AMBATOLAMPY SOLAR PV

Document Prepared by AERA Group

On behalf of New Energy Africa Ambatolampy (NEA Ambatolampy)

Project Title	Ambatolampy solar PV
Version	*2.2*
Date of Issue	*24-01-2025*
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Ambatolampy solar PV ("the project") consists of the construction and operation of a greenfield 40 MW solar photovoltaic power plant in Ambatolampy, in the South-East of Vakinankaratra region, Madagascar. It involves the setting up of photovoltaic (PV) panels which will capture solar energy and convey such energy to the convertor station in order to produce electricity exported to the national grid.

Electricity in Madagascar is currently heavily reliant on imported fossil fuels currently consumed by thermal power stations (514 MW) versus hydropower plants (162 MW)[1], thus a baseline scenario also considered as the scenario prior to the implementation of the project activity leading to considerable greenhouse gas (GHG) emissions. The project activity undertaken by New Energy Africa Ambatolampy ("NEA Ambatolampy", previously known as Green Yellow Madagascar) will therefore substitute grid electricity by clean and renewable energy, and cut down GHG emissions.

The project is the first large-scale solar PV power plant on the island and will generate approximately 36,362 tCO_2e emission reductions per year and 363,615 tCO_2e of emission reductions over the 10 years crediting period.

1.2 Sectoral Scope and Project Type

The sectoral scope is Scope 1 – Energy Industries (renewable sources) – ACM0002: Large-scale Consolidated Methodology: Grid-connected electricity generation from renewable sources, Version 22.0.

The project is a renewable energy type and is not a grouped project.

1.3 Project Eligibility

The project is eligible under the scope of the VCS Program because:

- It results in CO_2 emission reductions, one of the six Kyoto Protocol greenhouse gases
- It consists in grid-connected electricity generation using (large scale) solar power plant in a Least Developed Country

[1] https://www.africa-eu-renewables.org/market-information/madagascar/energy-sector/

1.4 Project Design

The project has been designed to include a single installation of an activity which has been extended in 2022.

Eligibility Criteria

N/A

1.5 Project Proponent

Organization name	New Energy Africa Ambatolampy[2] (NEA Ambatolampy)
Contact person	Mairamou HAMAN ADJI
Title	Impact and Sustainability Manager
Address	Building Kube A Zone Galaxy Andraharo 101 Antananarivo Madagascar
Telephone	+ 261 34 00 308 69
Email	Mairamou.Hamanadji@axian-group.com

1.6 Other Entities Involved in the Project

Organization name	AERA Group
Role in the project	Carbon consultant
Contact person	Alexandre Dunod
Title	Chief Operating Officer
Address	28 Cours Albert 1er, 75008 Paris, France
Telephone	+33 1 42 18 02 02
Email	a.dunod@aera-group.fr

1.7 Ownership

New Energy Africa Ambatolampy ("NEA Ambatolampy", previously known as Green Yellow Madagascar) has gained project ownership through a production licence and power purchase agreement with Madagascar public utility, JIRAMA.

[2] In 2020, the Madagascan company Axian Energy acquired the majority of the shares of Green Yellow Ambatolampy. On January 9, 2023, Green Yellow Ambatolampy, the sole shareholder of Green Yellow Madagascar, changed its corporate name to "New Energy Africa Ambatolampy (NEA Ambatolampy)"

1.8 Project Start Date

10-July-2018, as the date of commissioning, synchronization and start of GHG emission reductions. Extension phase of the project started on 17-August-2022.

1.9 Project Crediting Period

The project crediting period started on 10-July-2018 and lasts 10 years (fixed), until 9-July-2028

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	x
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2018 (from July 10th)	11,358
2019	23,751
2020	23,632
2021	23,513
2022	31,864
2023	45,720
2024	45,478
2025	45,233
2026	44,990
2027	44,747
2028 (until July 9th)	23,328

Total estimated ERs	363,615
Total number of crediting years	10
Average annual ERs	36,362

1.11 Description of the Project Activity

The proposed project consists of setting-up 110,058 solar PV panels with an installed capacity of 40.01 MWp to produce electricity to be exported to RI-Tana grid operated by JIRAMA. This clean electricity development implies a substantial reduction in the production of carbon and its release in the atmosphere, thereby reducing the associated greenhouse impact upon the atmosphere.

The PV modules installed are new and of make Eagle 60 from Jinko Solar and JA Solar. They are of high-efficiency, poly-crystalline (for the Jinko) and mono crystalline (for the JA solar) silicon solar cells with high transmission and tempered glass, which results in module efficiency of up to 16.80% for initial phase, and 20.9 for the extension phase. According to the manufacturer's warranty, the average annual power output degradation of the module shall not exceed 0.5%/0.55% per year, ending with 80.7%/84.8% at the end of the 25th year, i.e. implying a life expectancy for at least this duration.[3] For the Balance of System components, including inverters, lifetime is also exceeding 25 years as per the extendable warranty.

