CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM
(CDM-SSC-PoA-DD) Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for the submission of a CDM PoA whose CPAs apply a small scale approved methodology.

(ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using a real case).

SECTION A. General description of small-scale programme of activities (PoA)

A.1 Title of the small-scale programme of activities (PoA):

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Chilean Small Hydroelectric Power Plants Programme of Activities

Version 6 – 18/07/2012

Document history:
Version 5 – 05/04/2012
Version 4 – 07/03/2012
Version 3 – 25/02/2012
Version 2 – 13/12/2011
Version 1 – 09/08/2011

A.2. Description of the small-scale programme of activities (PoA):

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General operating and implementing framework of PoA

The total installed capacity of small-scale hydroelectric power plants ("Small Hydro Plants") of less than 15MW in Chile was around 82MW[1], less than 10% of the total potential[2]. Compared to the total installed capacity of almost 12,000 MW in the main electricity grid, the SIC in 2010, this figure represented only around 0.67 %.[3]

There are various reasons for the extremely low exploitation of the potential for small hydro plants in Chile. Renewable electricity in general faces significant barriers that mainly relate to high up-front investment required during the preparation and construction phases. While this is true for all kind of hydro plants, small plants are particularly affected because of their comparatively low financial feasibility, resulting from high fixed costs that are independent from the size of a plant. Examples are costs for transmission lines, obtaining of permits, environmental impact assessment, hydrological studies, plant design, power purchase agreement (PPA) negotiation, etc.

Recognizing the hurdles for small hydro power plants and other types of renewable energy the Chilean government passed a law (Law 20257) to encourage the development of Non Conventional Renewable Energies (NCRE) on 01/04/2008. Under this law NCRE are defined as: small hydro power plants[4], wind

[1] Based on statistics from the Transmission System Operator CDEC, www.cdec-sic.cl, last visited: 13/12/2011

[2] CNE and CNR, 2007, "Estimation of the Hydroelectric Potential Associated with Existing or Planned Irrigation Projects" [Spanish] Available at: http://www.cne.cl/cnewww/export/sites/default/05_Public_Estudios/descargas/estudios/Texto12_PotencialEnObrasDeRiego.pdf, Last visited: 13/12/2011

[3] Based on statistics from the National Energy Commission (CNE), www.cne.cl, last visited 13/12/2011

[4] Principally small hydro power plants are defined as plants with an installed capacity <20MW. However, an important exception was included that also allows generators to also consider the generation of hydro power plants

farms, geothermal, biomass and solar power plants. The scheme is based on the Australian model and generators must supply 5% (as of 2010, progressively increasing to 10% in 2024) of their contracted energy from NCRE sources. If the generators do not comply with their objective they would have to pay a fine of around 30 USD per MWh that they fall short. However, in practice the law has not created any impact because of the low level of the fine and generous grace provisions in terms of the very low target of 5% for NCRE generation (and only a very slow rise), carryover regulations and grace periods for meeting the NCRE objectives and the scale of hydropower plants that may be considered as NCRE. Therefore, law 20257 can be seen as an acknowledgement of the Chilean government of the barriers that non-conventional renewable energies like small hydropower plants are facing in Chile but it fails to substantially lift any of them.

Altogether, small hydro plants are not seen as attractive investments by traditional Chilean electricity generation investors and local banks.

Despite these barriers, a new class of entrepreneurs exists who have an interest in the development of Chile's potential for small hydro plants. These entrepreneurs are for example owners of medium-size farms who own the water rights of small rivers or irrigation channels crossing their land. Traditionally, these farmers make use of the water resources only for irrigation. However, more recently there has been growing awareness of the potential to generate renewable electricity without major interference with the river flow. Amidst constantly decreasing income from farming due to international competition, every day farmers become more aware of the need to diversify their incomes. Generation of hydro electricity can be an opportune solution to this problem.

There are three fundamental reasons why no considerable number of Chilean farmers or other new players who own the water rights of irrigation channels or small rivers, despite their natural interest, have become hydro electricity entrepreneurs:

1. *Low profitability:*
   As indicated, the specific investment costs of small hydropower are very high because important parts of the investment like transmission lines, engineering, equipment, access roads, etc. are independent from the size of the plant. Therefore, project owners, equity investors and banks are reluctant to invest in this technology.

2. *Lack of finance*
   Construction of hydroelectricity infrastructure requires both equity and debt finance. Farmers generally lack own funds to provide equity. Hydroelectric entrepreneurs also have limited access to bank loans since local banks normally require guarantees worth more than 100% of project assets.

3. *Lack of knowledge and experience*
   The lack of knowledge and experience extends to all dimensions of the electricity generation and commercialisation sector. Farmers and small newly-established hydro electricity enterprises typically don't have expertise in all relevant fields, such as technology, project finance, permits, legal framework, and electricity sales.

These barriers for hydroelectric entrepreneurs are elaborated on in section E.5.

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up to 40MW installed capacity with a discount factor, calculated based on their excess installed capacity compared to 20MW.)

In response to these barriers for small hydro plants in Chile the Association of Small and Medium Scale Hydroelectric Power Plants (APEMEC A.G.) was founded in 2008 as a non-profit organization with the objective to:

1. Supply technical and market information to its members
2. Sensitize governmental authorities to the existing problems and hurdles faced by the sector
3. Foster the creation of incentives and subsidies by the government
4. Facilitate the contracting of project and consultancy services to its members
5. Organize capacity building seminars and events

Generally speaking APEMEC A.G. is seeking to promote small hydro plants politically, to provide expertise to its members along the project development cycle and to reduce preparation and transaction costs for individual projects through concerted action.

Regarding the latter APEMEC A.G.'s most important activity has been the development of the present small hydroelectric power plants programme of activities (the PoA) since late 2009.
The PoA was initially conceived by ProChile, an agency of the Chilean ministry of foreign affairs dedicated to the support of the Chilean economy abroad, and CORFO (Corporación de Fomento de la Producción), an agency of the Chilean government that implements national initiatives for the promotion of entrepreneurship and innovation in Chile. In 2006 ProChile and CORFO decided to scout for opportunities to promote the broad application of the UNFCCC's Clean Development Mechanism and thus the generation and sales of CERs by the Chilean industry. Following the EB's initial adoption of rules for the registration of multiple uniform activities under the umbrella of a programme of activities in June 2007 ProChile and CORFO identified this mechanism as the ideal means of promoting the CDM in various sectors of the Chilean industry on a broad scale. Hence, CORFO commissioned the Chilean CDM consultancy Poch with the identification of potential sectors for the development of a CDM PoA within the frame of Chile's national development goals. The service included the elaboration of draft CDM PoA documentation for the most promising of these sectors, which resulted to be the small hydropower sector.[5] At this point in time CORFO was foreseen to become the managing entity of the PoA. However, after the initial presentation of the draft PoA DD by Poch in late 2007 due to a shift in priorities no follow up was made until early 2009 when CORFO finally decided to move on with the development of the small hydropower PoA. A tender regarding the finalization of the CDM documentation of the PoA was launched that was again won by Poch who delivered the final draft of the PoA DD and the generic CPA DD in October 2009.[6] At this point in time CORFO identified and approached the Chilean small hydropower association APEMEC A.G., that had been founded in 2008, as a more suitable managing entity. APEMEC A.G. accepted CORFO's proposal and thus took over the responsibility to further develop and manage the small hydropower PoA as its managing entity in late 2009. The final drafts of the PoA and generic CPA DDs were handed over by CORFO and from this moment onwards the PoA was fully owned, managed and financed by APEMEC A.G..[7]

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[5] http://www.chile-co2.cl/newsletter/newsletter19072010/?t=w, last visited: 23/02/2012

[6] http://www.mercadopublico.cl/Procurement/Modules/RFB/DetailsAcquisition.aspx?qs=rJLtZ4aSmQzFf5adCbODJg== , last visited: 23/02/2012

[7] http://www.edicionesespeciales.elmercurio.com/destacadas/detalle/index.asp?idnoticia=20101004512236&idcuerpo= , last visited: 23/02/2012, and: http://www.corfo.cl/opensite_det_20090504112215.aspx , last visited 23/02/2012

As a first step to expedite the development and realization of the PoA APEMEC A.G. hired the German CDM PoA specialist Ole Meier-Hahn for the revision and finalization of the PoA documents and support in the structuring of the programme. In February 2010 the PoA DD and generic CPA DD were finalized and APEMEC A.G. initiated the search for potential partners in order to be able to offer Chilean small hydropower developers a one-stop-shop CDM solution. The ideal partner KfW was finally found. KfW is the promotional bank of the German government and joined the programme in May 2011 as the buyer of CERs. With this final piece in place APEMEC A.G. could move on with the contracting of CDM and legal service providers, the hiring of personnel dedicated to the PoA management and the initiation of the CDM PoA registration cycle.

Policy/measure or stated goal of the PoA

The goal of the PoA is to promote Non-Conventional Renewable Energy (NCRE) generation in Chile in the form of small hydro plants. [8]

Besides concrete and individual assistance to each project under the PoA the managing entity APEMEC A.G. seeks to unite and centralize efforts of the participating projects with respect to commercialisation of carbon credits and project finance, thus reducing transaction costs and increasing bargaining power for individual plant owners.

Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity.

The proposed programme of activities is a voluntary action by the coordinating entity and does not represent a measure or means to respond to any mandatory Chilean law, regulation or normative applicable to the energy sector. There are laws in Chile regarding incentives for Non Conventional Renewable Energy projects; nonetheless they do not represent an obligation to the coordinating/managing entity or any small-scale hydroelectric project. This is described in detail in chapter A.4.3.

A.3. Coordinating/managing entity and participants of SSC-POA:

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- Coordinating or managing entity of the PoA as the entity which communicates with the Executive Board:

  Asociación Chilena de Pequeñas y Medianas Centrales Hidroeléctricas A.G. (APEMEC A.G.).

[8] For national policies that seek to promote Non-Conventional Renewable Energy (NCRE) in Chile check section “General operating and implementing framework of PoA” above.

- Project participants being registered in relation to the PoA:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (host)	Asociación Chilena de Pequeñas y Medianas Centrales Hidroeléctricas A.G. (APEMEC A.G.).	No

A.4. Technical description of the small-scale programme of activities:

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The APEMEC A.G. programme of activities consists in the promotion of small-scale hydropower plants in Chile through the provision of access to innovative sources of finance and additional income from carbon credits. APEMEC A.G. unites and centralizes efforts of participating projects with respect to commercialization of carbon credits and project finance, thus reducing transaction costs and increasing bargaining power for individual plant owners.

