PROGRAMME DESIGN DOCUMENT FORM FOR SMALL-SCALE CDM PROGRAMMES OF ACTIVITIES (F-CDM-SSC-PoA-DD) Version 02.0

PROGRAMME OF ACTIVITIES DESIGN DOCUMENT (PoA-DD)

PART I. Programme of activities (PoA)

SECTION A. General description of PoA

A.1. Title of the PoA

>> Small Hydropower Programme of Activities in Armenia
Version 01
01/08/2012

A.2. Purpose and general description of the PoA

>>The proposed CDM programme of activities "Small Hydro Power Programme of Activities in Armenia" (hereafter referred to as "the PoA") is a programme for the installation of hydro power projects in Armenia.

The purpose of the PoA is to use carbon finance for small hydropower projects in Armenia. The PoA has been supported by EBRD through financing Technical Assistance for the set up of the PoA in the frame of the ArmSEFF program (the Armenian Sustainable Energy Finance Facility for industrial energy efficiency and renewable energy projects) in order to enable, simplify and support development of SHPP projects in Armenia.

The PoA consists of individual component project activities (CPAs) which will construct small hydro power plants (SHPP) within the boundaries of Armenia to generate electricity from the hydro energy and supply the electricity to the Armenian electricity grid.

The PoA will comprise the CPAs that

> install new small hydro power plants at a site where no renewable power plants have been operated prior to the implementation of the project activity (greenfield plants);

This PoA will include:

(i) small-scale run-of-river hydropower plants, and
(ii) small-scale hydropower plants with reservoirs.

Each small-scale CPA under this PoA will comprise one or more such hydropower plants and have a combined installed capacity of no more than 15 MW, the threshold for small-scale renewable energy CDM projects.

The PoA, through its successful implementation, will serve as a model for investors, authorities and public and will result in perception changes that are critical to expanding the use of small hydro power in Armenia. Further, the establishment of a market for investing in small hydro power projects will significantly impact building of capacity to manufacture system components domestically and lead to value creation and availability of green job opportunities in the region.

The PoA aims to develop a platform for overcoming institutional, financial and structural hurdles for the construction of small hydropower projects. In this way the PoA will promote the development of renewable energy and facilitate the abatement of greenhouse gas emissions through replacement of fossil fuel based electricity in Armenia.

The PoA is expected to contribute to sustainable development in the following manner, which are – among others - also required by the Armenian DNA as project approval criteria for CDM projects[1]:

Environmental benefits
- Improvement of air and water quality through increased use of renewable energy;
- Efficient utilization of natural resources;
- Biodiversity protection as a major part of the EIA process.

Economical benefits
- The PoA will promote sustainable development in Armenia by promoting investment and thereby improving the local economies;
- The PoA will generate demand for local products when spare parts are needed, leading to promotion of business activities;
- The PoA will support the transfer of green, sustainable and up-to-date technology and technical know-how to the host country
- New infrastructure will contribute to economic growth, improve standard of life of the local people and poverty alleviation;

Social criteria
- The PoA will increase employment opportunities in Armenia and increase the share of green jobs in the regions;
- The PoA will help to further develop local capacities
- Full respect of stakeholders' participation will be kept in the CPAs linked to this PoA

Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity
The PoA is a voluntary action taken by the CME. CME is not in any way enforced to accomplish its objectives.

A.3. CMEs and participants of PoA
>> Coordinating/Managing Entity (CME) of this PoA is Energy Changes Projektentwicklung GmbH.
CME will have the following responsibilities with respect to the implementation of the proposed PoA:
- Identifying the CPAs and evaluating their eligibility
- Creating PoA documentation (the CDM-PoA-DD and CDM-CPA-DD)
- Obtaining a Letter of Authorization from the host country
- Obtaining a Letter of Approval from the host country and the Annex I Party involved
- Communicating with and providing assistance and trainings for the CPAs implementers
- Coordinating the monitoring activities and managing the data
- Drafting monitoring reports for all CPAs in accordance with the methodology outlined in the PoA DD
- Coordinating and communicating with the validator, verifier and the CDM Executive Board
- Requesting the UNFCCC to issue CERs

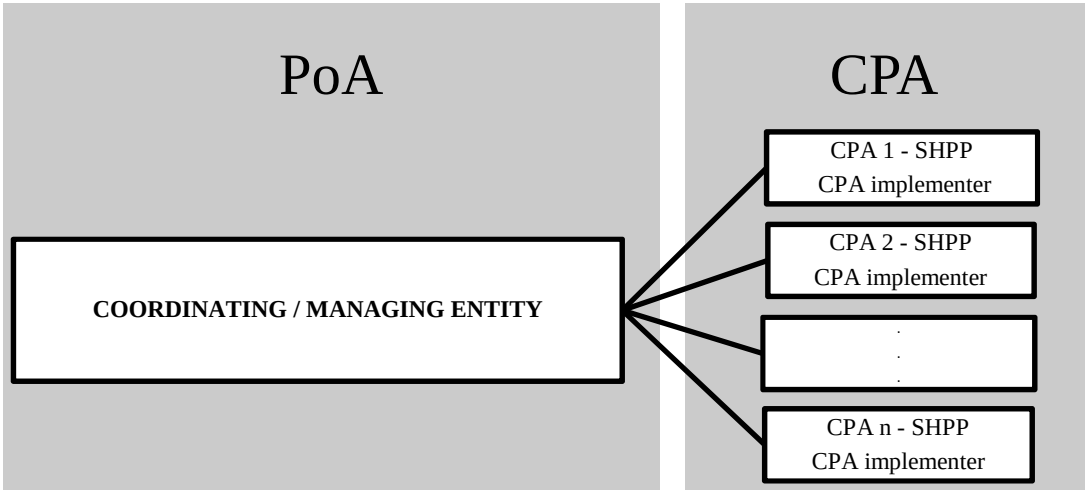
CME will enter into contractual agreements with the individual owner(s) of the small hydro power plants(s) at the time of inclusion of CPA under the PoA[2].

The overall structure of the proposed scheme is given in Figure 1 below:

[1] http://www.nature-ic.am/en/Projects_Approval_Criteria

[2] As per „Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities, Version 01.0 (EB 65, Annex 3), paragraph 19, the time of CPA inclusion under the PoA is specified as follows: *The CPAs shall be included in the PoA on the basis that the DOE has confirmed the eligibility of CPAs.*

Figure 1: Structure of the proposed Programme of Activities



CPA implementers who will operate CPAs under the PoA may be private or public sector entities. Ownership of each CPA will be defined at the CPA level and contractual agreements of CPA implementers with CME will be in place before inclusion of the respective CPA.

A.4. Party(ies)

Name of Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Armenia (host)	Energy Changes Projektentwicklung GmbH	No

A.5. Physical/ Geographical boundary of the PoA

>> The geographical boundary of the PoA extends up to the physical boundaries of Armenia.

A.6. Technologies/measures

>> The proposed PoA is a small scale CDM project activity, and falls under:

Type	I. - Renewable energy projects

Scale	Small scale (under 15 MW of installed capacity)
Applicable methodology	AMS-I.D. Grid connected renewable electricity generation
Version	17.0, (EB 61)
Technology/measure	1. Installing a new renewable energy power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant), 2. New renewable power plant will be supplying electricity to a national or a regional grid 3. New renewable power plant will be run-of-river small hydro power plant and/or small hydro power plant with reservoir 4. If small hydro power plants with reservoirs then • implemented in an existing reservoir with no change in the volume of the reservoir; • or implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section of the applied methodology, is greater than 4 W/m^2; • or implementing new reservoir and the power density of the power plant, as per definitions given in the project emissions section of the applied methodology, is greater than 4 W/m^2

A.7. Public funding of PoA

>> There is no public funding from an Annex I country involved in the proposed PoA.

SECTION B. Demonstration of additionality and development of eligibility criteria

B.1. Demonstration of additionality for PoA

>> The following is demonstrated in this section:

(i) The proposed PoA is a voluntary coordinated action;

The implementation of hydro power projects or any renewable power projects is not mandatory in Armenia. No obligation exists for any entity to develop a PoA in Armenia, either.

The proposed PoA is a voluntary initiative conceived by Energy Changes Projektentwicklung GmbH in order to stimulate sustainable development through renewable energy utilization in Armenia. The PoA has been supported by EBRD through financing Technical Assistance for the set up of the PoA in the frame of the ArmSEFF program (the Armenian Sustainable Energy Finance Facility for industrial energy efficiency and renewable energy projects) in order to enable, simplify and support the small hydro power development in Armenia. The proposed PoA can therefore be regarded as a voluntary coordinated action.

(ii) If the PoA is implementing a voluntary coordinated action, it would not be implemented in the absence of the PoA;

According to the PoA Standard, Paragraph 7, *the additionality shall be demonstrated by establishing that in the absence of CDM, none of the implemented CPAs would occur*.

The "Clarifications Regarding the Procedures for Registration of a Programme of Activities as a Single CDM Project Activity And Issuance of Certified Emission Reductions for a Programme Of Activities", (EB 60 Annex 26)[3], clarifies that *a full additionality assessment is not required in the context of component project activities, rather the confirmation of additionality for CPAs should be conducted by means of the eligibility criteria.*

Therefore each small scale CPA included under the proposed PoA shall clearly demonstrate its additionality by means of eligibility criteria which are derived from Attachment A to Appendix B of the simplified modalities and procedures for small scale CDM project activities, Version 08 (EB 63, Annex 24)[4], *"Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:*

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher."

Furthermore, the following documents are considered for further guidance and guidelines:

(a) "Non-binding best practice examples to demonstrate additionality for SSC project activities" (EB 35, Annex 34)[5],

(b) General Guidelines for SSC CDM Methodologies, EB 66, Annex 23, Version 18.0[6](c) "Guidelines for demonstrating additionality of microscale project activities", currently Version 03 (EB 63, Annex 23)[7]

[3] http://cdm.unfccc.int/Reference/Guidclarif/PoA/poa_guid06.pdf
[4] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid05.pdf
[5] http://cdm.unfccc.int/EB/035/eb35_repan34.pdf

Additionally in the case investment barrier is chosen to determine the eligibility criterion the relevant sections of the following tool and guideline shall be taken into account:

(c) „Tool for the demonstration and assessment of additionality“ Version 06 (EB 65, Annex 21)[8]
(d) “Guidelines on the assessment of investment analysis” Version 05 (EB 62, Annex 05)[9]

Additionality has to be proven by each CPA through one of the following paths, using the above stipulated guidelines and regulations in order to be eligible for being included in the PoA:

- In case of microscale projects smaller than 5MW: by means of eligibility criteria derived from the “Guidelines for demonstrating additionality of microscale project activities”

If the CPA is a small scale project activity, the attachment A of Appendix B of the “Simplified modalities and procedures for small-scale CDM project activities” shall be applied.
Only those projects which meet the eligibility criteria for additionality can be included in the PoA. Thus, by demonstrating the additionality of each CPA included in the PoA it is established that in the absence of the CDM PoA, none of the CPAs included in the PoA would be implemented.

(iii) If the PoA is implementing a mandatory policy/regulation, this would/is not enforced;

The implementation of small hydro power technology is not mandatory in Armenia. The proposed PoA is a voluntary action.

(iv) If mandatory a policy/regulation is enforced, the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.

The implementation of small hydro power technology is not mandatory in Armenia. The proposed PoA is a voluntary action.

As it is demonstrated above, the GHG emissions reduction through the replacement of grid electricity through generation of electricity from hydro power is not mandatory in Armenia and would not be implemented as part of the policy/regulation enforcement and each CPA included in the PoA will demonstrate its additionality. Thus it is demonstrated that the proposed PoA is additional.

B.2. Eligibility criteria for inclusion of a CPA in the PoA

>> The eligibility criteria for inclusion of a CPA in the PoA are based on the requirements of the “Standard for demonstration of additionality, development of eligibility criteria and application of multiples methodologies for programme of activities”, Version 01.0 (EB 65)[10]; further on referred to as “PoA Standard”. By using this PoA Standard it is demonstrated that all the CPAs that are in compliance with the additionality-related eligibility criteria set below will ensure that all the relevant additionality-related guideline, tools or any requirements embedded in the methodologies are met.

A CPA is eligible for inclusion under the PoA, provided that the CPA fulfils the following criteria, demonstrated through the listed evidences for each eligibility criteria, as follows:

	Eligibility criterion:	**Demonstration of criteria usability to assess the CPA inclusion:**

6
http://cdm.unfccc.int/filestorage/C/R/L/CRL8TYAOPD3HJXWK5G90ES6Q7BNUIZ/eb66_repan23.pdf?t=QXp8bTNyOWNjfDCadYXc_hmTSeQ8u55EXWUJ

[7] *http://cdm.unfccc.int/filestorage/W/V/I/WVI3RN692YMCGLZT40QXBOUA8H5KFP/eb63_repan23.pdf?t=alB8bTB4NTlifDAWgEvM1uR11OyTp5RT7Vdy*

[8] *http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.pdf/history_view*

[9] *http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf*

[10] *http://cdm.unfccc.int/Reference/Standards/meth/meth_stan04.pdf*

(a)	The geographical boundary of the CPA including any time-induced boundary[11] is consistent with the geographical boundary set in the PoA	Only the CPA installed within the boundary of Armenia as it may exist at the time of CPA shall be eligible for inclusion under the PoA.
(b)	Conditions that avoid double counting of emission reductions like unique identifications of product and end-user locations (e.g. programme logo)	Only the CPA uniquely identified and defined in an unambiguous manner shall be eligible for inclusion under the PoA. There must be no other CDM project activity registered with the same identification data.
(c)	The specifications of technology/measure including the level and type of service, performance specification including compliance with testing/certifications	Only the CPA that employs a hydro power technology with total installed capacity equal or below 15 MW shall be eligible for inclusion under the PoA.
(d)	Conditions to check the start date of the CPA through documentary evidence	Only the CPA with the starting date on the day or later of the start of validation of the PoA (uploading for global stakeholders comments on the UNFCCC web site) shall be eligible for inclusion under the PoA.
(e)	Conditions that ensure compliance with applicability and other requirements of single or multiple methodology/ies applied by CPAs	1. Only the CPA complying with the applicability criteria of the methodology AMS-I.D., Version 17.0 (EB 61) shall be eligible for inclusion under the PoA. Criteria as per the methodology AMS-I.D., Version 17.0 (EB 61): 2. Only the CPA connected to the Armenian electricity grid shall be eligible for inclusion under the PoA 3. If the CPA is a small hydro power plant with reservoir: Only the CPA fulfilling one of the following conditions shall be eligible for inclusion under the PoA: 3.1. The project activity is implemented in an existing reservoir with no change in the volume of the reservoir; 3.2. The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section of the applied methodology, is greater than 4 W/m^2; 3.3. The project activity is implementing new reservoir and the power density of the power plant, as per definitions given in the project emissions section of the applied methodology, is greater than 4 W/m^2.
(f)	The conditions that ensure that CPAs meet the requirements pertaining to the demonstration of additionality	1. Only the CPA that clearly demonstrates its additionality shall be eligible for inclusion under the PoA. 2.1. If the CPA is a micro scale project activity, the "Guidelines for demonstrating additionality of microscale project activities" shall be applied. 2.2. If the CPA is a small scale project activity, the

[11] *For example, an emission factor for electricity generation is dependent on the boundaries of regional or state or sub-regional grids.*

		attachment A of Appendix B of the "Simplified modalities and procedures for small-scale CDM project activities" shall be applied.
(g)	The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis[12]	1. Only the CPA that undertakes the environmental analysis as per requirements of the CDM modalities and procedures shall be eligible for inclusion under the PoA. Only the CPA that performs the environmental impact analysis (EIA) in accordance with the Armenian laws/regulations if it is required shall be eligible for inclusion under the PoA. 2. Only the CPA that has conducted the stakeholder involvement process and that has taken into the due account all the concerns raised during the process shall be eligible for inclusion under the PoA. 3. Only the CPA that installs new power generation equipment in the small hydropower plants shall be eligible under the PoA. No power generation equipment may be transferred from other existing facilities.
(h)	Conditions to provide an affirmation that funding from Annex I parties, if any; does not result in a diversion of official development assistance.	Only the CPA that has not/will not receive any public funding from Annex I country or the funding is not a diversion from the Official Development Aid (ODA) shall be eligible for inclusion under the PoA.
(i)	Where applicable, target group (e.g. domestic (commercial/industrial, rural/urban, grid-connected/off-grid) and distribution mechanisms (e.g. direct installation)[13]	Target group are SHPP developers in Armenia. There are no specific distribution mechanisms.
(j)	Where applicable, the conditions related to sampling requirements for a PoA in accordance with the approved guidelines/standard from the Board pertaining to sampling and surveys	Not applicable.
(k)	Where applicable, the conditions that ensure that CPA in aggregate meets the small-scale or micro-scale threshold criteria [14] and remain within those thresholds throughout the crediting period of the CPA	Only the CPA with the total installed capacity under or equal to 15 MW throughout whole crediting period shall be eligible for inclusion under the PoA.
(l)	Where applicable, the requirements for the debundling check, in case CPAs belong to small-scale (SSC) or microscale project categories[15]	Only the CPA which is a single small/micro scale project activity not a debundled component of a large scale project activity shall be eligible for inclusion under the proposed PoA.

[12] *See also paragraph 6 (m) of "Procedures for registration of a programme of activities as a single CDM project activity and issuance of CERs for a PoA"*

[13] *This is to re-test the validity of assumptions made at the PoA level. For example, in a lighting efficiency application, lighting usage hours of 3.5 hours per day would be valid if the target group is residence/households. Usage hours would be different in commercial applications and vice versa*.

