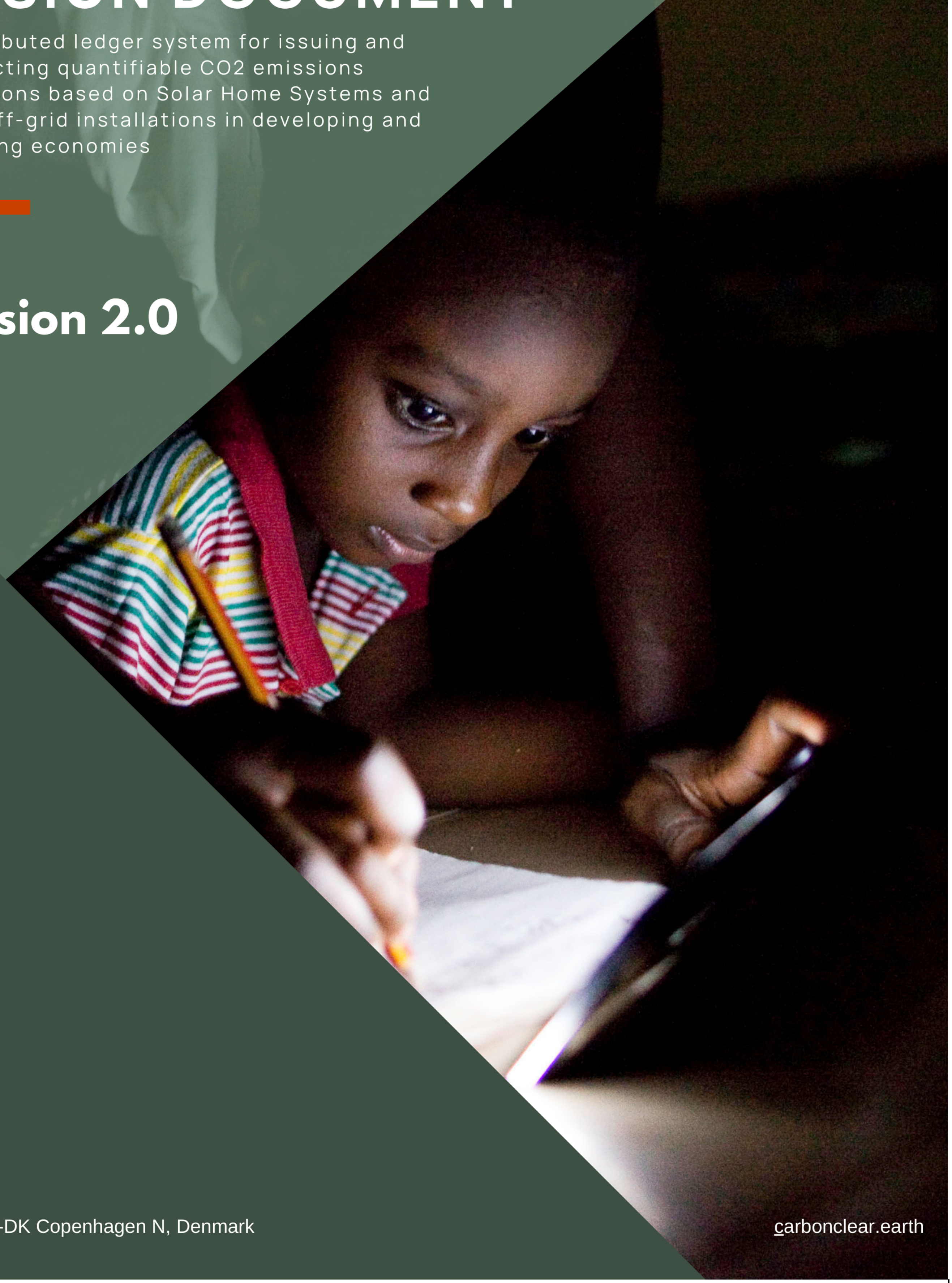
CarbonClear

PROGRAMME DESIGN DOCUMENT

A distributed ledger system for issuing and transacting quantifiable CO2 emissions reductions based on Solar Home Systems and solar off-grid installations in developing and emerging economies

Version 2.0



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carbonclear.earth

The following document has been verified by Det Norske Veritas (DNV) in detailing the company's chosen methodologies for quantifying CO_2 emissions within our solar projects. The contents of this booklet shall refer to the company using our previous brand name (Solstroem) instead of CarbonClear; however, it is important to note that all information remains relevant and true to CarbonClear.

Section 1 - Programme Details

1.1. Programme Goals, Design and Long-term viability

The purpose of the Solstroem programme is to enable the issuing of quantifiable CO2 emissions reductions based on the Solar Home Systems and solar off-grid installations deployed by programme partners in developing and emerging economies. These programme partners (solar companies) are registered business entities in their geographies of activity, whose primary business is to provide clean energy access to rural and otherwise unserved communities. The scope of application of the programme is restricted to geographies where the deploying of off-grid solar (primarily Solar Home Systems) through a lease-to-own or pay-as-you-go (PAYG) model is currently taking place or has the potential to be rolled-out. In practical terms this primarily means countries in Latin America, Africa, and South and Southeast Asia.

Implementing the Solstroem programme requires programme partners to join the Solstroem software platform. Here, the programme partners will transmit monitoring data of their solar installations to Solstroem, which in turn will apply codified CO2 calculations that transform this data into carbon avoidances that will be available for purchase by entities wishing to offset their CO2 emissions on a voluntary basis. The programme will allow the programme partners to generate a revenue stream from selling their emissions reductions, and to accelerate their rate of deployment of new solar installations, which will benefit user communities.

The Solstroem programme is set up in a way comparable to the CDM's Programme of Activities (PoA), where "it is possible to register the coordinated implementation of a policy, measure or goal that leads to emission reduction. Once a PoA is registered, an unlimited number of component project activities (CPAs) can be added without undergoing the complete CDM project cycle."

In this context, this means that the Solstroem programme is a coordinated implementation of a methodology, which allows for the quantification, and issuing of emissions reductions achieved by the project units (Solar Systems) that are added to the programme on an ongoing basis by the programme partners (Solar Providers).

The Solstroem programme is enabled by a software platform with a carbon registry at its core. It is this software platform that articulates the coordination modalities between programme participants (role allocation and monitoring) in a way that enables automated data-driven issuance of emissions reductions. The architecture of the software platform furthermore ensures the long-term viability of the programme, as it is based on Distributed Ledger Technology (DLT), and is designed to run on multiple synchronized servers maintained by various stakeholders in the off-grid solar industry. This means that should the programme proponent (Solstroem) go out of business, the registry will be able to continue operating.

1.2. Programme start date

The programme will start when the Solstroem software platform, and its underlying carbon registry, is launched and made available to buying customers. The programme start date is set at October 1st 2018.

1.3. Issuing boundaries for Project Units deployed by the Programme partners

Retrospectively, the programme accepts data transfers, which at the most date back to October 1st 2018. Transfers of data which dates further back than the programme starting date will automatically be discarded. On an ongoing basis, the programme accepts a rolling back-log of up to 2 years of data from each Project Unit deployed by a Programme Partner. Installations that are still operational, but which at the time of connection to the Solstroem system had been in operation for more than 2 years, can only issue avoidances that are based on data from the last 2 years. In alignment with the applied methodological calculations (presented in Section 3), the retrospective data received by the Solstroem programme will have to be made up of every individual data record having taken place over the given period, for the specific project units in question. Bulk, cumulative data, that cannot be associated with both a specific timestamp and geotag, cannot be accepted. Project Units that were deployed with a Lease-to-own model will only be eligible for exporting their data records from the time period before the ownership was passed onto the customer. Once ownership is passed onto the customer, the programme partner (solar provider) forfeits its claim over the carbon avoidances generated by the particular installation.

Prospectively, every connected Project Unit will issue micro carbon avoidances for as long as it remains connected to the monitoring system through which the programme software platform gets its data. Project Units "dropping off" the monitoring system will be assumed to be defective, and will stop issuing carbon avoidances immediately. Unlike traditional CDM projects, where bulk issuance of credits by the CDM EB only occurs every ±12 months, after a third-party verification is done on the monitoring data of the project/programme, the Solstroem programme is based on a Distributed Ledger System. This allows the programme to subject the data received from the programme partners to an automated internal verification, and to issue carbon offset credits on an ongoing basis, while only requiring external verification periodically. This external verification is done by DNV GL. Programme partners that run their operations efficiently and focus on the proper maintenance of their deployed Project Units will be rewarded by being able to generate avoidances for longer periods of time, whereas the ones with poorer quality hardware and poor service packages will see their installation go "off-line" faster.