Based on a mean annual global solar radiation of 2,072.1 kWh/m^2 in the project area and the specifications of the solar PV system (nominal annual output of 1,871 kWh/kWc and performance ration of 85.8 for phase I and nominal annual output of 1,773 kWh/kWc and performance ratio of 85.5% for phase II, including all losses & unavailability), the net annual output is expected at 69,695.29 MWh (minus yearly technical degradation of 0.5% / 0.55%, resulting in an average of 54,485 MWh/y over the 10-year crediting period) as provided to banks and/or equity financiers in the financial model, corresponding to a plant load factor of 20.3%[4] for the initial phase. The extension phase presents a load factor of 19.5%.

In the solar photovoltaic power plant, 14,832 modules JKM 270 PP-60 and 58,176 modules JKM 275 PP-60 are connected in strings of 24 modules, split between 3 inverters/transformers packs located on 5 Ingeteam skids (PTR1 to PTR5), the extension comprised of 37,050 JAM72S30-540/MR modules are split between inverters. These combined components feed a triple 20kV antenna towards the high-voltage sub-station comprising of an outdoor 20/63kV 17-20MVA transformer and its auxiliaries, protection equipment and control commands. The stepped power is then exported to JIRAMA Interconnected Grid through a 2.86 km overhead transmission line.

[3] see Eagle 60 260-280W specifications provided to the DOE

[4] cf. 171107_PVSyst Madagascar_Ambatolampy_Note de productible_Ind E

Table 1: Characteristics of Solar PV Modules

Manufacturer	Jinko Solar		JA solar
Model	Eagle 60 JKM 270 PP-60	Eagle 60 JKM 275 PP-60	JAM72S30-540/MR
Quantity	14,832	58,176	37,050
Peak Power (W)	270 W	275 W	540 W
Type of cells	Poly-crystalline 156×156mm (6 inch)		Mono
Rated voltage (V_{mpp}) (V)	31.7	32.0	41.64
Rated current (I_{mpp}) (A)	8.52	8.61	12.97
Efficiency (%)	16.5	16.8	20.9
Dimensions (mm)	1650×992×40		2279 x 1134 x 35

Table 2: Technical data of the inverters

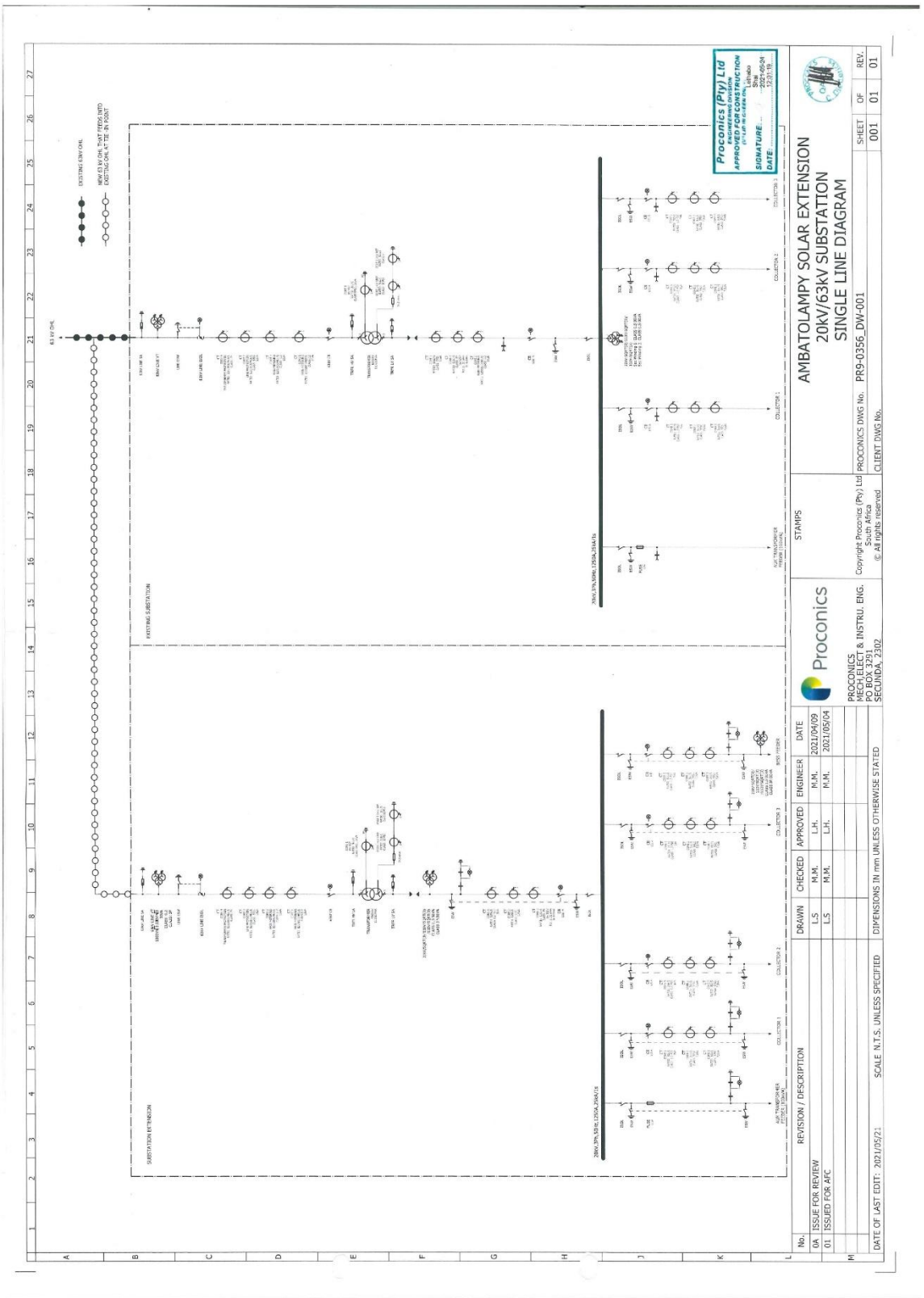
Parameter	Unit	Description	
Manufacturer	-	INGECON SUN	SUNGROW
Model	-	1220TL	SG250HX
Quantity	-	15	77
Maximum DC input voltage	V	1,050	1,500
Maximum DC input current	A	2,000	360
AC output power @35 °C / @50 °C	kVA	1,219 kVA / 1,122 kVA	250kVA /200kVA
Output frequency range	Hz	50/60	55-65
Maximum efficiency	%	98.9	99.0/98.5
Average power consumption per day	W	1,400	N/A