[14] *See the latest approved version of the Guidelines for demonstrating additionality of microscale project activities (Version 3, http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid22.pdf) and the latest approved version of the General Guidelines to SSC methodologies (https://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid06.pdf)*

[15] *Please refer to the latest approved version of the Guidelines on assessment of debundling for SSC project activities": Version 3, EB 54, http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid17.pdf*

Updating the eligibility criteria

According to the Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities, currently Version 01.0 (EB 65)[16], (further on referred to as "PoA Standard"), if the version of methodology AMS-I.D. applied by the proposed PoA is revised or replaced, subsequent to being placed on hold, the CME shall update the eligibility criteria to the requirements of the revised or new methodology/ies with immediate effect and include them in a new version of the PoA-DD (e.g. version 1.1) and new generic CDM-CPA-DD, validate it by a DOE, and shall submit it to the Board for approval.

B.3. Application of methodologies

>>The following approved baseline and monitoring methodology applies to all CPAs that will be included in the PoA:

Title: AMS-I.D. Grid connected renewable electricity generation
Version: 17.0, (EB 61)
Reference: *http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X*

In case the applied approved methodology is put on hold or withdrawn, no new CPAs will be added to the PoA in accordance with the timelines indicated in latest version of the "Procedures for the revision of an approved baseline and monitoring methodology by the EB", currently Version 09 (EB 35, Annex 13)[17].

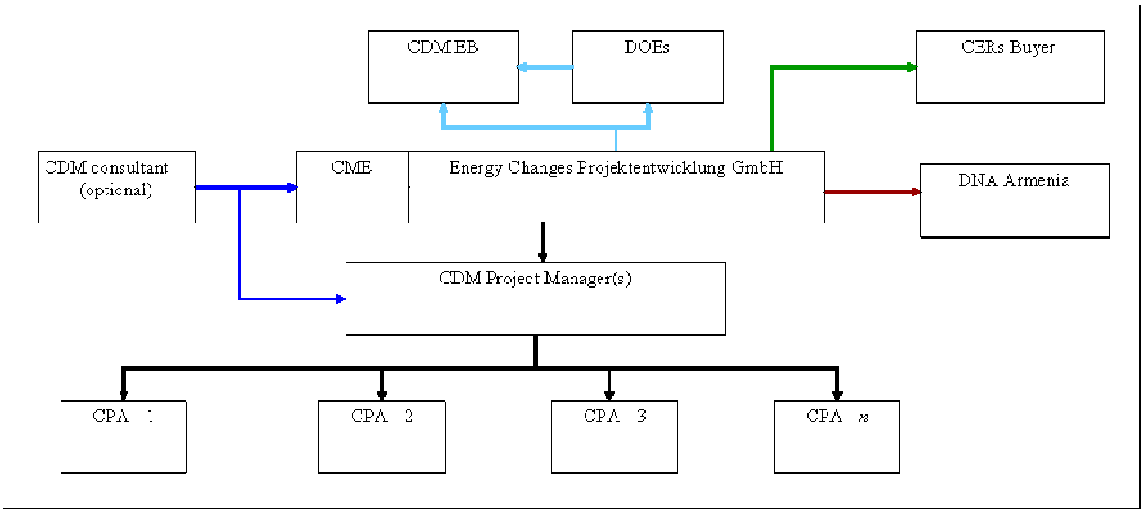
If the methodology is subsequently revised, the CDM-PoA-DD must be revised accordingly and validated by a DOE and approved by the EB that will define the new version of the PoA and the PoA specific CDM-CPA-DD. Such revisions are not required in cases where a methodology is revised without being placed on hold or withdrawn.

SECTION C. Management system

>> Energy Changes Projektentwicklung GmbH as the coordinating/managing entity of the PoA will be in charge of coordinating the project participants, collecting the monitoring data and communicating with DOEs and CDM Executive Board. The CME will build appropriate in-house CDM capacity for PoA management and CPA inclusions and it will ensure proper capacity building for CPA implementers, too.
The operational and management arrangements to be established at the CME level are described in this section.
Arrangements/structures to be established at the CPA level are described in Part II, Section B.7.2. of this PoA-DD.
Organisational structure of the PoA:

16 *http://cdm.unfccc.int/filestorage/E/6/T/E6TY7DMI28WGCUV5J0K3LAOHBQ9RFN/eb65_repan03.pdf?t=T2d8bTNucW9vfDCwxMNGjW1pvUALpRC-AVaL c*

17 *http://cdm.unfccc.int/Reference/Procedures/meth_proc03_ver09.pdf*



Operational/management arrangements established by CME for implementation of the proposed PoA include:

(a) A clear definition of roles and responsibilities of personnel involved in the process of inclusion of CPAs, including a review of their competencies;

The CME of this PoA Energy Changes Projektentwicklung GmbH (EC) is an Austrian consulting company with long term experience in development of CDM project activities and PoAs. The management of EC will be responsible for implementation of the PoA.

The CME will assign the tasks to individual personnel and/or hire new (internal employees or external consultants) if needed after the PoA gets registered with UNFCCC. Some of the positions or tasks may be outsourced by external experts.

CDM team within the company shall be established and tasks assigned as described below. CME will hire additional CDM Project Managers when needed.

Position	Responsibilities & competencies
EC	• Secures Training for the CDM team • Secures the legal and economical issues (contracts, invoices, etc.) • Secures external CDM consultant (optional) • Keeps personal files of the staff (on training and education) • Trades the CERs
CDM Project Manager	• Identifies and evaluates new CPAs • Ensures all requirements and eligibility criteria are met by all assigned CPAs • Keeps a database of CPAs (PoA database) • Communicates with CPA implementers • Provides training for CPA implementers • Collects monitoring data from CPAs • Prepares monitoring reports for emission reductions verification • Supports validation, registration and verification of the CPA(s) • Ensures all requirements, applicability criteria are met by the PoA • Controls the methodology & tools changes, makes amendments to PoA-DD as required • Quality control, reporting to management, suggestions and improvements

(b) Records of arrangements for training and capacity development for personnel

All training and education records of the employees are stored in personal employee´s file of the company.

(c) Procedures for technical review of inclusion of CPAs

Responsible person (CDM Project Manager) shall verify that the CPA complies with conditions and justifies the compliance by documentation/evidence, as listed in Part II, Section B.5 of this PoA-DD.

(d) A procedure to avoid double counting (e.g. to avoid the case of including a new CPA that has already been registered either as a CDM project activity or as a CPA of another PoA)

In order to avoid double counting the CME will confirm, as per the PROCEDURES FOR REGISTRATION OF A PROGRAMME OF ACTIVITIES AS A SINGLE CDM PROJECT ACTIVITY AND ISSUANCE OF CERTIFIED EMISSION REDUCTIONS FOR A PROGRAMME OF ACTIVITIES, EB 55 Annex 38 Paragraph 6(i), that the project activity included in the CPA is not registered in any other CPA of the PoA or any other registered CDM Project activity through the following procedure:

- At the time of CPA eligibility check, CME (CDM Project Manager) will perform thorough control to identify any double counting conflict on internal PoA level and external CDM level, as follows:

  Internal double counting check: The PoA database as described above will not enable duplicate entries of the GPS coordinates which are unique for each CPA. Thus it will be ensured that one SHPPSHPP is not included in more than one CPA and that one CPA is not included in the PoA more than once.

  External double counting check: CME (CDM Project Manager) will perform a control using the public information sources such as UNFCCC website data, UNEP Risoe CD4CDM data, the VCS website, etc. and confirm that the CPA is not registered as a CPA of other PoA or as any other registered CDM project activity.

- At the time of inclusion, CPA implementer shall sign a contract with CME, amongst other confirming that the CPA implementer will not register the particular SHPP or a unit thereof as a single CDM project activity or as a CPA under another PoA.

Should a case occur that the SHPP and/or the CPA is registered in other CPA of the PoA or other registered CDM project activity or that the CPA implementer fails to sign the contract then the CME will not proceed with inclusion of the corresponding CPA into the proposed PoA.

(e) Records and documentation control process for each CPA under the PoA

In order to ensure transparency and high quality of the information and documentation managed by CME the record keeping system for every CPA and the overall PoA database is specially designed.

Record keeping system for each CPA:

In order to unambiguously identify each small hydro power plant enrolled in the PoA the CME shall develop a serial number system and assign a unique serial number to each CPA. The serial number shall consist of letters and numbers and it will uniquely distinguish each CPA from the others.

This serial coding system shall be used to keep the PoA database. The database will be used to record the baseline and monitoring data continuously and to track the emission reductions of each CPA during the crediting period(s). CME will be responsible for management of records and data related to each CPA. The database will be kept electronically and on paper if appropriate (e.g. documentation and evidence) and it will constitute the basis for the verification by the DOE.

The data recorded and documented by CME in the PoA database:

- Serial number of the CPA
- Name of the CPA implementer, address, contacts
- Exact CPA Location: City/State/Province, GPS coordinate/s of the SHPP/s
- Commissioning date of the small hydro power plant and of each unit

- Start date and end date of each crediting period
- Technical specification of each SHPP (type, make, model, installed capacity, year, etc.)
- End dates of operation permits, if applicable
- Monitored parameters
- Verification status

A record-keeping system will be established by each CPA implementer, too.
CPA implementer shall monitor and record the plant data. The plant data monitoring will primarily include the measurement of electricity supplied to the grid and electricity imported from the grid (consumed) by each CPA. The CPA implementer will report the monitored parameters to the CME Project Manager.

(f) Measures for continuous improvements of the PoA management system

Management system of the PoA shall be continuously reviewed by all involved personnel in order to identify any potential weaknesses, threats and their elimination as well as opportunities for improvement. All personnel will be encouraged to raise their comments and suggestions to the CDM Project Manager or to the management board directly. CDM Project Manager or selected representative of the company management shall then execute detailed discussion with all involved in order to find the solution. If necessary, he will assign financial and/or human resources identify the responsible person to perform the actions and report about the results.
"Prevention before remedy" approach will be favoured.

(g) Any other relevant elements

1. Justification that the SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.

According to the Guidelines on assessment of debundling for SSC project activities, Version 03, (EB 54, Annex 13)[18], Section II "Guidance for determining the occurrence of debundling under a programme of activities (PoA), *a proposed small-scale CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity[19], which satisfies both conditions (a) and (b) below:*

(a) Has the same activity implementer as the proposed small scale CPA or has a coordinating or managing entity, which also manages a large scale PoA of the same technology/measure, and;

(b) The boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

If a proposed small-scale CPA of a PoA is deemed to be a debundled component in accordance with paragraph 2 above, but the total size of such a CPA combined with a registered small-scale CPA of a PoA or a registered CDM project activity does not exceed the limits for small-scale CDM and small-scale A/R project activities as set out in Annex II of the decision 4/CMP.1 and 5/CMP.1 respectively, the CPA of a PoA can qualify to use simplified modalities and procedures for small-scale CDM and small-scale A/R CDM project activities.

In order to exclude the de-bundling, at the time of inclusion of each CPA:

- The CME (management) shall check and confirm that it is not managing a large scale PoA of the same technology/measure within 1 km of this CPA´s project boundary, in the same project category and with the same technology, and
- The CME (CDM Project Manager) shall check and confirm that CPA implementer is not already implementing a project activity of the same technology/measure within 1 km of this CPA´s project boundary, in the same project category and with the same technology.

[18] *http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid17.pdf*
[19] *Which may be a (i) registered small-scale CPA of a PoA, (ii) an application to register another small-scale CPA of a PoA or (iii) another registered CDM project activity.*

Should a case occur that any of the two requirements is not met then the CME will not proceed with inclusion of the corresponding CPA into the proposed PoA.
Thus it shall be ensured for each CPA included under the PoA that it is not a debundled component of a large scale project activity.

2. *The CPA implementers are aware and have agreed that their activity is being subscribed to the PoA:*

The CPA implementer involved in any of the CPAs under this programme of activities shall confirm this by signing a contract with CME, as mentioned above.
Before inclusion of the CPA in the PoA the CPA implementer shall enter in to this contractual agreement with the CME, confirming that:

- The CPA has not been and will not be registered as a single CDM project activity or as a CPA under another PoA.
- The CPA implementer is aware that the CPA will be subscribed to the present PoA.

SECTION D. Duration of PoA

D.1. Start date of PoA

>>

Starting date of the PoA is the day of uploading of the CDM-PoA-DD to UNFCCC web site for global stakeholders' comments.

Expected start date of the proposed PoA is 03/08/2012.

D.2. Length of the PoA

>> 28 years 0 months

As per the "Procedures for registration of a programme of activities as a single CDM project activity and issuance of certified emission reductions for a programme of activities", Version 04.1 (EB 55), Annex 38[20] *the length of the PoA shall not exceed 28 years*.

SECTION E. Environmental impacts

E.1. Level at which environmental analysis is undertaken

>> Environmental Analysis is done at SSC-CPA level

Projects (CPAs) are unique in their technical conditions and environmental impacts and therefore the EIA shall be undertaken for each CPA separately.

E.2. Analysis of the environmental impacts

>> The environmental impact assessment/analysis will be done at the CPA level and it will be described in detail in the CPA-DD.

EIAs of all individual CPAs shall be carried out in accordance with national legislation of Armenia.

SECTION F. Local stakeholder comments

F.1. Solicitation of comments from local stakeholders

>> The Local Stakeholder Consultations will be held at the CPA level, taking into consideration the unique technical realisation and local impacts of CPAs.

Each CPA implementer with CME assistance shall:

- invite local stakeholders to provide comments on the proposed CPA and shall demonstrate how due steps/actions were taken to appropriately engage stakeholders and solicit comments,
- invite comments from local stakeholders in an open and transparent manner, in a way that facilitates comments to be received from local stakeholders and allows for a reasonable time for comments to be submitted. The CPA implementer shall describe the proposed CPA in a manner that allows the local stakeholders to understand it, prepare a summary of the comments received from local stakeholders, demonstrate that all comments received for the proposed CPA have been considered, complete the local stakeholder consultation process before submitting the proposed CPA to a DOE for validation.

F.2. Summary of comments received

>> The Local Stakeholder Consultations will be held at the CPA level, taking into consideration the unique technical realisation and local impacts of CPAs.

F.3. Report on consideration of comments received

>> The Local Stakeholder Consultations will be held at the CPA level, taking into consideration the unique technical realisation and local impacts of CPAs.

[20] *http://cdm.unfccc.int/filestorage/X/T/1/XT12DHPN79U4FISGMYA0OJW5KZLQVR.1/eb55_repan38.pdf?t=aXR8bHVocTNvfDD4bftQ4X81fyvUkfR1XEij*

SECTION G. Approval and authorization

>> As per Section F of the "Clean Development mechanism project standard", at the time of submission of this PoA-DD to the DOE for validation it is the Version 01.0, EB 65, Annex 5, the project participants shall obtain a letter of approval from the DNA of each Party involved in the proposed CDM project activity confirming that[21]:

(a) The Party is a Party to the Kyoto Protocol;

(b) Participation in the proposed CDM project activity is voluntary;

(c) Project participants are authorized to participate in the proposed CDM project activity.

In addition, for project participants from the host Party, the letter of approval shall also confirm that the proposed CDM project activity assists the host Party in achieving sustainable development.

PART II. Generic component project activity (CPA)

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

>> A typical CPA under this PoA:

- Is a new, greenfield hydro power plant,
- is located within the boundary of Armenia,
- consists of one or more hydro power plants/units,
- is run-of-river hydro power plant or a hydropower plant with reservoir,
- has a total installed capacity of no more than 15 MW,
- supplies the generated electricity to the Armenian electricity grid ,
- will result in an increased share of renewable energy utilization and reduction of carbon intensity of energy production in Armenia.

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

>> The following approved baseline and monitoring methodology applies to all CPAs that will be included in the PoA:

Title:	AMS-I.D. Grid connected renewable electricity generation
Version:	17.0, (EB 61)
Reference:	*http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X*

In case the applied approved methodology is put on hold or withdrawn, no new CPAs will be added to the PoA in accordance with the timelines indicated in latest version of the "Procedures for the revision of an approved baseline and monitoring methodology by the EB", currently Version 09 (EB 35, Annex 13)[22].

If the methodology is subsequently revised, the CDM-PoA-DD must be revised accordingly and validated by a DOE and approved by the EB that will define the new version of the PoA and the PoA specific CDM-CPA-DD. Such revisions are not required in cases where a methodology is revised without being placed on hold or withdrawn.

The approved methodology also refers to

[21] *At the time of making the PDD public at the stage of validation, a Party involved may or may not have provided its approval of the proposed CDM project activity, but by the time of requesting registration, approval from all Parties involved shall be obtained.*

[22] *http://cdm.unfccc.int/Reference/Procedures/meth_proc03_ver09.pdf*

- the latest approved versions of the "Tool to calculate the emission factor for an electricity system"; and
- the most recent version of "ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources", at the time of submission of this PoA to the DOE for validation it is Version 12.3.0 (EB 66)[23]
- "General guidelines to SSC CDM methodologies", at the time of submission of this PoA to the DOE for validation it is Version 18 (EB 66) [24]"

It is confirmed that the selected methodology and tools are approved for application to CPAs under PoAs by the Board.
The additionality of the CPAs shall be demonstrated and assessed according to the "Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities", at the time of submission of this PoA to the DOE for validation it is Version 01.0 (EB 65)[25].