1.4. Without-Programme scenario and additionality

According to GOGLA, the global association for the off-grid solar energy industry, we are still far from reaching Sustainable Development Goal 7 (SDG7) - affordable, reliable, sustainable and modern energy for all. Today, 840 million people still live without access to electricity and two billion more are estimated to live with unreliable supply. In their recent publication, "Powering Opportunity - Energising Work, Enterprise and Quality of Life with Off-Grid Solar", the association's findings were that "Electrification remains lowest in Sub-Saharan Africa with over 50% of the population living without access - 573 million people - while worldwide, rural areas lag behind urban areas with 79% of the rural population having access to electricity versus 97% of the urban population. According to the International Energy Agency (IEA) and other agencies tracking SDG 7, off-grid solutions provide the fastest and most cost-effective way to reach millions of people who are unconnected, particularly those in rural areas" (GOGLA, 2020).

The populations of un- and underserved referred to above, which are the targeted customer segments for the off-grid solar energy industry, are also the ones that the Solstroem programme sets out to support. In a baseline scenario, these users currently cover their energy needs (or parts of their needs) though the burning of high-emissions fossil fuels, primarily kerosene and diesel fuel, but also candles and logged firewood. The aggregate impact of burning these high-emissions fossil fuels cannot be understated. In a 2013 report, Ecologic Institute in Berlin estimated that kerosene lamps used in developing countries emit the equivalent of 270.000 tons of black carbon into the atmosphere each year, or roughly 4,5% of the CO_2 emissions of the United States.

Added to this, there remains an unmet need, even with the dirty baseline technologies. In fact, in certain remote deprived geographies, 4 in 5 households find the existing options cost prohibitive, and manage to survive with a suppressed energy demand. In order to make renewable energy a viable option to these populations, the solar providers that the Solstroem programme partners up with have been exploring alternative business models to traditional cash sales in order to deliver their products to the targeted users. Rather than cash sales, lease-to-own models and pay-as-you-go (PAYGo) models have emerged, aiming at lowering the access barriers for the unserved and vulnerable populations that they are serving. Despite a growing success of these models, particularly PAYGo, more efforts are needed. Indeed, in 2019, 1,19 million PAYGo units were deployed in rural areas across the developing world, which is a 19% increase compared to the previous year. Despite this, the financing gap in terms of the actual investment in off-grid electrification needed to live up to the targets enshrined in the Paris Agreement are lacking by a five-fold factor. And time is a seriously constraining factor. Therefore, efforts need to be aimed at accelerating the access to the types of services offered by the Solar Providers that Solstroem is partnering with.

Without the Solstroem program, the programme partners would continue deploying Solar Home Systems in the areas where they operate, as they have done so far. They will however not be able to:

- accelerate the rate at which they can deploy new systems, giving more communities access to renewable energy.
- lower of the rates paid by users of solar systems, thus making it more affordable for the ones that cannot afford their current offerings.
- demonstrate additional revenue streams when raising funds with institutional investors and others.

Project Units issuing emissions reductions under the Solstroem programme contribute to the realization of the three bullet points above, which makes them additional in the sense that these outcomes would not have taken place in a without-programme scenario. Monitoring of the specifics of the additionality for each project unit, and programme partner would require a number of reporting measures. However, since the project units are micro-scale and located in developing countries, some of which are LDCs, they can automatically be considered additional in accordance with the CDM simplified modalities for demonstrating additionality for project activities up to 5 megawatts that employ renewable energy as their primary technology. (EB63, Annex 23). More specifically, the project units are additional because: 8. (b): "The project activity is an off-grid activity supplying energy to households/communities (less than 12 hours' grid availability per 24 hours is also considered "off-grid" for this assessment)"

1.5. Management Capacity

Solstroem is registered as a limited liability company in Copenhagen, Denmark. In its role as programme (PoA manager) developer, Solstroem draws on a small staff in Copenhagen, and a distributed workforce internationally, that is remunerated on performance. The programme partners that Solstroem collaborates with, with the purpose of addressing the acceleration of access to renewable energy in developing countries, have been active in the domain for anything between 1 and 15 years. Their organizational capabilities have allowed them to deploy complex supply chains delivering last mile service to the otherwise unserved, and have led them to develop logistics systems that effectively monitor chain of custody, hardware maintenance, and payment management. Their specific operations, while contextual both geographically and otherwise, share a vision about serving the most vulnerable, and simultaneously promoting a leapfrogging toward energy infrastructures powered by renewable energy to the benefit of the climate and the users. It is the ambition of the collaborating parties to make the Solstroem programme the default solution for monetizing the emissions reductions achieved by the solar off-grid industry.

The partnership between (i) the PoA manager (Solstroem), designing and managing the proper execution of the programme, (ii) the programme partners (solar providers) implementing the programme, and (iii) the users of the project units deployed (end customers), is one of mutual benefit, where all parties collaborate in achieving a collective overall vision as embodied in the philosophy that Solstroem adheres to. More specifically, the Solstroem program is designed to support the solar providers who are active in the geographies of focus (developing countries), and who are aligned on the vision of accelerating the deployment of solar off-grid systems serving the needs of the most vulnerable. As such the PoA manager (Solstroem) is the entity whose responsibility it is to maintain the integrity of the programme, and to ensure that the selected programme partners are well equipped to take on a proper implementation of the programme. This involves adhering to specific legal obligation requirements (expanded in section 1.6.), as well as putting in place specific data transfer protocols, and practices that minimize the potential risk of malpractice. The programme partners whose profile, and management capabilities are deemed a good match for the Solstroem programme will be rewarded with an added revenue stream from selling the emissions reductions (micro carbon avoidances) that their deployment of solar systems has created. This new revenue stream will contribute to the expansion of the operations of the onboarded programme partners, to the advantage of the unserved populations to whom their services will now be available (or made more affordable).

The management capacity in place within Solstroem, as well as within the collaborating programme partners is currently adequate, and must at all times remain adequate to perform the tasks required to develop and manage the present programme. Failure to live up to the implementation responsibilities described throughout this programme design document, hereunder insufficient management capabilities, can potentially result in an exclusion from the programme.

1.6. Legal Status and Property Rights

In order to ensure that the Solstroem programme is implemented in accordance with its overall objective and claims, general considerations regarding (i) supply chain management, (ii) health and safety compliance, as well as compliance with (iii) labor laws and (iv) privacy laws are addressed.

Supply chain management: At the high-level, the Solstroem programme is agnostic to the specific procurement and supply chain management choices made by the programme partners. This means that the programme puts solar providers on equal footing regardless of how their supply chain is structured (integrated or not), and where (in which countries) they manufacture and assemble their solar systems. This being said, the programme emphasizes the need for the solar providers to be in compliance with local legislation in every jurisdiction that they operate in.

- Health and safety codes: Solstroem requires the programme partners to adhere to the health and safety codes in place in their geographies of operation.

- Labor laws: Solstroem requires the programme partners to adhere to the labor laws in place in their geographies of operation.

- Privacy laws: Solstroem requires the programme partners to adhere to the applicable privacy laws in effect in their geographies of operation. Solstroem furthermore commits to adhere to the privacy law requirements pertaining to the customers purchasing carbon avoidances through the Solstroem platform.

As part of the onboarding process, programme partners must share information about their supply chain, which will be treated confidentially. Furthermore, they must sign off on a statement in which they confirm the following:

- That they intend to comply with local legislation in every aspect in all the geographies in which they operate.

- That they keep records of health and safety incidents and cases that might occur in connection with the deployment of their solar systems, which can at a later stage be reviewed by Solstroem should there be a need for it.

- That they have training programmes in place for their operational staff aimed at minimizing health and safety risks, and that data about these training programmes can be shared with Solstoem at a later stage if the need occurs.

- That their recruitment and remuneration practices are aligned with the laws of the jurisdictions in which they operate.

- That they enforce data privacy of their users in accordance with the laws in effect in their specific jurisdictions of operation.

Section 2 -
Application of methodology

2.1. Applied methodology

The present programme applies a slightly amended version of the CDM “Small Scale Methodology: Electrification of rural communities using renewable energy” (AMS-I.L version 3.0). The methodology is adapted to fit the present application, which is enabled by an underlying software system and registry. This is done by allowing for (i) the codification of the formulas into time increments smaller than yearly calculations, and (ii) the ability to perform continuous monitoring of the project units via payment as well as meter data. The specific calculations, and standardized baselines, in the applied methodology are absolutely similar to the ones in the small-scale methodology from which they originate.

