The requirements from the RFP for each and comments on our approach are set out in Table 1.

Table 1 Approach to Output 1 Activities

No.	RFP Requirement	Approach
1.1	A detailed work plan of all activities, deliveries, outputs, deadlines, and responsible persons/organizations and a detailed budget to implement the Response Plan. The detailed work plan and budget must be based directly on this Response Plan.	<ul style="list-style-type: none"> • It is proposed that we will have (online) kick-off meetings with all relevant stakeholders, discuss CTCN's Response Plan document¹, identify key contact personnel, explain the scope of work, discuss the data that is available, and determine any timing constraints and/or preferences so that the work plan can be updated. • The detailed work plan, including timelines, communication protocols, and logistics, and other requirements will be prepared based on the outcomes.
1.2	Based on the work plan, a monitoring and evaluation plan with specific, measurable, achievable, relevant, and timebound indicators should be developed to monitor and evaluate the timeliness and appropriateness of the implementation. The monitoring and evaluation plan should apply selected indicators from the Closure and Data Collection report template and enable the lead implementer to complete the CTCN Closure and Data collection report at the end of the assignment.	<ul style="list-style-type: none"> • The work plan of (1.1) will undergo a risk review and indicators that can be measured identified to monitor project implementation. • Indicators that have already been identified in the Closure and Data Collection report template will be carefully reviewed and integrated into the Monitoring & Evaluation plan. • Note that routine reporting on the indicators and progress has been built into our work plan in the form of regular progress updates. • The framework that is adopted will carefully follow the template and required report to be produced under (1.4) at the end of the project.
1.3	A two-page CTCN Impact Description formulated at the beginning of the	<ul style="list-style-type: none"> • We will review the template and develop the Impact Description as necessary for the project,

¹ Response Plan document: <https://www.ctc-n.org/technical-assistance/projects/formulating-national-electricity-grid-code-and-definition-net>.



	technical assistance and updated/ revised once the technical assistance is fully delivered (a template will be provided)	given the work plan, and findings from kick-off meeting(s). • It is understood this will be revised following the delivery of the technical assistance.
1.4	A Closure and Data Collection report completed at the end of the technical assistance (a template will be provided).	• We will adopt the provided template and ensure it is aligned with the project requirements.

3.1.1 Output 1 Deliverables

The deliverables for Output 1 will be as follows:

- Detailed work plan
- Monitoring and evaluation plan
- CTCN Impact Description (initial and a final version)
- Closure and Data Collection Report.

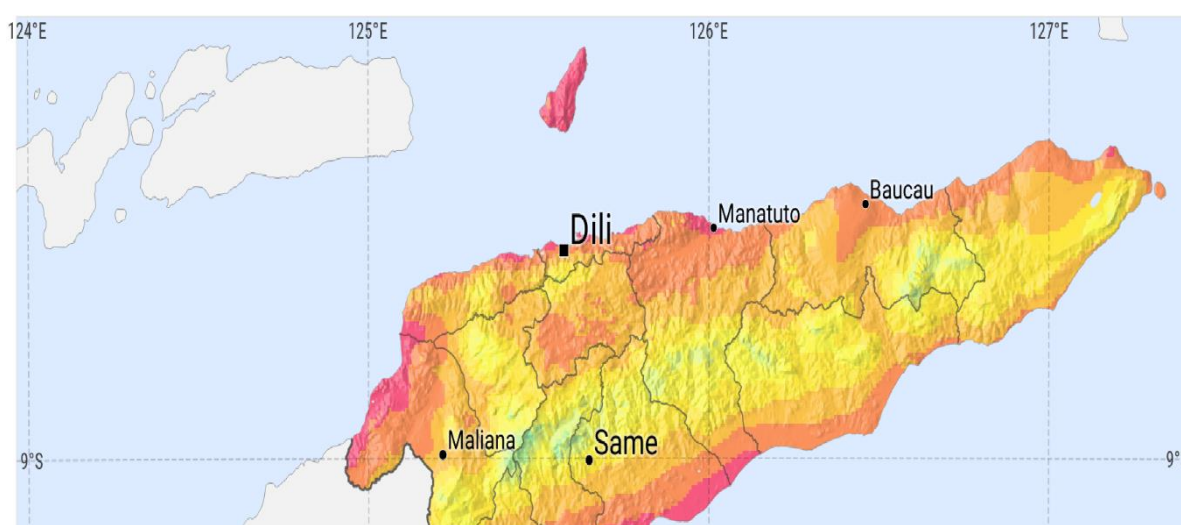
3.2 Approach to Output 2: Solar Resource Assessment

3.2.1 Solar Resource Assessment

Requirement: To assess the potential volume of solar capacity that could be generated through a net metering program, the Implementing Partner will perform a high-level solar resource assessment. This will include examining capacity factors across the island for different solar PV configurations.

The highest solar insolation is found along the coastal strips of Timor Leste, coincident with the large population centres.

Figure 2 Timor Leste solar insolation map



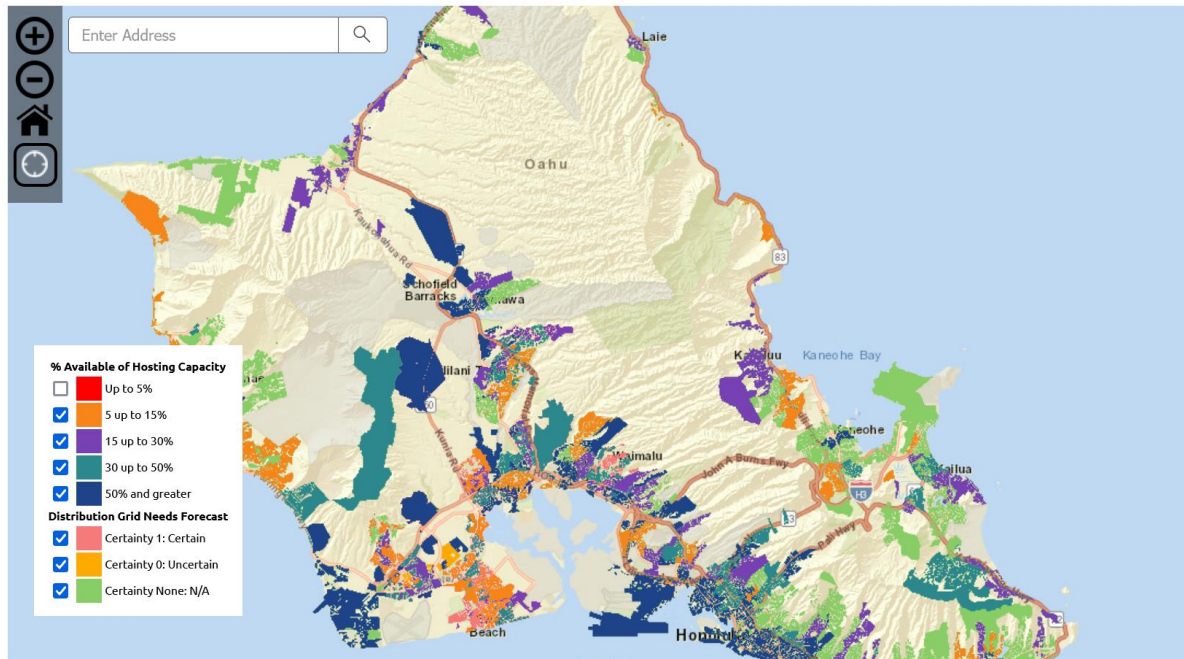
Solar PV maximum potential is fundamentally determined by solar insolation levels, but there are several factors that limit the potential. Existing land-use, particularly for agriculture, limits solar PV