The PoA follows:

- "Procedures for registration of a programme of activities as a single CDM project activity and issuance of certified emission reductions for a programme of activities", at the time of submission of this PoA-DD to the DOE for validation in is Version 04.1, EB 55, Annex 38[26],
- "Clean Development mechanism project standard", at the time of submission of this PoA-DD to the DOE for validation in is the Version 01.0, EB 65, Annex 5[27]

B.2. Application of methodology(ies)
>>
The methodology AMS-I.D. - "Grid connected renewable electricity generation" has been applied since it relates to grid-connected electricity generation from renewable sources and since it is foreseen that the total installed capacity of each CPA shall not overcome the small scale threshold of 15 MW. Only this type I methodology is applied. The applicability of this methodology is justified as all CPAs included in the PoA have to demonstrate the fulfilment of respective eligibility criteria. The applicability criteria of the methodology, along with component project activity eligibility criteria (Section B.5., criterion (e)), are provided in the table below:

Applicability condition	**Justification**
1. & 2. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: *(a) supplying electricity to a national or a regional grid; or* *(b) supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling."*	The proposed CPAs will install renewable energy generation units – small hydro power plants. The electricity generated by the CPA SHPP plants will be supplied into the electricity grid of Armenia.
3. This methodology is applicable to project activities that: *(a) Install a new power plant at a site where there was no*	The CPAs under this PoA will install SHPPs (a) Only at sites where there was no renewable energy power plant operating before (greenfield

[24] http://cdm.unfccc.int/filestorage/C/R/L/CRL8TYAOPD3HJXWK5G90ES6Q7BNUIZ/eb66_repan23.pdf?t=QXp8bTNyOWNjfDCadYXc_hmTSeQ8u55EXWUJ
[25] http://cdm.unfccc.int/Reference/Standards/meth/meth_stan04.pdf
[26] http://cdm.unfccc.int/Reference/Procedures/PoA_proc01.pdf
[27] http://cdm.unfccc.int/Reference/Standards/pp/pp_stan01.pdf

renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); *(b) Involve a capacity addition;* *(c) Involve a retrofit of (an) existing plant(s); or* *(d) Involve a replacement of (an) existing plant(s).*	plants)
4. Hydro power plants with reservoirs that satisfy at least one of the listed conditions are eligible to apply this methodology: *(a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir;* *(b) The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2;* *(c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2*	The CPAs under this PoA will install SHPPs either run-of-river type or SHPP with reservoir. In case of run-of-river hydropower plants, this condition is not applicable. In case of hydropower plants with reservoir, the individual CPAs will comply with the conditions indicated in the methodology in order to be eligible under the proposed programme of activities: (a) Will be implemented in an existing reservoir with no change in the volume of the reservoir; or (b) Will be implemented in an existing reservoir and the change in the power density is over 4W/m^2; or (c) Will result in a new reservoir with power density over 4W/m^2.
5. If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The CPAs of the proposed PoA will have only a renewable component which is within the 15 MW limit for a small-scale CDM project activity.
6. Combined heat and power (co-generation) systems are not eligible under this category.	Not relevant: the CPAs included under the proposed PoA project activity are not co-generation systems.
7. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not relevant: all the CPAs will be greenfield power plants.
8. In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	Not relevant: none of the CPAs included under the proposed PoA will be retrofit or a replacement projects.

B.3. Sources and GHGs

>> As per methodology AMS-I.D., Version 17.0 (EB 61), *the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.*
The baseline includes the emissions related to the electricity produced by the facilities and power plants to be displaced by the CPA. This involves emissions from displaced fossil fuel use at power plants connected to the electricity grid of Armenia.

Table below illustrates the emission sources and gases included in the project boundary for the purpose of calculating project emissions and baseline emissions:

Source		Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	Emissions from water reservoirs from hydro power plants	CO_2	No	Minor emission source
		CH_4	Yes	Main emission source if CPA is hydro power plant with reservoir
		N_2O	No	Minor emission source
	Emissions related to the operation of geothermal power plants	CO_2	No	Not applicable, no geothermal power plant
		CH_4	No	Not applicable, no geothermal power plant
		N_2O	No	Not applicable, no geothermal power plant
	CO_2 emissions from on-site consumption of fossil fuels due to the project activity	CO_2	No	Not applicable, no fossil fuel consumption
		CH_4	No	No
		N_2O	No	No

B.4. Description of baseline scenario

>> As per AMS.I.D., Version 17.0 (EB 61), paragraph 10, the baseline scenario is prescribed as follows: If the project activity is the installation of a new grid connected renewable power plant/unit, "*The baseline scenario is that the 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 into the grid*".
Baseline emissions of a CPA are calculated using the grid emission factor (GEF) that reflects the existing power plants' consumption of fossil fuels and expected electricity generation of the power plants implemented by the CPA.

B.5. Demonstration of eligibility for a generic CPA

>> A CPA is eligible for inclusion under the PoA, provided that the CPA fulfils the following criteria, demonstrated through the listed evidences for each eligibility criteria, as follows:

(a)	**Eligibility criterion:** The geographical boundary of the CPA including any time-induced boundary[28] is consistent with the geographical boundary set in the PoA
	Demonstration of criterion usability to assess the CPA inclusion:

[28] *For example, an emission factor for electricity generation is dependent on the boundaries of regional or state or sub-regional grids.*

	Only the CPA installed within the boundary of Armenia as it may exist at the time of CPA shall be eligible for inclusion under the PoA.
	Evidence for demonstration of CPA compliance with criterion: 1. GPS coordinates of the CPA 2. Map of the respective country with marked location of the project activity

(b)	**Eligibility criterion:** Conditions that avoid double counting of emission reductions like unique identifications of product and end-user locations (e.g. programme logo)
	Demonstration of criterion usability to assess the CPA inclusion: Only the CPA uniquely identified and defined in an unambiguous manner shall be eligible for inclusion under the PoA. There must be no other CDM project activity registered with the same identification data.
	Evidence for demonstration of CPA compliance with criterion: 1. UNFCCC web site check at the time of CPA inclusion under the PoA by the CME and confirmation that the CPA is not registered as a part of any other PoA or as an individual CDM project 2. Unique identification of the CPA, unique CPA code which shall be assigned to the CPA (when the CPA is included under the PoA) entered into the PoA database, containing data: • Name of the CPA implementer (SHPP owner), • Exact CPA location: State/Province/City/GPS coordinates of SHPPs , • Commissioning date of the SHPP (expected date if the SHPP is not commissioned yet), • Expected start date/end date of crediting period(s), • Installed capacity of each power unit 3. Alternatively, a protocol/ report of the CME´s own site visit to the location

(c)	**Eligibility criterion:** The specifications of technology/measure including the level and type of service, performance specification including compliance with testing/certifications
	Demonstration of criterion usability to assess the CPA inclusion: Only the CPA that employs a hydro power technology with total installed capacity equal or below 15 MW shall be eligible for inclusion under the PoA.
	Evidence for demonstration of CPA compliance with criterion: Provided evidence as appropriate and available, e.g. technical project report, technical project design, technology description from the manufacturer

(d)	**Eligibility criterion:** Conditions to check the start date of the CPA through documentary evidence
	Demonstration of criterion usability to assess the CPA inclusion: Only the CPA with the starting date on the day or later of the start of validation of the PoA (uploading for global stakeholder's comments on the UNFCCC web site) shall be eligible for inclusion under the PoA.
	Evidence for demonstration of CPA compliance with criterion: Check by CME, comparison of the dates and confirmation that the start date of the CPA (date when the technology has been/will be ordered/purchased) is/will be after the start date of the PoA

(e)	**Eligibility criterion:** Conditions that ensure compliance with applicability and other requirements of single or multiple methodology/ies applied by CPAs
	Demonstration of criterion usability to assess the CPA inclusion: 1. Only the CPA using the methodology AMS-I.D., Version 17.0 (EB 61) and complying with its applicability criteria at the time of CPA application for inclusion under the PoA shall be eligible for inclusion under the PoA. Criteria as per the methodology AMS-I.D., currently Version 17.0 (EB 61): 2. Only the CPA connected to the Armenian electricity grid shall be eligible for inclusion under the

	PoA 3. If the CPA is a small hydro power plant with reservoir: Only the CPA fulfilling one of the following conditions shall be eligible for inclusion under the PoA: 3.1. The project activity is implemented in an existing reservoir with no change in the volume of the reservoir; 3.2. The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section of the applied methodology, is greater than 4 W/m^2; 3.3. The project activity is implementing new reservoir and the power density of the power plant, as per definitions given in the project emissions section of the applied methodology, is greater than 4 W/m^2
	Evidence for demonstration of CPA compliance with methodology criterion: 1. UNFCCC web site check at the time of CPA inclusion under the PoA by the CME and confirmation that a valid version of the methodology is used 2. Provided evidence as appropriate and available, e.g. preliminary grid feed-in approval, Power Purchase Agreement, or other respective agreement or contract of CPA with operator of the electricity grid, or Technical Project Report specifying the grid connection point, etc. 3. Provided evidence as appropriate and available, e.g. Technical Project Report and/or hydro power technology order, technology purchase, etc. 3.1. Technical Project Report or a respective document if the project activity is implemented in an existing reservoir with no change in the volume of the reservoir 3.2. & 3.3. Power density calculation by CME. The information and evidences for the demonstration of the power density will be made available for inspection by the DOE and information will be included in the CPA-DD.

(f)	**Eligibility criterion:** The conditions that ensure that CPAs meet the requirements pertaining to the demonstration of additionality
	Demonstration of criterion usability to assess the CPA inclusion: Only the CPA that clearly demonstrates its additionality shall be eligible for inclusion under the PoA.
	Evidence for demonstration of CPA compliance with criterion: Evidence is provided through correct application of the procedures of the PoA Standard and by the fact that the statements and assumptions are supported by reliable data sources and evidence, where appropriate. Additionality is being assessed and demonstrated at CPA level, individually for each CPA. Every CPA will provide an explanation showing that the project activity would not have occurred otherwise due to at least one of the following barriers below and that it is voluntarily coordinated and would not be implemented in the absence of CDM. The assessment and demonstration of additionality of the CPA will be described in the CPA-DD. A typical CPA included in this PoA is a small scale project activity or a microscale project activity. • For small scale CPAs (from 5 and up to 15 MW): The additionality shall be demonstrated in accordance with the "Simplified modalities and procedures for small-scale CDM project activities", (decision 4/CMP.1, Annex II)[29], paragraph 28, • For microscale CPAs (up to 5 MW): The additionality shall be demonstrated in accordance with the "Guidelines for demonstrating additionality of microscale project activities", currently Version 03 (EB 63, Annex 23) or in accordance with the "Simplified modalities and procedures for small-scale CDM project activities", (decision 4/CMP.1, Annex II), paragraph 28, Details regarding different approaches on demonstration of additionality to be applied by the CPAs

[29] http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=43

	are described in the Appendix 6 of this PoA-DD.

(g)	**Eligibility criterion:** The PoA-specific requirements stipulated by the CMEs including any conditions related to undertaking local stakeholder consultations and environmental impact analysis[30]
	Demonstration of criterion usability to assess the CPA inclusion: 1. Only the CPA that undertakes the environmental analysis as per requirements of the CDM modalities and procedures shall be eligible for inclusion under the PoA. Only the CPA that performs the environmental impact analysis (EIA) in accordance with the Armenian laws/regulations shall be eligible for inclusion under the PoA. 2. Only the CPA that has conducted the stakeholder involvement process and that has taken into the due account all the concerns raised during the process shall be eligible for inclusion under the PoA. 3. Only the CPA that installs new power generation equipment in the small hydropower plants shall be eligible under the PoA. No power generation equipment may be transferred from other existing facilities.
	Evidence for demonstration of CPA compliance with criterion: 1. EIA report or description/explanation why the EIA is not performed. 2. Description and documentation of the stakeholder involvement process, summary of concerns raised and clarifications provided thereof, if applicable. 3. As appropriate and applicable: Technology orders, technology purchase.

(h)	**Eligibility criterion:** Conditions to provide an affirmation that funding from Annex I parties, if any; does not result in a diversion of official development assistance.
	Demonstration of complying with the eligibility criterion: Only the CPA that has not/will not receive any public funding from Annex I country or the funding is not a diversion from the Official Development Aid (ODA) shall be eligible for inclusion under the PoA.
	Evidence for demonstration of CPA compliance with criterion: CPA implementer confirms to CME that no public funding from Annex I country is involved in the CPA. or Respective evidence on the received funding from Annex I country, check and confirmation of no ODA conflict by CME on individual, case-specific basis.

(i)	**Eligibility criterion:** Where applicable, target group (e.g. domestic (commercial/industrial, rural/urban, grid-connected/off-grid) and distribution mechanisms (e.g. direct installation)[31]
	Demonstration of criterion usability to assess the CPA inclusion: Target group are SHPP developers in Armenia. There are no specific distribution mechanisms.
	Evidence for demonstration of CPA compliance with criterion: CPA implementer developing a small hydro power plant is specified in the CPA-DD. No specific evidence is needed.

(j)	**Eligibility criterion:** Where applicable, the conditions related to sampling requirements for a PoA in accordance with the approved guidelines/standard from the Board pertaining to sampling and surveys

[30] *See also paragraph 6 (m) of "Procedures for registration of a programme of activities as a single CDM project activity and issuance of CERs for a PoA"*

[31] *This is to re-test the validity of assumptions made at the PoA level. For example, in a lighting efficiency application, lighting usage hours of 3.5 hours per day would be valid if the target group is residence/households. Usage hours would be different in commercial applications and vice versa*.

	Demonstration of criterion usability to assess the CPA inclusion: Not applicable since no sampling will be done within any specific CPA.
	Evidence for demonstration of CPA compliance with criterion: Not applicable since no sampling will be done within any specific CPA.

(k)	**Eligibility criterion:** The conditions that ensure that CPA in aggregate meets the small-scale or micro-scale threshold criteria (please refer to the latest approved version of the Guidelines for demonstrating additionality of microscale project activities and the latest approved version of the General Guidelines to SSC CDM methodologies) and remain within those thresholds throughout the crediting period of the CPA
	Demonstration of criterion usability to assess the CPA inclusion: Only the CPA with the total installed capacity under or equal to 15MW throughout whole crediting period shall be eligible for inclusion under the PoA.
	Evidence for demonstration of CPA compliance with criterion: Evidence as appropriate and available, e.g. Technical Project Report and/or hydro power technology order, technology purchase, etc.

(l)	**Eligibility criterion:** Where applicable, the requirements for the debundling check, in case CPAs belong to small-scale (SSC) or microscale project categories
	Demonstration of criterion usability to assess the CPA inclusion: Only the CPA which is a single small/micro scale project activity not a debundled component of a large scale project activity shall be eligible for inclusion under the proposed PoA.
	Evidence for demonstration of CPA compliance with criterion: Check of the UNFCCC web site by CME confirming that there is no existing activity which has the same activity implementer as the proposed small scale CPA or has a coordinating or managing entity, which also manages a large scale PoA of the same sectoral scope; or If there is activity described in point II. 8. (a) of the "Guidelines on assessment of debundling for SSC project activities (Version 03)[32] its boundary is more than 1 km further from the proposed small scale CPA, at the closest point; or If there is activity described in points II. 8. (a) and 8 (b) of the "Guidelines on assessment of debundling for SSC project activities (Version 03), but the total size of such an activity combined with the proposed small scale CPA does not exceed the limits for small scale CDM project activity

B.6. Estimation of emission reductions of a generic CPA

B.6.1. Explanation of methodological choices

>>**Calculation of Baseline Emissions**

According to the selected methodology AMS-I.D. Version 17.0, paragraph 11: *The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.*

$$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$$

(Equation 1, AMS-I.D., Version 17.0)

Where:

BE_y	Baseline emissions in year y (tCO_2)
$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year y (tCO_2/MWh)

[32] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid17.pdf

The quantity of net electricity supplied to the grid ($EG_{BL,y}$) will be calculated annually according to the on-site measurements in the small hydro power plant as the difference between the total (gross) electricity generation of the project activity SHPP in the year *y* ($EG_{gross,y}$) and the electricity consumption of the project activity in the year *y* (electricity consumption by the auxiliary equipment at the plant: EC_y).

$$EG_{BL,y} = EG_{gross,y} - EC_y$$

(supportive equation)

Where:

$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EG_{gross,y}$	Quantity of the total (gross) electricity generation of the project activity SHPP in the year *y* (on-site measurements) (MWh)
EC_y	Quantity of the electricity consumption of the project activity in the year *y* (electricity consumption by the auxiliary equipment at the plant, on-site measurements) (MWh)

The grid emission factor:
According to the methodology AMS-I.D., Version 17.0, paragraph 12: *The emission factor (measured in tCO_2e/MWh) can be calculated in a transparent and conservative manner, as follows:*

> *(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system",*
>
> *OR*
>
> *(b) The weighted average emissions (in tCO_2e/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.*

The grid emission factor of the Armenian electricity grid is calculated according to the procedures prescribed in the UNFCCC methodological "Tool to calculate the emission factor for an electricity system", at the time of submission of this PoA-DD to DOE for validation the valid Version 2.2.1 (EB 63) (further on referred to as "GEF Tool")[33]

- For the Armenian GEF, only the grid connected power plants are considered and the simple adjusted OM method is applied for the calculation.

For the Armenian GEF the ex ante vintage option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

Calculation of the grid emission factor:

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

(Equation 14, GEF Tool, Version 2.2.1)

Where:

$EF_{grid,CM,y}$	Combined margin emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build emissions factor (%)

[33] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf

According to the "Electricity Tool" the following default values have been used for w_{OM} and w_{BM}:
All other projects (other than wind and solar power generation project activities): w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period.

Details of methodological steps applied to GEFs calculations and the data used are provided in the Appendix 4 of the PoA – DD. In the attached report under Appendix 4 the Combined Margin Grid Emission Factor is calculated for the year 2010. This is the most recent year where hourly electricity data is available.

According to paragraph 28 of the "Procedures for registration of a Programme of Activities as a single CDM Project Activity and Issuance of Certified Emission Reductions for a Programme of Activities", (Version 04.1), (EB 55, Annex 38)[34], *the latest version of the Procedures for Renewal of the Crediting Period of a Registered CDM project activity (currently Version 06.0, EB 63, Annex 29[35]) shall be applied, mutatis mutandi, to a PoA every seven years from the start date of the crediting period.*
In Annex 1 of these Procedures, "Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" it is stated in step 1.4 that updates should be undertaken in the following cases:

- Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC;
- Where emission factors are used and determined only once for the crediting period, they should be updated, except if the emission factors are based on the historical situation at the site of the project activity prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.

The grid emission factor of the Armenian electricity grid is calculated ex-ante, once at the validation of the PoA and fixed for the first crediting period. During the first 7 years of the PoA the GEF fixed at validation shall be used by all CPAs included under the PoA and thus will be fixed for the first crediting period of the respective CPAs.

The grid emission factors will be revised and updated at the point of the renewal of the crediting period of the PoA (every seven years) according to the applicable procedures.