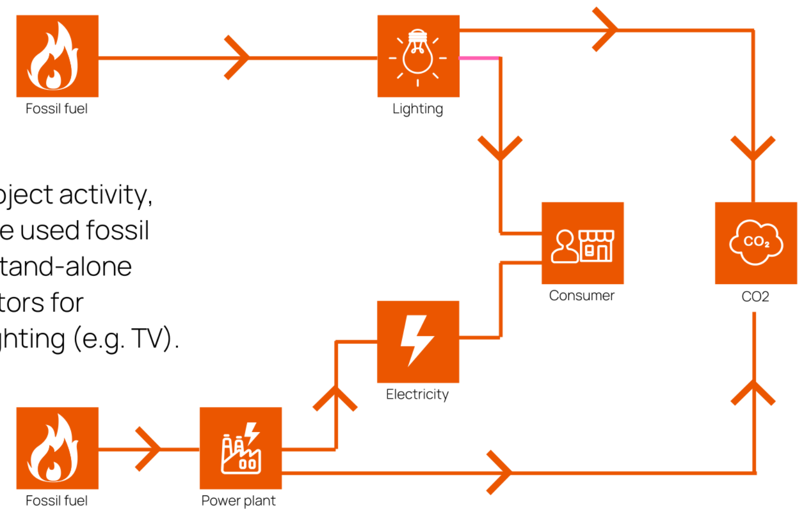
The minor amendments to the above mentioned CDM methodology are in alignment with ISO 14 064-2:2019, which details principles and requirements for determining baselines, and monitoring, quantifying and reporting of project emissions. It focuses on GHG projects or project-based activities specifically designed to reduce GHG emissions and/or enhance GHG removals. It provides the basis for GHG projects to be verified and validated.

2.2. Baseline scenario, project scenario, and added socio-economic co-benefits

The Solar Home Systems deployed by the programme partners are targeting low-income households in all regions. In these particular geographies of deployment, the baseline scenario comprises the usage of fossil fuels that are highly CO2 emitting (Kerosene, diesel, candle lights, disposable torch batteries, etc.), as well as in some cases, simpler forms of PV powered solutions, such as transportable solar lamps.

Baseline scenario:

In the absence of the project activity, the end users would have used fossil fuel based lighting and stand-alone diesel electricity generators for appliances other than lighting (e.g. TV).



Project scenario:

End users are supplied with electricity from renewable based energy systems (e.g. solar home systems or renewable mini-grid).

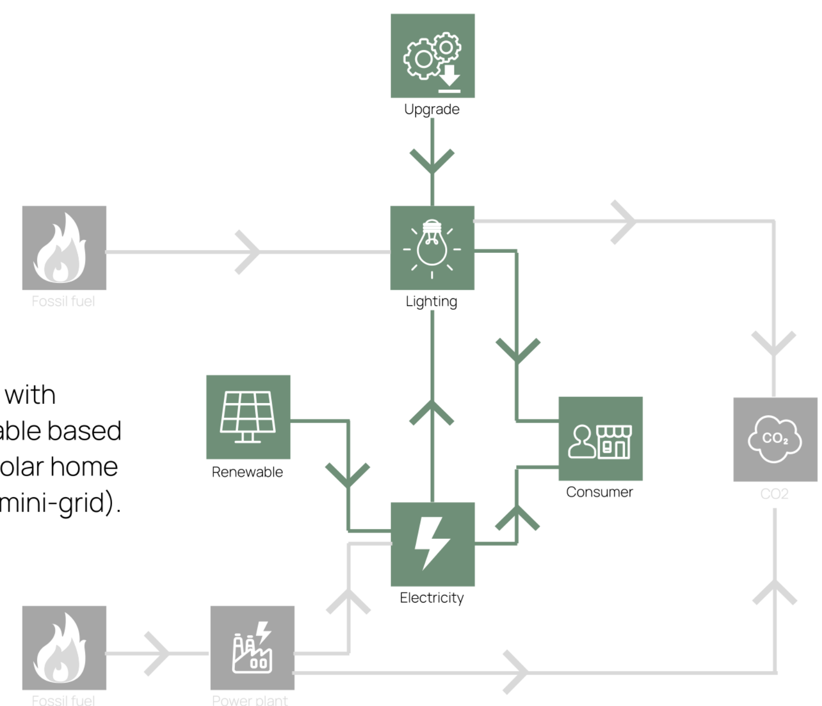


Figure 1: “Small Scale Methodology: Electrification of rural communities using renewable energy” (AMS-I.L) (CDM Methodology Booklet November 2019, p 180 https://cdm.unfccc.int/methodologies/documentation/meth_booklet.pdf#AMS_I_L)

According to GOGLA, the association for the solar off-grid energy industry, 65% of all new SHS customers in 2020 did not previously use any solar product in (see Figure 2 below). In a no-project scenario, these targeted communities would spend a larger part of their income on lighting, than they would in a scenario where they subscribe to a solution offered by a Solstroem programme partner (Project scenario in figure 1 above). By displacing their previous sources of energy, not only will the households contribute positively to the climate through quantifiable emissions reductions, they will also be able to achieve considerable financial savings, create jobs and undertake additional economic activities, improve health and safety, and get access to mobile and financial services. In other words, the Solstroem programme not only delivers impactful emissions reductions, but it also provides considerable socio-economic co-benefits.

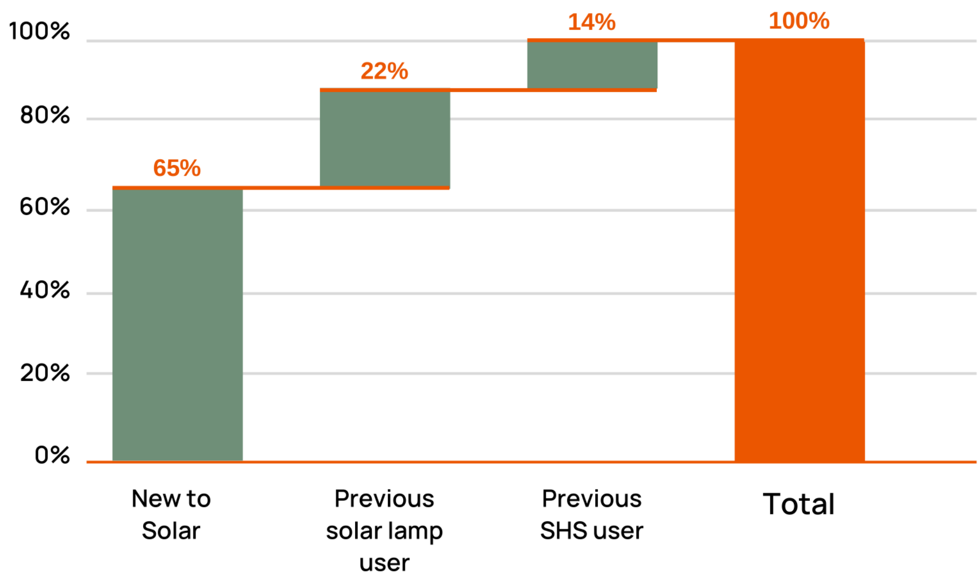


Figure 2: Energy staircase (GOGLA, "Powering Opportunity", May 2020)

<u>Customer profiles:</u> Of the served customers in East Africa, 59% report earning less than $3.20 per day. This figure is 42% in West Africa and 18% in South Asia (GOGLA, "Powering Opportunity", May 2020). Average household sizes range from 5.6 in East Africa to 7 in West Africa, meaning that SHS are benefitting several people in each home. In all countries and regions, the average size of households with off-grid solar are larger than the national average.

<u>Household Savings:</u> When basic solar lights replace kerosene lamps, battery powered torches or candles, they lead to cost savings of around 4% of total household income. A recent study in rural Kenya found that, on average, households spend 3% of income on lighting on average, rising to 8% ($1.60 per month) for the poorest quintile. With the acquisition of a solar light, the average number of kerosene lamps in use drops from 2.2 to 1.3, and expenditure on energy drops by 40-60% ($0.96 per month on average). Households with solar lights that charge phones make additional savings on phone-charging. To date, sales of solar lanterns and multi-light kits by GOGLA Members and Lighting Global affiliates will save off-grid households an estimated $8 billion in energy expenditure over the product lifetime.

Aggregate savings (examples): according to UNEP en.lighten, Kenya imports 853 million liters of kerosene, 464 million candles and 114 million batteries costing around $896 million per year. This is the equivalent to 6.3 million barrels of crude oil energy. A significant portion of this could potentially be saved by adopting off-grid solar as an alternative. For countries that subsidize kerosene for lighting, there are also significant savings on kerosene subsidies. For example, since 2009 the government of India has gradually reduced expenditure on kerosene subsidies, saving over half a billion dollars between 2015-16 and 2016-17, when expenditure dropped from $1.8 billion to $1.18b.