Table 3: Technical data of transformers

Parameter	Unit	Description		
Manufacturer	-	SEA	KYTE POWERTECH	SDEE
Model	-	A0Bk	-	SFZ-2000063
Quantity	-	5	5	1
Rated power	kVA	3,660	3750	20,000
Voltage	V	440	800	20,000

The figure below provides an overview of the full solar PV system. The engineering, procurement and construction of the project is managed by NEA Ambatolampy and its affiliates. All installed technologies, systems and equipment are new.

Figure 2: Solar PV System - From PV modules to grid connection



There are 7 meters in total :
3 for each phase (1 main, 1 check and 1 Internal control), measuring the net electrical energy delivered to RI-Tana grid and located before 20/63kV transformer at JIRAMA substation. They also measure the consumption of the plant, including BESS charging from the grid. The 7th meter, measuring office consumption, including lights, cameras, etc. (libeled as 'invoiced imports' on the ER sheet), is located at the JIRAMA VIE base, next to the offices. They feature the following specifications:

Initial phase			
Meter designation:	Main	Check	Internal control [5]
Meter ownership:	NEA Ambatolampy	JIRAMA	NEA Ambatolampy
Make:	Landis+Gyr	ZTE	Phoenix contact
Model:	E650[6]	DTSD178-M[7]	EEM-MA600[8]
Accuracy class:	0.2S (±0.2%)	0.5S (±0.5%)	0.2S
Serial Number:	No. 3507387521272	No. 012000005221	No. 17512310044_T

Extension phase			
Meter designation:	Main	Check	Internal control [9]
Meter ownership:	NEA Ambatolampy	JIRAMA	NEA Ambatolampy
Make:	Landis+Gyr	ZTE	Phoenix contact
Model:	E650[10]	DTSD178-M[11]	EEM-MA770[12]
Accuracy class:	0.2S (±0.2%)	0.5S (±0.5%)	0.2S (±0.2%)
Serial Number:	No. 3507576049226	No. 012000005522	No. 1127052

JIRAMA VIE base meter:	
Meter designation:	Main

[5] These 'internal control' meters are not part of the PPA, they are for indicative purpose : they serve as internal control meters for NEA Ambatolampy.

[6] https://www.landisgyr.eu/product/landisgyr-e650/
[7] https://en.dongfang-wisdom.com/html/ProductDetail_302-0-nul.html#3
[8] https://www.phoenixcontact.com/fr-fr/produits/appareil-de-mesure-eem-ma600-2901366

[9] These 'internal control' meters are not part of the PPA, they are for indicative purpose: they serve as internal control meters for NEA Ambatolampy.

[10] https://www.landisgyr.eu/product/landisgyr-e650/
[11] https://en.dongfang-wisdom.com/html/ProductDetail_302-0-nul.html#3
[12] https://www.phoenixcontact.com/fr-fr/produits/appareil-de-mesure-d-energie-eem-ma770-2907945#downloads-link-target

Meter ownership:	JIRAMA
Make:	ZTE
Model:	DTSD178-M[13]
Accuracy class:	0.5S (±0.5%)
Serial Number:	No. 170164261685

Battery Energy Storage System (BESS) :

Name of Project	AMBATOLAMPY PHASE-I	AMBATOLAMPY PHASE-II (Extension)
Energy Storage Technology	NA	LPF : Lithium Phosphate Fer
Battery Applications *(peak shaving/frequency regulation/inertial support etc.)*	NA	Peak shaving
Project Capacity (MW / MWh)	NA	- Battery: 2 x (2 x 1376 [kWh]) - PCS output: 2 x 2500 (kVA]
Equipment supplied	NA	- Battery: manufacturer : SUNGROW type M2L- - PCS (Power Conversion System): type SC1375UD; 550[Vac]/550[Vdc]; number: 04; - transformers PTR-BESS: type : 550[V]/20[kV]; 2500 [kVA]; DynO; number: 02; - transformers auxiliaries: 550[V]/400[V]; 80 [kVA]; DynO; number: 02; - TGBT BESS: 550 [V]; number: 02; - TGBT auxiliaries: 400 [V]; number: 02;