Calculation of Project Emissions
According to AMS-I.D., Version 17.0, paragraph 20: *For most renewable energy the project activities, $PE_y = 0$.*
However, for the categories of project activities geothermal power plants and water reservoirs of the hydro power plants, project emissions have to be considered following the procedure described in the most recent version of ACM0002.
At the time of submission of this PoA-DD to DOE for validation the latest is Version 12.3.0 (EB 66)[36].

The project emissions accounted for according to methodology ACM 0002 are:

- Project emissions from fossil fuel consumption in year *y* (tCO_2)
- Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e)
- Emissions from water reservoirs of hydro power plants in year *y* (tCO_2e)

[34] http://cdm.unfccc.int/Reference/Procedures/PoA_proc01.pdf
[35] http://cdm.unfccc.int/Reference/Procedures/reg_proc04.pdf
[35] http://cdm.unfccc.int/methodologies/DB/C505BVV9P8VSNNV3LTK1BP3OR24Y5L

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

(Equation 1, ACM 0002, Version 12.3.0)

Where:

PE_y	Project emissions in year *y* (tCO_2e)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year *y* (tCO_2)
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e)
$PE_{HP,y}$	Emissions from water reservoirs of hydro power plants in year *y* (tCO_2e)

Only the emissions from water reservoirs are relevant for the proposed PoA, as follows: *For hydro power project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoirs*, estimated per two alternatives:

a. <u>If the power density of the single or multiple reservoirs (*PD*) is greater than 4 W/m^2 and less than or equal to 10 W/m^2</u>

$$PE_{HP,y} = \frac{EF_{Res} * TEG_y}{1000}$$

(Equation 3, ACM 0002, Version 12.3.0)

Where:

$PE_{HP,y}$	Project emissions from reservoirs of hydro power plants in year *y* (tCO_2e)
EF_{Res}	Default emission factor for emissions from reservoirs of hydro power plants ($kgCO_2e/MWh$) As per decision by EB 23 $EF_{Res} = 90\ kgCO_2e/MWh$
TEG_y	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh)

b. <u>If the power density of the project activity (*PD*) is greater than 10 W/m^2</u>

$$PE_{HP,y} = 0$$

(Equation 4, ACM 0002, Version 12.3.0

<u>Calculation of the power density of the project activity (*PD*):</u>
The power density of the project activity is calculated as comparison of the installed capacity before and after the implementation of the project and the area of the reservoir/s before and after the implementation of the project.

$$PD = \frac{cap_{PJ} - cap_{BL}}{A_{PJ} - A_{BL}}$$

(Equation 5, ACM 0002, Version 12.3.0)

Where:

PD	Power density of the project activity (W/m^2)
cap_{PJ}	Installed capacity of the hydro power plant after the implementation of the project activity (W)
cap_{BL}	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ}	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL}	Area of the single or multiple reservoirs measured in the surface of the water, before

the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

Calculation of Leakage Emissions

According to AMS-I.D Version 17.0, paragraph 22: *if the energy generating equipment is transferred from another activity, leakage is to be considered.*

No power generating equipment will be transferred from another activity to any of the CPAs included in the proposed PoA and therefore no leakage is to be considered: $LE_y = 0$.

Calculation of Emission Reductions

Emission Reductions are calculated according to AMS-I.D Version 17.0, paragraph 23, as difference between baseline emissions and project emissions.

$$ER_y = BE_y - PE_y - LE_y$$

(Equation 10, AMS-I.D, Version 17.0)

Where:

ER_y	Emission reductions in year *y* (tCO_2/y)
BE_y	Baseline emissions in year *y* (tCO_2/y)
PE_y	Project emissions in year *y* (tCO_2/y)
LE_y	Leakage emissions in year $_y$ (tCO_2/y)

B.6.2. Data and parameters that are to be reported ex-ante

(Copy this table for each data and parameter.)

Data / Parameter	***$EF_{CO2,grid,y}$ ($EF_{grid,CM}$) (Armenian)***
Unit	tCO_2/MWh
Description	CO_2 emission factor of the grid in year *y*
Source of data	Calculated as Combined margin CO_2 emission factor for grid connected power generation in year *y* (tCO_2/MWh)
Value(s) applied	**0.38138**
Choice of data or Measurement methods and procedures	Calculated *ex ante* according to the GEF Tool, Version 02.2.0 (EB 61) Background data provided by the official source, see details in Appendix 4
Purpose of data	(i) Calculation of baseline emissions
Additional comment	The Armenian grid emission factor is determined ***ex-ante*** once at the PoA validation stage, and fixed for the first 7 years of the PoA crediting period. Thus no monitoring and recalculation of the emissions factor for future CPAs is required during the first 7 years of the PoA. It will be used by all Armenian CPAs included into the PoA during the first 7 years of the PoA crediting period; and fixed for the first 7 years of the respective crediting period of these CPAs. The Armenian grid emission factor will be revised after 7 years of the PoA crediting period, and fixed and used accordingly.

Data / Parameter	***cap_{BL}***
Unit	W

Description	Installed capacity of the hydro power plant before the implementation of the project activity.
Source of data	As prescribed by methodology ACM 0002, currently Version 12.3.0 (EB 66), for new power plants, this value is zero.
Value(s) applied	0
Choice of data or Measurement methods and procedures	The proposed CPA is newly built hydropower station. Therefore, based on the methodology, for new hydro power plants, this value is zero.
Purpose of data	(ii) Calculation of project emissions
Additional comment	Only applicable if the project activity is a SHPP with reservoir.

Data / Parameter	A_{BL}
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.
Source of data	Technical documentation of the project, e.g. Technical Project Report. or measurement/calculation based on geographical data from credible sources; e.g.:topographical surveys, maps, satellite pictures, etc.
Value(s) applied	- Will be provided in each CPA-DD.
Choice of data or Measurement methods and procedures	If the value is not be available in the technical documentation of the CPA, it will be measured/calculated and it will be described in accordance with PoA Guidelines for completing the PoA –DD form for small-scale CDM PoAs, PART II. Generic component project activity (CPA) Section B.6.2, letter (c)[37]
Purpose of data	(ii) Calculation of project emissions
Additional comment	Only applicable if the project activity is a SHPP with reservoir

Data / Parameter	cap_{PJ}
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Technical documentation of the project
Value(s) applied	-
Measurement methods and procedures	Determined once for the whole lifetime of the CPA
Monitoring frequency	N/A
QA/QC procedures	N/A
Purpose of data	(ii) Calculation of the project emissions
Additional comment	Only applicable if the project activity is a SHPP with reservoir

[37] http://cdm.unfccc.int/Reference/Guidclarif/pdd/PDD_guid11.pdf

B.6.3. Ex-ante calculations of emission reductions

>> To demonstrate the calculation of emission reductions generated by a CPA included under the proposed PoA, a hypothetical CPA with a new reservoir with parameters as follows:

Installed capacity: 10 MW
Operating hours per year: 4,000 hrs
Gross electricity generation per year: 40,000 MWh/y
Auxiliary consumption of electricity: 130 MWh/y
Net electricity generation: 39,870 MWh/y
Area of the reservoir: 100 m^2
Power density: greater than 4 W/m^2 and less than or equal to 10 W/m^2

The emission reductions calculation is then performed as follows:

Calculation of Baseline Emissions

$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$ *(Equation 1, AMS-I.D., Version 17.0)*

a) If the CPA is installed in Armenia:
$EF_{CO2,grid,y}$ (Armenian) = 0.38138 tCO_2/MWh
BE_y = 39,870 MWh/y * 0.38138 tCO2/MWh = 15,205.6 t CO_2/y

Calculation of Project Emissions

$PE_{HP,y} = \frac{EF_{Res} * TEG_y}{1000}$ *(Equation 3, ACM 0002, Version 12.3.0)*

As per decision from EB23: EF_{Res} = 90 $kgCO_{2e}/MWh$
$TEG_y = EG_{gross,y}$ = 40,000 MWh/y
$PE_{HP,y}$ = 90 $kgCO_{2e}$/MWh * 40,000 MWh/y / 1000 = 3,600 tCO_{2e}/y

Calculation of Leakage Emissions

No power generating equipment will be transferred from another activity therefore $LE_y = 0$.

Calculation of Emission Reductions

$ER_y = BE_y - PE_y - LE_y$ *(Equation 10, AMS-I.D, Version 17.0)*

a) If the CPA is installed in Armenia:
ER_y = 15,205.6 t CO_2/y - 3,600 tCO_{2e}/y - 0 t CO_2/y = 11,605.6 t CO_2/y

B.7. Application of the monitoring methodology and description of the monitoring plan
B.7.1. Data and parameters to be monitored by each generic CPA
(Copy this table for each data and parameter)

Data / Parameter	$EG_{BL,y}$
Unit	MWh/y
Description	Quantity of net electricity supplied to the grid as result of the implementation of the CDM project activity in the year *y*
Source of data	Calculated from the on-site measurements Calculated as the difference between the total (gross) electricity generation of the project activity in the year *y* ($EG_{gross,y}$) and the electricity consumption of the project activity in the year *y* (auxiliary electricity consumption at the SHPP (EC_y)
Value(s) applied	(estimated value for the purpose of *ex-ante* emission reductions calculation)
Measurement methods and procedures	Calculated from the on-site measurements by electricity meter(s) at the point of feeding to the grid
Monitoring frequency	The measurements will be continuous, with at least monthly recording and annual summarization. The data will be archived electronically for 2 years following the end of the last crediting period.
QA/QC procedures	Measured data used to calculate the net electricity supplied to the grid will be cross-checked with electricity purchase and the invoices for consumed electricity from the grid operator. Measuring equipment will be properly calibrated and with proper accuracy, as described per each parameter individually
Purpose of data	(i) Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{gross,y}$
Unit	MWh/y
Description	Quantity of the total gross electricity generated and supplied by the project activity SHPP to the grid in the year *y*
Source of data	On-site measurements by electricity meter(s) installed at the point of feeding in to the grid
Value(s) applied	(value for ex ante estimation)
Measurement methods and procedures	Electricity meter(s) at the point of feeding into the grid
Monitoring frequency	The measurements will be continuous, with at least monthly recording and annual summarization. The data will be archived electronically for 2 years following the end of the last crediting period.

QA/QC procedures	The metering equipment will be properly calibrated in accordance with the instructions (schedules, procedures) for quality assurance from the technology provider and according to the relevant national/international calibration standard, as available. Calibration should be undertaken as prescribed in the relevant paragraph of "General Guidelines to SSC CDM Methodologies". The accuracy of the meter is not lower than national standards. Measured data used to calculate the net electricity supplied to the grid will be cross-checked with electricity purchase and the invoices for consumed electricity from the grid operator.
Purpose of data	(i) Calculation of baseline emissions
Additional comment	-

Data / Parameter	EC_y
Unit	MWh/y
Description	Quantity of the electricity consumption by the project activity SHPP in the year *y*
Source of data	On-site measurements by electricity meter(s)
Value(s) applied	-
Measurement methods and procedures	Electricity meter(s) at the point of feeding into the grid
Monitoring frequency	The measurements will be continuous, with at least monthly recording and annual summarization. The data will be archived electronically for 2 years following the end of the last crediting period.
QA/QC procedures	The metering equipment will be properly calibrated in accordance with the instructions (schedules, procedures) for quality assurance from the technology provider and according to the relevant national calibration standard. The accuracy of the meter(s) will be in accordance with the national/international industry standards or grid operator´s requirements. Electricity consumed by the project activity will be imported from the grid and therefore it will be cross-checked with the electricity invoices from the grid operator.
Purpose of data	(i) Calculation of baseline emissions
Additional comment	-

Data / Parameter	$TEG_y = EG_{gross,y}$
Unit	MWh/y
Description	Quantity of the total gross electricity generated and supplied by the project activity SSC HPP to the grid in the year *y*
Source of data	See table of parameter $EG_{gross,y}$ above
Value(s) applied	See table of parameter $EG_{gross,y}$ above

Measurement methods and procedures	See table of parameter $EG_{gross,y}$ above
Monitoring frequency	See table of parameter $EG_{gross,y}$ above
QA/QC procedures	
Purpose of data	
Additional comment	

Data / Parameter	**A_{PJ}**
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	Technical documentation of the project, e.g. Technical Project Report and/or Land documents, etc. or measurement/calculation based on geographical data from credible sources; e.g.:topographical surveys, maps, satellite pictures, etc.
Value(s) applied	-
Measurement methods and procedures	Annual measured or calculated from topographical surveys, maps, satellite pictures, etc.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	(ii) Calculation of project emissions
Additional comment	Only applicable if the project activity is a SHPP with reservoirs

B.7.2. Description of the monitoring plan for a generic CPA

>> In the proposed PoA the Option (ii) is chosen, i.e. the CME opts for a verification method that does not use sampling but verifies each small scale CPA.

For each small scale CPA a monitoring plan and QA&QC measures will be prepared and described in the CPA-DD. The monitoring plan will outline the procedures for monitoring and recording of parameters as described in the Section B.7.1. above.

CPA implementer will be responsible for

- Operating the small hydropower plant,
- monitoring and recording the data, reporting the data to the CME
- and arranging the maintenance and calibration of the monitoring equipment, as will be described in the monitoring plan of the CPA.

Data sources for the emergency situations when the measurement equipment fails shall be specified in the CPA-DD (e.g. back-up electricity meters, electricity invoices, or other official sources).

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Appendix 1: Contact information on entity/individual responsible for the PoA

Organization	Energy Changes Projektentwicklung GmbH
Street/P.O. Box	Obere Donaustrasse 12-28
Building	
City	Vienna
State/Region	
Postcode	1020
Country	Austria
Telephone	+43 (0) 1 96 84 529
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E-mail	clemens.ploechl@energy-changes.com
Website	www.energy-changes.com
Contact person	Clemens Ploechl
Title	Managing Partner
Salutation	
Last name	Ploechl
Middle name	
First name	Clemens
Department	
Mobile	
Direct fax	
Direct tel.	+43 676 847133100
Personal e-mail	clemens.ploechl@energy-changes.com

Appendix 2: Affirmation regarding public funding

No public funding from Annex 1 country is involved for the proposed PoA.

Appendix 3: Application of methodology(ies)

Application of the methodology is described in the Section B.3 of this PoA-DD.

Appendix 4: Further background information on ex ante calculation of emission reductions

According to the approved UNFCCC "Tool to calculate the emission factor for an electricity system (Version 02.2.0)", hereinafter referred to as the "Tool" the Combined Margin (CM) consists of the combination of Operating Margin (OM) and Build Margin (BM).

This methodological tool determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the combined margin emission factor (CM) of the electricity system. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the operating margin (OM) and the build margin (BM).

The following report is based on the Armenian study "Calculation of Grid (Baseline) Emission Factor for the Electricity System of the Republic of Armenia for the year 2010[38]" provides the accurate calculation of the CM Grid Emission Factor 2010 for the Armenian electricity grid according to the above mentioned approved UNFCCC "Tool".

Introduction

The document presents results of the second assessment of the grid emission factor (baseline study) of the Armenian power system which is carried out for 2010. The first assessment was performed for 2009. Grid emission factor can be applied for development of CDM project activities that substitutes grid electricity, i.e. where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects). The grid emission factor for 2010 was calculated in accordance with the Version 02.2.0 of the "Tool to calculate the emission factor for an electricity system" approved by CDM EB 61.

In particular, the document presents the following information:

- Explanation of the concept of baseline and its specification under the CDM;
- Description of the Armenian power system and power plants serving the system in 2010;
- Description of the methodological tool and approaches used for calculation of the emission factor;
- Description of data and parameters used in calculation.
- Calculation of Operating Margin and Build Margin;
- Estimation of Combined Margin (grid factor), i.e. GHG emissions that would have occurred in absence of the proposed CDM project activity;

The document is developed by request and for the Ministry of Nature Protection of RA (MoNP), serving as Designated National Authority for the CDM in Armenia (DNA), and is aimed to facilitate development of renewable energy CDM projects in Armenia via reducing project development costs associated with data collection and baseline calculation.

Once approved by the DNA, the document will be made publicly available for all interested local and international parties via posting it on the website of the Climate Change Information Center at www.nature-ic.am.

Application of the baseline calculation for CDM projects should be in accordance with the relevant rules and procedures set by the CDM Executive Board as well as with national procedures set by the DNA.

The grid emission factor presented in this document is recommended by the DNA for development of CDM projects in 2011; however, it is not compulsory for project developers.

[38] http://www.nature-ic.am/res/pdfs/projects/CP/SNC/Baseline%20Study%20for%202010%20ENG.pdf

According to the acting CDM procedures, baseline study is a subject to validation by a Designated Operational Entity (DOE). In other words, application of the baseline recommend by the DNA will help project participants to reduce transaction costs associated with baseline development; however, it does not release them from an obligation to validate the baseline once it is used for CDM project activity as a component of the Project Design Document (PDD).

The study provided MO Excel based grid emission factor calculation model to DNA which can used for subsequent years given that system for input data acquisition from agencies responsible for power system data collection and archivation.

The baseline study is a subject to annual update via using the proposed MO Excel based grid emission factor calculation model.

The model, source data and reference documents used for current assessment are available in MoNP and Climate Change Information Center (CCIC).

For further question regarding this document please contact Dr. Aram Gabrielyan, Head of Environmental Protection Department of MoNP, UNFCCC National Focal Point and CDM Contact Person at: aram@nature.am.

1. Clean Development Mechanism

The Clean Development Mechanism (CDM), defined in Article 12 of the Kyoto Protocol, allows industrialized countries with legally binding greenhouse gas reduction commitments (also referred to Annex I countries to the UNFCCC) to invest in emission-reduction projects in developing countries (non-Annex I parties) as an alternative to more expensive emission reductions in their own countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tone of CO_2, which can be counted towards meeting the Kyoto targets.

So far, the CDM is the only mechanism under the Protocol promoting partnerships between developed and developing countries. The CDM rules, however, do not explicitly exclude projects from being undertaken by partnership between one or more developing countries; these are referred to as ‘unilateral' or ‘South-South' projects.