Job creation and economic activities: According to a 2016 study by the International Renewable Energy Agency, IRENA, the solar off-grid industry is creating tens of thousands of jobs along the value chain. Globally, the decentralized renewable energy industry, including both mini-grids and standalone solutions, is expected to directly employ 3.5 million people by 2030 (Renewable Energy and Jobs – Annual Review 2016). Within market countries, the off-grid sector employs both full-time staff and agents in management, logistics, finance, sales, marketing, retail, engineering and software development. Job growth has been driven by market growth in the sector. Focusing on the household level, a 2018 study (GOGLA and Altai Consulting, 2018) found that 7% of households owning an SHS reported that ownership of such a system had enabled a family member to take on a new job. Among 44% of households, an SHS also unlocked more time for people to work, and 24% of households use the energy generated directly in a business or other income-generating activity.

Health and safety: The microfinance organization FINCA International's 2018 study in Uganda paints a stark picture of health and safety in energy poor households that use kerosene for lighting, explaining: "Life is... dangerous and unhealthy. In Uganda, single-wick lanterns are responsible for 70% of fire incidents and 80% of burn injuries. Kerosene, a clear fluid in plastic bottles, spoils food and is accidentally ingested by children. Meanwhile, fuel combustion releases hundreds of pollutants into the air, including carbon monoxide, formaldehyde and benzene, along with a myriad of other damaging particles" (Perceived Health Benefits of Off-Grid Products: Results of an end user survey in Uganda, FINCA International, 2018). The customers of organization's nearly 800 Ugandan solar home systems and lanterns describe the variety of health improvements they felt after they switched from kerosene to off-grid solar, including fewer burns and eye problems, as well as reduced respiratory problems. 95% of solar home system customers reported health and safety improvements once they switched to off-grid solar.

Access to mobile and financial services: Research by the industry association for mobile network operators, GSMA (the global association for mobile operators), has concluded that PAYG is accelerating adoption of mobile money through helping to scale agent networks in off-grid areas; helping to acquire new customers; facilitating digital financial literacy and generating frequent account activities. It is estimated that globally, PAYG solar generates close to 1.6 million mobile money transactions per month (Mobile for Development Utilities: Lessons from the use of mobile in utility pay-as-you-go models, GSMA, January 2017).

The PAYG model enables companies to collect data on customer power, consumption patterns, and create credit history for the unbanked. PAYG-enabled credit scoring is making it possible for customers with no formal financial history to access loans, savings and credit products. Towards the end of their payment term, customers with positive credit ratings have the opportunity to access products such as fuel-efficient stoves, rainwater harvesting tanks, smartphones, TVs, water pumps, bicycles or school fee loans.

2.3. Suppressed energy demand and standardized baselines

Suppressed demand arises when the actual demand of user groups (mostly households) is insufficient to meet their basic human needs due to low income (income effect), inadequate infrastructure, the high costs of technology, or a combination of these. In many LDCs, household consumption is constrained by these factors and, as a result, their basic human needs go unmet. As the situation improves, for example, incomes start rising, consumption levels are likely to go up as well and over time basic human needs will be duly met. Moreover, as technology costs go down and energy efficiency goes up, households may start using more services (rebound effect). At present there are no accurate methods to estimate suppressed demand or define basic (that is, minimum) human needs or levels for services such as lighting and cooking.

The AMS-I.L v3.0 methodology that is used by the programme, however, takes into account suppressed demand through a standardized baseline. Standardized baselines allow setting a baseline that is not necessarily specific to one type of project activity, but can be applicable to most of the possible project activities in a sector. Furthermore, the applied methodology exempts the need for additionality demonstration for each project unit ex-post, but allows for a standardized ex-ante confirmation of specific criteria applicable to all project units. For this PoA, the AMS-I.L. v3.0 methodology automatically deems the totality of solar systems deployed under the programme to be additional given their size (< 1500 KW), application (household/communities), and in some cases project location (LDCs).

In terms of standardized baseline, the AMS-I.L v3.0 methodology applies a tiered emissions factor ladder, that allocates higher factors to smaller project units up until a Minimum Service Level (MSL) that corresponds to thresholds established by national/international peer-reviewed research or relevant studies and benchmarks. These take into account that emissions will rise to achieve the international/national development goals. Therefore, the applied methodology estimates an MSL based on a lighting service equivalent to two 15 W CFLs run for five hours per day for 365 days, one 100 W fan/TV run for five hours per day for 365 days and a 10 W radio run for five hours per day for 365 days. This leads to an estimated electricity consumption of 250 kWh per user per year in order to cover basic human needs (report of the 35th meeting of the CDM Small-Scale Working Group, annex 5, para. 2).
https://cdm.unfccc.int/Panels/ssc_wg/meetings/035/ssc_035_an05.pdf

2.4. Programme of Activities: Allocation of roles

The AMS-I.L v3.0 Methodology applied is applicable as a Programme of Activities as defined by the CDM. In this connection the following will ensure that it is clear which entities are responsible for which parts of the methodology. The structure of the programme and role allocation is covered below.

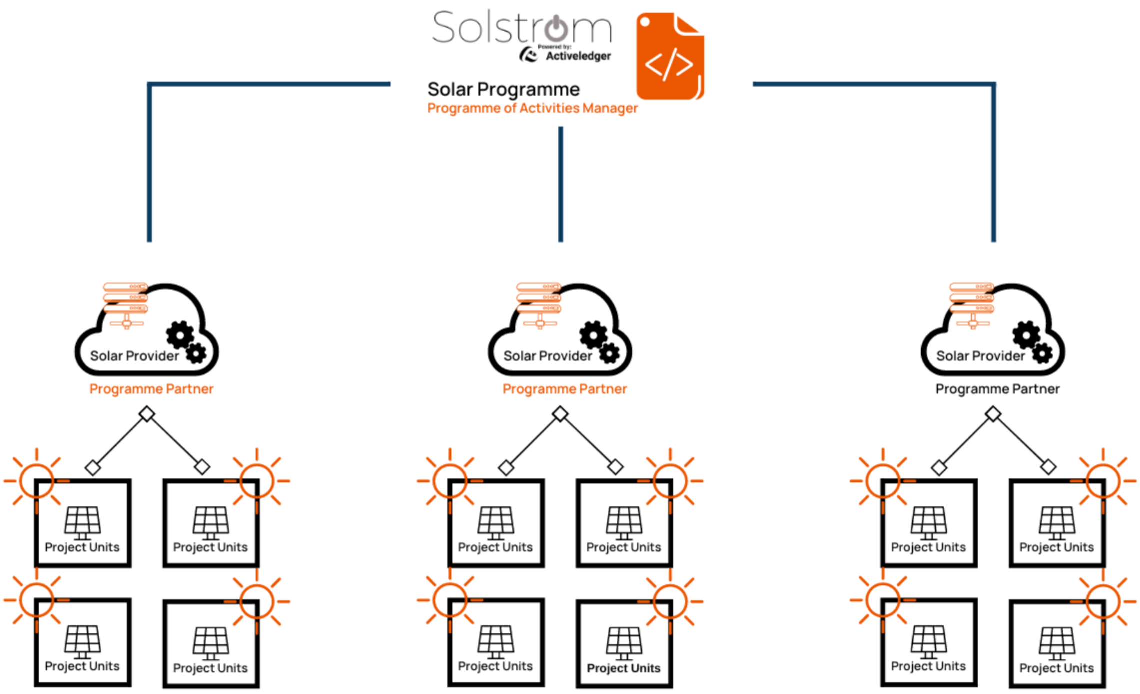


Figure 3: Stucture of the Solar Programme

2.4.1 Solstroem Programme (Programme Developer):

- Sets overall guidelines for the programme
- Develops carbon methodologies
- Translates carbon methodologies into code
- Develops and maintains IT infrastructure
- Performs due diligence on programme partners
- Accepts or reject programme partners based on due diligence
- Monitors programme partners
- Receives data from programme partners
- issues Micro Carbon avoidances
- Maintains the Solstroem Registry

2.4.2 Solar Providers (programme Partners)

- Implements Solstroem programme
- Commits to the programme and requirements that Solstrøm has set out in the agreement.
- Deploys, owns and/or operates Project Units
- Monitors Project Units
- Transmits data fo Programme Developer
- Agrees that the issuing of MCAs starts when the Program Partner joins the Solstroem programme, and the solar system is installed and connected to the monitoring software of the Program Partner.
- Contractually obliged to demonstrate good data handling procedures
- Uses the revenues from sales of MCAs generated by owned/operated Project Units (minus fees to Programme Developer) to enable an increased deployment of solar systems.

2.4.3 Project units (households)

- Signup the offering of the programme partner (Pay-as-you-go or lease-to-own)
- Allow the installation, use and maintenance of the solar system in line with the instructions of the programme partner.
- Buy electricity in line with the Programme partner's payment schedule.
- Commit not to default on their payment obligations.