potential. Suitable rooftop area limits solar PV capacity. The distribution network hosting capacity places limits on how much and where solar PV can inject power. We consider that the ultimate goal of a solar PV resource assessment for Timor Leste is a locational value map that defines net solar PV potential after taking into account all restrictions.

We consider that a Locational Value Map (LVM) is a useful tool for understanding solar PV potential. An example that is pertinent to Timor Leste is the LVM produced for the island of Hawaii.

Figure 3 Example of Locational Value Map (LVM) for Hawaii



The Locational Value Map is a convenient method for visualizing how much space is available for private rooftop solar installations and private ground mount solar installations. Typically, an LVM displays the percentage of capacity available on the primary voltage system (20kV), but not on the many secondary low voltage circuits embedded within the primary system.

The LVM also takes into account the hosting capacity of the distribution system, for both existing and future grid needs. Grid needs are based off the certainty of future loads coming to fruition and occurring within the near term, say 5 years. A certainty rating of 1 is a grid need identified within the next 5 years that includes firm new service requests. All other cases receive a certainty rating of 0.

As Implementing Partner, we propose to produce an LVM for Timor Leste, and to orient the training so that EDTL can produce and regularly update such a map.

As Implementing Partner, we will follow a solar PV resource assessment process, using the process as the basis for setting the training objectives. The process depends on various tools, both software and spreadsheets as indicated in brackets.

- Quantifying maximum solar PV resource potential, including capacity factors (GIS, NREL SAM software)
- Identifying land-use exclusions (GIS)



- Estimating ground mount potential (with net metering potential, e.g. private village solar PV)
- Estimating rooftop potential, capacity and locations (GIS)
- Estimating distribution network hosting capacity (existing and future) (bespoke substation / line capacity spreadsheet model, PSCAD software)
- Producing an LVM (layered GIS)

3.2.2 Training

Requirement: Provide training on the highly resolved geographical information system (GIS) on topography and land-use availability, solar resource data, and potential light detection and ranging (LiDAR) for mapping rooftop availability that EDTL could explore in the future.

Overall approach for training is as follows:

- 2 days on GIS
- 2 days on Solar Resource Data – Training
- 2 days on LiDAR

It is understood that the key stakeholders will be Electricidade de Timor Leste (EDTL), Secretariat of State for Energy Policy, Faculdade de Engenharia, Ciência e Tecnologia, Universidade Nacional Timor Lorosa'e.

3.2.2.1 GIS – Training

We propose to provide training in the use of the open-source tool QGIS.

QGIS has excellent mapping functionality for displaying solar resource datasets. Coupled with land-use geodata, solar PV resources can be displayed visually with exclusion zone layers.

The training will commence with basic familiarisation with the QGIS application, followed by specific training in solar resource mapping using available PV resource datasets. Land-use geodata will be used to overlay exclusion zones. If such data is not available for Timor-Leste, then an appropriate geo-dataset(s) will be used to demonstrate the techniques.

We envisage that the training will require 2 days, covering GIS fundamentals on the first day, with hands-on practical exercises on the 2nd day designed to address solar PV resource mapping.

3.2.2.2 Solar Resource Data – Training

As Implementing Partner, we envisage providing training in solar resource assessment using the open-source NREL System Advisor Model (SAM) software to demonstrate how to take a solar resource dataset and to transform the data into production profiles and annual yield estimates based on typical solar rooftop PV design parameters.

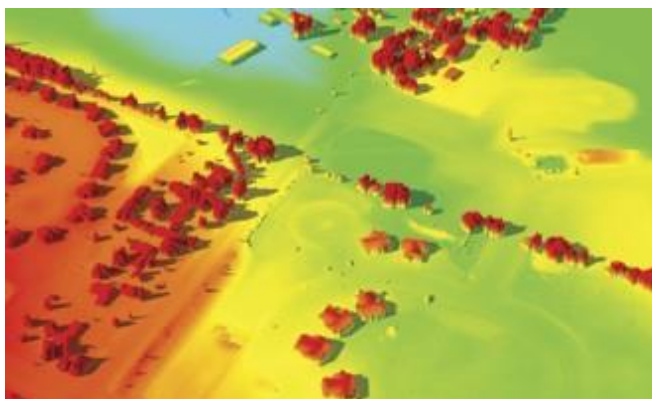
A more advanced training module will address solar PV design aspects based on PVSyst software, comparing the relative advantages of fixed and tracking systems.



We envisage that the training will require 2 days, covering fundamentals on the first day, and hands-on practical exercises on the 2nd day.

3.2.2.1 LiDAR – Training

The state-of-the-art practice in the assessment of rooftop solar PV potential involves the use of LiDAR data. LiDAR provides the high-resolution point data that an object-oriented extraction tool needs to create a surface model. The surface model is a virtual world of shadows, slopes and solar hot spots.



Object oriented extraction tools are trained to recognize key features of interest, based on pattern recognition.

As Implementing Partner, we will provide training in the use of state-of-the-art extraction tool functionality using eCognition software. We envisage a 2-day training course, covering fundamentals and hands-on practical exercises.

3.2.3 In-Person Kick-off Meeting

As shown in our implementation plan we propose to have an in-person kick-off meeting during the implementation of Output 2 with all project team members. We consider that face-to-face meetings and discussions on project requirements will be an important to successful project implementation and to ensure knowledge transfer.

3.2.4 Output 2 Deliverable

The key deliverable that is to be provided at the conclusion of this activity is the Report on Solar Resource Data and Insights for Timor Leste. This report will detail the solar resource potential for Timor Leste and provide capacity factors across the country for different technology options and configurations.

3.3 Approach to Output 3: Net Energy Metering Policy

Requirement: Regarding net metering policy, the Implementing Partner will provide guidance on metering infrastructure, eligible technologies, system and program size caps, and the type of net energy metering being explored (i.e., full retail rate, feed in tariff, no compensation, time-of-export, etc.). They will also outline the program's overall goal.