The CDM has three stated objectives:

- To assist Parties not included in Annex I (i.e. developing countries) in achieving sustainable development;
- To contribute to the ultimate objective of the Convention to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system; and
- To assist Parties included in Annex I (developed countries) in achieving compliance with their quantified emission limitation and reduction commitments under Article 3 of the Kyoto Protocol.

2. CDM Designated National Authority

DNA is the body granted responsibility by a Party to authorize and approve participation in CDM projects. The CDM rules provide only limited guidance on the role of the DNA or the requirements for establishing a DNA. These issues are instead left to the Party to determine. Establishment of a DNA is one of the requirements for participation by a Party in the CDM.

The Republic of Armenia signed the United Nations Framework Convention on Climate Change (UNFCCC) on June 13, 1992 and ratified it as a non-Annex I country on May 14, 1993. On December 26, 2002, the National Assembly of Armenia ratified the Kyoto Protocol, which made the Armenia the 108th Party to join the Protocol. Thus, Armenia has met one of the main requirements for participation in the CDM. It is important to mention that Armenia, as a non-Annex I country, does not have any quantitative obligations regarding greenhouse gases emissions reduction or limitation.

On September 16, 2003, the Ministry of Foreign Affairs of the Republic of Armenia submitted a notification to the UNFCCC Secretariat on the assignment of the Ministry of Nature Protection (MoNP) of the Republic of Armenia as Designated National Authority for CDM in Armenia. The Head of Environmental Protection Department of the MoNP acting as UNFCCC National Focal Point has been nominated the DNA Contact Person.

On July 19, 2006, the Government of the Republic of Armenia adopted Decision N-974N on "Implementation of Projects within the framework of the Clean Development Mechanism of the UNFCCC". The document defines key functions of the DNA, particularly, approval of the CDM project activities in Armenia and ensuring availability of information on projects implemented under the CDM.

More information the DNA is available at the CCIC website at: www.nature-ic.am.

3. Concept of the CDM Project Baseline

The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A (of the Kyoto Protocol) within the project boundary.

A baseline for a CDM project activity is a hypothetical reference case, representing the volume of greenhouse gases that would have been emitted if the project were not implemented. In such a way, the baseline can be used to determine the volume of additional greenhouse gas emission reduction achieved by a project activity. A baseline shall be deemed to reasonably represent the anthropogenic emissions by sources that would occur in the absence of the proposed project activity if it is derived using either baseline and monitoring methodologies previously approved by the CDM Executive Board (EB) or new methodologies established in accordance with modalities and procedures for establishing a new methodology set by EB.

Application of a baseline and monitoring methodology should be necessary described and justified in the Project Design Document. Thus, calculation of a baseline (evaluation of GHG emission reduction to be achieved by the proposed project) is a mandatory condition for development, approval, validation and registration of the CDM project activity. For this particular study a Methodological tool to calculate the emission factor for an electricity system (Version 02.2.0) approved by the CDM Executive Board has been applied. More detailed information on the tool and its application is given in the Chapter 5 of the report.

4. Power System of Armenia

There is one integrated power supply system in Armenia. The main capacities of power generation in Armenia are nuclear, thermal and large hydro power plants, as well as small power plants (small HPPs, a biogas plant, a wind power plant and cogeneration units), which provide about 38%, 22%, 33% and 7% of total electricity generation for 2010.

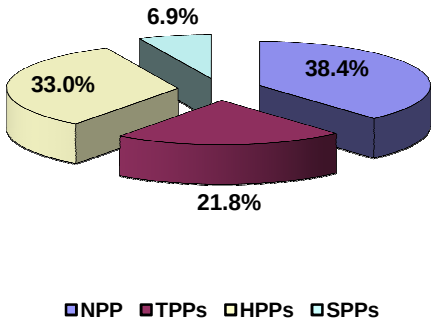


Figure 1: Electricity generation structure of the Armenia power system for 2010

Table below presents information on the installed capacities and commissioning dates of power plants operating within Armenian energy system for year 2010.

Table 1: Generating capacities and dates of commissioning of the Armenian power plants

Plant Type and Name	Capacity [MW]	Years of separate aggregates start-up
Nuclear Power Plant	**815 (408)**	**1976 - 1980 (1995)**
NPP (Medzamor) Unit 2	408	1980 (1995)
Thermal Power Plants	**1.998**	**1963 – 2010**
Hrazdan TPP	1110	1966, 1967, 1969, 1972,1974
Yerevan TPP	550	1963, 1964, 1965
Vanadzor TPP (not operational)	96	1964, 1966, 1976
Combined Cycle Gas Turbine Unit at YTPP	242	2010
Hydro Power Plants	**1.120**	**1913 – 2010**
Sevan-Hrazdan cascade of HPPs (IPC)	561	1936 - 1944, 1949 – 1962
Vorotan cascade of HPPs	404	1970, 1977, 1989
Dzora HPP	25	1932-1933
Small HPPs	130	1913-2010
Other Power Plants	**15,67**	**2005 – 2010**
Lori-1 Wind Power Plant	2,64	2005
Energy Center at Yerevan State Medical University (EC at YSMU) - CHP	4	2007
Lusakert Biogas Plant - CHP	0,83	2008
Erfrez OJSC - CHP	0,1	2009
ArmRoscogeneration CJSC - CHP	2	2009
Lus Astgh Shugar - CHP	6	2010
TOTAL	**3.542**	

Power transmission and distribution is provided by a high voltage power transmission network company, settlements center, power system operator and electricity distribution company.

The Armenian power system has also over 1300 MW of power exchange capability with the neighboring countries i.e. Georgia, Islamic Republic of Iran and Turkey as well as with Nagorno Karabakh Republic. Natural gas is supplied to Armenia from the Russian Federation (through the territory of Georgia) and Islamic Republic of Iran.

4.1. Nuclear Power Plant

The Armenian Nuclear Power Plant (Medzamor NPP) is the only nuclear power plant in the country. It provides about 40% of the total electricity generation. Two units of the power plant were commissioned in 1976-1980, each comprising VVER - 440/V270 reactor. The total installed capacity of the plant at that time was 815 MW.

The earthquake of 1988 generated safety concerns and resulted in the power plant shut-down. The second unit of NPP (nominal capacity 407,5 MW) was re-commissioned in 1995 after extensive renovation and seismic safety improvements. The current working capacity of the plant is 390 MW. The plant works as base load plant working at constant load. Every year NPP stops operation for the period from 1 to 3 months for the maintenance. Nuclear fuel for NPP is imported from Russia.

While the Republic of Armenia is the sole owner of the plant, the Russian company United Energy Systems (UES) manages the Metzamor NPP. The table below provides information on power generation and supply (delivery) of NPP for 2006-2010.

Table 2: Power generation and supply of NPP for 2006-2010

Metzamor NPP	2006	2007	2008	2009	2010
Power generation, mln kWh	2640.3	2553.4	2461.7	2493.7	2490.0

Power supply, mln kWh	2431.2	2347.8	2265.9	2290.4	2286.5

Source: [2]

4.2. Thermal Power Plants

Thermal power plants provide about 20-25% of the total electricity generation. Currently, the plants operate on natural gas.

The Hrazdan TPP with an installed capacity of 1.100 MW was commissioned in 1966-1973, the Yerevan TPP with an installed capacity of 550 MW – in 1963-1968 and the Vanadzor TPP with an installed capacity of 96 MW – in 1964-1976.

These plants underutilize their installed capacities due to their poor technical conditions and insufficient power load. Nowadays, Yerevan TPP works on cogeneration mode, supplying heat to Nairit chemical plant (synthetic rubber producer) and operates mainly on must run mode in conjunction with technological cycle of chemical plant.

Operation of Vanadzor TPPs was stopped in 1997.

The new combined cycle gas turbine unit with an electric capacity of 242 MW was put into operation at the Yerevan TPP in 2010.

The state-of-the-art plant was built with a $247 million loan provided by the Japanese government through the Japan Bank of International Cooperation (JBIC). The long-term loan was disbursed to the Armenian government on concessional terms in 2007. The plant was inaugurated on 22 April 2010.

Table 3 gives overview of generating capacities and dates of commissioning of aggregates of TPPs.

Table 4 provides information on power generation and supply of the TPPs in 2006-2010.

Table 3: Armenian thermal power plants

Power plant	Separate aggregates start-up	Capacity, MW	Quantity and capacity of aggregates q-ty x MW
Yerevan TPP	1963 - 1964	550	5 x 50
	1965 - 1966		2 x 150
Hrazdan TPP	1966	1110	1 x 50
	1967		1 x 50
	1969		2 x 100
	1972		2 x 200
	1974		1 x 200 + 1 x 210
Vanadzor TPP	1964	96	2 x 12
	1966		1 x 25
	1976		1 x 47
CCGT unit at Yerevan TPP	2010	242	1 x 242

Source: [2, 6]

Total installed capacity of the first three TPPs is 1756 MW; however at present time the actual capacity of Yerevan and Hrazdan TPPs is lower due to obsolete equipment, changes in operation conditions, decrease in heat consumption, etc. Vanadzor TPP has not been operated for more than 10 years. The modern and newly constructed CCGT works at its full capacity.

Table 4: Power generation and supply of TPPs for 2006-2010

Hrazdan TPP	2006	2007	2008	2009	2010
Power generation, mln kWh	1138.3	1131.6	1495.5	887.8	348.4
Power supply, mln kWh	1045.8	1048.0	1387.3	823.9	320.6
Yerevan TPP					

Power generation, mln kWh	336.9	357.1	336.4	240.7	73.4
Power supply, mln kWh	285.3	304.8	286.8	203.7	61.3
CCGT Unit at YTPP					
Power generation, mln kWh					991.3
Power supply, mln kWh					957.0

Source: [2]

In 2010 Hrazdan TPP and Yerevan TPP produced about 60% and 70% less electricity in comparison with the previous year. This is due to commissioning of the modern and efficient CCGT unit at Yerevan TPP and changes in operational regimes of the old inefficient facilities.

Table 5 below shows natural gas and syngas[39] consumption of Yerevan and Hrazdan TPPs in 2008-2010.

Table 5: Natural and synthetic gas consumption at the Armenia TPPs in 2008- 2010

TPPs	Fuel Type	Fuel Consumption 1000 m^3			Caloric Value kcal/m^3	Caloric Value [MJ/m^3]
		2008	2009	2010	2010	2010
Yerevan TPP	Natural Gas (NG)	157262	113288	38195	8288	34.700
	Syngas (SG)	38233	16830	6689	2400	10.048
Hrazdan TPP	Natural Gas (NG)	44894	250914	104271	8277	34.654
CCGT at YTPP	Natural Gas (NG)			217824	8260	34.5083

Source: [1]

4.3. Hydro Power Plants

The hydro power system of the country includes the Sevan-Hrazdan cascade (International Energy Corporation) with seven plants; the Vorotan cascade with three plants as well as a number of small HPPs. Hydro power plants generates approximately 30-35% of total power generated in Armenia. The total installed capacity of the HPPs is 1120 MW. Table 6 provides information on generating capacities and dates of commissioning of aggregates of HPPs.

Table 6: Generating capacities and dates of commissioning of HPPs

N	Power plant	Separate aggregates start-up	Capacity, MW	Quantity and capacity of aggregates q-ty x MW
Sevan-Hrazdan Cascade of Hydro Power Plants (IEC)				
1	Sevan HPP	1949	34,24	2 x 17 + 1 x 0,32
2	Atarbekyan (Hrazdan) HPP	1959	81,6	2 x 40,8
3	Gyumush (Argel) HPP	1953	224	4 x 56,0
4	Arzni HPP	1956	70,5	2 x 23,52
		1957		1 x 23,52
5	Kanaker HPP	1936	102	1 x 12,5
		1937		3 x 12,5
		1940		1 x 25
		1944		1 x 25
6	Yerevan HPP-1	1962	44	2 x 22,0
7	Yerevan HPP-3	1950	5	1 x 5
TOTAL			**561**	
Vorotan Cascade of Hydro Power Plants (CHPPs)				
8	Spandaryan HPP	1989	76	2 x 38,0

[39] Syngas is produced by Nairit Plant CJSC during production of acetylene and supplied to Yerevan TPP.

9	Shamb HPP	1977	171	2 x 85,5
10	Tatev HPP	1970	157,2	3 x 52,4
TOTAL			**404**	
Dzora Hydro Power Plant				
11	Dzora HPP	1932	**25**	1 x 8,4
		1933		2 x 8,4
Small Hydro Power Plants				
12	Small HPPs	1913 - 2010	**130**	96 small HPPs
TOTAL			**1120**	

Source: [2, 6]

Sevan-Hrazdan cascade of HPPs is built on Hrazdan River, taking water from Sevan Lake.

Sevan-Hrazdan cascade is the most powerful cascade of HPPs in Armenia with the total installed capacity of 561 MW and considerable power generation potential of more than 2 TWh/y. However, nowadays, discharges from the Sevan Lake to Sevan-Hrazdan cascade are limited and strongly depend on irrigation regime, since no water discharge from the lake is allowed for energy purposes. Therefore the power production in Sevan-Hrazdan cascade is tied to irrigation releases from the lake and varied from 500 to 700 mln. kWh annually during the last 5 years (see Table 7).

The owner of the Sevan-Hrazdan cascade is International Energy Corporation (hereinafter IEC), a Russian company and a subsidiary of Inter RAO UES.

Table 7: Power generation and supply of Sevan-Hrazdan cascade (IEC) in 2006-2010

IEC	2006	2007	2008	2009	2010
Power generation, mln kWh	583.9	521.3	576.2	486.5	727.1
Power supply, mln kWh	574.8	512.4	566.9	478.2	716.2

Source: [2]

As it is seen from the table in 2010 IEC produced about 50% more electricity in comparison with the previous year. This is explained by increase of water release from the Lake Sevan during the year 2010.

Vorotan cascade of HPPs is built on Vorotan River and is equipped with water reservoirs which let to vary load of the plants. Therefore Vorotan cascade power plants are used to follow the hourly demand of the integrated power system. However the total number of power generated by Vorotan cascade power plants is limited and depends on water flow in Vorotan River. Therefore the load of Vorotan cascade is highest during the spring-summer months and lowest during autumn-winter months.

Table 8: Power generation and supply of Vorotan CHPPs in 2006-2010

Vorotan CHPPs	2006	2007	2008	2009	2010
Power generation, mln kWh	1007.9	1030.0	907.6	1130.6	1311.4
Power supply, mln kWh	1000.8	1021.3	899.4	1122.2	1302.9

Source: [2]

Dzora Hydropower Plant with total installed capacity of 25 MW was built on Debet River in 1932. This was the firs large HPP constructed in Armenian and first HPP with pressure tunnel diversion constructed in the former USSR.

Table 9 provides information on electricity generation and supply of Dzora HPP for 2006-2010.

Table 9: Power generation and supply of Dzora HPPs in 2006-2010

Dzora HPP	2006	2007	2008	2009	2010

Power generation, mln kWh	64.4	85.5	77.1	95.1	104.0
Power supply, mln kWh	63.2	83.8	75.5	93.1	102.1

Source: [2]

There are 96 small hydro power plants constructed in Armenia. The majority of SHPP were constructed with the last 10 years due to promotional electricity purchase tariff for renewable energy sources set by Public Services Regulatory Commission of RA. The power supplied from small HPP depends on seasonal water flow in the rivers.

Table 10 provides information on SHPP serving the Armenia energy system as well as on power supplied by these plants in 2008-2010.

Table 10: Power supply of SHPPs in Armenia in 2008-2010

	SHPP	Capacity, kW	Generation, 1000 kWh		
			2008	2009	2010
1	Salenergo LLC	3,028	11913.7	12775.8	9448.4
2	Gyumri SHPP	5,280	17059.0	16307.8	16380.0
3	Energo CJSC	684	488.9	738.2	793.0
4	Kapan-Energy CJSC	12,400	28035.2	37939.1	37874.2
5	Hakobjanyani-Galstyani SHPP LLC	840	3254.8	4084.8	4027.9
6	Q-H LLC	840	1912.8	2337.7	2722.9
7	Agarak SHPP	792	1515.3	2196.5	2764.3
8	Armavir Luys CJSC	2,040	3245.7	4845.7	4569.3
9	Mushegh SHPP LLC	442	2434.3	2601.8	2703.9
10	Ijevan SHPP	612	3397.4	4211.9	3434.5
11	Hydroenergia LLC (Yerevan)	750	3149.7	3421.9	3546.6
12	Energia LLC (Avan)	200	974.9	1061.0	1131.3
13	Energia LLC (Aparan)	1,648	13778.6	15560.6	14694.1
14	Ararat JEG CJSC (Kamenka)	620	3297.3	3568.6	2009.4
15	Hydroenergia LLC (Kotayk)	1,190	3011.8	2613.0	2581.2
16	G.Tatevosyan LLC	47	124.8	207.0	236.5
17	Energotekhnika LLC	320	1128.9	1054.8	1181.6
18	Ler - Jur LLC (Atchut 1)	500	1823.8	2187.6	2170.2
19	Energatsantsshin OJSC	1,200	922.5	1066.2	22.8
20	Elegis SHPP LLC (Elegis)	800	4676.2	4673.9	5144.7
21	Zovashen SHPP LLC	1,520	2613.8	3218.7	3788.1
22	Atlas Energo LLC	440	575.9	562.1	545.9
23	Elgia LLC	180	1524.0	2180.4	1153.4
24	Narenergo LLC	1,000	4759.9	5520.7	6362.5
25	Bazenk CJSC (Yeghegis SHPP)* *(CDM project activity)*	9,950	26528.8	26230.9	30844.7
26	Ler - Jur LLC (Atchut 2)	800	3687.0	3796.7	4059.7
27	H-G HPP LLC	1,200	6643.6	7701.9	8388.1
28	G.G.V. LLC	1,710	5617.0	4640.2	5546.7
29	Akinq CJSC	1,400	1340.7	1423.3	2223.8
30	H.A.G. Eryak CJSC	350	2020.7	2144.7	2345.7
31	Zangezur - 95 SHPP	800	2664.5	5210.2	5338.9
32	Benzar Energy LLC	279	1060.9	978.2	898.1
33	Loraget SHPP LLC	514	1699.7	1473.9	2328.7