Section 3 - Quantification of GHG Emission Reduction and Removals

This section will present (i) how the baseline calculations set forth in the applied CDM AMS-I.L. v3.0 methodology are expressed in the context of the Solstroem programme, (ii) how these baselines are quantified, and (iii) how the high-level yearly equations are adapted to allow for the quantification of emissions reductions associated with the particular data readings that are received via digital data transfer protocols from the Programme partners on an ongoing basis.

3.1. Overall baseline calculation:

The yearly baseline emissions calculation applied in the Solstroem Programme is a multiplication between two basic factors, (i) electricity consumption and (ii) emissions factor. The calculation uses the following equation:

$$BE_y = EG_{x,y} \times EF_{CO2}$$

Where:

$EG_{x,y}$	=	Electricity consumed by Project Unit solar system x in year y (MWh) - (variable values based on measurements)
EF_{CO2}	=	Emissions factor (t CO_2/MWh) - (default values taken from the AMS.I.L methodology)
X	=	Project Unit supplied with renewable electricity from solar system in year *y*

The applied baseline emission factors are default values taken from the AMS.I.L v3.0 methodology. At a high level, the following are the baseline emission factors for each tier of annual amount of renewable electricity consumed per Project Unit on an ongoing basis:

- For the first 55 kWh of renewable electricity consumed by each Project Unit solar system, the baseline emission factor is 6.8 (t CO2/MWh);
- For the Project Unit consumption more than 55 kWh but equal to or less than 250 kWh, the baseline emission factor is 1.3 (t CO2/MWh) for the tranche between 55 and 250 kWh;
- For the Project Unit consumption beyond 250 kWh, the baseline emission factor is 1.0 (t CO2/MWh) for the tranche beyond 250 kWh.

The Solstroem programme does its baseline calculations, based on the AMS.I.L v3.0 methodology, in time intervals smaller than yearly. This allows for automatic internal verification of the applied calculations by the Solstroem software system on an ongoing basis (for each data reading), and for the subsequent issuing of carbon offset credits associated with that particular data reading. In order to do that, we convert the yearly baseline emission factors presented above into smaller increments. Going forward, daily baseline emissions factors are applied as follows (note that the metrics are set in Wh and g CO2e respectively, and not MWh and tCO2e as in the yearly equations presented above):

- For the first 150.5817 Wh of renewable electricity consumed by each Project Unit solar system, the baseline emission factor is 6.8 (g CO2/Wh);

- For the Project Unit consumption more than 150.5817 Wh but equal to or less than 684.4626 Wh, the baseline emission factor is 1.3 (g CO2/Wh) for the tranche between 150.5817 and 684.4626 Wh;

- For the Project Unit consumption beyond 684.4626 Wh, the baseline emission factor is 1.0 (g CO2/Wh) for the tranche beyond 684.4626 Wh.

3.2. Equations specifying how baseline emissions are calculated in the Solstroem Programme:

3.2.1. For Project Units that on a daily basis consume equal to or less than 150.5817 Wh, Equation (1) or Equation (2) is selected, depending whether the daily electricity consumption is a variable based on meter data, or a constant based on maximum available daily capacity. Baseline emissions when applying equation (1) and (2) are calculated as follows:

Equation (1): Where daily consumption is a variable based on meter data.

$$BE_{150,d} = EG_{x,d} \times EF_{CO2,150}$$

Where:

$EG_{x,d}$	=	Electricity consumed by Project Unit solar system x in day d, where the electricity consumed by that facility is equal to or less than 150.5817 Wh in day *d.*
$EF_{CO2,150}$	=	6.8 (g CO_2/Wh)
X	=	Project Unit supplied with renewable electricity from solar system in an amount equal to or less than 150.5817 Wh in day d

Equation (2): Where daily consumption is a constant based on maximum available daily capacity.

$$BE_{150,d} = DA_y \times (EG_{y,d} \times EF_{CO2,150})$$

Where:

DA_y	=	Days of electricity made available to the user of a Project Unit y. DA_y can either be expressed as days available out of a given time interval *ti* ($DA_{y,ti}$), or as days available per payment amount *pa* made ($DA_{y,pa}$)
$EG_{y,d}$	=	Electricity consumed by Project Unit solar system x in day d, where the electricity consumed by that facility (based on maximum available daily capacity) is equal to or less than 150.5817 Wh in day *d.*
$EF_{CO2,150}$	=	6.8 (g CO_2/Wh)
y	=	Project Unit supplied with renewable electricity from solar system in an amount equal to or less than 150.5817 Wh in day d

Equation (3): Where daily consumption is a variable based on meter data.

$$BE_{684,d} = \left(\left(EG_{x,d} - 150.5817\right) \times EF_{CO2,684} + C\right)$$

Where:

$EG_{x,d}$	=	Electricity consumed by Project Unit solar system x in day *d*, where the electricity consumed by that facility is more than 150.5817 Wh but equal to or less than 684.4626 Wh in day *d*.
$EF_{CO2,684}$	=	1.3 (g CO_2/Wh)
x	=	Project Unit supplied with renewable electricity from solar system in an amount higher than 150.5817 Wh but equal to or less than 684.4626 Wh in day d
C	=	1023.9555 (g CO_2), a constant calculated as (150.5817 Wh x 6.8 g CO_2/Wh)

Equation (4): Where daily consumption is a constant based on maximum available daily capacity.

$$BE_{684,d} = DA_y \times \left(\left(EG_{y,d} - 150.5817\right) \times EF_{CO2,684} + C\right)$$

Where:

DA_y	=	Days of electricity made available to the user of a Project Unit y. DA_y can either be expressed as days available out of a given time interval *ti* ($DA_{y,ti}$), or as days available per payment amount *pa* made ($DA_{y,pa}$)
$EG_{y,d}$	=	Electricity consumed by Project Unit solar system y in day *d*, where the electricity consumed by that facility (based on maximum available daily capacity) is more than 150.5817 Wh but equal to or less than 684.4626 Wh in day *d*.
$EF_{CO2,684}$	=	1.3 (g CO_2/Wh)
y	=	Project Unit supplied with renewable electricity from solar system in an amount higher than 150.5817 Wh but equal to or less than 684.4626 Wh in day d
C	=	1023.9555 (g CO_2), a constant calculated as (150.5817 Wh x 6.8 g CO_2/Wh)

3.2.3. For Project Units that on a daily basis consume more than 684.4626 Wh, Equation (5) or Equation (6) is selected, depending whether the daily electricity consumption is a variable based on meter data, or a constant based on maximum available daily capacity. Baseline emissions when applying equation (5) and (6) are calculated as follows:

Equation (5): Where daily consumption is a variable based on meter data.

$$BE_{684\,plus,d} = \left((EG_{x,d} - 684.4626) \times EF_{CO2,684\,plus} + D\right)$$

Where:

$EG_{x,d}$	=	Electricity consumed by Project Unit solar system x in day *d*, where the electricity consumed by that facility is more than 684.4626 Wh in day *d*.
$EF_{CO2,684\,plus}$	=	1 (g CO_2/Wh)
x	=	Project Unit supplied with renewable electricity from solar system in an amount higher than 684.4626 Wh in day *d*.
D	=	1718.0007 (g CO_2), a constant calculated as (150.5817 Wh x 6.8 g CO_2/Wh) + (533.8809 Wh x 1.3 g CO_2/Wh)

Equation (6): Where daily consumption is a constant based on maximum available daily capacity.

$$BE_{684\,plus,d} = DA_y \times \left((EG_{y,d} - 684.4626) \times EF_{CO2,684\,plus} + D\right)$$

Where:

DA_y	=	Days of electricity made available to the user of a Project Unit y. DA_y can either be expressed as days available out of a given time interval *ti* ($DA_{y,ti}$), or as days available per payment amount *pa* made ($DA_{y,pa}$)
$EG_{y,d}$	=	Electricity consumed by Project Unit solar system y in day *d*, where the electricity consumed by that facility (based on maximum available daily capacity) is more than 684.4626 Wh in day *d*.
$EF_{CO2,684\,plus}$	=	1 (g CO_2/Wh)
y	=	Project Unit supplied with renewable electricity from solar system in an amount higher than 684.4626 Wh in day *d*.
D	=	1718.0007 (g CO_2), a constant calculated as (150.5817 Wh x 6.8 g CO_2/Wh) + (533.8809 Wh x 1.3 g CO_2/Wh)

3.3. Applying the methodology equations to data records received from Programme Partners via API:

When applying the methodology equations to the data readings received from the programme partners, the Solstroem programme uses two different approaches, depending on the type of data received: (1) meter data, or (2) payment data. Both approaches result in electricity consumption monitoring (direct or by-proxy) that is at a level of granularity sufficient enough to be able to issue carbon avoidances based only on the periods when the solar system is in use, thus substituting the need to add a standardized availability factor to the calculation. More about this in the monitoring section, 3.3.1. Option1: The data is expressed in energy consumed by the user over a given time period (Wh)

Under this option, the data received is the result of an ongoing monitoring of the electricity consumption (meter data). In this case, the amount of energy consumed is simply entered into the appropriate equation, which should be selected based on the size of the daily availability of the solar system in question.