3.3.1 Objective of Net Energy Metering (NEM)

The ultimate goal of a Net Energy Metering policy is to increase power system flexibility by engaging “prosumers” by incentivizing:

- Self-consumption and injecting electricity in the grid when prices are high, and
- Withdrawing electricity from the grid when prices are low.

The key enabling factors are:

- Injected energy valued according to power system needs,



- Mechanisms to recover network costs,
- Advanced metering infrastructure, and
- Prosumer awareness, empowerment. and engagement.

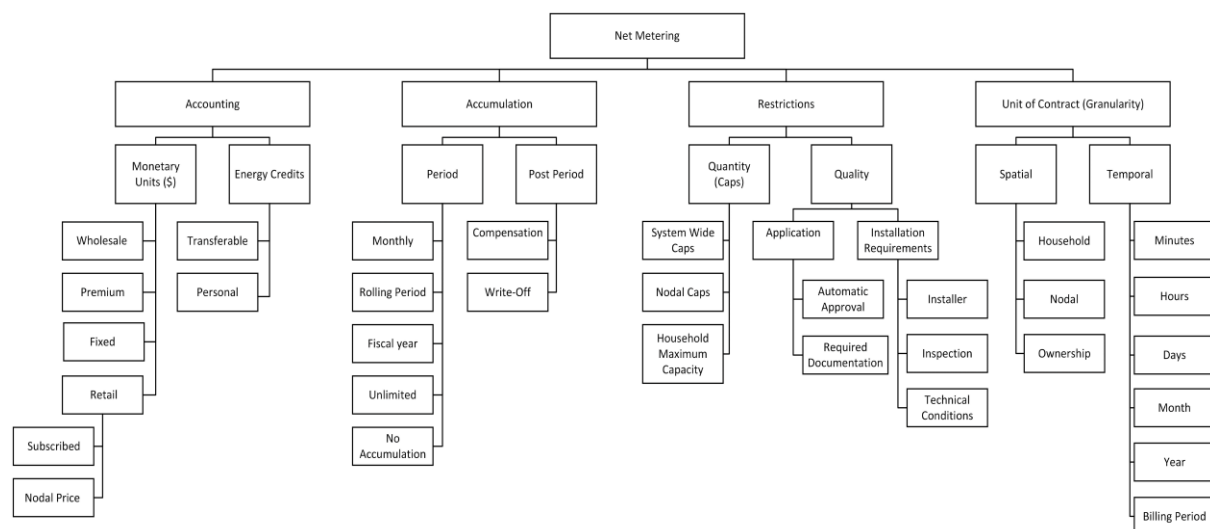
When formulating a policy, a NEM policy should be developed with three different perspectives in mind: the perspectives of the regulator, the utility, and the consumer. The benefits desired by all stakeholders are different and need to be considered differently, even though the decision taken in favour of one stakeholder, affects the other.

Net metering / billing schemes are used in many countries, both developing and developed, e.g. Indonesia, Italy, Mexico, Portugal, Latin American countries (17 countries), Australia and the USA (NY and AZ). There are many examples to draw on, providing lessons learned. As Implementing Partner, we will share details of the approaches taken internationally, highlighting the good practices that are both relevant and pertinent to Timor Leste. Within net metering policy settings, practices will be discussed with EDTL, presented as a set of elements and expectations based on the above policy framework.

3.3.2 NEM Policy Framework

As Implementing Partner, we will utilize the following practical framework when evaluating policy options and designing net metering rules.

Figure 4 Net Metering Policy Framework



The framework comprises 4 domains, each of which addresses a particular issue.

3.3.2.1 Accounting Rules

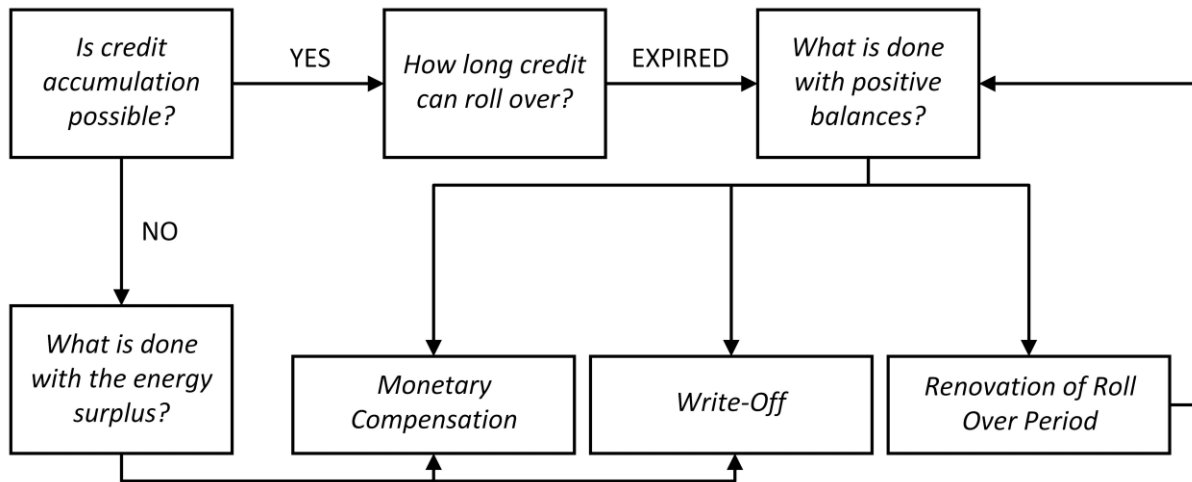
It is necessary to define what is traded between a distributed generator and the network. Two possible types of credits can be accumulated: (a) energy credits and (b) monetary credits.

3.3.2.2 Accumulation Rules

Accumulation rules concern physical energy credits and monetary credits, and how they are dealt with over time. Limits to accumulation, and expiry periods are key settings:



Figure 5 Accumulation



Accumulation rules are set based on a cost-benefit trade-off, using scenario modelling. The Implementing Partner will undertake this modelling and share the model with EDTL.

3.3.2.3 Restrictions

Restrictions can be divided into two categories: Quantity (or capacity restriction), and Quality (or technical restriction). Net Metering rules can permit unlimited capacity installation or limit it to some degree.

3.3.2.4 Unit of Contract (granularity)

Granularity refers to the level of balancing aggregation between distributed generators, which can be as small as a single individual (with many facilities) or a single household facility or even multiple individuals aggregated in a net energy balancing group.