The concrete activities to be undertaken by APEMEC A.G. under the PoA are:

1. Streamlined CDM registration through the present PoA
2. Streamlined CDM verification and issuance
3. CER sales service
4. Activation of additional, non-traditional sources of finance, including:
   a) Carbon loans
   b) Bank loans secured through Emission Reduction Purchase Agreements
   c) National and international subsidies

A.4.1. Location of the programme of activities:

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The location of the APEMEC A.G. Programme of Activities is within the regions of Chile covered by the Central Interconnected System.

A.4.1.1. Host Party(ies):

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The Host Party is Chile

A.4.1.2. Physical/ Geographical boundary:

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The geographical boundary of the proposed Programme of Activities are those regions of Chile that are covered by the Central Interconnected System (SIC). The SIC, which is constantly extended, currently

stretches approximately between 20º56'S to the North and 44°3'S to the South, and covers regions II to X, Region XIV and the Metropolitan Region[9].

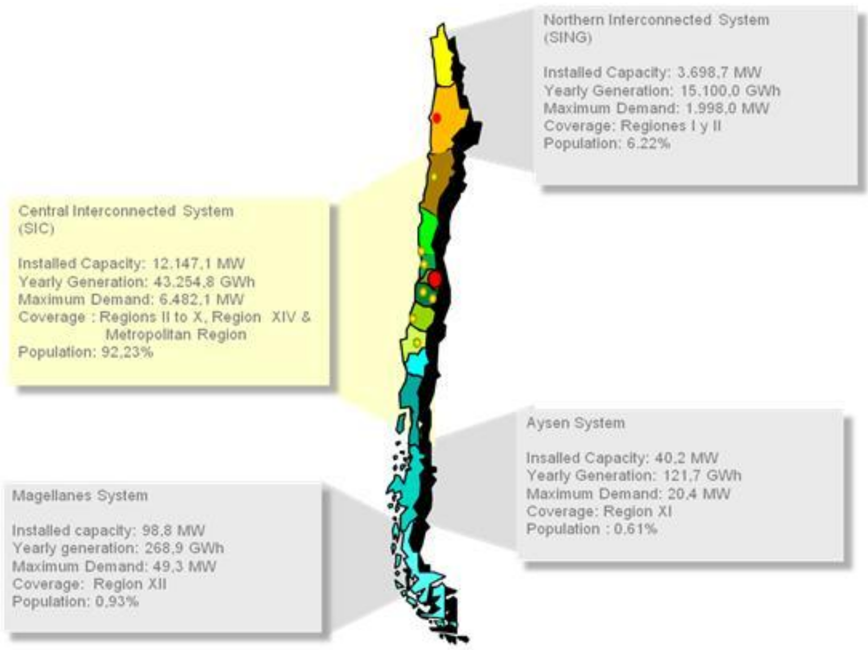

Figure 1: Geographic location of the electricity systems in Chile[10]

The national and sectoral policies and regulations that are particularly applicable to CPAs under the PoA and thus to the PoA itself are the laws and regulations of the following sectors:

1. Energy (http://www.bcn.cl/leyes_temas/leyes_por_tema.2006-02-06.7424430932)
2. Renewable energy (http://www.bcn.cl/leyes_temas/leyes_por_tema.2007-03-20.7683847886)
3. Environment (see section C.3 below)
4. Construction (http://www.bcn.cl/leyes_temas/leyes_por_tema.2006-09-13.5030445534 and http://www.bcn.cl/leyes_temas/construcciones-sismicidad)
5. Water (http://www.bcn.cl/leyes_temas/leyes_por_tema.2007-03-20.6210077070)

Full lists of the concrete laws and regulations applying to each of the identified sectors can be found under the respective links above. The definition of the geographical boundary of the PoA is in line with all of the above stated laws and regulations and with any other prevailing Chilean laws and regulations as they apply to the entire territory of Chile of which the geographic boundary of the PoA is a sub-section.

A.4.2. Description of a typical small-scale CDM programme activity (CPA):

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The description of a typical CPA is presented in section A.4.2.1.

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[9]CDEC-SIC 2011. "Yearbook 2001-2010" p.Available at: http://www.cdec-sic.cl/datos/anuario2011/ingles/4introduction/index.html Last visited: 13/12/2011

[10]Ibid, http://www.cdec-sic.cl/datos/anuario2011/ingles/xlseng/mapa_resumen.xls. Last visited: 13/12/2011

A.4.2.1. Technology or measures to be employed by the SSC-CPA:

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The typical CPA consists of a small-scale hydroelectric project located in Chile, connected to the Central Interconnected System (SIC) grid. The project will consist, among others, in the installation of one or more turbines with a maximum combined installed capacity of 15 MW and will generate electricity to be delivered to the SIC, the main Chilean power grid.

A small scale hydroelectric power plant consists of an installation able to transform the water potential energy in mechanical energy through a turbine, and finally into electrical energy through a generator. The energy transformation process is accomplished by taking water from one or more sources; (i.e. lakes, dams, rivers, canals or any other water source) then by the force of gravity with which water enters through a conduction system (tunnels, channels, pipes, surge tanks) to the engine room, the potential energy is transformed into mechanical energy by the rotation of turbines (type Pelton, Francis, Kaplan, Dive, among others) and subsequently the generators transform the rotational energy in electrical energy. Finally the tension is raised in a substation and injected into the transmission grid.

In Chile, the implementation of small scale hydroelectric projects requires non consumptive water rights, which must be requested from and granted by the General Water Direction (DGA). The typical CDM programme activity represents the interest of natural persons (e.g. farmers), small companies and irrigation associations who own water rights in small and medium size water courses.

There are two different types of hydroelectric projects, run-of-river and dam. Generally the small scale hydroelectric projects are run-of-river.

- Hydroelectric power plants with a dam: A large volume of water is dammed upstream of the turbines. The dam allows the regulation of the amount of water through the turbines and increases the water fall height.

- Hydroelectric run-of-river power plants: There are no water reservoirs upstream the turbines other than water accumulations of low capacity. The turbines receive the available flow, with seasonal variations, and the excess water is lost by spillage. This sort of power plants may count with an accumulation pond upstream of the turbine just for regulation purpose. The power plant may be located outside the river basin or submerged in the river.

In general terms, a small scale hydroelectric plant includes the following facilities:

1. The weir and head pond: water accumulation, deviation and/or regulation civil works.
2. Adduction channel and penstock to conduct the water to the turbine.
3. Power house equipped with turbines (one or more turbines), generators and auxiliary equipment.
4. The civil works for the discharge channel towards natural water resource (tailrace).
5. Sand trap: necessary to clean water of coarse solids to prevent turbine damage.
6. Electrical equipment: transformer electricity line for the grid connection.
7. Monitoring Equipment

There is no manufacturer of hydropower turbines for small-scale hydropower plants in Chile and all turbines are imported, either directly or through a limited number of importing companies. Only the civil

works and the equipment for the transformation of the current to higher voltage may be from local suppliers[11]. Therefore, the construction and operation of a hydropower plant alongside with the training and gathering of experience of the people involved can be considered technology transfer to the Host Country.

A.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:

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A CPA to be included in the present PoA shall meet the following criteria:

1. The CPA shall consist in either:

   a. a run-of-river hydro power plant, as characterised by the World Commission of Dams 2000: "*Dams that create a hydraulic head in the river to divert some portion of the river flows. They have no storage reservoir or limited daily poundage.*"[12]; or
   b. a hydro power plant with a reservoir where either[13]:
      1) the CPA is implemented in an existing reservoir with no change in the volume of reservoir; or
      2) the CPA is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per the definition given below, is greater than 4 W/m^2; or
      3) the CPA results in new reservoirs and the power density of the power plant, as per the definition given below, is greater than 4 W/m^2.

2. The hydropower plant shall have an installed capacity of ≤ 15MW,

3. The plant shall be a newly built plant and must not involve retrofitting or modifying of an existing facility for renewable energy generation. A CPA may however involve the addition of renewable energy generation units at an existing renewable power generation facility. In this case:

   a. the capacity of the units added by the CPA should be lower than 15 MW and should be physically distinct from the existing units; and
   b. if the existing renewable power generation facility is NOT registered as a standalone CDM project or a CPA of a CDM Programme of Activities, the net increase in electricity generation shall be determined through the procedure specified in AMS I.D (Version 17) par.15.

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[11]Pontt et al. 2008 "Estudio de contribución de las ERNC al SIC al 2025: Energía Renovable No Convencional Hidroeléctrica en Chile" Universidad Técnica Federico Santa María: Santiago de Chile: http://www.neim.utfsm.cl/arch/20080808-06-Hidroelectricidad%20-%20Hidro.pdf Last visited: 13/12/2011

[12]World Commission on Dams – WCD 2000. "Dams and development: a new framework for decision making". Earthscan Publications. London, U.K: http://hqweb.unep.org/dams/WCD/report/WCD_DAMS%20report.pdfLast visited:13/12/2011

[13]According to the requirements of AMS I.D (Version 17) the power density in sub-items 1.b.ii and 1.b.iii above shall be determined following the approach defined in ACM0002. The approach in version 12.3.0. of ACM0002 is further presented in section E.6.2. of this document.

4. The hydropower plant shall be connected to the Chilean Central Interconnected System (SIC).

5. The hydropower plant shall be located in one of the regions of Chile that are covered by the SIC.

6. The CPA implementer shall provide evidence that he is indeed the owner of the project. The evidence shall include at least the title of the land where the project is located and the rights to utilize the related water resources during the expected lifetime of the project.

7. The CPA implementer shall contractually cede its rights to claim and own emission reductions under the Clean Development Mechanism of the UNFCCC to the managing entity of the present PoA.

8. In order to avoid double-counting the CPA implementer shall confirm with a written statement that:

    a. The CPA implementer has not seriously considered grid connected electricity generation with a different technology as an alternative to the project.
    b. The CPA has not been and will not be registered as a single CDM project activity nor as a CPA under another PoA.
    c. The CPA implementer is aware and has agreed that the CPA will be subscribed to the present PoA.

9. In order to determine the starting date of a CPA the CME will obtain from the CPA implementer those of the following three documents that are available at the time of validation of the CPA:

    a. Purchase order of the electromechanical equipment;
    b. Evidence of financial closure of the project (e.g. minutes of the board meeting during which the final decision was made to invest in the project, loan agreement with a bank);
    c. Subscription of the CPA to the PoA via a contractual agreement between the CPA implementer and the CME.