34	Astghik - Hovhannes LLC	60	0.0	0.0	22.1
35	Tirakal LLC	5,200	10159.3	13973.8	15299.6
36	Singl Gor LLC	621	1967.2	2207.2	2567.6
37	Bitlis Men LLC	2,000	3592.6	2607.2	3458.4
38	Ler Eks Energia LLC (2)	224	1130.8	1793.8	1813.5
39	Ler - Jur LLC (Chichkhan)	1,000	2537.2	3267.8	2791.9
40	RINE LLC	90	360.9	358.4	526.4
41	Elegis SHPP LLC (Hermon)	1,200	4084.7	4465.5	5763.1
42	Pargev - Vardan LLC	280	1151.4	1094.3	1101.0
43	Mavr LLC (Chanakhchi)	1,440	2479.9	3097.9	2996.6
44	Engels Tumanyan LLC	60	341.2	295.1	282.2
45	Izodrom LLC	1,000	3926.0	6688.5	7539.3
46	Tezh SHPP	2,064	4937.0	6452.7	6038.0
47	Smbul LLC	100	627.8	858.4	927.6
48	Ost-El LLC (Haghpat 1)	320	0.0	0.0	0.0
49	Ost-El LLC (Haghpat 2)	1,900	2943.4	2175.3	4493.8
50	Firma G.A.K. LLC	740	1165.6	1428.6	1753.3
51	Ler Eks Energia LLC (4)	285	1658.5	1900.9	1887.9
52	Ararat JEG CJSC (Gnevank 1 and 2)	1,287	6235.1	5602.3	6384.5
53	Shaghat LLC	55	104.4	176.7	220.0
54	Hosk LLC	380	1083.9	1783.0	2268.4
55	Ler Eks Energia LLC (6)	340	2223.3	2408.1	2500.5
56	Qurkik Jalal LLC	420	407.0	852.2	648.0
57	Lernapati Kantegh LLC	549	768.4	1319.9	1459.7
58	THS LLC	5,140	3779.6	8921.8	10205.7
59	Zorakar LLC	1,280	677.6	2106.8	2536.3
60	Atlas Energo LLC	2,000	575.9	2274.7	5480.2
61	Gosghek LLC	364	115.8	784.9	1017.7
62	Syunik LLC	1,500	3107.2	7762.1	9296.1
63	Hak Hek LLC	1,530	646.6	3367.3	4313.2
64	Ler Eks Energia LLC (3)	256	722.0	2074.0	2061.9
65	Sektor Qvant LLC	493	249.1	2960.0	3537.8
66	A.A.Khachatrayn LLC	306	195.2	2241.9	4174.1
67	Hermon MAD LLC	1,570	0.0	1601.9	2636.8
68	Ani OJSC	3,900	0.0	904.7	4719.3
69	Surb Aghbyur LLC	737	0.0	1466.6	3731.1
70	Arnavar LLC	1,229	0.0	1761.7	3309.7
71	Qarevard LLC	1,640	0.0	1256.8	6407.1
72	Eliza Farm LLC	725	0.0	938.1	3287.2
73	Vakuflo LLC **	1,260	0.0	1560.8	3263.0
74	Firma G.A.K. LLC (Her-Her 1)	630	0.0	1181.0	4760.3
75	Sektor Qvant LLC (Dzoragyugh 3)	274	0.0	596.9	4336.2
76	Gosh SHPP	650	0.0	340.3	1653.7
77	Sanrayz Electric CJSC	959	0.0	0.0	2093.6
78	El-Kas LLC	2,910	0.0	0.0	9558.7
79	Amberd SHPP (1)	2,280	0.0	0.0	5585.0
80	VICI GROUP LLC (Hakhunm)	640	0.0	0.0	692.1

81	Loraget Hek LLC (Sisakan-1)	850	0.0	0.0	1987.7
82	MINA-MAYA LLC (Eghegnadzor)	1620	0.0	0.0	5357.3
83	VG ev Vordiner (Her-Her-1)	1610	0.0	0.0	2903.5
84	Jaghayi Dzor (Goght-1)	1950	0.0	0.0	5589.8
85	Jaghayi Dzor (Goght-2)	2320	0.0	0.0	5178.9
86	Lusakunq LLC (Ayrq HPP-1)	360	0.0	0.0	132.7
87	Kh & M Ynkerner (Vararakn)	708	0.0	0.0	3062.6
88	El-En-Eks LLC (Aghstev-1)**	1400	0.0	0.0	2110.1
89	Lusakunq LLC (Ayrq HEK-2)**	700	0.0	0.0	297.8
90	Apahov Taniq LLC (Vahagni)**	1000	0.0	0.0	3146.8
91	Jahuk LLC (Artavan-1)**	2900	0.0	0.0	1181.4
92	Azatek HEK CJSC (Azatek)**	500	0.0	0.0	114.9
93	Tigran & Ashkhen LLC (T&A SHPP)**	370	0.0	0.0	1041.8
94	Energatsntsshin OJSC (Tsav)**	2740	0.0	0.0	1934.8
95	ERIK SHPP LLC (Erik)**	2460	0.0	0.0	1608.3
96	Qanar CJSC (Sarnakunq)**	390	0.0	0.0	1742.9
TOTAL		**130,142*** **	**230,836.7**	**297,445.7**	**400,052.6*** **

Source: [1 and 2]

**)installation and operation of the second power generation unit of Yeghegis SHPP with installed capacity of 3.75 MW and projected annual power generation of 7296 MWh is registered as the CDM project activity* [4];

***) these are the recent 9 SHPP capacity additions to the grid as of December 2010;*

****) for the year 2010;*

*****) According to the information provided by the Settlement Centre LLC, the total power generation of the above listed SHPPs is 408,4 mln kWh; however no detailed information on power generation by each power plant is given. This is explained by the fact that commercial meters of the majority of the SHPPs are installed not at the plants but in electric substations vie which power is supplied to the grid. Hence, for the majority of SHPPs listed above commercial meters register supplied (not generated) energy.*

4.4. Wind Power Plant and CHP Units

Lori-1 Wind Power Plant with installed capacity of 2.64 MW is the very first (and only) wind power plant constricted and operated in Armenia as of 2009. The plant consist of four 660 kW capacity wind turbines located in Pushkin Pass, the Armenia's northern region of Lori. The plant was constricted in 2005 by the Iranian company "Sunir" using grant money provided by Iran. Table 11 provides detailed information on electricity generated and supply of Lori-1 WPP.

Table 11: Power generation of Lori-1 WPP in 2007-2010

Lori-1 WPP	2007	2008	2009	2010
Power generation, mln kWh	2.9	1.9	4.25	4.06
Power supply, mln kWh	2.7	1.8	3.9	3.7

Source: [2]

A number of small CHP (combined heat and power) units were constructed and operated recently within the scope of locally and internationally financed projects and initiatives. These units are integrated into the power system and supply electricity to the national grid. Information on capacities, power generation and fuel consumption of the mentioned CHP units is provided in the table below.

Table 12: Installed capacities, power generation and fuel consumption of CHP units

Facility	Fuel type	Fuel Consumption for 2010	Installed capacity	Power Generation		
				2008	2009	2010

		mln m^3	*MW(e)*	*mln kWh*		
Energy Center at Yerevan State Medical University (EC at YSMU)	Natural gas	6.806	4	21.7	25.27	24.91
ArmRoscogeneration CJSC	Natural gas	1.687	2	0.0	0.26	4.364
Lusakert Biogas Plant[40]	Biogas	-	0.83	0.4	2.71	2.97
Erfrez OJSC	Natural gas	0.095	0.1	0.0	0.45	0.35
Lus Astgh Sugar[41]	Natural gas	6.1	6	0.0	0.0	0.5
TOTAL			**12.93**	**22.1**	**28.69**	**33.09**

Source: [1, 2, 10]

4.5. Power Exchange Balance

The Armenian transmission network has interconnections with the neighboring countries such as Georgia, Iran, Azerbaijan and Turkey, with the following capacities:

- Armenia-Iran, two 220 kV transmission lines that were built in 1997 and 2003 with 300-450 MW capacity. Plans are to increase the capacity to 600 MW.
- Armenia-Georgia, one 220 kV transmission line with 250 MW capacity, and two 110 kV transmission lines with a total capacity of 100 MW.
- Armenia-Azerbaijan, one 330 kV line with 420 MW capacity, which is currently disconnected.
- Armenia-Turkey, one 220 kV line with 300 MW capacity, which is currently disconnected.
- Armenia-Nagorno Karabakh Republic, one 110 kV line with 40 MW capacity.

Currently, Armenia maintains electricity export and exchange activities with Nagorno Karabakh Republic and Iran. Usually Armenia operates on zero-saldo swap exchange with Iran: it exports electricity during the summer months (April-September), when it has surplus electricity and imports from Iran during the winter months (October-March). However, in 2010 a positive balance (+904.5 mln kWh) of intersystem power exchange between Armenia and Iran was registered.

The country also exports some of its surplus electricity to Nagorno Karabakh Republic. Export of electricity to Georgia (which reached up to 656 mln kWh in 2005) has been reduced since 2006 down to zero in the subsequent years. In 2009-2010 some increase of power import from Georgia was registered (19.76 and 89.45 mln kWh).

Table 13 provides information on power exchange balance of the Armenian energy system for 2006-2010.

Table 13: Armenian Power Export / Import Balance for 2006 – 2010

	2006	**2007**	**2008**	**2009**	**2010**
Export, mln kWh	754.5	451.4	485.8	464.8	1149.4
Import, mln kWh	354.9	418.4	343.5	291.2	287.2
Balance, mln kWh	399.6	32.7	142.4	173.6	862.2

Source: [2]

As it is seen from this chapter, total power generation in 2010 of 6491.2 mln kWh is 14.4% higher that generation in 2009 (5671.2 mln kWh). Increase in generation is explained by growth of electricity

[40] Lusakert Biogas Plant has been constructed and operated under the Clean Development Mechanism. The plant generates electrical and thermal energy and runs on biogas produced from the anaerobic digestion of poultry manure in animal waste digestion facility. More information on the project is available on the Climate Change Information Center website at: www.nature-ic.am.

[41] New backpressure power turbine was commissioned at Lus Astgh Sugar LLC in 2010. The turbine serves mainly for heat generation.

consumption in the Republic and power export to neighboring countries. In particular, export of power to Iran reached 1149.4 mln kWh in 2010 which demonstrates 147% increase in comparison with the previous year. The mentioned growth is conditioned by increase of power flow to Iran (1061.2 mln kWh) within the framework of "gas in exchange of for electric power" project.

4.6. Energy System Development Strategy

"Energy Sector Development Strategies in the Context of Economic Development in Armenia" adopted by the Government of Armenia in August 2005, revealed that:

- 38% of Armenian installed capacity has been in operation for more than 30 years;
- The primary equipment at TPPs has reached 200 thousand hours level and does not correspond to international standards in terms of technical, economic and ecologic criteria;
- 70 % of the installed equipment at HPPs has been in operation for more than 30 years, and 50% for more than 40 years.

The document provides information on measures aimed at modernizing and replacing of the generating capacity. In particular, the following capacity additions to the power system are planned before 2016.

Before 2010:

- The first gas fired combined cycle unit at Yerevan TPP – 208 MW;
- A gas turbine Unit 5 at Hrazdan TPP – 440 MW;
- Meghri HPP on Araks River – 140 MW;
- Small HPPs – 70 MW;
- Wind power plants – 100 MW.

Before 2016:

- Loriberd HPP – 60 MW;
- Small HPPs – 65 MW;
- Wind power plants – 200 MW;
- The second gas fired combined cycle unit at Yerevan TPP – 208 MW;
- The 6^{th} combined cycle unit at Hrazdan TPP – 400 MW.

Commissioning of the first CCGT unit at Yerevan TPP took place in 2010. The actual electric capacity of the unit is 242 MW. Gas turbine Unit-5 at Hrazdan TPP will be commissioned in 2011.

5. Methodology

As it was mentioned in the chapter 3 of this report for this particular study a Methodological tool to calculate the emission factor for an electricity system (Version 02.2.0) approved by the CDM Executive Board (EB61) has been applied. In this chapter detailed explanation of the mentioned tool is given.

5.1. Scope and Applicability

This methodological tool determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the Combined Margin emission factor (CM) of the electricity system. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the Operating Margin (OM) and the Build Margin (BM).

OM is the emission factor that refers to the group of **existing power plants** whose current electricity generation would be affected by the proposed CDM project activity.

BM is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the proposed CDM project activity.

This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity, i.e. where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects). This tool is also referred to in the "Tool to calculate project emissions from electricity consumption" for the purpose of calculating project and leakage emissions in case where a project activity consumes electricity from the grid or results in increase of consumption of electricity from the grid outside the project boundary. This tool provides procedures to determine the following parameters:

Parameter	Unit	Description
$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin CO_2 emission factor for electricity system in year y
$EF_{grid,BM,y}$	tCO_2/MWh	Build margin CO_2 emission factor for electricity system in year y
$EF_{grid,OM,y}$	tCO_2/MWh	Operating margin CO_2 emission factor for electricity system in year y

5.2. Baseline Methodology Procedure

The tool sets the following six steps for calculation of baseline:

STEP 1. Identify the relevant electricity systems.

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

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

STEP 4. Calculate the operating margin emission factor according to the selected method.

STEP 5. Calculate the build margin emission factor.

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

Step 1: Identify the relevant electricity systems

For determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

For the purpose of this study the national grid is considered as the project electricity system.[42].

Electricity transfers from connected electricity systems to the project electricity system are defined as electricity imports and electricity transfers to connected electricity systems are defined as electricity exports.

Electricity exports should not be subtracted from electricity generation data used for calculating and monitoring the electricity emission factors.

The Armenian power system maintains power exchange with the national electricity grid of Iran. In such a way, Iranian national grid is considered as the connected electricity system. According to the methodology for net electricity import from the connected electricity system located in another country, the emission factor is 0 tons CO_2 per MWh.

[42] No information on delineation of the project electricity system and connected electricity system has been published by the host country DNA. According to the acting legislation, the proposed renewable power generation project (capacity) will be connected to the Armenian national power grid operated by the Electric Networks of Armenia" CJSC (ENA). This national electricity grid is the unique transmission and distribution line, to which all power plants serving the energy system of Armenia are physically connected.

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

This step is not relevant to this study.

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

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

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM.

For the purpose of this study option (b) – Simple adjusted OM was selected for calculation of the operating margin emission factor. This is because low-cost/must-run resources[43] constitute more than 50% of the total grid generation in the host country (see Chapter 7).

For calculation of the Simple adjusted OM, the model proposes to use either of the two following data vintages:

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

Ex post option: If the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year *y-1* may be used.

For this study ex post option was selected for calculation of Simple adjusted OM.

Currently hourly electricity generation data are collected at the Ministry of Energy and Natural Resources of RA for the year 2011. As soon as the data are provided (this will be the case during validation) the GEF will be calculated ex-ante for the years 2009 to 2011.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple adjusted OM emission factor (EF_{grid}, $OM\text{-}_{adj,y}$) is a variation of the simple OM, where the power plants / units (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*m*). The simple adjusted OM is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OM\text{-}adj,y} = (1-\lambda_y)\cdot\frac{\sum_m EG_{m,y}\times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y\cdot\frac{\sum_k EG_{k,y}\times EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

Where:

[43] Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

$EF_{grid,OM\text{-}adj,y}$ -	Simple adjusted operating margin CO_2 emission factor in year *y* (tCO2/MWh)
λ_y -	Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y*
$EG_{m,y}$ -	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EG_{k,y}$ -	Net quantity of electricity generated and delivered to the grid by power unit *k* in year *y* (MWh)
$EF_{EL,m,y}$ -	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{EL,k,y}$ -	CO_2 emission factor of power unit *k* in year *y* (tCO_2/MWh)
m -	All grid power units serving the grid in year *y* except low-cost/must-run power units
k -	All low-cost/must run grid power units serving the grid in year *y*
y -	The relevant year as per the data vintage chosen

Net electricity imports must be considered low-cost/must-run units *k*.

Emission factors $EF_{EL,m,y}$ is determined in the following way.

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$ -	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$ -	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$ -	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ -	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO2/GJ)
$EG_{m,y}$ -	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m -	All power units serving the grid in year *y* except low-cost/must-run power units
i -	All fossil fuel types combusted in power unit *m* in year *y*
y -	The relevant year as per the data vintage chosen

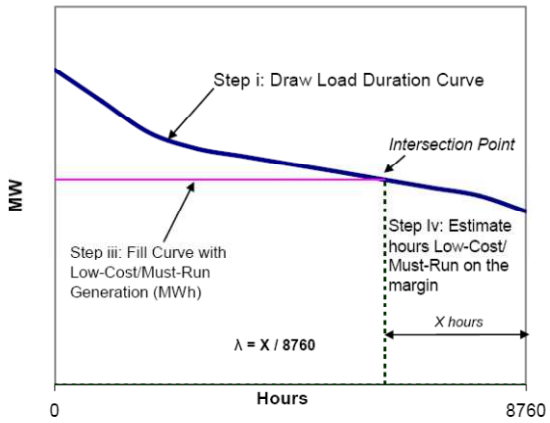
The same equation is used for calculation of CO_2 emission factor for low-cost/must-run power units ($EF_{ELk,y}$).

The parameter λ_y *is* defined as follows:

$$\lambda_y\ (\%) = \frac{\text{Number of hours low - cost / must - run sources are on the margin in year y}}{\text{8760 hours per year}}$$

Lambda (λ_y) should be calculated as follows (see figure below):

Step (i) Plot a load duration curve. Collect chronological load data (typically in MW) for each hour of the year *y*, and sort the load data from the highest to the lowest MW level. Plot MW against 8760 hours in the year (in descending order).



Step (ii) Collect power generation data from each power plant/unit. Calculate the total annual generation (in MWh) from low-cost / must-run power plants/units (i.e. $\Sigma k\ EGk,y$).

Step (iii) Fill the load duration curve. Plot a horizontal line across the load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from

low-cost/must-run power plants/units (i.e. $\Sigma k\ EG_{k,y}$).