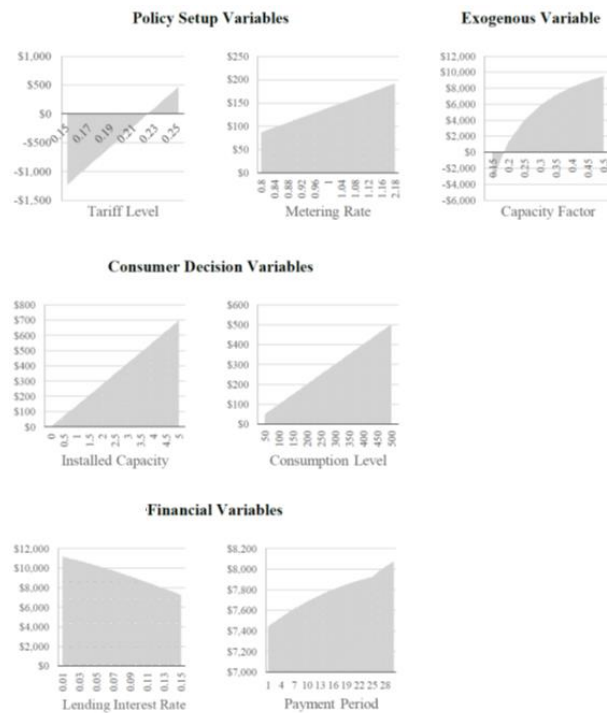
3.3.3 Formulating NEM Policy and Solar Payback Model

The 4 domains provide a mutually exclusive and comprehensively exhaustive approach to development of a net metering / billing policy. Some decisions can be readily taken based on benchmarking comparison. However, a key issue that must be considered specifically for Timor Leste is the customer incentive provided by a net metering policy, since the incentive will influence solar PV take up rates.

We will undertake an analysis of the customer incentive based on a cost-benefit analysis of a Solar Photovoltaic System project (calculating the Net Present Value, NPV). The model will be used to understand the sensitivity of the NPV to different variables in policy, customer and financial domains. Key variables of interest are the tariff rate for retail energy, the net metering rate, the capital costs of the solar PV scheme, the private sector lending rate, and the expected payback period. The sensitivity of the NPV to these variables will be used to develop a NEM policy proposal that delivers an incentive commensurate with government expectations.



Figure 6 Example Sensitivity Test Decision Panel



3.3.4 NEM Policy Workshop for Policymakers

As Implementing Partner, we will provide guidance on metering infrastructure, eligible technologies, system and program size caps, and the type of net energy metering being explored (i.e., full retail rate, feed in tariff, no compensation, time-of-export, etc.). We will also quantify the cost-benefits of a range of solar projects under different NEM policy scenarios for Timor Leste (including IRR, NPV, payback period and sensitivity tests).

The work undertaken will culminate in a NEM proposal. A study report will be tabled, after which a consultation process will be undertaken (at least with EDTL, but ideally with NGO's and other interested consumer associations).

An in-person NEM policy workshop for policymakers is envisaged which will be attended by all project team members. This will cover the NEM Policy options and discuss the rooftop penetration scenarios and payback calculations. As noted earlier, we consider face-to-face meetings is important to knowledge transfer and successful project implementation.

3.3.5 Output 3 Deliverable

The overall deliverable is a report on Net Energy Metering Policy and the results of the payback modelling for different NEM policy options for Timor Leste.



3.4 Approach to Output 4: Grid Code

3.4.1 Grid Code for DERs and IBRs in Timor Leste

The Terms of Reference require the Implementing Partner to carry out two main tasks in relation to the Grid Code.

- 1) Examine existing grid codes, both for transmission and distribution, examining frequency and voltage bounds, trip settings, and regulation services. The Implementing Partner is expected to request operational data (voltage and frequency for bulk and distribution), where available, to help understand the existing power quality that may inform grid code design. The Implementing Partner is also expected to request current interconnection regulations and guidelines, if they exist, for distributed generation.
- 2) The Implementing Partner is expected to develop the grid code by examining elements of IEEE 2800 and IEEE 1547-2018 that may help safely integrate inverter-based resources. These will include; voltage and frequency trip and ride-through capabilities along with voltage and frequency regulation services. These services are to be examined in the context of EDTL's grid operation, the level of DER adoption anticipated, and the current state of power quality for the Timor Leste power system.

IEEE 1547 establishes criteria and requirements for interconnection of DERs with electric power systems (EPS) and associated interfaces. The standard provides uniform rules for the interconnection and interoperability of DERs with the grid. It provides requirements relevant to the interconnection and interoperability performance, operation, and testing, and safety, maintenance, and security considerations. IEEE 1547-2003 specifically allowed voltage regulation at the Point of Connection and widened voltage and frequency operation ranges to accommodate voltage and frequency ride-through requirements desired by some utilities. IEEE 1547-2018 defined additional capabilities for DER to become active power controllers that can provide reliability services, including voltage support, voltage regulation, and frequency regulation.

We consider that the main issues to be addressed in a combined Grid Code are the setting of suitable performance criteria for inverter-based resources, in accordance with IEEE 1547. Our experience in Australia shows that the performance criteria are best developed based on commercially available inverters that have been certified to meet a Voltage Disturbance Ride Through (VDRT) test.

The requirements of the VDRT test need to align with the characteristics of the voltage and frequency performance. In this regard, analysis of existing frequency and voltage bounds, trip settings, and regulation services is a starting point. Ultimately, the Grid Code needs to reflect a set of performance criteria that DER / IBRs must meet as a condition of connection. These criteria are typically given as 'operating' diagrams that follow:

- Figure 7 shows active voltage regulation (reactive power),
- Figure 8 shows frequency ride-through standard, and
- Figure 9 shows voltage ride-through standard.

Figure 7 Active Voltage Regulation (Reactive Power)