    The starting date is then determined as the earliest of the dates of the three documents. Therefore, in order to identify the starting date of the CPA, at least one of the three documents has to be available at the time of validation. If any one or two of the documents are not yet available during validation the CME shall, via the PoA Management & Monitoring System, follow up regularly with the CPA implementer and obtain the missing document(s) as soon as it/they become(s) available and verify that the date of the new document(s) is in no case earlier than the previously defined starting date of the CPA.

10. The CPA implementer shall have conducted a stakeholder consultation as per the requirements of the CDM. The stakeholder consultation shall be performed in either of the ways described in section D.2 of the Generic CPA DD and compliance with the described approach shall be assured by APEMEC A.G. by means of the PoA management & monitoring system.

11. The CPA implementer shall provide a sworn declaration that prior to the start of operations of the project he will obtain all environmental approvals as applicable to the project in accordance with Chilean environmental laws and especially with the procedures described in section C.3 below. The sworn declaration is part of the requirements of the Chilean DNA who, in the context of its host country approval procedures, will also monitor the compliance with the declaration at the start of operations of any CPA.

12. The CPA shall pass the de-bundling test presented in section A.4.4.1. below.

13. The CPA shall comply with the additionality demonstration criteria presented in section E.5.2.

14. The CPA implementer shall provide APEMEC A.G. with an affirmation that funding from Annex I parties, if any, does not result in a diversion of official development assistance.

15. The CPA implementer shall warrant to APEMEC A.G. via a contractual agreement that he will at all times implement, operate and maintain the project in compliance with applicable law, regulations and usual and prudent standards in conformity with Chilean environmental law, appropriate health, building, safety protection and other applicable or advisable requirements.

A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):

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

In Chile private electricity generators are free to choose the technology to be deployed in their projects as long as all environmental, construction and operational permits required are in place. Although there are three laws in Chile with the objective to foster the implementation of Non-Conventional Renewable Energy (NCRE) projects, the Law 19.940 (Short Law I)[14], Law 20.018 (Short Law II)[15] and Law 20.257[16], neither of these laws constitutes an obligation to the managing entity to implement the measures laid out in section A.2. Nor do these laws constitute any obligation to the implementing entities of any of the small-scale hydroelectric projects being developed as CPAs under the PoA. Therefore, the PoA is 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:

The principal voluntary coordinated action under the PoA is the promotion of small-scale hydropower projects in Chile through a platform (the CDM PoA) that gives the projects access to additional income from CER generation and sales under the CDM. The initiative therefore consists of two layers:

1. The implementation and operation of the CDM PoA
2. The implementation and operation of many small hydropower projects

[14] http://www.cdec-sic.cl/imagenes/contenidos/File/normativa/Ley_electrica/Ley_Corta_I_%28Ley19940%29.pdf Last visited: 13/12/2011

[15] http://www.cdec-sic.cl/imagenes/contenidos/File/normativa/Ley_electrica/Ley_Corta_I_%28Ley19940%29.pdf Last visited: 13/12/2011

[16] http://www.cne.cl/archivos_bajar/20_257_1.pdf Last visited: 13/12/2011

For the second layer an extensive demonstration and criteria why the respective activities (small hydropower projects) would not be implemented in the absence of the PoA are presented in section E.5 of this PoA-DD.

For the first layer a demonstration why the respective activities (setup and operation of the PoA framework) would not be implemented in the absence of the PoA (read CDM registration of the PoA) is given in the following:

The setup and management of the PoA is being performed by the managing entity APEMEC A.G., which is the not-for profit organization of the small hydropower sector in Chile. As such APEMEC A.G. does not dispose of any important funds for setting up the PoA. Therefore, after taking over the responsibility for the development of the CDM PoA from CORFO in late 2009 APEMEC A.G. was not able to firmly move on with the development (finalization of design documents and validation) of the PoA.
Consequently, APEMEC A.G. scouted for a partner that would help with the financing of this task. With the German promotional bank KfW this partner was finally found. In May 2011 APEMEC A.G. and KfW entered into an Emission Reduction Purchase Agreement. One piece of the agreement was financial support that KfW provided to APEMEC A.G. in order to conclude the development of the PoA. With this support APEMEC A.G. moved on with the PoA registration cycle, hiring services for the finalization of the design documents, the preparation of supporting documents (such as standard contracts and the PoA management & monitoring system) and the validation of the PoA.
Since the financial support of KfW was conditioned to the CER purchase agreement it is clear that in the absence of CDM APEMEC A.G. could not possibly implement the PoA as a platform for small hydropower projects in Chile.

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

Not applicable. The proposed PoA is not implementing a mandatory policy/regulation.

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

Not applicable. No mandatory policies and/or regulations are being enforced.

A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):

A.4.4.1. Operational and management plan:

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A PoA management system has been developed in order to establish the rights and obligations of all parties involved in the implementation, financing and management of the PoA. The PoA management system consists of a PoA management plan that governs the basic setup, personnel, roles, responsibilities and roll out of the PoA and a PoA management & monitoring system that establishes the concrete procedures to be followed by the entities involved in the PoA, i.e. the CME, CPA implementers, consultants, during the operation and management of the PoA. Both, the PoA management plan and the PoA management & monitoring system are living documents meant to be refined and improved as to meet the evolving UNFCCC requirements and the specific needs of the PoA and the parties under it.

However, they establish the bases and minimum conditions and responsibilities that ensure the correct management of the programme as well as the monitoring, traceability and storage of the data related to emission reductions.

Furthermore, the following measures have been undertaken as part of the PoA management & monitoring system:

(i) A record keeping system for each CPA under the PoA,

The following table will be used in order to keep a record of every CDM programme activity that is included under the proposed PoA. This is the minimum required information. The PoA management & monitoring system, which is a living document, contains additional items and is provided to the DOE at validation. Information will be stored in an electronic database by the managing entity. A paper version of the records is kept for quality assurance.

Table 1: CDM Programme Activity record keeping system

	CPA Developer Information
CPA Developer Name:	
Contact Name:	
Telephone Number:	
Fax Number:	
Email:	
Address:	
ZIP Code:	
Website:	
	CPA Information
CPA Title	
CPA installed capacity	
CPA geographic coordinates	
Greenfield project or capacity addition?	
Existing, new or no reservoir?	

The PoA management & monitoring system also contains procedures for determining if a CPA meets the eligibility criteria, the storing of the respective evidence in the information management system and the creation of respective entries in the electronic database. A schematic overview of the data tables contained in the electronic database has been provided to the DOE during validation as part of the PoA management & monitoring system.

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

In order to avoid double accounting and to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA, the implementing entity of a CPA shall enter into a contractual arrangement with APEMEC A.G. including respective provisions that:

1. The CPA has not been and will not be registered as a single CDM project activity, nor as a CPA under another PoA.

2. The implementing entity is aware that the CPA will be subscribed to the present PoA.
3. The implementing entity cedes its rights to claim and own emission reductions under the Clean Development Mechanism of the UNFCCC to the managing entity of the present PoA

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

In order to ensure that all SSC-CPA that will be included in this PoA are not de-bundled components of another CDM project or CPA, the coordinating entity will follow the procedures stated under "Guidance for determining the occurrence of de-bundling under a Programme of Activities (PoA)" of the "Guidelines on Assessment of Debundling for SSC Project Activities", Version 3.

According to the Guidance, the demonstration will be carried out by checking if there is any activity registered as SSC-CPA, applying to register as SSC-CPA or registered as a CDM project activity, with the same implementer as the proposed small scale CPA or with the same coordinating/managing entity managing a large scale PoA of hydroelectric power plants.

If there is an activity that satisfies the above condition, then in order to be included in the PoA, the proposed SSC CPA will need to be located farther than 1 km from the existing SSC-CPA or CDM project activity at the closest point. Exceptions will be made only in case that the sum of the installed capacity of the CPAs involved does not exceed the 15 MW limit.

(iv) The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA;

According to literals 2. and 3. of item (ii) above every CPA implementer will be aware and explicitly agree that its activity is subscribed to the PoA.

A.4.4.2. Monitoring plan:

>>

Monitoring of electricity supplied to the grid will be carried out per CPA. For each CPA, the corresponding parameters included in section E.7.1.will be monitored by the implementing entity of the CPA according to the procedures and monitoring framework established in E.7.2. and will be submitted to the managing entity. Primary data will be stored by the implementing entities. The managing entity will store the data in an electronic database.

Data trails in the PoA management and monitoring system with respect to inclusion and equipment related information and monitoring data for all kinds of CPAs are visualized in Figure 2 below.

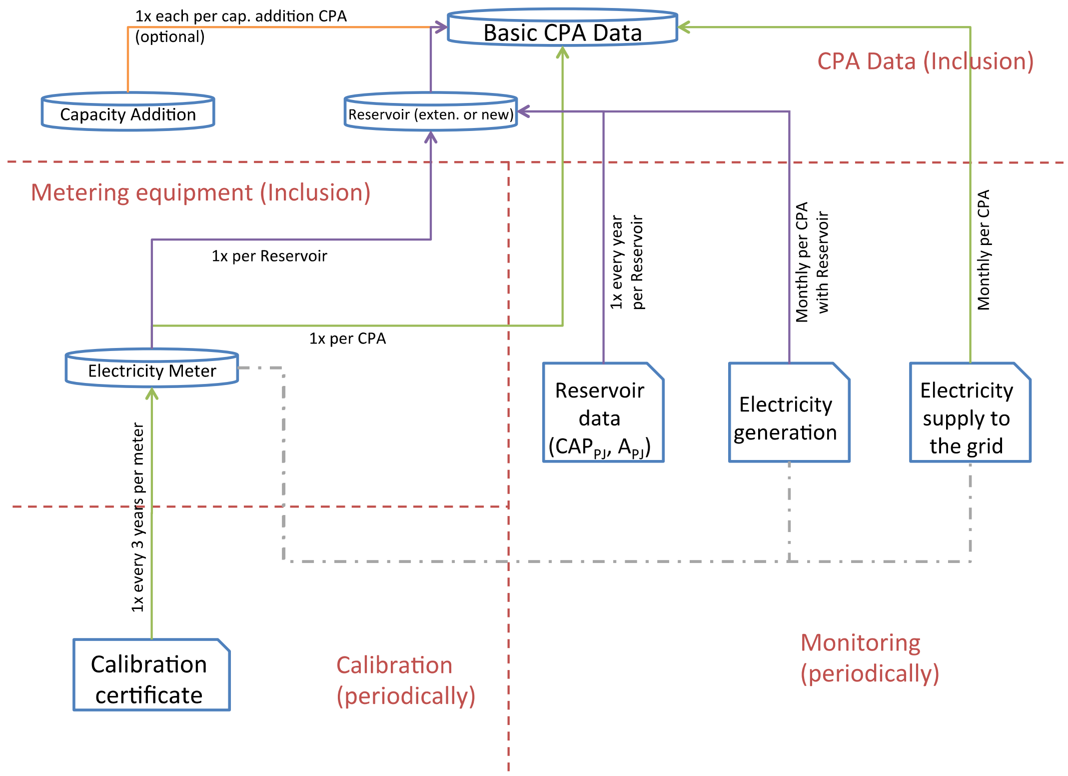


Figure 2: Data trails in the PoA management and monitoring system

The PoA management & monitoring system provided to the DOE for validation contains procedures and a recording mechanism through which the status of verification for each CPA can be unambiguously identified at any time. These procedures establish that for every given monitoring period of the PoA all CPAs that where operational during the full period or a part thereof shall be included in the respective periodic verification. Furthermore, for CPAs considered for a certain monitoring and verification period of the PoA the period of each CPA that is considered for monitoring, reporting and verification shall be equal to the PoA monitoring and verification period, which is again safeguarded by the procedures of the PoA management & monitoring system.