1.12 Project Location

Host Party: Madagascar

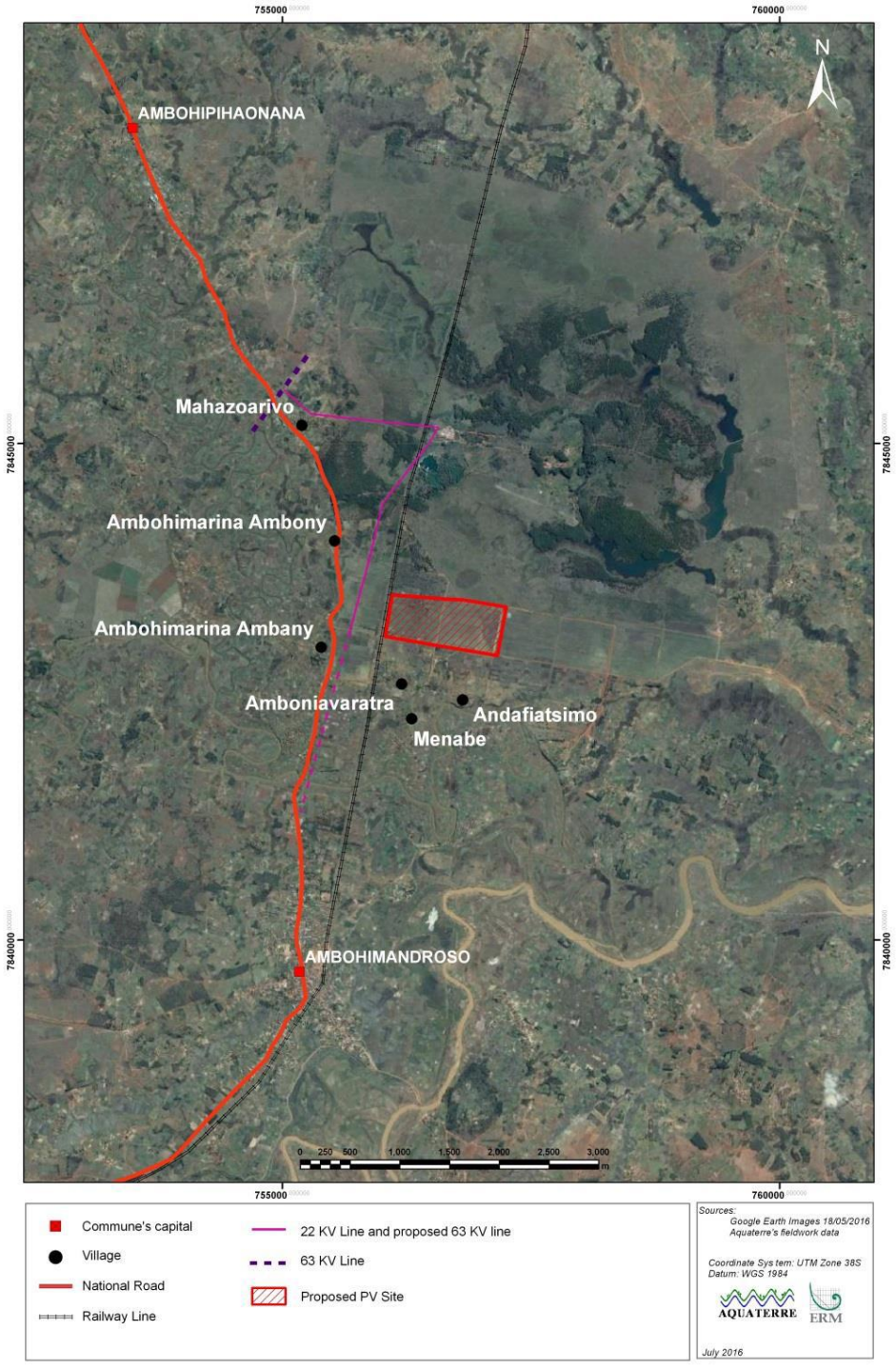
Region/State/Province: Region of Vakinankaratra, District of Ambatolampy

City/Town/Community: The site is located in Ambatolampy, 90km South of Antananarivo, Madagascar.

[13] https://en.dongfang-wisdom.com/html/ProductDetail_302-0-nul.html#3

The project surface is 28 ha and its geo-coordinates are: Latitude: 19°29'22"S; Longitude: 47°26'42"E.

Figure 1: Localisation of project site



1.13 Conditions Prior to Project Initiation

According to ACM0002 Version 22.0 and since the project activity is the installation of a new grid-connected renewable power plant (Greenfield) the baseline scenario is the following:

"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system."