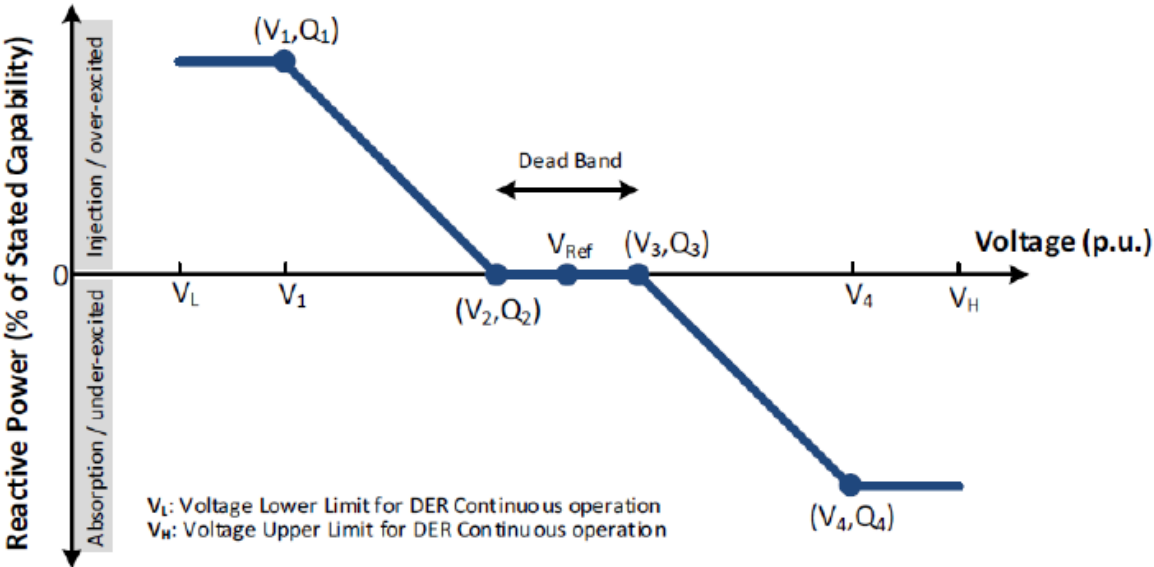


Figure 8 Frequency Ride-Through

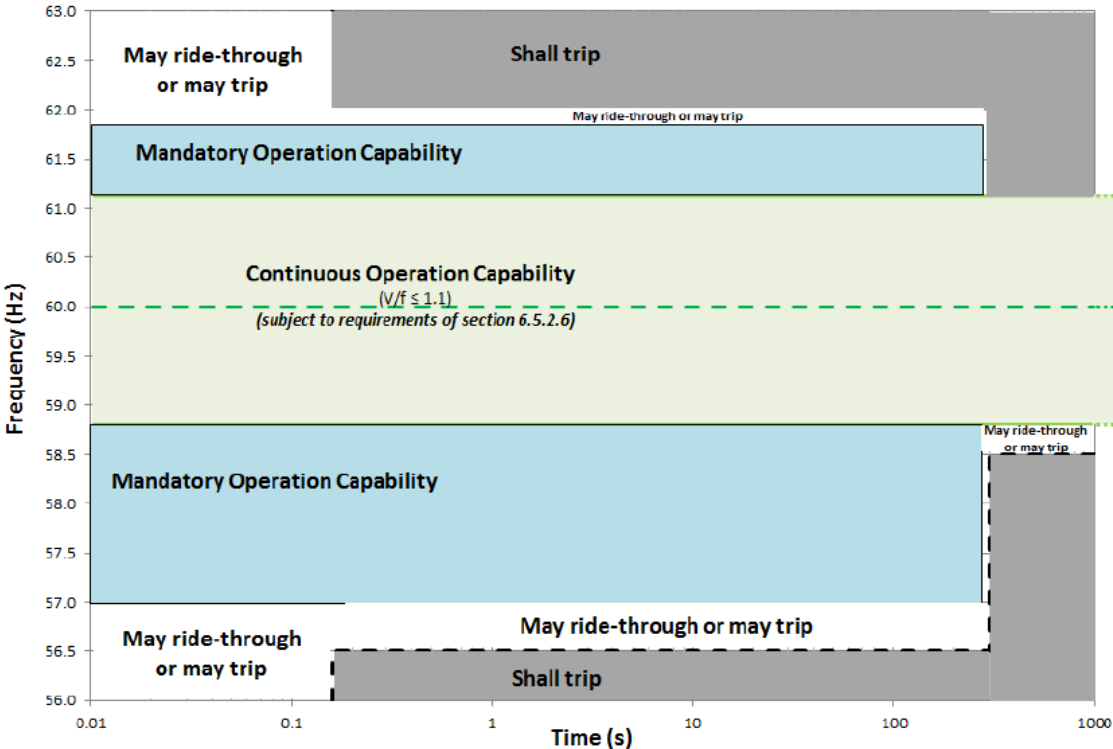
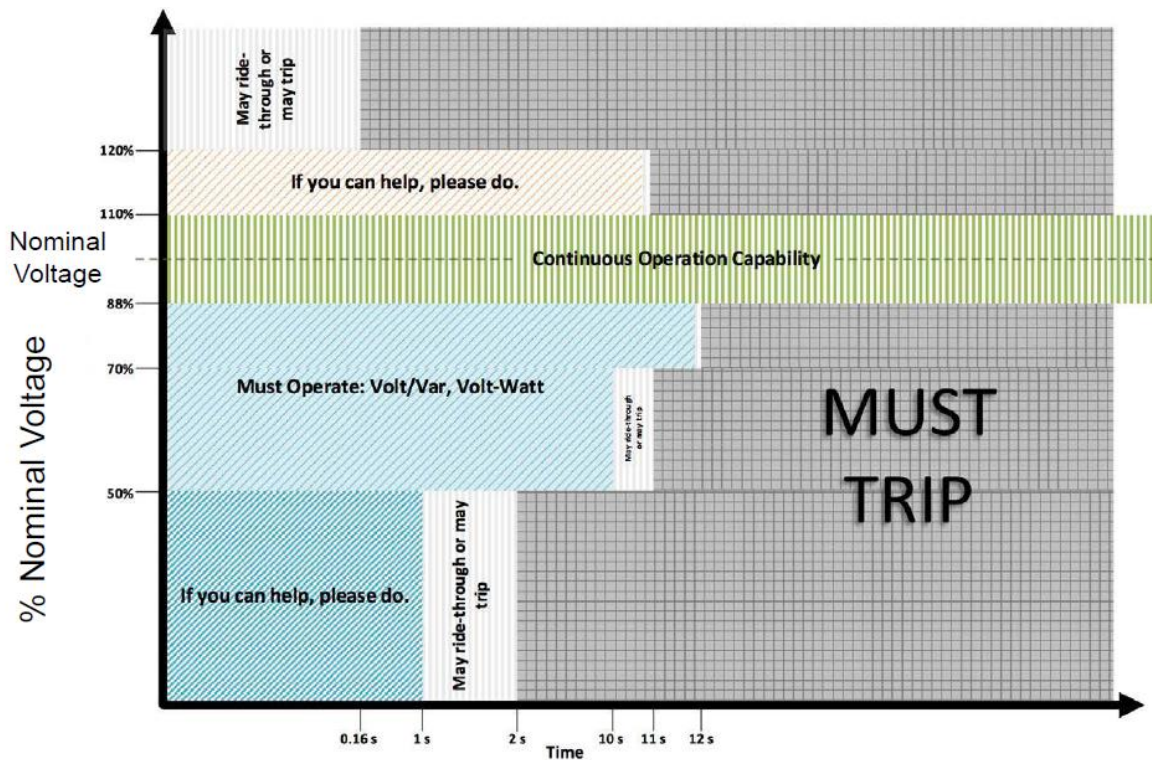
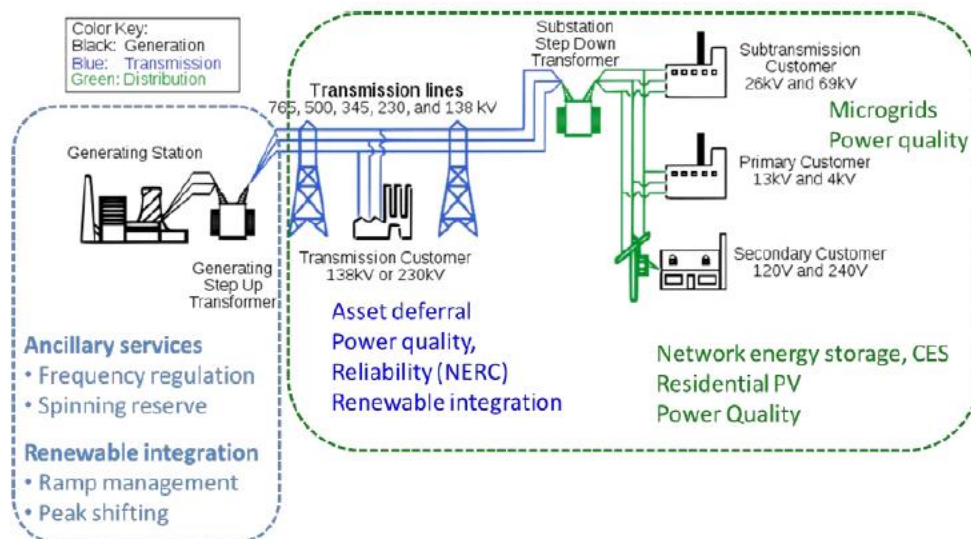