The monitoring of grid emission data and the ex post calculation of the grid emission factor will be done by the managing entity according to the procedures and monitoring framework established in E.7.2..

Periodic verifications will be commissioned and managed by the managing entity. Each verification will include all CPAs that were operational during the respective monitoring period or a fraction thereof. In any case data shall be verified per CPA and the verification status of each CPA will be recorded by the managing entity in the database.

A.4.5. Public funding of the programme of activities (PoA):

>>

The initial development of the PoA Design Document and the CPA Design Document were financed by the Chilean Economic Development Agency (CORFO).[17]

The PoA itself as described in section A.2 does not receive public funding[18].

In order to be included in the PoA, each CPA is to provide evidence that any public funding from Annex I parties does not result in a diversion of official development aid.

SECTION B. Duration of the programme of activities (PoA)

B.1. Starting date of the programme of activities (PoA):

>>

17/05/2011 was the date on which the Emission Reduction Purchase Agreement for the PoA was signed between KfW and APEMEC A.G. and the financing of the PoA was secured. It is therefore considered the starting date of the PoA.

B.2. Length of the programme of activities (PoA):

>>

28 years

SECTION C. Environmental Analysis

>>

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at SSC-CPA level ☒

As further specified in section C.3 below in Chile strict and specific regulations exist for the environmental impact assessment and authorization of energy generation projects. Regulations are specific with respect to the planned capacity of installations and the location of projects. Since CPAs to the present PoA may fall into different categories of the Chilean Environmental Impact Assessment System (SEIA) it is most appropriate to analyse environmental impacts on CPA level.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

N/A

C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA),:

[17] CORFO, 2009. Tender for the contracting of services for pre-validation support for a CDM programme of activities for hydropower plants. Provided to the DOE for validation,

[18] ibid

>>
In Chile, the assessment of the environmental impacts and the environmental approval of a specific project is regulated by the Law N° 19.300[19], "The Environmental General Basis Law" ("Ley de Bases Generales del Medio Ambiente"). On January 26 of 2010 the General Secretariat of the Presidency Ministry ("Ministerio Secretaría General de la Presidencia") published an additional environmental law: Law Nº 20.417. The law creates the Environmental Ministry, the Environmental Impact Assessment Service[20] and the Environmental Superintendence ("Ley Nº 20.417, crea el Ministerio del Medio Ambiente, el Servicio de Evaluación de Impacto Ambiental y la Superintendencia del Medio Ambiente"). This new law covers some aspects not regulated previouslyand modifies some aspects already included in law 19.300.

According to Law 19.300 and its modification (law N° 20.417), every project developer has to analyse if his project requires an Environmental Impact Assessment, following the specific criteria stated on the Environmental Impact Assessment System (SEIA) Regulations[21]. If the CPA requires an Environmental Impact Assessment, the project shall obtain from the Environmental Assessment System "Servicio de Evaluación Ambiental–SEA", the approval for this Assessment, which is done by means of an authorization document, Environmental Qualification Resolution (RCA) published on the SEIA web page[22]. If the CPA does not require an Environmental Impact Assessment, CPA developers must present a letter from SEIA expressing this matter (Letter of Pertinence).

According to the Law 19.300, article 3c), electrical power sources with an installed capacity greater than 3 MW will be subject matter to the Environmental Impact Assessment System. Therefore, all energy generation projects fulfilling this condition must be submitted to the SEIA before starting its construction. This can be identified as the first condition for the development of the project.

As a second condition, the projects with installed capacity lower than 3 MW which are located in a national park, national reserve, natural monument, virgin zone reserve, nature sanctuary, marine park, marine reserve or any other area under official protection shall also be submitted to the SEIA, in attention to the stipulated on article 10 p) of Law 19.300.

These two conditions are general for electricity energy generation power plants. Furthermore, projects which include additional installed capacity to an existing and operating project must be subject matter to the SEIA under the following conditions:

1. If adding new turbines to an operating small-scale hydroelectric power plant, the 3 MW installed capacity limit is exceeded in accordance with article 3 c) of Law 19.300.
2. If adding new turbines to an approved project (with RCA) or modifying an original project processes characteristics as approved under the Environmental Impact Assessment Study. Such "project modifications,"as established in article 8 of Law 19.300, must count with Environmental Impact Assessment Study (EIA) and will have to be submitted to the SEIA.

---

[19] Last version available at http://www.leychile.cl/Navegar?idNorma=30667, Last visited: 13/12/2011
[20] The Environmental Assessment Service ("Servicio de Evaluación Ambiental" – SEA) is a public organism whose functions are technify and administrate the Environmental Impact Assessment System ("Sistema de Información de Impacto Ambiental" – SEIA)
[21] http://www.sea.gob.cl/contenido/que-es-el-sistema-de-evaluacion-de-impacto-ambiental, Last visited: 13/12/2011
[22] http://www.sea.gob.cl, Last visited: 13/12/2011

Finally, it should be mentioned that high voltage transmission lines and substations with voltages higher than 23 kilovolts must also be submitted to the SEIA as stated in article 10 b) of Law 19.300 and article 3 b) of the SEIA regulation. An electricity generation power plant is associated to a transmission line, however, a power plant with an installed capacity lower than 3 MW (not obligated to be submitted to the SEIA) but with a transmission line greater than 23 kV must be submitted to the SEIA.

There are other situations that will require the project to be submitted to the SEIA, this situations will occur depending on the location where the project is located and its area of influence:

- Location with protected flora or fauna according to the national regulation and that the project needs to remove.
- Effects on the quality and quantity of the hydrological resources.
- Effects to the anthropologic dimension due to the extraction of resources or near a protected group of people.
- Location inside a protected area or under official protection.
- Location on an area with landscaping or tourist value.
- Location on an area that counts with archaeological remains or in general remains belonging to the cultural heritage of the country.

Therefore, the submission to the Environmental Impact Assessment System must be analysed for each CPA considering the characteristics of the project and location.

SECTION D. Stakeholders' comments

>>

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at SSC-CPA level ✕

The Local Stakeholder Consultations will be held at a CPA level, taking into consideration the different circumstances and opinions of communities in the vicinity of each CPA. It is essential to capture communities' views on the impact of the CPA implemented in their surroundings. Since typically CPAs will have different neighbouring communities it is appropriate to conduct the local stakeholder consultation at CPA level. Also, under certain conditions (e.g. installed capacity of the project is greater than 3 MW) extensive local, regional and national stakeholder consultations are required by the Chilean authorities, e.g. in the context of obtaining the environmental authorization or the construction permit. Where appropriate the CPA implementer may integrate the CDM local stakeholder consultation with one of these stakeholder consultations. A detailed approach to undertaking the local stakeholder consultation on the CPA level is presented in section D of the Generic CPA DD.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

>>
N/A

D.3. Summary of the comments received:

>>
N/A

D.4. Report on how due account was taken of any comments received:

>>
N/A

SECTION E. Application of a baseline and monitoring methodology

E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:

>>
Title of Approved Baseline and Monitoring Methodology:
AMS.I.D. "Grid connected renewable electricity generation".

Reference:
Type I. Renewable Energy Projects, Category I.D. Version 17, Sectoral Scope 01, EB 61.

In order to estimate the emission factor for the grid, AMS-I.D refers to the "Tool to calculate the emission factor for an electricity system", Version 2.2.1, EB63.

AMS-I.D. is an approved monitoring methodology with specific provisions for project activities under a programme of activities. It was approved for application under a programme of activities in EB 33, Annex 23, on 27 July 2007.

E.2. Justification of the choice of the methodology and why it is applicable to a SSC-CPA:

>>
Methodology AMS I.D. (Version 17) is applicable to a CPA because:

1. A CPA will consist of a renewable energy generation unit (hydro) that

   a) supplies electricity to a national grid, or
   b) supplies electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.

   The condition is always fulfilled as per eligibility criterion 4 projects always connect to the SIC. For projects connected to the SIC in Chile there are exactly three options for commercializing the generated electricity[23]:

   i) Power purchase agreements (PPAs) with regulated clients (e.g. distribution companies)
   ii) PPAs with unregulated clients (e.g. medium/large consumers)

---

[23] Systep 2010. "Venta de Energía y Conexión de PMGD - Barreras Asociadas" Published in Santiago de Chile: Systep. Available at: http://www.systep.cl/documents/ApemecSystep060710.pdf , Last visited: 13/12/2011

iii) Spot market sales

Options i) and iii) comply with condition a). Option ii) complies with condition b). Therefore, any CPA that meets the eligibility criteria of the present PoA meets this requirement of AMS I.D (Version 17).

2. A CPA will consist of any of the below:

   a) installation of a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant);
   b) capacity addition to an existing hydropower plant.

3. As per the eligibility criteria in section A.4.2.2 CPAs with reservoirs satisfy at least one of the following conditions:

   a) The CPA is implemented in an existing reservoir with no change in the volume of reservoir;
   b) The CPA 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/m2;
   c) The CPA 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/m2.