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

To date, there are no regulations and policies preventing the implementation of the project activity, which is in line with the regulatory or legal requirements existing for power plants, essentially consisting of the following framework:

- Malagasy Environment Charter N°90.033 that precise the National Policy of the Environment
- Decree N°98-032 concerning the reform of the electricity sector
- MECIE Decree N°99-954 about Environmental Investments Compatibility
- Law n° 2017-020 acting as Electricity Code in Madagascar

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project is registered under the Clean Development Mechanism[14] (Project #10481) on 03-May-2019, although its GHG emission reduction will either be claimed under the VCS programme or the CDM programme, never both.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has neither sought nor received another form of GHG-related environmental credits.

[14] https://cdm.unfccc.int/Projects/DB/RWTUV1556909746.23/view

1.17 Additional Information Relevant to the Project

Leakage Management

As per approved methodology ACM0002 (Version 22.0), no leakage is considered for the proposed project.

Commercially Sensitive Information

There is no information deemed as commercially sensitive for this project activity.

Sustainable Development

The project participants are confident that the proposed project activity will make significant impact on Madagascar sustainable development, as also confirmed by the host country in its Letter of Approval of January 19th 2021.

Greenhouse Gas emissions reduction

The project will generate electricity from a renewable and clean energy source, thus avoiding the dispatch of the same amount of electricity produced by fossil-fuelled power plants to Madagascar grid. Besides, the SOx emissions from coal-fired power plants would also be reduced.

Development of renewable energy

The project will form a major part of the country's approach to sustainable development also in helping to diversify energy supply away from non-renewable sources, in line with the objectives of the Madagascar Action Plan[15] launched in 2006 (see development of the infrastructure and the rural areas, protection of the environment), complemented by the New Energy Policy 2015-2030 vision. The project will improve energy self-sufficiency of the country, alleviating the associated risks of price variations.

Employment opportunities

The project contributes to the local employment throughout its building and operation phases, its workforce consisting of up to 80 workers at the peak of construction phase and approximately 10 workers in the operations phase. It will also induce indirect employment by increasing the competitiveness of local industry from reducing the country's dependency on fossil fuels.

Therefore, Madagascar Government is supportive of the project because the development of solar PV power is in accordance with the national criteria for sustainable development and national policies relating to energy resources and the environment, which will push forward the use of renewable and clean energy across the country – where less than one person out of five currently has access to electricity.

Technology transfer

This type of renewable energy project will assist building capacities in the country, through advanced technology transfer from industrialized countries. The project will introduce solar PV technology, methods and

[15] https://www.imf.org/~/media/Websites/IMF/imported-publications/external/pubs/ft/scr/2007/fra/_cr0759f.ashx

skills in the island and demonstrate its applicability and efficiency, thus widening its accessibility. The technology is manufactured by Jinko Solar and JA solar. The technology for large scale solar PV power generation is still at starting stage of consideration in the country, Ambatolampy project being the first large-scale solar PV realization in Madagascar.

Further Information

The project participants obtained all necessary clearances; hence no legislative, economic, sectoral, social, environmental, geographic, site-specific risks are anticipated which may have impact on the eligibility of the project activity and the net GHG emission reductions.

2 SAFEGUARDS

2.1 No Net Harm

Not applicable (see registered CDM-PDD)

2.2 Local Stakeholder Consultation

(see registered CDM-PDD for information regarding initial phase)

In the context of the extension, field investigations were carried out in order to agree individual and public consultations with all project stakeholders, with two missions :

- Mission 1: meeting with internal stakeholders, the Fokontany chief and subcontractors (from 03 to 07 December 2019, held in offices of GreenYellow)

- Mission 2: meetings with the mayor, the client, the district chief, the local population and representatives of vulnerable groups. (from 10 January to mid-March 2020, held in the municipal premises of the fokontany Lovahinjafy)

The local authorities were informed of the extension project from the start, and when contact was established; they expressed their willingness to work with GreenYellow Madagascar to develop the project. The local authorities facilitated the identification of vulnerable people and other local stakeholders interested in the project. The stakeholders were invited orally by the project developers, during visits to the fokontany and town, and also by the local authorities.

In the first mission, the main objectives were the identification of the major environmental and social issues of PPs activities, the expectations and concerns of the local population, PPs environmental commitment programme and explaining the project progress including the extension project. In the second mission, face-to-face interviews on the same themes that were mentioned during the first mission were caried out. A formal public hearing, chaired by local authorities, was organized to share general information with the local population and gather their opinions.

The participation of the local population in the extension project is achieved through local recruitment and the social actions that the project will bring. A list of the fokontany's expectations has been drawn up, and a report has been produced to this effect, in order to substantiate the Environmental and Social Action Plan (ESAP).

Expectations range from health and education actions from the vulnerable people representants, to social peace, formulated by the local authorities. A table of all the stakeholders, with entities and expectations identified can be seen on table 16 of the PREE.

Regarding ongoing communication, there are annual meetings with the community in order to consider the community expectations from the project. This will continue in the future, and will be useful for the selection of projects for NEA ambatolampy's environmental and social program.