Figure 9 Voltage Ride-Through



DER penetration levels can reach levels at which significant back feed to transmission occurs. The combined transmission and distribution DER effects are addressed in IEEE 2030 and IEEE 2800.



As Implementing Partner, we will establish the level at which back feed occurs, and undertake studies needed to check the stability of the combined power grid. We envisage using PSCAD software, which is the state-of-the-art tool for the analysis of grids with high penetration of inverter-based resources. (In Australia, PSCAD modelling is a mandatory requirement for all renewable energy developers where inverter-based resources are involved).



In summary we will develop the operating diagrams, and other settings defined by IEEE 1547, taking IEEE 2030 and IEEE 2800 standards into account, and draft a combined Grid Code accordingly.

3.4.2 Training

Requirement: Provide training to EDTL on grid codes for distributed energy resources and a combined bulk and distribution grid code. They will examine the applicability of IEEE 1547-2018 for Timor Leste, including voltage and frequency trip and ride-through and voltage and frequency regulation capabilities that could be integrated into the grid code.

We envisage providing training on Grid Codes for DER and a combined bulk and distribution Grid Code, using IEEE Std 1547-2018 as a guiding framework, covering the following critical domains:

- Types of Intentional Electrical Islands
 - Local Electric Power System Island (Facility Island)
 - Area Electric Power System Island
- Intentional Island Systems Containing a Portion of the Bulk Power System
- Other Similar Configurations and Systems
 - Stand-Alone Systems (Off-Grid Systems)
 - Emergency and Standby Power Systems
 - Virtual Power Plants
- Selected Relevant Standards and Scopes
- Intentional Islanding Operational Stages
 - Distributed Energy Resource Requirements During Parallel Operation
 - Distributed Energy Resource Requirements During the Transition to Islanding
 - Distributed Energy Resource Requirements During the Islanded Operation
 - Distributed Energy Resource Requirements During the Transition to Parallel Operation

The above topics will be addressed by a training course organized by the following modules:

- Overview of Functional Technical Requirements for Intentional Islands
- Background Information on the Protection Requirements
- Unintentional Islanding Protection Requirements
- Requirements Regarding Voltage and Reactive Power Control
- Power Quality Requirements
- Guide to Updating Interconnection Rules
- Interoperability Requirements
- Clause-by-Clause Summary of Requirements of IEEE Standard 1547-2018

Note that the module “Interoperability” will deal with voltage / frequency trip and ride-through, and voltage and frequency regulation capabilities, that are applicable to a combined Grid Code.

We envisage the training will require 3 days of classroom participation by relevant personnel.

3.4.1 Output 4 Deliverable

The key deliverable for is a report on Grid Code for DERs and IBRs in Timor Leste. The report on the development of grid code that could be included in future revisions of the Timor Leste grid code,



including voltage and frequency trip and ride-through capabilities along with voltage and frequency regulation services.

3.5 Approach Output 5: GCF Note

3.5.1 Objectives of Output 5

The two objectives of Output 5 are:

- Develop a GCF Concept Note for a full-scale project, and
- Delivery of an in-person workshop and dissemination of the findings of the project across the entirety of the project – Solar Resource Assessment, Net Energy Metering policy, and Grid Code for DERs and IBRs.

3.5.2 Activity 5.1: Development of 1 x GCF Concept Note

To develop the Green Climate Fund (GCF) concept note, we will utilize the available resources, guidebooks, and documents including the following GCF concept notes and funding proposals, including:

- 2016 Green Climate Fund, GCF Concept Note User’s Guide,
- 2020 Acclimatise and the Climate and Development Knowledge Network, Green Climate Fund Proposal Toolkit, and
- 2018 Green Climate Fund, FP076: Cambodia Climate-Friendly Agribusiness Value Chains Sector Project Funding Proposal.

The project concept will be identified during the project implementation and will include the standard elements of a GCF concept note to justify financing. The areas include the following:

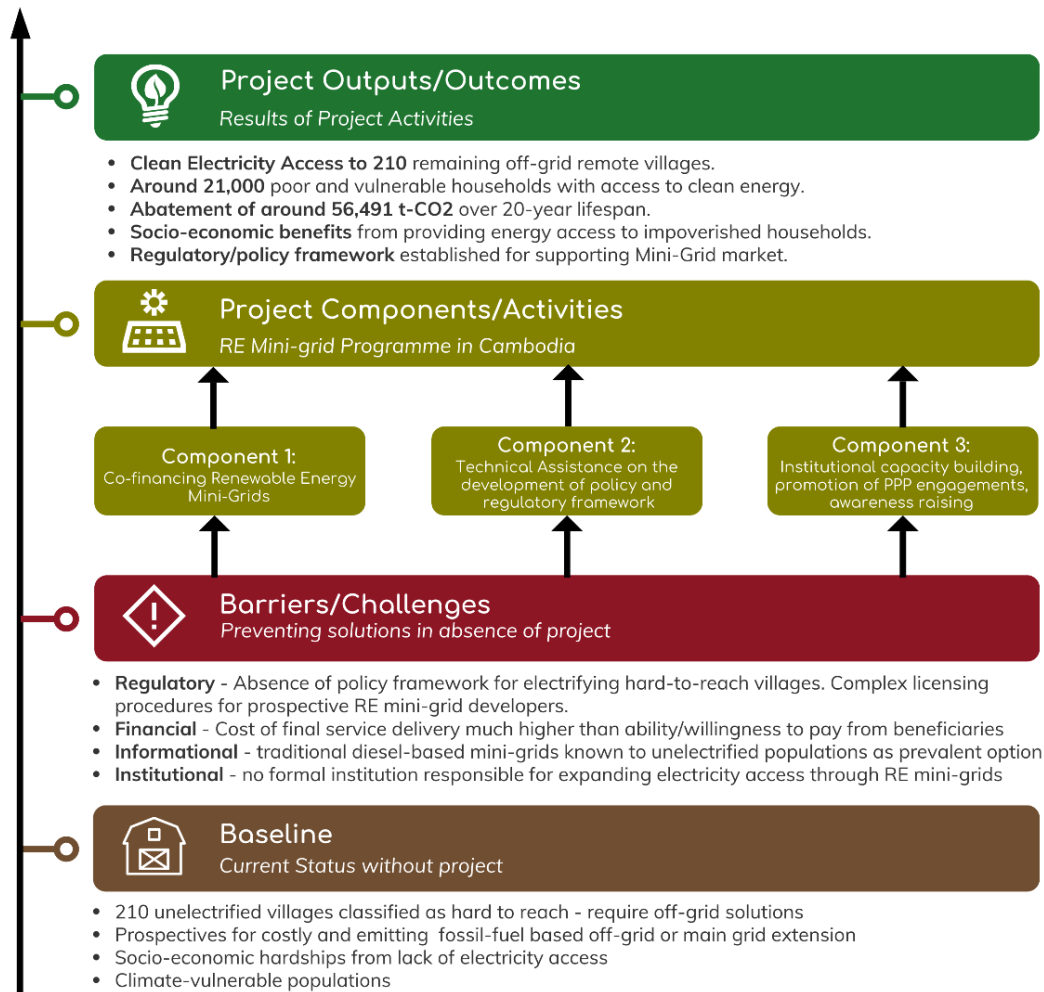
- Project summary,
- Detailed project information
- Indicative financing/cost information
- Supporting documents that include:
 - A theory of change,
 - Economic and financial models,
 - Pre-feasibility studies,
 - Evaluation reports from prior projects, and/or
 - Results of environmental and social risk screening

The inputs will leverage the findings from Output 2 and Output 3, the latter of which will have developed a payback model for solar rooftop systems under NEM policy implementation.

An example of the application the Theory of Change to a mini-grid project from a prior GCF concept note (in Cambodia) is shown in Figure 10, where it was necessary to establish a baseline outcome – without the project, then identify the barriers / challenges to the project – which included regulatory, financial, and institutional barriers. Through several enabling measures across 3 components – consisting of co-financing arrangement, delivery of a technical assistance package and institutional capability building, the project could be implemented, and the project’s outcomes assessed against the baseline.



Figure 10 Example of Theory of Change for Mini-Grid (Cambodia)



Throughout the duration of this project, we expect to be able to apply the same framework to a solar rooftop installation. Supporting the analysis will be estimation of the avoided emissions and contribution to adaption and resilience to climate change.

This work will be carefully informed by meetings with key stakeholders: Green Climate Fund, GCF Accredited Entity, Electricidade de Timor Leste (EDTL), Secretariat of State for Energy Policy.

3.5.3 Activity 5.2: In-Person Workshop & Project Wrap-Up

An In-person workshop and project wrap-up session will be carried out at the conclusion of Output 5. The focus will be on all material developed in the project. The in-person workshop will be attended by all team members.

3.5.1 Output 5 Deliverables

The deliverables for Output 5 include: (1) 1 x GCF Concept Note, (2) an overall final report where deliverables 2, 3, 4 and 5 will be combined into a final report, and (3) completion of project presentation delivering key project findings in-person in Timor Leste.



3.6 Approach to Gender Mainstreaming

Our project team is committed to achieving the gender equality during implementing this project in the following ways:

1. **In conducting consultation activities:** Gender stakeholders' consultation will be carried out with participation of women and men in the policymaking process to ensure that their voices are heard, and their priorities are reflected in policies, roadmap, and projects. We target the proportion of consultations involving female counterparts to be at least 30%. Furthermore, in situations where third parties are required to provide services to the project team (such as booking venues for workshops and procuring professional translation services), equal treatment will be provided between males or females.
2. **In the management of our organizations:** Mobilize woman for promoting women involve in this assignment and achieving gender equality are core commitments of IES and AMC. We will take measures to ensure that women have the same benefits in this assignment as men – including daily rates, time for breaks and no discrimination against religion, age, or sexual orientation. There are activities in which participation by women is expected to be predominant; those areas include project accounting, administration, translation, workshop preparations etc. During project decision-making all team members input will be equally valued, from the Team Lead to project experts to our clients. Measures will also be taken to ensure the project team members all have uniform conduct during the engagement – in particular, IES has a code of ethics and a gender mainstreaming code of conduct that will be communicated to all project team members ahead of engagement.
3. **During the workshops:** Measures will be taken to ensure gender equality in terms of the invitation list, ensuring that woman will have access to the workshop, will be entitled to the same opportunities, benefits, and resources during the workshop. Furthermore, workshops will be well equipped with equipment to ensure communication and knowledge transfer is fair and equal to all parties attending.
4. **Positions of Experts within Project Team:** Equal pay and benefits for comparable roles with similar responsibilities has been ensured in the proposal. Both IES and AMC offer equal opportunities for promotions and career progression to both males and females internally.
5. **Beneficiaries for Project Deliverables:** Measures will be taken to ensure that there is equal treatment of females and males in the implementation of deliverables to ensure that both females and males will gain equal benefits from the deliverables produced in the project. It is important that the projects deliverables and recommendations be disseminated to audiences represented both by females and males, and any subsequent training programs or implementation initiatives feature both groups at comparable ratios.

Gender Specialist, Retno Agustin will be integrated into the project team to ensure that appropriate measures are built into our plan and its implementation to ensure gender equality.