The daily consumption for a given solar system will determine which emissions factor equation to apply in order to calculate the daily CO2 emissions reductions for that particular solar system. The tiers devised in the applied methodology will apply, i.e. (a) below 150.6850 Wh/day, (b) between 150.6850 and 684.9351 Wh/day, and (c) above 684.9351 Wh/day. The tiers will imply the application of equations (1), (3) and (5) respectively.

Example 1: 80W panel with a 260Wh daily capacity, which has consumed 190Wh in a given day:

In this case, the consumption measurement is based on live metering. Based on the daily consumption registered in that particular day, equation (3) will be applied:

Equation (3):

$$ER_{684,d} = \left(\left(EG_{x,d} - 150.5817\right) \times EF_{CO2,684} + C\right)$$

Equation applied to this example:

$$ER_{684,pp} = \left((190 - 150.5817) \times 1{,}3 + 1023.9555\right) = 1075.1992\ g\ CO2e$$

For the particular day of use, the Solstroem programme will issue a carbon record of 1075 g of CO2e, which will be stored on the Solstroem registry.

3.3.2. Option 2: The data measurement is expressed in an amount of time that the solar system has been available to the user over the course of the measurement period.

Under this option, the time that the solar system has been available to the user (number of days) has to be multiplied by the daily emissions reductions generated by the particular type of solar system. But before doing that, the appropriate equation needs to be chosen. Depending on the capacity of the given solar system, equations (2), (4), (6) will apply. Below is an illustrative example that applies the carbon calculation to this particular data measurement option.

Example 2: A 50Wp solar system with a daily available capacity of 175Wh. The user of the solar system has in a 30-day period had her solar system switched on 24 days (monitored by the programme partner).

This formula would be applicable in cases where the measurement data received by the Solstroem programme is based on meter data, and expressed in daily increments, i.e. numbers of days in use out of a given period.

In this case, the calculation is based on the maximum daily available capacity (175Wh), which puts the system in tier (b) thus equation (4) will be applied:

Equation (4):

$$ER_{684,d} = DA_y \times \left(\left(EG_{y,d} - 150.5817 \right) \times EF_{CO2,684} + C \right)$$

The number of days available DA_y in this particular case is expressed as a "period of electricity available, out of a given time interval" ($DA_{y,ti}$), in this case the time interval is 30 days.

$$ER_{684,pp} = DA_{y,ti} \times \left(\left(EG_{y,d} - 150.5817 \right) \times EF_{CO2,684} + C \right)$$

Where:

$ER_{684,pp}$	=	Emissions reductions per payment period pp for a project unit with a daily electricity consumption in the 150.5817 – 684.4626 Wh bracket (in g CO2e)
$DA_{y,ti}$	=	Days of electricity available to Project Unit solar system y in time interval ti (days)
$EG_{y,d}$	=	Electricity consumed by Project Unit solar system yin day d (kWh)
$EF_{CO2,684}$	=	1.3 (g CO2/Wh)
C	=	1023.9555 (g CO_2), a constant calculated as (150.5817 Wh x 6.8 g CO_2/Wh)

Equation applied to the case:

$$ER_{684,pp} = 24 \times \left((175 - 150.5817) \times 1.3 + 1023.9555 \right) = 25336.7829\ g\ CO2e$$

For the 24 days that the solar system was in use out of a 30-day period, the Solstroem programme will issue a carbon record of 25336 g of CO2e, which will be stored on the Solstroem registry.

Option 3: The data measurement is expressed in a numeric amount in a given currency, which the user of the solar system has spent in order to unlock her system for a given period of time.

Under this option, the time that the solar system has been available to the user (number of days) has to be determined by converting the amount paid by the user into an availability period (in days or hours). The ID of the specific payment is linked to the ID of the solar system for which the payment is made, thus the same payment cannot activate multiple solar systems, meaning that "double consumption" of electricity, as well as "double issuing" of Micro Carbon avoidances is not possible. In this scenario it is assumed that payment codes purchased by the user will be activated, and that the availability period paid for by the user will be consumed. Considering that the users in question spend upwards of a third of their income to get access to electricity, we expect them not to be wasteful with their purchased codes, and to make use of all the electricity that they have purchased.

The availability period paid for by the user, will then, as in example 2 above, be multiplied by the daily emissions reductions generated by the particular type of solar system in use. Similarly to the examples previously stated, the first step will be to select the appropriate equation to be applied. Below is an illustrative example that applies the carbon calculation to this particular data measurement option.

Example 3: A 325Wp solar system with a daily available capacity of 1200 Wh, where the user of the solar system has made a payment of 50 pesos, and where the cost per day for using such a system is 6.5 pesos. As mentioned above, the payment is linked to the solar system ID.This formula would be applicable in cases where the payment data received by the Solstroem programme is based on variable numerical payment amounts made by the user of a given solar system. In this case, the daily available capacity of the system puts it in tier (c), thus equation (6) will be applied:

Equation (6):

$$ER_{684\ plus,d} = DA_y \times \left((EG_{y,d} - 684.4626) \times EF_{CO2,684\ plus} + D\right)$$

The number of days available DA_y in this particular case is expressed as a "number of days available as a result of the payment" ($DA_{y,pa}$). In this case, $DA_{y,pa}$ is calculated as the payment amount divided by the cost per day - $DA_{y,pa} = (PA_y \ / \ CD_{st})$

The equation then looks as follows:

$$ER_{684\ plus,pa} = (PA_y \ / \ CD_{st}) \times \left((EG_{y,d} - 684.4626) \times EF_{CO2,684\ plus} + D\right)$$

Where:

$ER_{684\ plus,pa}$	=	Emissions reductions per amount paid *pa* by the user of a project unit with daily electricity consumption (based on the maximum daily capacity available) in the above 684.4626 Wh bracket (in g CO2e)
$DA_{y,pa}$	=	Days of electricity made available to the user of a Project Unit y by paying the amount pa
PA_y	=	Payment amount made by the user of solar system y
CD_{st}	=	Cost per day for using a solar system of type st
$EF_{CO2,684\ plus}$	=	1 (g CO2/Wh)
D	=	1718.0007 (g CO_2), a constant calculated as (150.5817 Wh x 6.8 g CO_2/Wh) + (533.8809 Wh x 1.3 g CO_2/Wh)

Equation applied to the case:

$$ER_{684\ plus,pa} = \left(\frac{50}{6.5}\right) \times \left((1200 - 684.4626) \times 1 + 1718.0007\right) = 17181.0623\ g\ CO2e$$

For the electricity purchase of 50 pesos made by the user of the solar system, the Solstroem programme will issue a carbon record of 17181 g of CO2e, which will be stored on the Solstroem registry.

3.4. Expected aggregated emission reductions over time.

Below are conservative estimations of the aggregate emission reductions of the Soltroem programme over the course of the next 3 years.

	2021		2022		2023		tCO2e
Project unit capacity	Number of project units	Expected emission reductions	Number of project units	Expected emission reductions	Number of project units	Expected emission reductions	Total
Large >685 Wh/day	30.000 3 partners	19.500	50.000 5 partners	32.500	200.000 8 partners	130.000	182.000
Medium 150-685 Wh/day	200.000 3 partners	63.000	350.000 5 partners	110.250	1.000.000 8 partners	315.000	488.250
Small <150 Wh/day	100.000 2 partners	15.000	150.000 3 partners	22.500	300.000 5 partners	45.000	82.500
							752.750

Section 4 - Monitoring

In order to derive a correct usage of the solar systems deployed by the programme partners, the Solstroem programme makes use of one of the options explicitly mentioned in the monitoring methodology section of the applied CDM methodology (AMS-I.L) v3.0. This implies that the Solstroem programme sets out to "Measure the net amount of renewable electricity delivered to each consumer connected to the project renewable electricity generation system(s). Such measurements shall be made continuously and recorded at least on a monthly basis" (Section 6.1. of the CDM AMS-I.L. "Small Scale Methodology: Electrification of rural communities using renewable energy").

4.1. Monitoring parameters

Data / Parameter Table 1.