4. CPAs will be exclusively hydro plants and thus units added do only have renewable components.

5. CPAs will be exclusively hydro plants and thus units added will not be combined heat and power systems.

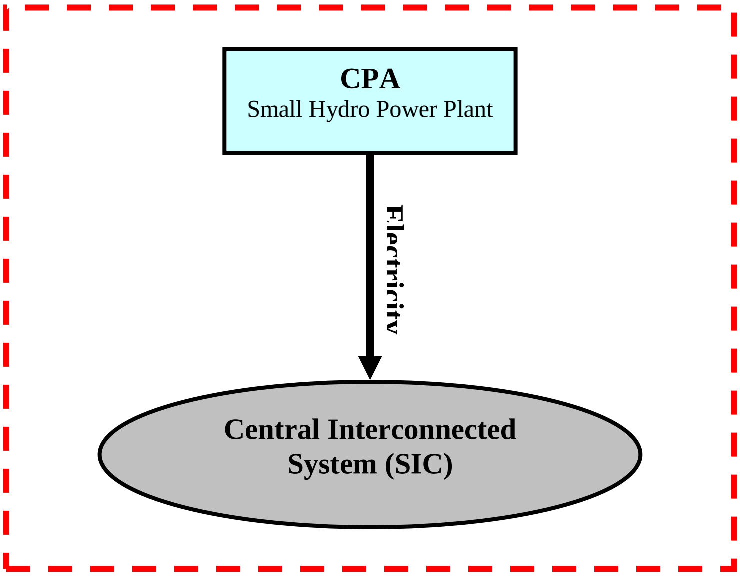
6. In the case that a CPA will not consist of a standalone project but of an addition of a renewable energy generation unit to an existing renewable power generation facility the capacity added by the CPA will be lower than 15 MW and the added unit will be physically distinct from the existing units.

7. A CPA will not retrofit or modify an existing facility for renewable energy generation.

E.3. Description of the sources and gases included in the SSC-CPA boundary

>>

The project boundary for each individual CPA includes the project power plant and all powerplants connected physically to the Central Interconnected System (SIC), as visualized in the figure below.



The GHG emission sources included in or excluded from the project boundary are as follows:

	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	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	Minor emission source
		CH_4	Yes / No	Main emission source (only in case of CPAs that involve new or increased reservoirs)
		N_2O	No	Minor emission source

Table 2: GHG Sources included within project boundary

E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

>>

In accordance with AMS-I.D. version 17, paragraph 10, 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.

E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA): >>

E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:

>>
The determination of additionality for a CPA under the present PoA shall be performed as presented below, in accordance with Attachment A to Appendix B to Annex II of 4/CMP.1 ("Attachment A") (Version 08) and/or the "Guidelines for Demonstrating Additionality of Microscale Project Activities" (Version 03). The managing entity may apply **any** of the additionality arguments presented. As long as a new CPA demonstrably meets the conditions for one of the presented approaches the CPA shall be deemed additional. The set of conditions for each approach and how demonstration of their fulfilment shall be performed at the time of inclusion of a CPA is implied in the explanations below and summarized in section E.5.2.

A. MICROSCALE APPROACH

According to the "Guidelines for Demonstrating Additionality of Microscale Project Activities" (Version 03) a project activity is additional if it falls into the following category of projects:

"2. Project activities up to 5 megawatts that employ renewable energy technology are <u>*additional*</u> *if any* <u>*one*</u> *of the conditions below is satisfied:*

…….

(d) The project activity employs specific renewable energy technologies/measures recommended by the host country designated national authority (DNA) and approved by the Board to be additional in the host country. The following conditions shall apply for DNA recommendations:

- *(i) "Specific renewable energy technologies/measures" refers to grid connected renewable energy technologies*[24] *of installed capacity equal to or smaller than 5 MW;*
- *(ii) The ratio of installed capacity of the specific grid connected renewable energy technology in the total installed grid connected power generation capacity in the host country shall be equal to or less than 3 per cent*[25]*;*
- *(iii) Most recent available data on the percentage of contributions of specific renewable energy technologies shall be provided to demonstrate compliance with the 3 per cent threshold. In no case shall data older than three years from the date of submission be used;*
- *(iv) Technologies/measures recommended by DNAs and approved by the Board to be additional in the host country remain valid for three years from the date of approval. However, additionality of eligible project activities applying the guidelines remains valid for the entire crediting period;*
- *(v) DNA submissions shall include the specific grid connected renewable electricity generation technologies that are being recommended and provide the required data as indicated above (e.g. wind power, biomass power, geothermal power, hydropower)."*

With regard to literal (d) the Chilean DNA Ministerio del Medio Ambiente (MMA = Ministry of Environment) submitted a recommendation on specific renewable energy technologies to be considered additional in Chile to the Executive Board of the CDM on 23/02/2012. According to the submission the

[24] Renewable technologies that do not generate electricity, such as heating and cooling technologies, are not eligible.
[25] For example, if the ratio of total installed capacity of all grid-connected hydropower plants with the capacity equal to or smaller than 5MW and the national grid-connected installed electricity generation capacity is less than 3 per cent in a host country then microscale hydropower is eligible for DNA recommendation in that host country.

MMA recommends to consider any renewable energy project up to 5 MW, including solar power, hydropower, tidal/wave, wind power, geothermal power and renewable biomass power, that supplies electricity to and/or displaces electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit as additional in Chile.

The Executive Board approved the recommendation of the MMA on 16/04/2012.

Therefore, any CPA with an installed capacity of up to 5 MW, connecting and supplying electricity to the SIC in Chile is deemed to be additional without the need for further analysis.

According to the "Guidelines for Demonstrating Additionality of Microscale Project Activities" (Version 03) the automatic additionality for micro grid connected hydropower projects in Chile has a validity of 3 years. However, after 3 years the Chilean DNA may renew its recommendation on microscale additionality and obtain respective approval by the EB.

B. NON-MICROSCALE APPROACH

Projects that do not follow the microscale approach above follow the approaches defined in Attachment A to Appendix B to Annex II of 4/CMP.1("Attachment A") version 08 to prove additionality.

APPROACH B.1: INVESTMENT BARRIER

According to paragraph 1.a. of Attachment A, an "investment barrier" exists when "a financially more viable alternative to the project activity would have lead to higher emissions. The baseline scenario described in section E.4. would lead to higher emissions than the implementation of a small-scale hydropower plant. Thus, if it can be demonstrated that the CPA is not financially attractive for a potential investor, it can be safely assumed that the baseline scenario would take place and lead to higher emissions.

The approach chosen here to demonstrate the existence of an investment barrier is the assessment of the financial indicators of projects against a benchmark.

NOTE: For a typical CPA, the Project IRR will be the preferred approach as the basis for benchmark analysis. Therefore, this approach is outlined in the present section. This approach to perform the benchmark analysis is explicitly allowed for use in the context of specific CPAs. The chosen approach must be transparently documented within the specific CPA DD.

Small hydro projects are electricity generation projects that require a high investment during the construction phase but have relatively small operational and maintenance costs. The typical investment horizon for these projects is 20 years, although this may vary depending on the context of the project. A suitable and widely used financial indicator to determine the attractiveness of such an investment is the Project IRR.

When analysing a potential project, investors compare the project IRR of the project against a benchmark, usually the Weighted Average Cost of Capital (WACC). Possible methods for calculating the WACC and the project IRR are elaborated further below.

Calculation of the benchmark

The benchmark against which a CPA's viability will be evaluated is the **pre-tax Weighted Average Cost of Capital (WACC)**.

In the following one approach for defining the pre-tax WACC is presented:

The Pre-tax WACC computation involves the estimation of three parameters, namely,

(b) debt/equity ratio,
(c) cost of debt and
(d) cost of equity,

The respective formula for computing the WACC is[26]:

$$WACC = ER * \frac{E}{D+E} + CD * \frac{D}{D+E}$$

Where:

Parameter	Explanation	Sources
ER	Expected return on investment = cost of equity	Calculated (see below) or internal company benchmark if applicable in accordance with par. 14 of the "Guidelines on the Assessment of Investment Analysis" version 05
CD	Cost of debt	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks; bank financing agreement; quotation of loan terms from banks; Chilean (government) bond lending rates; typical interests for comparable loans in the same sector in Chile Example: 8% (according to personal communication with Chilean banks (Bci and BICE), average of lower values, August 2011)
E/(D+E)	Share of equity in total financing	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks; bank financing agreement; quotation of loan terms from banks; typical debt to equity ratios for similar projects from scientific sources; default value as per par. 18 of the "Guidelines on the Assessment of Investment Analysis" version 05 Example: 30% (according to personal communication with

[26] http://www.investopedia.com/terms/w/wacc.asp , last visited: 24/02/2012

		Chilean banks (Bci and BICE), August 2011)
D/(D+E)	Share of debt in total financing	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks; bank financing agreement; quotation of loan terms from banks; typical debt to equity ratios for similar projects from scientific sources; default value as per par. 18 of the "Guidelines on the Assessment of Investment Analysis" version 05 Example: 70% (according to personal communication with Chilean banks (Bci and BICE), August 2011)

In financial analytics the most widely used approach to determine the cost of equity of an investment is the Capital Asset Pricing Model (CAPM).[27] The CAPM provides a formalized approach for estimating the cost of equity through:

Expected Return = Riskfree Rate + Beta$_{Asset}$**(Equity Risk Premium)*

Where:

Expected Return (ER)	The return that an investor expects on his investment
Riskfree Rate (RFR)	The return of a riskless investment with an investment horizon comparable to the analysed investment (e.g. sovereign country debt)
Beta$_{Asset}$ *(ß)*	The relative exposure of an investment to market risks
Equity Risk Premium (ERP)	Additional return of an asset investment over a riskless investment (based on historical data)

According to Damodaran 2010 the Equity Risk Premium for investments in emerging economies or economies in development can be established in the following way:

Equity Risk Premium = Mature Market Equity Premium + Country Risk Premium

Where:

Mature Market Equity Premium (MMEP):	Additional return of asset investment over a riskless investment in a mature market, e.g. US (based on historical data)
Country Risk Premium (CRP):	Premium that reflects the extra risk of the analysed market over a mature market

This leads to the following CAPM formula for calculating the Expected Return in an emerging market like Chile:

[27] A. Damodaran, 2010: Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2010 Edition; Stern School of Business; http://pages.stern.nyu.edu/~adamodar/ ; Reviewed on 18/07/2011.

*ER = RfR + ß * (MMEP + CRP)*

On the other hand it has been widely recognized that the traditional CAPM notoriously underestimates the required returns of investments of small companies.[28] The regular line of argumentation is that the impact of changes in the market environment on companies with a low capitalization is much heavier than on large companies since the former do not have sufficient financial resources to overcome temporary adversities. They are thus more prone to bankruptcy and have a higher risk of failure. To compensate for this additional risk investors expect higher returns from investments in small companies than from large ones.

The Size Premium is particularly relevant for small hydro projects because they are normally developed via a special purpose company that does not own any other assets than those of the project. The total value of the company's/project's assets may then range between 2 to 30 Million USD depending on the installed capacity. According to scientific studies on the size effect even projects on the upper end of this range will typically be classified as very small companies by investors.