Step (iv) Determine the "Number of hours for which low-cost/must-run sources are on the margin in year *y*". First, locate the intersection of the horizontal line plotted in Step (iii) and the load duration curve plotted in Step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero.

Step 5: Calculate the build margin emission factor

The sample group of power units m used to calculate the build margin should be determined as per the following procedure:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. Ignore steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

If the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of thegeneration of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{->}10yrs}$).

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

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

Where:

$EF_{grid,BM,y}$ -	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ -	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ -	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m -	Power units included in the build margin
y -	Most recent historical year for which power generation data is available

Step 6: Calculate the combined margin emissions factor

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

(a) Weighted average CM; or

(b) Simplified CM.

For the purpose of this study the weighted average CM method (option A) has been used as the preferred option.

The combined margin emissions factor is calculated as follows:

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

Where:

$EF_{grid,BM,y}$ -	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$ -	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM} -	Weighting of operating margin emissions factor (%)
w_{BM} -	Weighting of build margin emissions factor (%)

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

- Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;
- All other projects: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, 9 unless otherwise specified in the approved methodology which refers to this tool.

6. Data Sources

In accordance with the provisions of the tool, calculation of baseline is done based on data from an official source (where available). Information from the following organizations has been used for all relevant calculations:

- Public Services Regulatory Commission of RA (former Energy Commission of Armenia) was established in on April 3, 1997 by the Order of the President of the Republic of Armenia to implement regulatory and tariff policy in the energy sector of the country. The main functions of the commission are as follows: issues generation operational licenses and construction authorizations, sets maximum tariffs for electricity and gas imports, issues licenses for power market service provision activities, sets tariffs for electrical and thermal energy and gas, etc.

- "Settlement Center" Close Joint-Stock Company (under the Ministry of Energy and Natural Resources of RA) is the state-owned company, which executes registration and measuring of power generation and supply through the country, based on commercial meters indicators, as well as carries out relevant financial calculations and analysis necessary for the settlement of accounts between power generating companies and electricity purchaser – "Armenian Electric Network of Armenia" CJSC.

Settlement Center runs comprehensive and advanced software which allows both simultaneous estimation of more than 40 parameters of the network and power system and archiving the most important data, including half-hourly generation and own consumption for all power plants serving the Armenian energy system.

The current document incorporates information and data on the Armenian energy sector, officially obtained from the Ministry of Energy and Natural Resources (Settlement Center CJSC) and Public Services Regulatory Commission of RA as well as from other publicly available official sources referred in this chapter and in the bibliography. All data as well as reference documents can be obtained from the DNA and furnished to a DOE upon request of the project proponents should the latter use this study for CDM project development.

Some specific data were obtained from Nairit Plant CJSC and ArmRosgasprom CJSC.

The tool requires that the data used for baseline assessment be presented in a matter that enabled reproducing of the calculation of the build margin and operating margin grid emission factors. For that reason all key data and parameters used for this study and available for validation are introduced in the tables below.

Measurement procedures and monitoring frequency of each particular data and parameter should be decided as per provisions of the Tool and corresponding monitoring plan requirements. Given that ex post option was chosen, the emission factor is determined for the year in which the project activity displaces grid electricity. This approach requires that the emissions factor be **updated annually** during monitoring of the project activity.

Data / Parameter:	$FC_{i,m,y}$
Data unit:	1000 m^3 / year
Description:	Amount of fossil fuel type *i* consumed by power plant / unit *m* in year *y*
Source of data:	Public Services Regulatory Commission of RA, ArmRosgazprom CJSC
Value of data:	All data are available at the DNA (see Tables 5 and 17)

Data / Parameter:	$NCV_{natural\ gas,\ y}$
Data unit:	kcal/m^3
Description:	Net calorific value (energy content) of natural gas in year *y*
Source of data:	Public Services Regulatory Commission of RA
Value of data:	All data are available at the DNA (see Tables 5 and 17)

Data / Parameter:	$NCV_{syngas,\ y}$
Data unit:	kcal/m^3
Description:	Net calorific value (energy content) of syngas in year *y*
Source of data:	Public Services Regulatory Commission of RA
Value of data:	2400 (see also Table 5)

Data / Parameter:	$CF_{Gcal/TJ}$
Data unit:	unitless
Description:	Conversion factor for energy TJ/Gcal
Source of data:	IPCC, Climate Change 2000: Working Group III: Mitigation

	http://www.grida.no/climate/ipcc_tar/wg3/477.htm
Value of data:	4.1868 x 10^{-3}

Data / Parameter:	$EF_{CO2,i,y}$ and $EF_{CO2,m,i,y}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of natural gas used in power unit *m* in year *y*
Source of data:	Default value of the IPCC 2006 Guidelines (lower value of 95% confidence interval)
Value of data:	54.3

Data / Parameter:	$EF_{CO2, SYNGAS}$
Data unit:	tCO_2/TJ
Description:	Carbon dioxide emission factor per unit of volume of syngas
Source of data:	"Nairit Factory" CJSC
Value of data:	74.0
Comments	The carbon dioxide emission factor for syngas is calculated by specialists of the Environmental Department of "Nairt Factory" CJSC. Emission factor of syngas is strongly depends on gas composition, which, in its turn depends on processing procedures. Thus, only company's experts' judgment and estimation can provide objective information on gas emission factor.

Data / Parameter:	$EG_{m,y}$ and $EG_{k,y}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit *m* or *k* in year *y*
Source of data:	Settlement Center CJSC
Value of data:	All data are available at the DNA (see Chapter 4 and 7)

Data / Parameter:	Group of power source plants for the OM
Data unit:	Name of plants
Description:	OM includes all generating power plants serving the power system except for low-cost / must-run power plants / units and imports.
Source of data:	Public Services Regulatory Commission of RA
Value of data:	All data are available at the DNA (see Chapter 7)

Data / Parameter:	Group of power source plants for the BM
Data unit:	Name of plants
Description:	BM includes either the set of five power units that have been built most recently or the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.
Source of data:	Public Services Regulatory Commission of RA
Value of data:	All data are available at the DNA (see Chapter 7)

Data / Parameter:	**$EF_{grid,OM,y}$**
Data unit:	tCO_2/MWh
Description:	Operating margin (OM) emission factor
Source of data:	Public Service Regulatory Commission of RA, Settlement Center CJSC
Value of data:	All data are available at the DNA (see Chapter 7)

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build margin (BM) emission factor
Source of data:	Public Service Regulatory Commission of RA, Settlement Center CJSC
Value of data:	All data are available at the DNA (see Chapter 7)

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build margin (BM) emission factor
Source of data:	Public Service Regulatory Commission of RA, Settlement Center CJSC
Value of data:	All data are available at the DNA (see Chapter 7)

Data / Parameter:	Import of electricity
Data unit:	MWh
Description:	Electricity transfers from connected electricity systems
Source of data:	Settlement Center CJSC
Value of data:	All data are available at the DNA (see Table 13)

Data / Parameter:	Lambda factor
Description:	Period of time when low-cost / must run sources are on the margin
Source of data:	Settlement Center CJSC
Value of data:	All data are available at the DNA (see Chapter 7)

7. Baseline Calculation

This chapter represents the results of Operating, Built and Combined Margin emissions calculations performed in accordance with the above described methodological approaches.

Calculations have been made by means of MO Excel based model which allows a user to assess grid emission factor under various scenarios of power system development.

Results of Combined Margin calculation presented in this report may be used by project participants for evaluation of GHG mitigation potential of CDM project activities and, thus, can be allied for development of both CDM Project Idea Notes and Project Design Documents. However, these results should not be treated us compulsory.

7.1. Calculation of Simple Adjusted Operational Margin

For calculation of the operational margin emission factor option (b) Simple Adjusted OM method was selected because low-cost/must-run resources constitute more than 50% of the total grid generation in Armenia. This is demonstrated in the table below.

In accordance with provisions of the Tool, Hrazdan TPP and Yerevan TPP were selected as **no** low-cost / must-run power plants.

Table 14: Share of low-cost/must-run plants in total power generation in 2006-2010 (mln kWh)

	2006	2007	2008	2009	2010
NPP	2640.26	2553.4	2461.7	2493.7	2490.0
Hrazdan TPP (no low-cost/must run)	1138.27	1131.6	1495.5	887.8	348.4
Yerevan TPP (no low-cost/must run)	336.97	357.1	336.4	240.7	73.4
CCGT Unit at YTPP (no low-cost/must run)	0.0	0.0	0.0	0.0	991.3
Sevan-Hrazdan cascade of HPPs (IPC)	583.85	521.3	576.2	486.5	727.1
Vorotan cascade of HPPs	1007.9	1030	907.6	1130.6	1311.4

Dzora HPP	64.44	85.5	77.1	95.1	104.0
Small HPPs and other small plants*	166.5	215.7	259.7	337.0	445.5
TOTAL	**5940.79**	**5897.5**	**6114.2**	**5671.4**	**6491.2**
Must-run and low-cost plants	4465.55	4408.8	4282.3	4542.6	5078.0
Share of low-cost/must-run plants, %	**75.17%**	**74.76%**	**70.04%**	**80.10%**	**78.23%**

Source: [2]

**) This category also incorporates 5 small-scale CHP units listed in Table 12 and the wind power plant Lori-1 WPP listed in Table 11!*

In order to evaluate Operational Margin, net quantity of electricity (mln kWh) generated and delivered to the grid by all power units serving the system need to be identified as well as CO_2 emission factor (tCO_2/MWh) of power units operated on fossil fuels need to be calculated.

Information on electricity generation and supply (delivery) by low-cost/must-run and other plants for the year 2010 is presented in the table below. According to the Tool, electricity import is also considered in calculation of Simple Adjusted OM.

Table 15: Data on electricity generation and supply by low-cost/must-run and other plants in 2010

POWER PLANT	Capacity	Generation	Delivery	Type of fuel
	MW	mln kWh	mln kWh	
Metzamor NPP	408.0	2490.0	2286.5	nuclear
Hrazdan TPP*	1110.0	348.4	320.6	NG
Yerevan TPP*	550.0	73.4	61.3	NG and SG
CCGT Unit at Yerevan TPP*	242.0	991.3	957.0	NG
Sevan-Hrazdan CHPPs (IEC)	561.0	727.1	716.2	hydro
Vorotan Cascade of HPPs	404.0	1311.4	1302.9	hydro
Dzora HPP	25.0	104.0	102.1	hydro
Lori-1 WPP	2.64	4.06	3.7	wind
EC at YSMU – CHP	4.0	24.91	24.64	NG
ArmRoscogeneration CJSC – CHP	2.0	4.36	4.36	NG
Lusakert Biogas Plant - CHP	0.83	2.97	2.9	biogas
Erfrez OJSC - CHP	0.1	0.35	0.33	NG
Lus Astgh Sugar - CHP	6.0	0.5	0.5	NG
Small HPPs	130.14	408.4	400.05	hydro
Total	**3445.7**	**6491.2**	**6183.1**	
Import		287.16	287.16	
TOTAL	**3,445.7**	**6,778.31**	**6,470.24**	
No low-cost/must-run plants	**1,902**	**1,413.1**	**1,338.9**	
Low-cost/must-run plants (incl. imports)	**1,543.7**	**5,365.26**	**5,131.34**	

Source: [2]

All small CHP units are included in low-cost/must-run plants list because these plants are not dispatched by the national operator (dispatching unit) but rather operated independently based on power purchase agreements. According to the acting legislation[44] national grid is obliged to purchase all power generated by such type of power plants within 5 years after the plants operation date.

[44] Decree of the Government of RA N509-N (dated on April 13, 2006) on Heating System Rehabilitation Pioneer Projects based on CHP Plants.

In the tables 16 and 17 results of calculation of emission factors for no low-cost/must-run and low-cost/must-run power plants for 2010 are given.

Table 16: Calculation of emission factors for no low-cost/must-run power plants for 2010

POWER PLANT	Capacity	Delivery	Type of fuel	$FC_{i,m,y}$	$NCV_{i,y}$	$EF_{CO_2,I,y}$	Emission factor tCO_2/MWh
	MW	MWh		$1000NM^3$	$GJ/1000NM^3$	tCO_2/GJ	
Hrazdan TPP	1,110	320,600	NG	104,271.3	34.654	0.0543	**0.61**
Yerevan TPP	550	61,300	NG	38,195	34.700	0.0543	**1.26**
			SG	6,689	10.048	0.0740	
CCGT at YTPP	242	957,000	NG	217,823.7	34.583	0.0543	**0.43**
TOTAL	**1,902**	**1,338,900**					

Table 17: Calculation of emission factors for low-cost/must-run power plants for 2010

POWER PLANT	Capacity	Delivery	Type of fuel	$FC_{i,m,y}$	$NCV_{i,y}$	$EF_{CO_2,I,y}$	Emission factor tCO_2/MWh
	MW	GWh		$1000NM^3$	$GJ/1000NM^3$	tCO_2/GJ	
Metzamor NPP, Large and Small HPPs, Lori-1 WPP	1,530.8	4,811.450	HY	0	0	0	**0**
EC at YSMU	4.0	24.64	NG	6806	34.654	0.0543	**0.52**
ArmRoscogeneration	2.0	4.36	NG	1687	34.654	0.0543	**0.73**
Erfrez OJSC	0.1	0.33	NG	95.14	34.654	0.0543	**0.54**
Lus Astgh Sugar	6.0	0.5	NG	6100	34.654	0.0543	**22.96***
Lusakert Biogas Plant *(CDM project activity)*	0.83	2.9	BG	-	-	-	**0****
TOTAL	**1,543.7**	**4,844.18**					

**) Extremely high level of EF is explained by the fact that the backpressure turbine is mainly used for heat production.*

***) Emission factor for LBP is zero because power is generated from renewable source (biogas).*

Calculation of lambda factor

After calculation of emission factors for all the relevant power plants serving the system it is necessary to calculate lambda factor in accordance with the procedure set by the Tool based on chronological (hourly) power generation data for each plant/unit. Chronological data required for this calculation was provided by the Settlement Center CJSC as per request of the DNA. On the figure below the load duration curve is depicted as well as number of hours during which low-cost/must-run plants are on the margin are identified. Table 18 shows the result of lambda factor calculation.

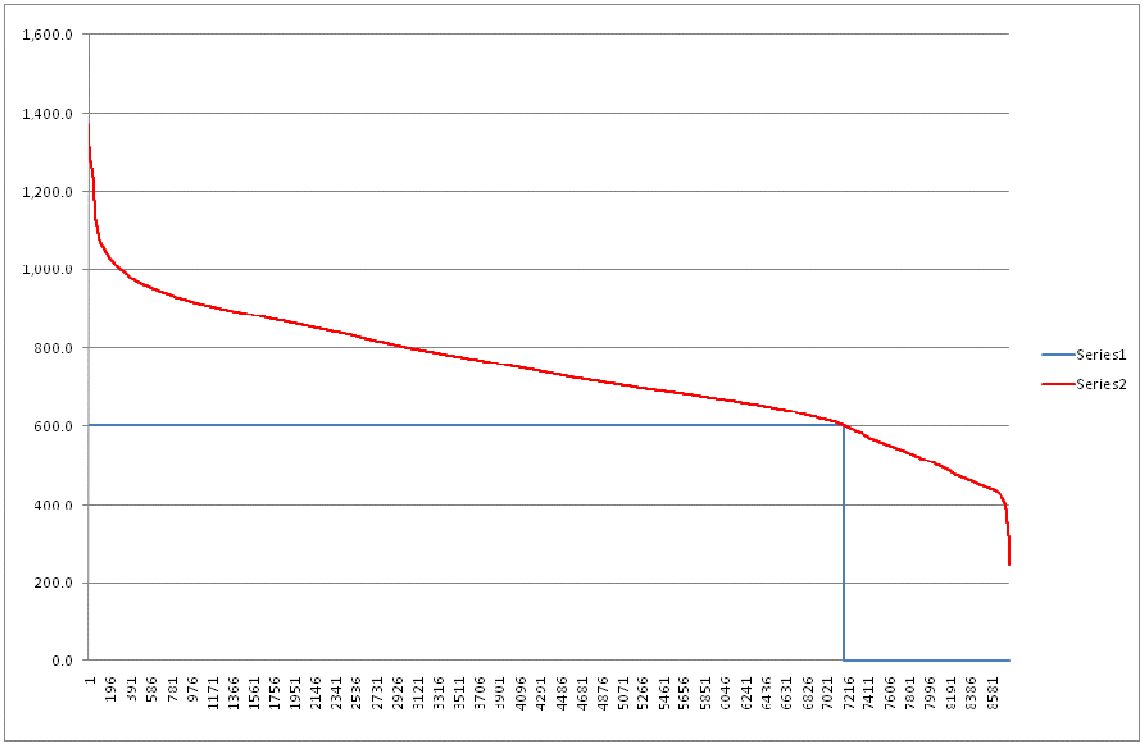


Figure 2: Lambda calculation for Simple Adjusted OM method

Table 18: Lambda factor for 2010

The number of hours for which low-cost/must-run sources are on the margin for 2009	1580 hours
Lambda factor for 2009	1580 / 8760 = **0.1803**

Table 19 summarizes all key parameters necessary for calculation of Simple Adjusted OM for the year 2010.

Table 19: Data necessary for calculation of Simple Adjusted OM for 2010

Net quantity of electricity generated and delivered to the grid by no low-cost/must-run power plants (MWh)	$EG_{m,y}$	1,338,900
Net quantity of electricity generated and delivered to the grid by low-cost/must-run power plants (MWh) (incl. imports)	$EG_{k,y}$	5,131,343
Emission factor of Hrazdan TPP (tCO_2/MWh)	$EF_{EL,m,y}$	0.61
Emission factor of Yerevan TPP (tCO_2/MWh)		1.26
Emission factor of CCGT Unit at Yerevan TPP (tCO_2/MWh)		0.43
Emission factor of EC at YSMU (tCO_2/MWh)	$EF_{EL,k,y}$	0.52
Emission factor of ArmRoscogeneration CJSC (tCO_2/MWh)		0.73

Emission factor of Erfrez OJSC (tCO_2/MWh)		0.54
Emission factor of Lus Astgh Sugar LLC (tCO_2/MWh)		22.91
Lambda factor for 2010		**0.1803**

Based on received results calculation of Operating Margin and Simple Adjusted Operating margin for 2010 was performed. The results of calculations are shown in the chapter 7.3.