Data / Parameter:	$EG_{x,d}$
Data unit:	Wh/d
Description:	Electricity consumed by Project Unit solar system x in day d For programme partners who live-monitor the electricity consumption of their deployed solar systems (meter data) The parameter is variable depending the daily readings from the meter.
Measurement procedures (if any):	1) the meter connected to the solar system will be remotely monitored continuously (continuous monitoring). 2) Data from this meter will be sent to the monitoring software system used by the programme partner at least daily (daily measurement). 3) The daily measurements will either be recorded in the Solstroem system via API as they happen (daily or more frequently), or be compiled in less frequent data transfers of records in time increments not exceeding one month (at least monthly recording).
Monitoring frequency:	Continuous monitoring, daily measurement and at least monthly recording
Comment:	-

Data / Parameter Table 2.

Data / Parameter:	$EG_{y,d}$
Data unit:	Wh/d
Description:	Electricity consumed by Project Unit solar system y in day d For programme partners who monitor their deployed solar systems using payment data The parameter is constant and based on the maximum available capacity of Project Unit solar system y.
Measurement procedures (if any):	The daily available capacity of solar system y is taken from the newest available datasheet forwarded by the programme partner. The measurement is done when Project Unit solar system y is initially added to the portfolio of systems of the programme partner deploying it. The measurement is done when the Programme of Activities Manager (PoA), i.e. the Solstroem Programme, is notified by the programme partner of changes in the available capacity of solar system y Every 6 months consistent measurements of the available capacity of all systems is performed by the PoA Manager.
Monitoring frequency:	Consistent measurements every 6 months, plus whenever changes to the available capacity of the system is announced by the programme partner.
Comment:	-

Data / Parameter Table 3.

Data / Parameter:	x
Data unit:	
Description:	Solar system Project Units whose production measurement is variable, and based on live meter data.
Measurement procedures (if any):	The programme partner live-monitors the electricity consumption of their deployed solar systems (meter data) via software. The actual live measurements get entered into equations (1), (3) or (5), as applicable.
Monitoring frequency:	Continuous monitoring, daily measurement and at least monthly recording
Comment:	-

Data / Parameter Table 4.

Data / Parameter:	*y*
Data unit:	
Description:	Solar system Project Units whose production measurement is based on a constant maximum daily capacity.
Measurement procedures (if any):	The constant daily available capacity of the solar system is determined by the datasheets forwarded by the programme partner, pertaining to the particular solar system type. The recorded maximum daily capacity gets entered into equations (2), (4) and (6) as applicable.
Monitoring frequency:	When onboarding the programme partners, when new datasheets are submitted by the programme partners, and as a standard monitoring every 6 months.
Comment:	-

Data / Parameter Table 5.

Data / Parameter:	$P_{y,ti}$
Data unit:	Days
Description:	Period of electricity made available to Project Unit solar system y in time interval *ti*
Measurement procedures (if any):	1) The programme partner live-monitors the electricity consumption of their deployed solar systems (meter data) via software. 2) When monitored the solar system returns data in a binary on/off format. 2) The measurements will either be recorded in the Solstroem system vi API as they happen (daily or more frequently), or be compiled in less frequent data transfers of records in time increments not exceeding one month (at least monthly recording).
Monitoring frequency:	Continuous monitoring, daily measurement and at least monthly recording
Comment:	-

Data / Parameter Table 6.

Data / Parameter:	PA_y
Data unit:	Monetary amount
Description:	Payment amount made by the user of solar system y
Measurement procedures (if any):	For programme partners who track the electricity consumption of their deployed solar systems via their software payment system. PA_y is monitored for every Project Unit solar system deployed by the programme partner. 1) the user will unlock solar system for specific time periods based on activation codes bought at partner sites (kiosks, agents, etc.). Payments can take place at any given time (ongoing payments). 2) Payment transaction data is sent by the partner sites to the ERP or payment monitoring software system used by the programme partner. This generally happens daily, but longer intervals can occur. 3) The payment measurements will either be recorded in the Solstroem system vi API as they happen (daily), or be compiled in less frequent data transfers of records in time increments not exceeding one month (at least monthly recording).
Monitoring frequency:	Continuous monitoring, daily measurement and at least monthly recording
Comment:	PA_y is used to calculate $DA_{y,pa}$, i.e. days of electricity made available to the user of a Project Unit x by paying the amount pa. $DA_{y,pa} = (PA_y\ /\ CD_{st})$

Data / Parameter Table 7.

Data / Parameter:	CD_{st}
Data unit:	Monetary amount
Description:	Cost per day for using a solar system of type st
Measurement procedures (if any):	For programme partners who track the electricity consumption of their deployed solar systems via their software payment system: The Cost per day for using a solar system of type st is included as a static data point in the payment data file forwarded to the Solstroem programme. A CD_{st} measurement is connected to each particular type of solar system deployed by the programme partner.
Monitoring frequency:	One-off recording. Automatically adjusted in the data transfer file when pricing changes.
Any comment:	CD_{st} is used to calculate $DA_{y,pa}$, i.e. days of electricity made available to the user of a Project Unit y by paying the amount pa. $DA_{y,pa} = (PA_y / CD_{st})$

4.2. Automated internal verification & recurrent external verification by DNV GL

The application of the CDM AMS.I.L v3.0 methodology in daily intervals allows for the frequent measurement of the quantity of renewable electricity made available to the users of the Project Unit solar systems, and for the ongoing issuing of carbon offset credits (as described in section 3). The measurements in question are facilitated by the software architecture of the Solstroem platform, which automatically receives the specific data parameters highlighted in the boxes above, in various time intervals of one month or less. This approach sets the Solstroem programme apart the traditional CDM projects, where the bulk issuance of credits by the CDM EB only occurs after a third-party verification is done on the monitoring data of the project/programme. Issuing frequency is normally every ±12 months.

Because the daily carbon calculations applied by the Solstroem programme are codified into the software platform, and because these codified calculations are verified by DNV GL, it is possible to do an automated verification of the specific data measurements received (internal verification), and to simultaneously issue the carbon offset credits associated with these specific measurements. The data received is thus automatically verified, converted into an emissions reduction quantity, and stored on the Solstroem registry as carbon offset credits (as illustrated in the examples in Section 3).

Added to this automated internal verification through the software platform, and the simultaneous issuing of carbon offset credits on an ongoing basis, the Solstroem programme is also subjected to a yearly external verification by DNV GL. Here an audit will be done, based on random spot samples, to ensure that the automatic issuing of carbon offset credits that has occurred since the last external verification has taken place in accordance with the carbon calculations equations set forth in the applied CDM AMS-I.L v3.0 methodology.

Section 5 -
Quality Assurance Measures

Besides a clear monitoring procedure, the Solstroem programme also needs to put in place a number of quality assurance measures that will aim at minimizing the risk of programme partners failing to implement the programme as intended. These measures are further developed below:

5.1. Eligibility criteria employed to accept new Programme Partners

At the high level, and in alignment with the applied CDM AMS-I.L v3.0 methodology, solar providers eligible for the Solstroem programme must work towards the "electrification of a community achieved through the installation of renewable electricity generation systems that displace fossil fuel use, such as in fuel-based lighting systems, stand-alone power generators, and fossil fuel based mini-grids."
Initially, this means solar companies that implement individual, renewable energy systems such as roof top solar photovoltaic systems, with a specific focus on Solar Home Systems. Operators of isolated mini-grid which distributes electricity generated only from renewable energy systems can also be eligible, although it is not the main focus of the programme at the initial stage.
Other high-level eligibility criteria are (taken from the CDM AMS.L.I v3.0 methodology):

- At least 75 per cent (by number) of the consumers serviced by the programme partners must be households.
- The utilized solar hardware must comply with applicable international standards or comparable national, regional or local standards/guidelines.
- The solar systems deployed by the programme partners must be intended for permanent installation. Portable systems, such as portable electricity generating systems or LED lanterns do not qualify.
- The end-user(s) and facility(ies) services by the programme partners can include households; public buildings; and/or small, medium and micro enterprises (SMMEs). Electricity uses may include interior lighting, street lighting, refrigeration, or agricultural water pumps.

Added to these high-level eligibility criteria, the following specific requirements also apply:

5.1.1. Company requirements:

- The companies operating the deployed solar installations must be an officially incorporated business entity, in business for more than 12 months.
- The companies must deploy Solar Systems in off-grid and/or poor grid environments (where grid availability is less than 50% on average).
- The companies must monitor their Solar Systems through software (either payment data, or production data)

5.1.2. Specifications of the deployed home solar systems & size of the portfolio:

- Minimum capacity of the solar systems deployed per Project Unit: 25 Wh/day
- Maximum installed capacity for microgrids 15 MWp.
- Minimum portfolio of 500 deployed solar systems per Programme Partner. This minimum is to ensure the financial viability of investing in an API to the IT system of the Programme Partner.
- GSM-enabled hardware as well as non-GSM-enabled hardware is accepted.
- All installations must be tracked on an ongoing basis through software (either meter data or payment data).