Ongoing communication also include the presence of grievance logbooks in the plant and also in the 2 fokontany and townhall, which are checked once per month (once per week since autumn 2024). Finally, contact informations (mail and phone number) from two resource persons acting as relays from project developers and proponents NEA Ambatolampy are communicated with stakeholders :

- Hery TIANA RASOLOARIVELO (QHSSES supervisor)
- Jeremie Harison TATA (Operations Manager Ambatolampy)

2.3 Environmental Impact

Not applicable (see registered CDM-PDD)

2.4 Public Comments

Not applicable (see registered CDM-PDD)

2.5 AFOLU-Specific Safeguards

Not applicable (see registered CDM-PDD)

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	22.0
Tool	01	Tool for the demonstration and assessment of additionality	07.0.0
Tool	23	Additionality of first-of-its-kind activities	3.0
Tool	07	Tool to calculate the emission factor for an electricity system	7.0

3.2 Applicability of Methodology

ACM0002 version 22.0 applicability conditions	Project activity applicability
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 plants/units; (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s). (f) Install a Greenfield power plant together with a grid-connected Greenfield pumped storage power plant. The greenfield power plant may be directly connected to the PSP or connected to the PSP through the grid.	The project activity is a greenfield solar photovoltaic power plant substituting electricity produced on the grid by renewable energy.
In case the project activity involves the integration of a BESS, the methodology is applicable to grid-connected renewable 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 photovoltaic 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).	The project activity involved the integration of a BESS, together with implementing a capacity addition to an existing solar photovoltaic plant. This applies here as the BESS system has been developed in the context of the capacity addition of the Ambatolampy solar initial plant. Such applicability is confirmed by table 2. of combinations applicable for integration : BESS + capacity addition to existing

(e) Integrate a BESS together with a Greenfield power plant that is operating in coordination with a PSP. The BESS is located at site of the greenfield renewable power plant.	plant is eligible under solar photovoltaic.
The project activity may include renewable energy power plant/unit of one of the following types: • 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;	The project activity is the construction and operation of a solar photovoltaic power plant and hence the methodology is applicable.
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.	The project activity does not involve any capacity additions, retrofits, rehabilitations or replacements.
In case of Greenfield project activities applicable under paragraph 7 (a) above, the project participants shall demonstrate 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)	Not applicable as the BESS is not implemented as part of a greenfield project but a capacity addition
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	The BESS is mainly charged with electricity generated from the associated renewable energy power plant. Grid imported energy is only used on a minority basis, and corresponding GHG emissions shall be accounted for as project emissions. Also, it should not amount to more than 2 per cent of the electricity generated by the project renewable energy plant during a monitoring period.
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 (3) of the methodology ACM0002, is greater than 4 W/m^2; or	Not applicable as the proposed project activity involves a solar photovoltaic power plant.

(c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3) of the methodology ACM0002, is greater than 4 W/m^2; 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 (3) of the methodology ACM0002, is lower than or equal to 4 W/m^2, and all of the following conditions shall apply: - The power density calculated using the total installed capacity of the integrated project, as per equation (4) of the methodology ACM0002, is greater than 4 W/m^2; - Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; - Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 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.	
In the case of integrated hydro power projects, project proponent shall: - 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 - 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 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 five years prior to implementation of CDM project activity.	Not applicable as the proposed project activity involves a solar photovoltaic power plant.
The methodology is not applicable to: - 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; - Biomass fired power plants/units.	The proposed project activity neither involves - 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, nor - biomass fired power plants/units.
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 project activity does not involve capacity additions,

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".	retrofits, rehabilitations or replacements.
In addition, the applicability conditions included in the tools referred to above apply.	Applicability conditions of the applied tools are justified.

3.3 Project Boundary

Not applicable (see registered CDM-PDD)

3.4 Baseline Scenario

Not applicable (see registered CDM-PDD)

3.5 Additionality

Dimension	Impact
Applicability of methodology ACM0002, V.22	Para 2.2.7 (b) of the methodology : In case the project activity involves the integration of a BESS, the methodology is applicable to grid-connected renewable energy power generation project activities that integrate a BESS The project activity involved the integration of a BESS, together with implementing a capacity addition to an existing solar photovoltaic plant. This applies here as the BESS system has been developed in the context of the capacity addition of the Ambatolampy solar initial plant. Such applicability is confirmed by table 2. of combinations applicable for integration : BESS + capacity addition to existing plant is eligible under solar photovoltaic. Other applicability conditions include, section 2.2.8 : (a) Solar power plant ; (b) Is only applicable for projects that are not wind, solar, wave or tidal power capacity addition projects (c) Is not applicable as the BESS is not implemented as part of a greenfield project but a capacity addition (d) The BESS is mainly charged with electricity generated from the associated renewable energy power plant. Grid imported energy is only used on a minority basis, and corresponding GHG emissions shall be accounted for as project emissions. Also, it should not amount to more than 2 per cent of the electricity generated by the project renewable energy plant during a monitoring period. (e) For other criteria please see section 3.2
Additionality	Registered CDM Project Design Document used the presence of solar photovoltaic technologies in the positive list[16] to confirm additionality. Since