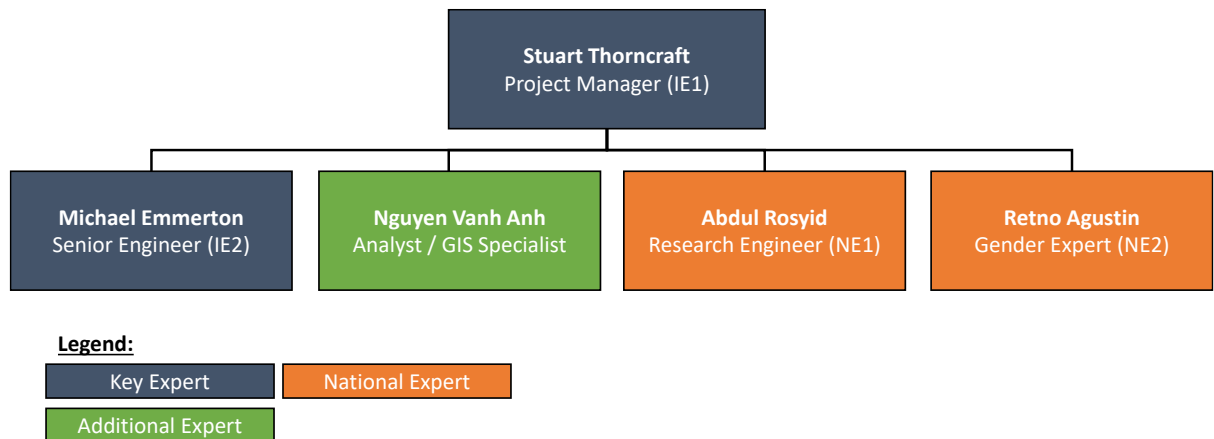


4 Organigram & Project Team

4.1 Organigram

The project team organigram is provided in Figure 11.

Figure 11 Project Team Diagram (Organigram)



4.2 Team Member Profiles

The following are brief profiles of the project team members:

- **Dr. Stuart Thorncraft (PhD, BEng, BSc) (Sydney, Australia)** is a Managing Consultant at IES and is responsible for the IES Asia Advisory practice. He has over 20+ years' experience in carrying out studies on power system planning and power system operations in the Asia-Pacific region. Dr. Thorncraft has an extensive background as the team leader having undertaken solar grid integration studies, development of inverter-based resources (IBR) standards, solar rooftop policy studies, and supporting the development of regulatory frameworks considering energy storage, distributed energy resources (DER), onshore / offshore wind farms and utility-scale solar projects.
- **Michael Emmerton (BEng)** brings with almost 40 years' experience in the energy industry. He has worked in technical and managerial He has undertaken assignments for utilities, energy ministries, regulators and private companies integrated energy planning, power sector planning, modelling power systems and providing advice on energy policy and regulatory frameworks. He has over 15 years of direct project experience in Southeast Asia's energy industries and energy markets. His focus areas of recent are renewable energy masterplans, solar/wind feasibility studies (rooftop and ground-mount), BESS energy storage development (studies/specification/tendering/training), distribution pricing/tariff setting, metering policy/procurement.
- **Dr. Van Anh Nguyen (PhD Eng, BEng) (Sydney, Australia)** is an Energy Analyst at IES with substantial experience in data analytics and power system modelling. He specializes in advising on energy and electricity market development in Asia, supporting clients (utilities, electricity retailers, regulators, and system/market operators) to support power system planning, grid impact studies, analysis of impact of energy efficiency (EE)



programs, renewable energy integration and impacts of decarbonisation on power systems. In the recent past, Van Anh has completed least cost generation planning studies, transmission economic cost-benefit analysis, QGIS mapping to support EIA / SIA work, and modelled the impact of solar and hydro hybrids being connected to power systems using power flow, least cost planning, and dispatch simulation software packages.

- **Abdul Rosyid (Dr.-Ing., MSc, Drs.) (Jakarta, Indonesia)** is a Solar Energy Researcher who works in research institution with substantial experience in research and development on PV component and system. He has over 30+ years of experience in carrying out studies and research on solar power system planning and development as well as engagement with various multi-stakeholders in renewable energy sector in Indonesia. He also had project experience in Timor Leste. Dr. Rosyid has an extensive background as the Team Leader having undertaken design on floating PV Pumping, pre-feasibility study on floating PV development, development program for Electric Vehicle Fast Charging Technology, physical examination of PV Rooftop systems and Study of Technology, Industry, and Investment of solar power plant.
- **Retno Agustin (MA, BA) (Yogyakarta, Indonesia)** is a Gender and Social Inclusion (GESI) Expert who work in intensive involvements in several gender programs and gender mainstreaming consultations. She has more than 15 years of experience on project design, planning, implementation, learning and evaluation. As well as 7 years of experience of researching women, marginal and vulnerable groups and give input on gender and social impact assessment on several projects in Indonesia within regional and national level. She also had project experience in Timor Leste.

4.3 Team Member Match to Roles

Table 2 Project Team

No.	Name	Role on Project	Experience
1	Stuart Thorncraft	Project Manager (IE1)	<ul style="list-style-type: none"> • 20 years industry experience • Renewable energy • Power system planning • Technical standards for inverter-based resources & power systems • Solar and wind project development • Renewable energy Integration • Energy Storage systems (pumped storage and battery) • Power system operations & control • Training and capacity building
2	Michael Emmerton	Senior Engineer (IE2)	<ul style="list-style-type: none"> • 40 years industry experience • Power system planning, control, operations & maintenance • Solar PV Feasibility Studies • Solar PV Contract Management



No.	Name	Role on Project	Experience
			<ul style="list-style-type: none"> • Rooftop PV • Real-Time Forecasting • Training (classroom)
3	Van Anh Nguyen	Analyst / GIS Specialist (Non-Key Expert)	<ul style="list-style-type: none"> • 40 years industry experience • Power system planning, control, operations & maintenance • Solar PV Feasibility Studies • Solar PV Contract Management • Rooftop PV • Real-Time Forecasting • Training (classroom)
4	Abdul Rosyid	Research Engineer (NE1)	<ul style="list-style-type: none"> • 30 years research experience • Renewable energy • Solar PV Feasibility Studies • Rooftop PV • Solar Project Development • Solar Power System Planning • Training and capacity building
5	Retno Agustin	Gender Specialist (NE2)	<ul style="list-style-type: none"> • 18 years industry experience • Project Management • Research and Assessment in social policy and poverty reduction, governance and decentralization and social environmental impact • Gender and Social Inclusion (GESI) and Social Impact Assessment • Training and Meeting Facilitation

4.4 Field Trips

We recommend three field trips as set out in Table 3. These will enable key findings to be carried out and for some of the training that has been proposed to be undertaken in-person.

Table 3 Field Trips

No.	Field Trip	Description	Timing	Team Members Attending			
				ST	ME	AR	RA
F-1	In-Person Kick-Off + Solar Resource Assessment	Kick-off and coverage of some solar resource training topics	JUL-2024	✓	✓	✓	✓
F-2	In-Person Workshop + Training (Net Metering Policy)	NEM Policy workshop and completion of solar resource training	JAN-2024	✓	✓	-	✓
F-3	In-Person Workshop + Training + Wrap-up	Final workshop and Grid Code training	MAY-2024	✓	✓	✓	✓

ST = Stuart Thorncraft (IE1), ME = Micheal Emmerton (IE2), AR = Abdul Rosyid (NE1), RA = Retno Agustin (NE2)