5.1.3. Supported business models:

- Pay as you go (PAYG) is accepted.
- Lease-to-own is accepted.
- Cash sales of Solar Home Systems is not accepted (because the Solstroem programme is technically unable to service individual Solar Home System owners – see minimum portfolio requirement)

5.2. The due diligence process applied by the Solstroem programme

The Programme Developer (Solstroem) sets requirements towards the Programme Partners (Solar Providers), which in turn through their business operations ensure that the specific Project Units (Solar Systems) are deployed to the adequate target groups through whom the CO2 emissions reductions occur. In terms of Know Your Customer (KYC), the project developer will perform due diligence on its Programme Partners in order to ensure that they have the capabilities of implementing the Solstroem Programme. The table below summarizes the deliverables that the Programme Partners must submit to the Programme Developer in order to get approved for MCA issuance on the Solstroem platform.

Deliverables	Type	Content
Onboarding Documentation	KYC documentation to be submitted	1- Proof of registration in national registry of companies 2- Latest financial statement 3- Complete datasheet for every Solar System type deployed 4- Audited statement signed by local third-party auditor confirming (i) the number of deployed solar systems in operation at the time of joining the Solstroem programme, (ii) that the installations are active, (iii) that the solar systems are monitored by software (either payment data or meter data), and that (iv) if needed, historical data (payment or meter) is available in a correct format to issue MCOs retrospectively in accordance with the programme requirements. 5- for partners using a "lease-to-own" model, the number of installations that have been paid off in the past two years must also be provided.
Sign-offs	Onboarding form: consent, and acceptance of fundamental terms and obligations.	Fill in onboarding form with questions on the following topics: 1- Company details 2- Solar system information 3- Business model details 4- General responsibilities
Partnership Agreement	Standard contract – with minor customized elements	3 steps: 1- Sign Mutual NDA and MOU related to "sandbox testing" of data and MCO issuing. 2- Issue sample batch of MCOs in a test environment. Optimize data transfer protocol. 3. Sign Partnership Agreement

5.3. Assuring the reliability of the data provided by the programme partners

It is important for the Solstroem programme to ensure the reliability of the data received from the programme partners (solar companies), and to put in place measures that address all potential malpractice scenarios that could occur if the programme partners were intending to cheat the system by transferring fake data, or otherwise.
In order to give an overview of the potential risks and specific measures put in place to counter those risks, the following will first break down the risks associated with each specific data transfer protocol available to the programme partners, and then expand on the measures put in place by Solstroem to mitigate those risks.

Option 1: In this option, the data (payment or production data) gets transferred to Solstroem via a shared updateable spreadsheet such as a Google Doc. The content of the spreadsheet is (i) pulled from the programme partner's relevant database, be it proprietary or third-party, (ii) shared with Solstroem, and (iii) set to update at agreed intervals.

The risk for malpractice in this scenario is higher than in the two other options because the spreadsheet could in fact be populated in other ways than though export from a given database (e.g. manual input). The effort associated with intentional malpractice relates to manually amending a spreadsheet in such a way that the output in terms of MCAs issued is inflated, while at the same time avoiding detection by Solstroem. This option is not associated with having to give direct access to the solar company's actual database, rather it is a simple export of data. Therefore, one might be able to tamper with the data without running a complete alternative (fake) database (which would be needed in order not to "contaminate" the real database with fake data, should it be directly connected with Soltroem).

Since the risk of malpractice is higher in this option, the shared spreadsheet is only used in the initial stages of onboarding a new programme partner. As soon as possible after onboarding, an API solution will be implemented, either to a proprietary database, or to a third-party software such as ANGAZA. Even when programme partners use this data transfer protocol (that can be seen as loose), the measures explained further down will prevent the data from being faked to an acceptable degree.

Option 2: In this option, the data (payment or production data) gets transferred to Solstroem via a Direct API to the solar company's own ERP, or monitoring database. Through this RESTful API, the solar company can POST their dataset to the Solstroem server, where it is protected by Basic HTTP Authentication. Depending of the size and number of installations (Project Units) deployed by the project partner, the intervals of data transfer will vary.

The risk for malpractice in this scenario is considerably lower than for option 1, since the effort required to carry out malpractice is higher. It would involve de-facto running two separate databases on the programme partner's server. When programme partners use this data transfer protocol, the measures explained further down will prevent the data from being faked to an acceptable degree.

Option 3: In this option, the programme partner's data gets transferred to Solstroem via various API endpoints to ANGAZA (https://www.angaza.com), which is the most widespread dedicated software for monitoring last mile deployment and payments (PAYG) in the solar off-grid industry. These RESTful APIs, to the ANGAZA system allows solar companies using the system to POST relevant data to the Solstroem server, where it is protected by Basic HTTP Authentication. The APIs cover various customizations of the ANGAZA system that suit the business practices of the programme providers using this system for managing PAYG payments. For instance, these API endpoints include (i) client registration data (solar companies), (ii) static pricing data, and (iii) payment transaction data. Depending of the size and number of installations (Project Units) deployed by the project partner, the intervals of data transfer will vary.

The risk for malpractice in this scenario is the lowest of all data transfer options, since running a separate database for fraudulent data will require setting up a second account on the ANGAZA system, which will automatically raise flags. When programme partners use this secure data transfer protocol, the measures explained below will further prevent potential data manipulation.

5.3.2. Measures taken by Solstroem to prevent malpractice:
In order to prevent malpractice on the part of the programme partners implementing the Solstroem programme, a mechanism that checks the transmitted data for consistency has been devised. The logic of the mechanism is to check the data against a determined production ceiling at a frequency that allows to uncover malpractice rapidly enough to strongly incentivize honest and transparent data transfer practices. The data-checking mechanism is further supplemented by severe indemnities in case of exposed malpractice, as expanded upon further down in this document.
In order to implement a coherent and effective data-checking mechanism, the first step is to properly assess the applied production ceiling for each programme partner. The following unpacks the process step by step:

- The Solstroem programme will only admit the specific number of Project Unit solar systems disclosed by the programme partners at the onboarding stage. This number of solar systems must be verified by an independent third-party auditor and signed off on in an audited statement, which is to be submitted as part of the onboarding process.
- The maximum daily output of MCAs for a newly onboarded programme partner is calculated based on the material received at onboarding, i.e. number of solar systems, maximum capacity of solar systems, geography, payment packages, etc.
- The maximum daily output represents the ceiling below which the actual issuance of MCAs will have to remain.
- Additional Project Unit solar systems can get added in batches whenever a given programme partner wishes to do so. In order to do so, a new updated audited statement highlighting the number of solar systems in operation must be submitted.
- Whenever a new audited statement is received from a programme partner, the maximum daily output possible is adjusted accordingly.
- In order to ensure that the programme partner does not send fake data that inflates their MCA issuance, Solstroem will regularly double check the received data against the maximum yield possible. This is done through random sample tests in intervals of no more than one month.

5.4. Punitive actions in case of malpractice

If when applying the data-checking mechanism, Solstroem finds evidence of a programme partner intentionally mishandling of their data with the purpose of inflating their MCA yield, severe actions will immediately be implemented. These actions are inscribed in the contracts that the programme partners have signed when being onboarded, and are punitive both in terms of termination of collaboration, and in terms of indemnities due for loss of reputation. Below are two specific clauses in the standard partnership contract that enshrine the actions that will result from malpractice.

4.2. Failure by the Provider to comply with the general responsibilities, particularly in cases where intentional fraud can be proven, will result in an immediate termination of the collaboration, and a cancellation of the Provider's remaining MCAs on the registry. These MCAs will in such cases be withdrawn from circulation from the registry by Solstroem.

2.1. By agreeing to this partnership, the Provider acknowledges the exclusivity of the partnership for the time period covered by this agreement. The Provider is contractually obliged (i) not to list CO2 emissions reductions on other registries for carbon avoidances, and (ii) not to sell these CO2 emissions reductions to offsetting customers directly, or through CO2 wholesalers or retailers. The purpose of this restriction is to ensure that no MCA is issued more than once. Issuing avoidances more than once could be considered "double spend" and cannot be allowed since it would be equivalent to fraud. By signing this agreement, the Provider hereby certifies that (i) it will never seek to issue avoidances for its systems more than once and that (ii) it is committed to protecting the integrity of the Solstroem system. If Solstroem proves that the Provider violates this clause, effectively "double spending" avoidances in a fraudulent manner, the Provider hereby acknowledges that Solstroem will be owed legal compensation amounting to a minimum of one hundred thousand Euros. The Provider acknowledges that it will be Solstroem's discretion to obtain this compensation directly or via a third party that is assigned the right to collect on behalf of Solstroem.

CarbonClear

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