Given the importance of the Size Premium specialized financial service providers have emerged that supply investors with updated information and quantification of the Size Premium based on historical data. Almost all scientific analysis of the Size Premium is based on data of the historical capital markets in the United States collected and published by Ibbotson Associates in its annual publication "The Ibbotson SBBI Classic Yearbook". The yearbook is used by advisors, financial planners, and brokers to analyse asset class performance. It contains total returns and index values dating back to 1926 for large and small company stocks, long-term corporate bonds, long- and intermediate-term government bonds, treasury bills, and inflation.

Normally, the providers of estimates of the Size Premium provide "beta-adjusted size premia". Therefore, the effect of the Size Premium is not subject to the beta value of the analysed investment and the size-premium-adjusted CAPM is as follows:[29]

Expected Return = Riskfree Rate + $Beta_{Asset}$**(Mature Market Equity Premium + Country Risk Premium) + Size Premium*

or short:

*ER = RfR + ß * (MMEP + CRP) + SP*

Where:

Parameter	Explanation	Sources
RfR	The RiskfreeRate is the return of a riskless investment with an investment horizon comparable to the	e.g. sovereign country debt, i.e. treasury bills or treasury bonds of a mature market (e.g. US); official publicly available data for a mature market (e.g. US) Example: Risk-free-rate for US Market, 2011,

[28]Damodaran 2010; Barad, M.W., 2001: Technical analysis of the size premium, Ibbotson Associates; Banz, R.W., 1981: The Relationship between Return and Market Value of Common Stocks, Journal of Financial Economics, 9, pp. 3-18

[29]2011 Duff & Phelps Risk Premium Report, Business Valuation Resources, LLC

	analyzed investment.	http://www.stern.nyu.edu/~adamodar/pc/datasets/histimpl.xls (last accessed: 03/04/2012)
ß	Beta is the relative exposure of an investment to market risks. An unlevered beta value shall be used since the share of loan finance within the underlying portfolio of companies may vary substantially. For the same reason the beta should, wherever possible, also be corrected for cash.	e.g. rating agencies; independent financial experts; official publicly available data If no sufficient and reliable information on beta is available a conservative approach is either to use a beta value from a mature market or to set beta equal 1. Example: Total beta (unlevered) for power industries in emerging markets, 2011, http://www.stern.nyu.edu/~adamodar/pc/datasets/totalbetaemerg.xls (last accessed: 03/04/2012)
MMEP	The Mature Market Equity Premium is the additional return of an asset investment over a riskless investment in a mature market, e.g. US (based on historical data)	e.g. rating agencies; independent financial experts; official publicly available data Example: Implied (Equity Risk) Premiums for US Market, 2011, http://www.stern.nyu.edu/~adamodar/pc/datasets/histimpl.xls (last accessed: 03/04/2012)
CRP	The Country Risk Premium reflects the additional risk of investing in an emerging economy compared to a mature equity market.	e.g. rating agencies; independent financial experts; official publicly available data Example: Country Risk Premium Chile, 2011, http://www.stern.nyu.edu/~adamodar/pc/datasets/ctryprem.xls (last accessed: 03/04/2012)
SP	The Size Premium reflects the risk of investing in a small company.	e.g. rating agencies; independent financial experts; official publicly available data Example: Smoothed Premium over CAPM for companies with a market value of equity smaller than 68 Mio USD: p.30, 2011 Duff & Phelps Risk Premium Report, Business Valuation Resources, LLC, http://www.duffandphelps.com/sitecollectiondocuments/2011_Duff_Phelps_Risk_Premium_Report_EXCERPT.pdf (last accessed: 03/04/2012)

Table 3: Explanation of financial parameters of the adjusted CAPM approach

The values and sources of the financial indicators assessed shall be valid and applicable at the time of the investment decision.

As per the formula and per definition the pre-tax WACC is a benchmark **before taxes**.

Calculation of financial indicators:

The calculation of the Project IRR of a typical CPA shall be presented in excel format and will be submitted along with the CPA DD. Since different CPAs may consider different items (e.g. different levels of data aggregation) in their calculations of the Project IRR different excel formats may be used, as long as they fully comply with the approach presented in the following. The Project IRR shall be calculated before taxes, in line with the WACC, which is also calculated before taxes. All assumptions of critical parameters have to be substantiated with reliable sources or evidence where available. The following table presents the key parameters and examples for appropriate sources:

Parameter	Unit	Sources
Total investment	USD	e.g. (Pre-) Feasibility Study revised and certified by an independent expert; (Pre-) Feasibility Study as presented to banks; quotations for major equipment; purchase orders
Date of the investment decision	dd/mm/yyyy	e.g. Purchase order of electromechanical equipment; Minutes of the board meeting when the final investment decision was made; Bank loan approval
Depreciation term	years	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks; National laws and regulations
Installed capacity	MW	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks; quotations for electro-mechanical equipment
Yearly electricity generation	kWh/year	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks[30]
Plant load factor		e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks
Yearly O&M costs	USD/year	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks
Electricity feed in tariff (including subsidies, excluding VAT)	USD/kWh	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks; Electricity sector legislation or official feed-in tariff analysis; Project PPA;

[30]Based on the installed capacity of the plant and the yearly electricity generation the plant load factor can be calculated as a derived parameter. According to the "Guidelines for the Reporting and Validation of Plant Load Factors" version 1, EB 48, either the plant load factor as reported to a bank and/or equity financiers while applying the project activity for project financing, or to the government while applying the project activity for implementation approval; or the plant load factor determined by an third party (e.g. an engineering company) should be used. Therefore, the source options provided for installed capacity and yearly electricity generation guarantee the compliance with the plant load factor guidelines cited above.

		Feed-in tariff studies by sectoral experts
Technical lifetime of equipment	years	e.g. Provisions for determining the technical lifetime of equipment as contained in the latest version of the CDM "Tool to determine the remaining lifetime of equipment", according to the tool project participants may use either of the following sources for determining the technical lifetime of a project: - Option (a): Manufacturers information (e.g. from equipment specifications) - Option (b): Expert evaluation (e.g. feasibility study) - Option (c): Default values (for hydropower projects the default value for the technical lifetime of turbines should be used) ; National laws and regulations; (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks;
Fair value of the project at the end of the period of analysis	USD	e.g. (Pre-) Feasibility Study prepared or revised by an independent expert; (Pre-) Feasibility Study as presented to banks; Calculated on the basis of national laws and regulations

Table 4: Key parameters applied in the calculation of the CPA Project IRR

The values used should be either the ones known at the moment of the investment decision or, if the investment decision is not yet taken during the validation of the CPA documentation, the latest available information prior to the validation of the CPA. In most cases this might imply that the Feasibility Study has to be used.

NOTE: For a specific CPA the list of parameters that is used for determining the project IRR may be different, according to the particular circumstances of the project.

Comparison of the financial indicator against the benchmark

The results of the calculation of the Project IRR compared to the benchmark and the CPA implemented with CER revenues will be presented as:

Project IRR of CPA without CER revenues	
Project IRR of CPA with CER revenues	
Benchmark	

As a result of the benchmark analysis it will be clearly demonstrated that the proposed CPA (project) is not financially attractive without considering CER revenues. Through comparison of the Project IRR to the benchmark, it can be clearly seen that CER revenues help the CPA to reach an acceptable return on investment.

Sensitivity analysis

The essential parameters for the profitability of a hydroelectric project are the total investment, electricity generation and the electricity price.

Operation and maintenance costs usually have a very small impact on the IRR, as unlike the CAPEX, they are spread over time and are usually assumed to be a certain small percentage of the investment costs (usually between 1% and 5% yearly). Therefore even a large variation in operation and maintenance costs is likely to have only a marginal impact on the IRR.
Thus, a sensitivity analysis is conducted on total investment, electricity generation and electricity price. The assessed variation is +/-10%.

Project IRRs					
Sensitivity on kWh price	-10%	-5%	0%	5%	10%
without CERs					
with CERs					
Sensitivity on Investment	-10%	-5%	0%	5%	10%
without CERs					
with CERs					
Sensitivity on electricity generation	-10%	-5%	0%	5%	10%
without CERs					
with CERs					

Table 5: Sensitivity Analysis

For a typical CPA even the most favourable variations, e.g. +10% electricity price or electricity generation (limited with the installed capacity of the plant less at least 5% for outages and maintenance) 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 without access to CER revenues.

Rationale for the choice of sensitivity analysis variation:

1. **<u>10% variation of the electricity price:</u>**

Hydropower electricity generators have four main options for selling their electricity in Chile[31]:

- Power Purchase Agreements (PPAs) covering the generation curve: these contracts are usually signed among electricity generation companies and the client purchases all electricity generated. As the supplier doesn't bear the risk of variation in the generation, the tariffs in production contracts tend to be lowest and are set for longer periods.
- Power Purchase Agreements (PPAs) covering the demand curve: these contracts are signed with unregulated clients and are meant to cover the entire demand of the client, irrespective of the actual generation. This type of contracts usually has a higher price than the abovementioned generation curve contracts, but brings along very high risks due to the variable electricity generation that depends on the hydrology of the water course. These contracts are therefore not very suitable for small hydropower plants.
- Tendered Power Purchase Agreement (PPA): PPAs can be signed with distribution companies through tenders. The risk of insufficient generation is borne by the supplier. The

[31] Systep 2010. "Venta de Energía y Conexión de PMGD - Barreras Asociadas" Published in Santiago de Chile: Systep. Available at: http://www.systep.cl/documents/ApemecSystep060710.pdf , Last visited: 13/12/2011

prices (Node Prices, or Precios de Nudo in Spanish) are set centrally by the National Electricity Commission (CNE) for each particular tender and company. The node energy and power prices are the long-term projections used regularly in the energy sector, that take into consideration the market conditions, the spot price, and the distribution companies' contracts with power generators. Tenders are also difficult to access for small companies[32].

- Spot prices: if a generator opts to sell electricity on the spot market, he/she bears not only the risk of fluctuating electricity generation, but also an additional risk of highly volatile electricity prices. Spot prices are usually higher than other prices, but are less predictable.

In summary, the typical electricity sales model for small hydro power projects is via a long-term PPA. The most frequent model is going to be the generation curve PPA since on the one hand small projects will usually not be able to access tenders and on the other hand the financing bank will require secured long-term sales price for a large part of a project's generation, which cannot be achieved through a demand curve PPA.