[16] See https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v1.pdf/history_view

these technologies were excluded from the list in 2022, another approach is used to demonstrate additionality for this deviation:
According to the methodology, para. 36 of section 5.3.2 the additionality of the project activity shall be demonstrated and assessed using the TOOL01. In the methodological TOOL01 version 07.0.0, the step 0 is the demonstration whether proposed project activity is the first-of-its-kind. Para 16 of section 4.1 says that if the project activity apply measures that are listed in the definitions section above, the latest version of the "Guidelines on additionality of first-of-its-kind project activities" shall be applied to demonstrate that the project activity is the first-of-its-kind. The latest active tool that enables the demonstration of 'first-of-its-kind status is tool23, version 03.0.
"Ambatolampy Solar PV" is a first-of-its-kind project activity, as demonstrated below :
In the applicable geographical area – the entire country of Madagascar – Ambatolampy Solar PV is the first solar PV project of this capacity. This fact was valid at the time of its registration as a 20MW solar power plant on May 3rd, 2019, and remains unchanged now that its capacity amounts to 40MW in 2023. Although a few solar power stations projects emerged in Madagascar, several are still under development, and none of them is, or will be able to deliver the same electricity output[17]. Ambatolampy remains the only large-scale plant of this technology. The project is implementing one measure of the mentioned technology: solar PV as power generation based on renewable energy, as described in section 9.b) of the FOIK tool, and crediting period for the project activity is updated to 10 years with no option of renewal.
Requirements for FOIK demonstration are summed up in the table below :

Definitions as per Annex 7 of CDM-EB-69	Applicable area	Entire host country of Madagascar
	Measure	Switch of technology with change of energy source (b) power generation based on renewable energy
	Output	Goods/services produced by the project activity: Electricity
	Different technologies	Size of installation (power capacity) (c) Large (iii)
	Evidence	As of project's start date, no other large-scale solar power plant (>15 MW) is in commercial operation in Madagascar

Therefore, the requirements (a), (b) and (c) are fulfilled and the proposed project is a first-of-its-kind project activity and according to section 5.2.13

[17] The Electricity Regulatory Office of Madagascar was contacted in order to obtain an updated list of Malagasy plants. They responded in early 2024 and transmitted an updated version, which confirms the inexistence of any solar plant with a similar electricity output. The same list is transmitted to VVB. Same constant status can be seen on the International Energy Agency website, on the profile of Madagascar : https://www.irena.org/-/media/Files/IRENA/Agency/Statistics/Statistical_Profiles/Africa/Madagascar_Africa_RE_SP.pdf

	of the methodological tool : Additionality of first-of-its-kind project activities v3, the project activity is additional. As per the methodological tool section 5 (c), carbon accountability of this project activity is 10 years with no option of renewal.
Appropriateness of the baseline scenario	The extension is a deviation of the initial registered VCS project, as the second phase of the VCS-registered project, and not a separate new capacity addition project. Therefore, the original baseline context and emission factor still apply.
Compliance with the applied methodology ACM0002, V.22.*0*	No impact, as the deviation remains compliant with all provisions of ACM0002, As stated section 3.2 and in upper row of table.

3.6 Methodology Deviations

No methodology deviations were applied.

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Not applicable (see registered CDM-PDD)

4.2 Project Emissions

Project emissions are calculated as follows:

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

Where:

PE_y	=	Project emissions in year *y* (t CO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (t CO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (t CO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year *y* (t CO_2e/yr)
$PE_{BESS,y}$		Project emissions from charging of a BESS using electricity from the grid or from fossil fuel electricity generators (t CO2e/yr)

$PE_{FF,y}$, is linked to the use of fossil fuels

$PE_{GP,y}$ and $PE_{HP,y}$ are equal to 0 as the project is an installation of a solar power plant with no auxiliary fossil fuel consumption.

In particular, ACM0002 §36 stipulates that for all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected.

$PE_{BESS,y}$: There are project emissions from the extension phase and its associated BESS battery system. The emissions resulting from the use of the electricity grid to charge it outside of daylight is considered thanks to the 'Consumption' data collection. This data includes, but is not limited to, electricity from the grid used during the night to charge the battery system. Using this data for PE(BESS) calculations is therefore conservative

4.3 Leakage

Not applicable (see registered CDM-PDD)

4.4 Estimated Net GHG Emission Reductions and Removals

According to the approved methodology ACM0002 ver.22.0, emission reductions are calculated as follows equation (17) :

$$\mathbf{ER_y = BE_y - PE_y}$$

Where:

ER_y = Emission reductions in year y (t CO_2e)

BE_y = Baseline emissions in year y (t CO_2)

PE_y = Project emissions in year y (t CO_2e)

Table 8: Calculation of emission reductions

	Value/Result	Source/reference
Total installed capacity	40 MWc	Project documents
Net electricity delivered to the grid ($EG_{PJ,y}$)	54,485 MWh/yr	Project documents (nominal average) $[EG_{PJ,y} = EG_{facility,y}]$
Grid emission factor ($EF_{grid,CM,y}$)	0.6703 tCO_2e/MWh	CDM-PDD section B.6.1.