7.2. Calculation of Built Margin

Following the procedure for selection of power units *m* used to calculate the build margin described under section 5.2 (Step 5), the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) has been identified along with their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh).

In the Table 20 information on net electricity generation and cumulative share of power generation of these plants is given.

Table 20: The set of five power units (excluding power units registered as CDM project activities) that started to supply electricity to the grid most recently (SET5-units)

N	POWER PLANT	First year in service	Power generation in 2009, MWh	Cumulative share, %
1	Tigram&Ashkhen LLC (T&A SHPP)	2010	1,041.8	0.02
2	LusAstghSugar LLC	2010	500.0	0.02
3	Energatsntsshin OJSC (Tsav)	2010	1,934.8	0.05
4	ERIK SHPP LLC (Erik)	2010	1,608.3	0.08
5	Qanar CJSC (Sarnakunq)	2010	1,742.9	0.11

As it is seen form the Table 20 the total power generation of the plants is 6,827 MWh which comprises about 0.11% of total power generation of the system.

The next step requires determining the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh), and to identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

The following power units are registered as CDM project activities in Armenia:

1. Lusakert Biogas Plant - annual electricity generation of 2,970 MWh;
2. Second power generation unit of Yeghegis SHPP with installed capacity of 3.75 MW and projected annual electricity generation of 7,296 MWh. Since no actual data on generation of electricity by the second unit of the SHPP is available for 2010, the projected data is used for calculation.

In such a way, AEG_{total} = 6,491,200 – (2,970 + 7,296) = 6,480,934 MWh

Following the requirement of the Tool, the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} ($SET_{\geq 20\%}$) includes the following plants:

- Lori-1 WPP (2005)
- All CHP units except for Lusakert Biogas Plant (2007-2010) (CDM project activity)
- All SHPPs which started to supply electricity to the grid from 2004 to 2010 period (except for the second unit at Yeghesis SHPP)
- CCGT Unit at YTPP (2010)

Given the chronology of commissioning of SHPPs, the plants which started to supply electricity to the grid within 1999-2003 timeframe are replaced by CCGT Unit at YTPP which started to supply electricity to the grid in 2010.

In the Table 21 information on annual electricity generation as well as share of electricity generation of the plants included in $SET_{\geq 20\%}$ is given.

Table 21: The set of power units (excluding power units registered as CDM project activities) that started to supply electricity to the grid most recently and that comprise 20% of the system generation (SET≥20%)

POWER PLANT	First year in service	Fuel	Power generation in 2010, MWh	Share of AEG_{total} (%)
Lori-1 WPP	2005	WP	4,060	0.063
EC at YSMU	2007	NG	24,910	0.384
Erfrez CJSC	2009	NG	350	0.005
ArmRoscogeneration	2009	NG	4,364	0.067
Lus Astgh Sugar	2010	NG	500	0.008
Small HPPs commissioned in 2004-2010 (except for 2nd unit at Yeghegis SHPP)	2004-2010	HY	270,985.8	4.181
CCGT Unit at YTPP	2010	NG	991,300	15.296
TOTAL			**1,296,469.8**	**20.004**

Addition of electricity generated by the CCGT Unit (15.296%) to the cumulative share of the rest plants (4.708%) results in achieving 20% threshold set in the Tool.

As it is seen from the tables 20 and 21 above the group of power units included in $SET_{\geq 20\%}$ comprises the larger annual electricity generation (1,296,469.8 MWh) than power plants included in $SET_{5\text{-units}}$ (6,827 MWh).

Since all power units included in the selected group ($SET_{\geq 20\%}$) started to supply electricity to the grid no more than 10 years ago, the set of power plants in the table 21 is used for calculation of the Build Margin.

In the Tables 22 emission factors for plants included in Build Margin are given.

Table 22: Emission factors for plants included in Build Margin

POWER PLANT	Emission factor tCO_2/MWh
Lori-1 WPP	0
EC at YSMU	0.52
Erfrez CJSC	0.54
ArmRoscogeneration	0.73
Lus Astgh Sugar	22.96
Small HPPs commissioned in 2004-2010 (except for 2nd unit at Yeghegis SHPP)	0
CCGT Unit at YTPP	0.43

7.3. Calculation of Combined Margin

As the result of the performed calculations the following emission factors have been received for 2010.

Operating Margin for 2010	**0.5095 tCO_2/MWh**
Simple Adjusted Operating Margin for 2010	**0.4186 tCO_2/MWh**
Build Margin for 2010	**0.3442 tCO_2/MWh**
COMBINED MARGIN FOR 2010	**0.3814 tCO_2/MWh**

References

1. Public Services Regulatory Commission of RA (www.psrc.am).
2. Analysis of Technical and Economic Indices of the Armenian Power Energy System for 2010. Report developed in 2011 by Settlement Center CJSC under the Ministry of Energy and Natural Resources of RA.
3. Ministry of Energy and Natural Resources of RA (www.minenergy.am).
4. Climat Change Information Center's web site (www.nature-ic.am)
5. Strategy of the Development of the Energy Sector within the Context of Economic Development in Armenia. Protocol Decision No1 of the Government of the Republic of Armenia. Adopted by the Government of Armenia on June 23, 2005 (protocol N24).
6. 100 Years of Armenian Energetic, Musaler Tpagratun Ltd., Yerevan, 2003.
7. CDM Development Manual. EC "Technical Assistance to Armenia, Azerbaijan, Georgia and Moldova with Respect to their Global Climate Change Commitments" Project, 2006 (www.nature-ic.am).
8. Methodological Tool to calculate the emission factor for an electricity system, Version 02.2.0 (www.unfccc.int).
9. CDM Rulebook (www.cdmrulebook.org)
10. Armrosgazprom CJSC (www.armrusgasprom.am)

Abbreviations

BG	Biogas
BM	Build Margin
CCIC	Climate Change Information Center
CCGT	Combined Cycle Gas Turbine
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CJSC	Closed Joint Stock Company
CM	Combined Margin
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
EC at YSMU	Energy Center at Yerevan State Medical University
GEF	Global Environment Facility
GHG	Greenhouse Gases
HY	Hydropower
IEC	International Energy Corporation
NG	Natural Gas
NPP	Nuclear Power Plant
MO	Microsoft Office
MoNP	Ministry of Nature Protection of Republic of Armenia
OM	Operating Margin
SHPP	Small Scale Hydro Power Plant
SG	Syngas
TPP	Thermal Power Plant
UNFCCC	United Nations Framework Convention on Climate Change
WP	Wind Power
WPP	Wind Power Plant
YTPP	Yerevan Thermal Power Plant

Appendix 5: Further background information on the monitoring plan

Monitoring plan is described in the Section B.7. of PART II of this PoA-DD.

Appendix 6: Demonstration of additionality of a small scale CPA

Only for CPAs <= 5MW installed capacity additionality can be demonstrated as follows:
According to the "Guidelines for Demonstrating Additionality of Microscale Project Activities" (Version 03) a CPA shall be additional if

- it is located in a special underdeveloped zone of the host country identified by the government before 28 May 2010; or

- hydropower <= 5MW installed capacity is recommended by the host country designated national authority (DNA) and approved by the Executive Board to be additional in the host country at the time of inclusion of the CPA into the PoA.

For all CPAs > 5MW additionality shall be demonstrated as follows; CPAs <= 5MW shall either apply above mentioned procedure or the one outlined below:

In accordance with the "Simplified modalities and procedures for small-scale CDM project activities", (decision 4/CMP.1, Annex II)[45], paragraph 28, *a simplified baseline and monitoring methodology may be used for a small-scale CDM project activity if project participants are able to demonstrate to a designated operational entity that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in* attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities", currently Version 08 (EB 63, Annex 24) [46]:

For demonstration of additionality of a typical CPA within this PoA, additional guidance or guidelines of the following documents may be used:

(a) "Non-binding best practice examples to demonstrate additionality for SSC project activities" (EB 35, Annex 34)[47],
(b) "Guidelines for demonstrating additionality of microscale project activities", currently Version 03 (EB 63, Annex 23)[48]

Additionally in the case investment barrier is chosen to determine the eligibility criterion the relevant sections of the following tool and guideline shall be taken into account:

(c) „Tool for the demonstration and assessment of additionality" Version 06 (EB 65, Annex 21)[49]
(d) "Guidelines on the assessment of investment analysis" Version 05 (EB 62, Annex 05)[50]

According to "Non-binding best practice examples to demonstrate additionality for SSC project activities" (EB 35, Annex 34), best practice examples include but are not limited to CPA included under the proposed PoA shall provide an explanation to show the project activity would not have occurred anyway due to at least one of the barriers, as follows:

[45] http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=43
[46] https://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid05.pdf
[47] http://cdm.unfccc.int/EB/035/eb35_repan34.pdf
[48] http://cdm.unfccc.int/filestorage/W/V/I/WVI3RN692YMCGLZT40QXBOUA8H5KFP/eb63_repan23.pdf?t=alB8bTB4NTlifDAWgEvM1uR11OyTp5RT7Vdy
[49] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.pdf/history_view
[50] http://cdm.unfccc.int/Reference/Guidclarif/index.html#meth

(a) ***Investment barrier****: a financially more viable alternative to the project activity would have led to higher emissions;*

Best practice examples include but are not limited to, the application of investment comparison analysis using a relevant financial indicator, application of a benchmark analysis or a simple cost analysis (where CDM is the only revenue stream such as end-use energy efficiency). It is recommended to use national or global accounting practices and standards for such an analysis.

Determination of eligibility criterion – Investment barrier

The proposed PoA "Small Hydropower Programme of Activities in Armenia" involves CPAs that will generate electricity and supply/sell it to the grid. Thus the CPAs will generate financial benefits other than CDM-related income; and therefore the simple cost analysis (Option I) is not applicable. Since there is an alternative to the proposed PoA – the electricity generated by CPA small hydro power plants would be otherwise delivered from the existing grid - which is outside the control of the project developers; the investment comparison analysis (Option II) is not applicable.

Therefore, **benchmark analysis (Option III)** [51] shall be chosen in the case additionality is demonstrated through investment analysis by calculating a project IRR according to the latest version of the above mentioned guidance tools relating to the additionality.

As an appropriate benchmark for the demonstration of the additionality the **post-(income)-tax weighted average costs of capital (WACC)** shall be calculated with 0.5:0.5 as percentage weights of debt/equity financing, respectively.

$$WACC = w_d * K_d (1-T) + w_e * K_e$$

Where:

w_d	Percentage of debt financing
w_e	Percentage of equity financing
k_d	Average cost of debt financing
k_e	Average cost of equity financing in nominal terms; $k_{e\ NOM} = k_{eREAL} +$ inflation rate
T	Applicable corporate tax rate

The **average cost of equity financing,** $\mathbf{k_{e\ REAL}}$, in real terms shall be derived from the default values for the expected return on equity in real terms from latest version of the Guidelines on the assessment of investment analysis"[52] , which shows post-tax benchmarks in real terms (or from equivalent sources). The **inflation rate** shall be obtained from the inflation forecast of the central bank of Armenia for the duration of the crediting period. If this information is not available, the target inflation rate of the central bank shall be used. If this information is also not available, then the average forecasted inflation rate for the host country published by the IMF (International Monetary Fund World Economic Outlook) or the World Bank for the next five years after the start of the project activity shall be used. In order to derive the average cost of equity financing in nominal terms, $k_{e\ NOM}$ the inflation has to be added to the cost of equity in real terms.

[51] According to the Guidelines on the assessment of the investment analysis, Version 05 (EB 62, Annex 5), *in cases where a benchmark approach is used, local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR while required/expected returns on equity are appropriate benchmarks for an equity IRR. Benchmarks supplied by relevant national authorities are also appropriate if it can be demonstrated that they are applicable to the project activity and the type of IRR calculation presented.*

[52] EB 62, Annex 05)http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

As **average cost of debt financing,** k_d, the last available commercial lending rate for long term credits in the currency, which is relevant for the specific CPA, shall be taken into account.

The CPA implementer shall use the determined WACC to compare with the **project IRR** to assess the financial attractiveness of the investment in the proposed CPA.

According to the "Guidelines for assessment of the investment analysis" the following guidance is given:

- The cost of financing expenditures (i.e. loan repayments and interest) shall not be included in the calculation of the **project IRR**.
- Depreciation, and other non-cash items related to the project activity, which have been deducted in estimating gross profits on which tax is calculated, should be added back to net profits for the purpose of calculating the financial indicator.

In case other financial indicators are more suitable for the demonstration of the financial additionality of individual projects, the justification will be provided in the specific CPA.

The calculation and the complete investment analysis of a specific CPA will be provided in excel format, unprotected, together with the relevant documents of the specific CPA. Assumptions included in the investment analysis will be supported by available evidences or excluded from the analysis.

As a general approach, the following procedure will be applied by the CPA:

- Period considered for investment analysis: the period considered for conducting the investment analysis should not be limited to the crediting period of the specific CPA, but will be referring to the expected operational lifetime of the main equipment, based on the indications of the technological provider;
- If any rehabilitation or maintenance is expected to occur in the period considered for assessment, the calculation of the IRR may include the costs related to these;
- Plant load factor, defined ex-ante in the CDM-PDD according to one of the following options, according to the provisions in EB48, Annex 11:
    - The PLF provided to banks and/or equity financiers while applying the project activity for project financing, or to the government while applying the project activity for implementation approval;
    - The PLF determined by a third party contracted by the project participants (e.g. an engineering company);

Based on the above assumptions and approaches, the CPA implementer will calculate the Project IRR based on the available data at the time of investment decision. IRR without expected incomes from CDM will be compared to the benchmark as derived above.

An investment analysis will be conducted for the specific proposed project activity, including the variables and input data related with capital investment, O&M cost and the estimated savings or revenues at the time of investment decision. The following table presents typical data used in the IRR calculation of the project and the main sources of this information. The calculation will be based on conservative assumptions all of which should be listed in the SSC-CPA-DD of the future specific project.

Table: Key assumptions for investment analysis

Input	Unit	Value	Source	Comment
Investment cost	EUR		Quotations, purchase agreements, feasibility study reports (FSR), internationally	

			accepted values (investment/installed MW), others.	
Equity	EUR		Investment analysis, loan agreements, others.	
Project life-time (years of operation)	Years		Concession Agreement, technical specifications of main equipment, others	
Start of operational generation	Date		FSR, others	
Installed capacity	MW		FSR, others	
Annual gross generation	GWh		FSR, hydrological studies, others	
Losses (for transmission to the grid connection point)	%		FSR, others	
Wholesale Power Price (Base Load)	EUR/MWh		FSR, Power Purchase Agreement,	
OPEX	EUR/MW		FSR, others	
Income tax	%		FSR, national regulation, others For Albania: http://www.doingbusiness.org/data/exploreeconomies/albania/paying-taxes/	
Depreciation	%		FSR, others	
Host country inflation rate	%		Inflation forecast of the central bank of the host country for the duration of the crediting period; Target inflation rate of the central bank; average forecasted inflation rate for the host country published by the IMF (International Monetary Fund World Economic Outlook) or the World Bank for the next five years after the start of the project activity	
Project IRR (without CER)	%		Financial analysis	
Project IRR (with CERs)	%		Financial analysis	

As a result of the comparison of the project IRR with the benchmark analysis it shall be demonstrated that the proposed CPA (project) is not financially attractive.

As per the "Guidelines on the assessment of the investment analysis", *only variables that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation and the results of this variation should be presented in the PDD and be reproducible in the associated spreadsheets.*

A sensitivity analysis shows whether the conclusion regarding the financial/economic attractiveness is robust to reasonable variations in the critical assumptions. The results of the variation shall be presented in the CPA-DDs and reproduced in the associated spreadsheets. In any case the following parameters shall be part of a scenario analysis.

Table: Variations of input parameters

IRR Sensitivity Analysis	90%	95%	100%	105%	110%
Investment costs					
Generation volume					
Electricity price					

For the specific CPA it shall be demonstrated that even the most favorable variations, e.g. +10% electricity price or -10% investment, will not help the project to reach the required benchmark. It is hence further substantiated that the CPA is not financially attractive and therefore additional.

(b) ***Access-to-finance barrier****: the project activity could not access appropriate capital without consideration of the CDM revenues;*

Best practice examples include but are not limited to, the demonstration of limited access to capital in the absence of the CDM, such as a statement from the financing bank that the revenues from the CDM are critical in the approval of the loan.

Determination of eligibility criterion - Access-to finance barrier:

The CPA implementer shall provide a statement by a financing entity (not only banks are financing but also e.g. manufacturers or ESCOs) which contains information that associated income from CO_2 reductions is critical in the approval of the loan or other form of capital provided (such as Mezzanine or equity).

(c) Technological barrier: *a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;*

Best practice examples include but are not limited to, the demonstration of non- availability of human capacity to operate and maintain the technology, lack of infrastructure to utilize the technology, unavailability of the technology and high level of technology risk.

Determination of eligibility criterion – Technological barrier

It is demonstrated by providing a confirmation from an independent DOE (other than the validating DOE) that the CPA is facing such barrier.

(d) ***Barrier due to prevailing practice****: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;*

Best practice examples include but are not limited to, the demonstration that project is among the first of its kind in terms of technology, geography, sector, type of investment and investor, market etc.

Determination of eligibility criterion – Barrier due to prevailing practice

It is demonstrated by providing a confirmation from an independent DOE (other than the validating DOE) that the CPA is facing such barrier.

(e) ***Other barriers*** *such as institutional barriers or limited information, managerial resources, organizational capacity, or capacity to absorb new technologies.*

It is demonstrated by providing a confirmation from an independent DOE (other than the DOE validating the PoA DD) that the CPA is facing such barrier.

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