However, as PPAs are bilateral contracts between generation and distribution companies information on PPA pricing levels is generally not publicly available. An exception is the PPA electricity sales prices negotiated as part of tenders, which are regularly published by the CNE. Therefore, a good estimate ~~of~~ for the range of variation of PPA prices is the difference between tender prices for particular nodes within the same tender. As can be seen in the technical report "Setting of Average Node Prices for the SIC May 2011"[33], the difference between the Long-Term Node Prices (the prices of the contracts between distribution companies and electricity suppliers) for each tender is always less than 10%. Therefore, it is considered appropriate and conservative to vary the electricity price 10% within the sensitivity analysis.

2. 10% variation in investment costs:

Investment costs impact the IRR of a project in an inverse way, i.e. the lower the CAPEX, the higher the IRR. The CAPEX of a hydropower project present in a feasibility study tends to be based on past experience, rough and optimistic. Furthermore, small-scale projects rarely can afford very detailed feasibility studies customized to the precise project setting. This means thatthe actual costs incurred during the implementation of the projects tend to be higher, not lower than the ones eventually incurred by the investor. In this sense, 10% decrease in investment costs is a very conservative assumption for small hydropower plants in Chile.

3. 10% variation in electricity generation:

Electricity generation has a major impact on the IRR of a project. Hydrological studies of Chilean rivers show that the yearly variations of the water supply can be as much as 20% compared to historical averages. However, since project engineers use the historical average flow of a river as the basis of hydropower feasibility studies these variations are already accounted for. So, although in some years there will be a substantially higher electricity generation as predicted this is going to be levelled out by equivalent underperformance in other years. In this sense the variation of the **average yearly electricity**

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[32] See Mocarquer, S. 2011. "Seminario micro centrales hidroeléctricas: Estrategia comercial mini-micro hidro". Published in Santiago de Chile: Systep Available at: http://www.systep.cl/documents/Mocarquer%20Minihidro%2031052011.pdf , Last visited: 29/11/2011

[33] CNE, 2011. "Fijación de precios de nudo promedio Sistema Interconectado Central", available at: http://www.cne.cl/cnewww/export/sites/default/07_Tarificacion/01_Electricidad/Otros/Precios_nudo/precio_nudo_promedio/descargas/11_PNP_MAY_2011/Informe_Txcnico_PNP_May-11.pdf, Last visited: 13/12/2011

generation by 10% seems more than appropriate, because it only represents the variations of the water supply beyond the historic variations, which are already taken into account in projects' feasibility studies. More than 10% increase in electricity generation can thus hardly be possible and 10% is considered sufficient variation for a CPA's sensitivity analysis.

If the CPA's IRR remains below the benchmark even after varying each of the three parameters above by 10%, the CPA shall be considered less attractive than the alternative i.e. not to invest in a small-scale hydropower plant. The alternative leads to more emissions than the CPA as the electricity that could have been supplied by the CPA would need to be supplied by the current generation mix in the SIC which contains an increasing number of fossil fuel power plants. Therefore, if the CPA's IRR is demonstrated to be below the benchmark, the CPA shall be considered additional by fulfilling paragraph 1.a) of attachment A of Appendix B of the "Simplified modalities and procedures for small-scale CDM project activities."

APPROACH B.2: ACCESS-TO-FINANCE BARRIER (LOAN)

As suggested by the "Guidelines for objective Demonstration and Assessment of Barriers" Version 1.0 par. 4, the demonstration of barriers related to the lack of access to capital, technologies and skilled labor shall include *"information on the nature of the companies and entities involved in the financing and implementation of the project. More specifically:*

- *While demonstrating barriers related to the lack of access to capital, information should include nature of company, organization and its ownership, and financial information;*

- *While demonstrating barriers related to technologies and skilled labor, information should include nature of company, organization and its ownership, and previous experience with similar project (that is under consideration for CDM) in other locations."*

Therefore, when applying Approach B.2 to a CPA for inclusion under the present PoA the managing entity will provide the following information on the implementer of the CPA, as contained in the inscription of the company:

1. Nature of the company
2. Organizational structure
3. Ownership structure

Furthermore, when applying Approach B.2, the managing entity will facilitate the latest available (audited) balance sheet of the implementer of the respective CPA. Where no audited balance sheet is available because of very recent inscription of the company a preliminary balance sheet shall suffice.

In Chile local banks do not usually provide project loans to small entities like operators of small hydro plants. This is due a variety of difficulties that their investors might face:

- Relatively low return on investment: there are significant economies of scale directly proportional to the scale of the hydropower plant. Banks therefore prefer investing in larger installations.
- Project owners who are often inexperienced in the setting-up of hydropower plants: the typical implementer of a CPA under this PoA will be a medium-scale farmer or a small company who does not have a professional background in the development of hydroelectric projects and does

not have any significant experience in the field of hydroelectricity generation or in the electricity market. An implementer of a CPA many times will have no or limited knowledge on:

1. Project preparation (hydrological and environmental studies, market analysis, feasibility studies)
2. Suppliers of equipment, civil works and construction
3. Negotiation of the transmission grid connection
4. Electricity sales
5. Project finance
6. Obtaining permits
7. CDM
8. Carbon markets

If despite of this a local bank is willing to provide a project based loan it will, on top of the project assets, require additional securities. The accumulated value of securities demanded by the bank can easily surpass 120% of the total project value. Moreover, banks require rather high debt-to-equity ratios (usually around 70/30), which causes further hurdles to the financing process.

Thus, small hydro plants in Chile face a loan investment barrier. This barrier can be alleviated by creatively involving project CERs in the funding structure. Examples how CDM income can help to facilitate a bank loan are:

a) An early ERPA of the project is pledged as security.
b) The bank conditions the loan to successful CDM registration, e.g. to substantiate the inclusion of CER revenues in the cash flow and meet the bank's requirements for the project's financial indicators (IRR, NPV).
c) The bank values CDM income as a collateral that tips the scales in favour of the project.

Therefore, evidence on any of the situations described above or any other situation where a bank decides to grant a loan based on the ability of the project to generate CERs can be considered sufficient proof that:

1. the CPA was facing a loan investment barrier that prohibited its implementation; and
2. the CDM alleviates the loan investment barrier to a level that the project is not prevented anymore from occurring.

Considering the above, evidence for the demonstration of the existence of the loan investment barrier and for CDM's role in overcoming it shall involve:

1. The loan agreement; and
2. Provisions in the loan agreement or an additional official statement from the bank that the loan will not enter into force if the project is not registered as a CDM project/CPA.

To further underpin the argument the CPA implementer may choose to provide official denials of loan applications from other banks that evaluated the same project information as the bank that finally provided the loan, stipulating any of the situations laid out in literals a) through c) above or any comparable circumstances that led to the alleviation of the loan finance barrier.

By providing this type of evidence the requirements of par. 9 and 5 of the "Guidelines for objective Demonstration and Assessment of Barriers" are met and the loan investment barrier can be considered real and proven.

NOTE: Loans as described in this approach depend on a successful CDM registration of the project in question. The respective arrangements will be conditional on successful inclusion of the project as a CPA to the present PoA. Thus, to evidence a bank loan based on CDM, a conditional agreement or a letter of intent shall be sufficient.

E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:

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A. MICROSCALE APPROACH

According to section E.5.1., all CPAs with an installed capacity up to 5 MW are additional as such. No further criteria beyond the installed capacity need to be assessed.

B. NON-MICROSCALE APPROACH

According to section E.5.1., CPAs that do not follow the microscale approach may choose between two approaches to prove additionality. Depending on the approach chosen key criteria and data for assessing additionality vary.

ALL B.x

For any CPA a statement by the CPA implementer shall be provided stipulating that he is not obliged, nor does he have the immediate need to generate electricity.

APPROACH B.1

For a CPA following Approach B.1 in section E.5.1 the following criteria and data shall be assessed:

a) The applicable benchmark. Applied financial indicators have to be included with sources.
b) The Project IRR of the CPA. The key parameters for the calculation have to be included with sources.
c) A sensitivity analysis on electricity price, electricity generation and total investment.
d) The CPA fulfils this additionality criterion if its Project IRR (including all realistic scenarios of the sensitivity analysis) without CDM revenue is below the benchmark.

APPROACH B.2

For a CPA following Approach B.2 in section E.5.1 the following criteria and data shall be assessed:

1. Company inscription of the CPA implementer, indicating the:
    a) Nature of the company;
    b) Organizational structure; and
    c) Ownership structure

2. Latest available (audited) balance sheet of the CPA implementer. Where no audited balance sheet is available because of very recent inscription of the company a preliminary balance sheet shall suffice.
3. Evidence of a bank loan based on the ability of the project to generate CERs, in the form of:
   a) The loan agreement; and
   b) Provisions in the loan agreement or an additional official statement from the bank that the loan will not enter into force if the project is not registered as a CDM project/CPA.

E.6. Estimation of Emission reductions of a CPA:

E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:

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The emission reductions for each CPA are calculated on the basis of the small scale methodology AMS-I.D., version 17.

For each CPA 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 an emission factor (tCO_2/GWh) calculated in a transparent and conservative manner, as elaborated below.
In the specific case of capacity additions, the baseline emissions are calculated on the basis of actual electricity generation and historic electricity generation of the existing renewable energy plant/unit, as explained further in section E.6.2.

Emission factor

AMS.I-D gives two options that can be applied in order to estimate the emission factor:

(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 kg CO_2e/kWh) of the current generation mix. The data of each specific year in which project generation occurs must be used.

Option (a) is selected for the proposed PoA. CM, OM and BM are calculated according to the "Tool to calculate the emission factor for an electricity system" version 2.2.1 (EF tool).

The EF tool includes six steps to be applied in order to determine the combined margin emission factor:

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 (BM) emission factor;
STEP 6. Calculate the combined margin (CM) emission factor.

Step 1:Identify the relevant electric power system

The relevant electric power system is the Central Interconnected System (SIC).

Step 2:Choose whether to include off-grid power plants in the project electricity system (optional);

For the calculation of the emission factor of the grid for all CPAs under this PoA, only grid-connected power plants will be considered (Option I). Off-grid power plants are ignored. Moreover, the power plants considered are only those connected to the SIC grid, and not to other regional grids existent in the country.

Step 3: Select a method to determine the operating margin (OM)

The OM emission factor method selected is **(b)Simple Adjusted OM**.

The Simple Adjusted OM is calculated using the ***ex post* option** for the year in which the project activity displaces electricity and updated annually during monitoring. Since the annual start and end dates of monitoring period are not yet determined at the time of submission of this document the data vintage (y, y-1, or y-2) is left open. It will be fixed at the first verification according to the availability of the data during the first monitoring period and will be used consistently throughout the crediting period.

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

The calculation of the Simple Adjusted emission factor ($EF_{grid,OM-adj,y}$) is based on Option (A). The emission factor of each power unit is determined following either of the options A1, A2 orA3, (in this order, depending on the availability of fuel consumption and/or efficiency data).