Baseline emissions (BE_y)	36,521 tCO_2e	Section 3.1 $BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$
Project emissions (PE_y)	159 tCO_2e	Section 3.2
Emission reductions (ER_y)	36,362 tCO_2e	$ER_y = BE_y - PE_y$

Table 9: Summary of emission reductions

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2018 (from July 10th)	11,358	0	-	11,358
2019	23,751	0	-	23,751
2020	23,632	0	-	23,632
2021	23,513	0	-	23,513
2022	31,967	103	-	31,864
2023	45,993	273	-	45,720
2024	45,749	271	-	45,478
2025	45,503	270	-	45,233
2026	45,258	268	-	44,990
2027	45,014	267	-	44,747
2028 (until July 9th)	23,467	139	-	23,328
Total	365,205	1,590	-	363,615

5 MONITORING

5.1 Data and Parameters Available at Validation

Not applicable (see registered CDM-PDD)

5.2 Data and Parameters Monitored

Not applicable (see registered CDM-PDD)

5.3 Monitoring Plan

Not applicable (see registered CDM-PDD)

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Value applied:	**2018**: 15,029 ; **2019**: 31,958 ; **2020**: 9,478 ; **Total**: **56,465**
Comments	Electricity outputs is electronically recorded, stored and invoiced monthly to JIRAMA by GY Madagascar, based on main meter below (or back-up in case of main meter unavailability or default). The measurement devices of net electrical energy delivered to RI-Tana grid are both located before 20/63kV transformer at JIRAMA substation and feature the following specifications:

Meter designation:	Main	Back-up
Meter ownership:	JIRAMA	GreenYellow
Make:	Landis+Gyr Dialog	Landis+Gyr
Model:	ZMD402CT	ZMD405CT
Accuracy class:	0.2S (±0.2%)	0.5S (±0.2%)
Serial number:	38752127	95766898

6.2 Baseline Emissions

The monitoring period for which GHG emission reductions were achieved spans 10/07/2018 to 30/04/2020. Baseline emissions are calculated according to §4.1 methodological approach as the product of (i) the quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y ($EG_{facility,y}$ = Exports – Imports, in MWh/yr) and (ii) the combined margin CO_2 emission factor for grid connected power generation in year y ($EF_{grid,CM,y}$):

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

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 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 the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

$EG_{PJ,y} = EG_{facility,y}$ i.e. the quantity of net electricity generation supplied by the project plant to the grid, as monitored and displayed below on a monthly basis.

$EF_{grid,CM,y}$ = 0.6703 tCO_2/MWh, as the Project Proponent have calculated, the DOE validated and the CDM-EB registered.

Year	Exports	Imports	$EG_{facility,y}$	$EF_{grid,CM,y}$	BE_y
	MWh	MWh	MWh	tCO_2/MWh	t CO_2
juil-18	957 370	4 140	953	0,6703	**639**
aug-18	3 108 940	3 440	3 106	0,6703	**2 082**
sept-18	3 171 550	2 150	3 169	0,6703	**2 124**
oct-18	3 216 780	1 230	3 216	0,6703	**2 155**
nov-18	1 927 210	1 300	1 926	0,6703	**1 291**
déc-18	2 660 790	1 470	2 659	0,6703	**1 783**
jan-19	2 456 900	2 010	2 455	0,6703	**1 646**
feb-19	2 547 020	2 200	2 545	0,6703	**1 706**
mar-19	2 622 970	2 880	2 620	0,6703	**1 756**
apr-19	2 654 630	1 890	2 653	0,6703	**1 778**
may-19	2 328 640	2 410	2 326	0,6703	**1 559**
jun-19	1 690 850	2 680	1 688	0,6703	**1 132**
jul-19	2 541 360	3 650	2 538	0,6703	**1 701**
aug-19	3 027 010	3 300	3 024	0,6703	**2 027**
sept-19	2 860 290	2 010	2 858	0,6703	**1 916**
oct-19	3 153 780	1 810	3 152	0,6703	**2 113**

nov-19	2 976 130	840	2 975	0,6703	**1 994**
déc-19	3 126 240	1 680	3 125	0,6703	**2 094**
jan-20	2 202 730	880	2 202	0,6703	**1 476**
feb-20	2 474 460	1 500	2 473	0,6703	**1 658**
mar-20	2 478 520	1 320	2 477	0,6703	**1 660**
apr-20	2 327 740	1 360	2 326	0,6703	**1 559**
TOTAL	56 511 910	46 150	56 465,8		**37 847**

6.3 Project Emissions

No project emissions are expected as the project activity only involves renewable electricity generation from the solar power plant. Hence according to ACM0002 guidelines PEy = 0.

6.4 Leakage

As stated in the applicable methodology, no leakage emissions are considered, therefore LEy = 0.

6.5 Net GHG Emission Reductions and Removals

The monitoring period for which GHG emission reductions were achieved spans 10/07/2018 to 30/04/2020, split by vintage as follows:

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2018 (from July 10th)	10 073	-	-	10 073
2019	21 421	-	-	21 421
2020 (until April 30th)	6 353	-	-	6 353
Total	**37 847**	**-**	**-**	**37 847**