Step 5: Calculate the build margin (BM) emission factor

The BM emission factor will be calculated following **Option 2** of the EF tool:

"For the first crediting period, the BM emission factor will be updated annually, ***ex post****, including those units built up to the year of registration of the Programme of Activities or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor will be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period will be used."*

PoAs have only a single crediting period of 28 years. Nevertheless, according to par. 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 the PoA DD and specifically the baseline have to be re-validated every 7 years. Therefore, the following adjusted procedure of Option 2 shall apply:

1. For the first 7 years of the crediting period of the PoA the BM emission factor will be updated annually, **ex post**, including those units built up to the year of registration of the Programme of Activities or, if information up to the year of registration is not yet

available, including those units built up to the latest year for which information is available.

2. For the second 7 years of the crediting period of the PoA, the build margin emissions factor will be calculated ex ante, as described in Option 1 of the EF tool.
3. For the final 14 year of the crediting period of the PoA, the build margin emission factor calculated for the second 7 years of the crediting period will be used.

Step 6: Calculate the combined margin emissions factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) will be based on **Option (a) Weighted Average CM.**

Emission Reductions:

The emission reductions of each CPA are the baseline emissions minus project emissions and leakage.

According to AMS-I.D version 17 par. 20 and 21, only project emissions from water reservoirs and emissions from on-site consumption of fossil fuels are to be considered. In case a CPA includes a reservoir, the project emissions will be calculated according to ACM0002, “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” version 12.3.0. Project emissions from fossil fuel combustion are not considered because small hydropower projects in Chile do not involve on-site consumption of fossil fuels, i.e. no auxiliary fossil fuel fired generators are operated on the project site.

According to AMS-I.D. version 17 par.22, no leakage is to be considered unless the energy generating equipment is transferred from another activity. If a CPA involves the transfer of equipment leakage will be considered accordingly.

E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:

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Emission reductions:

The emission reductions of each CPA will be calculated using the following equation 10 of AMS-I.D. version 17:

$$ER_y = BE_y - PE_y - LE_y \qquad (1)$$

Where:

ER_y Emission reductions in year *y* (t CO_2/y)

BE_y Baseline Emissions in year *y* (t CO_2/y)

PE_y Project emissions in year *y* (t CO_2/y)

LE_y Leakage emissions in year *y* (t CO_2/y)

Baseline emissions:

Given that there are two possible types of projects (greenfield and capacity addition) eligible as CPAs for the proposed Programme of Activities, this section presents two separate methods for calculating the baseline emissions of a CPA:

1. Greenfield Projects

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 as per equation 1, AMS-I.D, version 17.

$$BE_y = EG_{BL,y} \times EF_{CO2,grid,y} \quad \textbf{(2)}$$

Where:

BE_y Baseline Emissions in year *y* (t CO_2)

$EG_{BL,\ y}$ Quantity of net electricity supplied to the grid as a result of the implementation of the CPA in year *y* (MWh)

$EF_{CO2,grid,y}$ CO_2 Emission factor of the grid in year *y* (t CO_2/MWh)

1. Capacity Addition Projects

For the estimation of the baseline emissions for CPAs that involve capacity additions to existing hydropower facilities, the electricity generation is calculated taking into account historical data of the generation of the existing units.

$$BE_{CapacityAddition,CO2,y} = [EG_{BL,CapacityAddition,y}] \times EF_{CO2} \quad \textbf{(3)}$$

Where:

$$EG_{BL,CapacityAddition,y} = EG_{PJ,facility,y} - (EG_{historical} + \sigma_{historical}) \quad \textbf{(4)}$$

Where:

$EG_{BL,CapacityAddition,y}$ Quantity of net electricity generation that is supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)

$EG_{PJ,facility,y}$ Quantity of net electricity generation supplied to the grid by the project plant/unit in year *y* (MWh)

$EG_{historical}$ Annual average historical net electricity generation by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh)

Average of historical net electrical energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofit, or modified in a manner that significantly affected output (i.e. by 5%or more), will be used.

To determine $EG_{historical}$, each CPA may choose between the following two historical periods.

(a) The five calendar years prior to the implementation of the CPA; or

(b) The time period from the calendar year following $DATE_{hist}$, up to the last calendar year prior to the implementation of the project, as long as this time span includes at least five calendar years where $DATE_{hist}$is latest point in time between:

(i) The commercial commissioning of the plant/unit;

(ii) If applicable: the last capacity addition to the plant/unit; or

(iii) If applicable: the last retrofit of the plant/unit

$\sigma_{historical}$ Standard deviation of the annual average historical net electricity generation supplied to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh).

Emission factor calculation

For both, greenfield and capacity addition projects, the grid emission factor is calculated in the same way as presented in this sub-section.

As explained in section E.6.1., both the operating and the build margin emission factors will be calculated on an *ex post* basis according to the EF tool.

The equations to be used in each step of the calculation are as follows:

Step 1:Identify the relevant electric power system:
N/A

Step 2:.Choose whether to include off-grid power plants in the project electricity system (optional);
N/A

Step 3: Select a method to determine the operating margin (OM)
N/A

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

The Simple Adjusted Operating Margin emission factor will be calculated *ex post* using equation (8) of the EF Tool. The parameters in the tool should be calculated based on option A1, A2 or A3 of the EF Tool.

$$EF_{grid,OM-adj,y} = \left(1-\lambda_y\right) \cdot \frac{\sum_m EG_{m,y} \times EF_{FL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \cdot \frac{\sum_k EG_{k,y} \times EF_{FL,k,y}}{\sum_k EG_{k,y}} \qquad \textbf{\textit{(5)}}$$

Where:

$EF_{grid,OM-adj,y}$ Simple adjusted operating margin CO_2 emission factor in year *y* (tCO_2/MWh)

λ_y Factor expressing the percentage of time when low-cost/must-run power units are onthe 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 in Step 3

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

Option A1: If for a power unit m data on fuel consumption and electricity generation is available, the emission factor should be determined as per equation (2) of the EF tool:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \qquad \textbf{(6)}$$

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*(tCO_2/GJ)
$EG_{m,y}$:	Net quantity of electricity generated and delivered to the grid by power unit *m*in year *y*(MWh)
m:	All power units serving the grid in year *y* except low-cost/must-run power units.
i:	All fossil fuel types combusted in power unit *m*in year *y*
y:	The relevant year as per the data vintage chosen in Step 3.

Option A2: If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as per equation (3) of the EF tool:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \qquad \textbf{(7)}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

$EF_{CO2,m,i,y}$ CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)

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

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

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

Where several fuel types are used in the power unit, the fuel type with the lowest CO_2 emission factor for $EF_{CO2,m,i,y}$ will be used.

Option A3: If for a power unit *m* only data on electricity generation is available, an emission factor of 0 tCO_2/MWh can be assumed as a simple and conservative approach.

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

$EF_{EL,k,y}$ will be determined in the same manner as $EF_{EL,m,y}$ (option A1, A2, or A3).

Net electricity imports: At the time of submission of the present document, the SIC is not interconnected with other grids and thus there are no electricity imports. If in the future this situation changes, net electricity imports, are to be considered as low-cost/must-run units *k*.

Determination of λ_y:

The parameter Lambda (λ_y) is defined as follows:

$$\lambda_y(\%) = \frac{Number\ of\ hours\ low\text{-}cost\ /must\text{-}run\ sources\ are\ on\ the\ margin\ in\ year\ y}{8760\ hours\ per\ year} \qquad (8)$$

Calculation method:

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 electricity generation data from each power plant/unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants/units (i.e. $\Sigma_k EG_{k,y}$).

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 (BM) emission factor:

As explained in detail in section E.6.1 the build margin is calculated following a PoA-adjusted version of Step 5, Option 2 of the EF tool. Thus, for the first 7 years of the crediting period of the PoA it is calculated *ex post*.

The sample group of power units *m* used to calculate the Build Margin will be determined as per the following procedure, consistent with the data vintage selected:

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. The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available. 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 than10 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 the generation 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 (tCO_2/MWh) of all power units *m* during the most recent year *y* for which electricity generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(9)}$$

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 electricity generation data is available.

The CO2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin.

If the power units included in the build margin *m* correspond to the sample group $SET_{sample\text{-}CDM\text{->}10yrs}$, then, as a conservative approach, only option A2 from guidance in Step 4 (a) can be used and the default values provided in Annex 1 of the EF tool will be used to determine the parameter $\eta_{m,y}$.

Step 6: Calculate the combined margin emission factor:

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on the weighted average CM method, and calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \textbf{(10)}$$

Where:

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year *y* (tCO_2/MWh)

$EF_{grid,OM\text{-}adj,y}$ Simple adjusted 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 (%)

For all CPAs, the values of w_{OM} and w_{BM} will be fixed at 0.5 each for the first crediting period, as prescribed for hydropower projects by the EF tool.

Therefore, the calculation of the combined margin emission factor will in end effect be based on the following equation:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times 0.5 + EF_{grid,BM,y} \times 0.5 \quad \textbf{\textit{(11)}}$$

Given that AMS-I.D. and the EF tool employ different names for the grid emission factor parameter, although AMS-I.D. refers to the EF tool, for the purposes of the present PoA the following terms can be used interchangeably:

$$EF_{grid,CM,y} = EF_{CO2,grid,y}$$

Project emissions:

According to ACM0002 version 12.3.0, for hydro power project activities that result in new reservoirs beyond a limited daily poundage and hydro power project activities that result in the increase of existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoir, estimated as follows:

(a) If the power density of the reservoir (*PD*) is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000} \quad \textbf{\textit{(12)}}$$

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)
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)

According to ACM0002 version 12.3.0, the default value for EF_{Res} is 90 $kgCO_2e$/MWh.

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

$$\boldsymbol{PE_{HP,y} = 0} \quad \textbf{\textit{(13)}}$$

The power density of the project activity (*PD*) is calculated as follows:

$$\boldsymbol{PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}} \quad \textbf{\textit{(14)}}$$

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 reservoir 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 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

Leakage:

If energy generating equipment is transferred from another activity leakage will be considered. The appropriate methodological approach for quantifying leakage will be determined for the respective CPA individually within the specific CPA DD.

E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:

Data / Parameter:	**Cap_{BL}**
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity.
Source of data used:	To be specified for each CPA
Value applied:	To be specified for each CPA; For new hydro power plants, this value is zero
Justification of the choice of data or description of measurement methods and procedures actually applied :	To be specified for each CPA
Any comment:	Only for CPAs that result in new reservoirs and CPAs that result in the increase of existing reservoirs

Data / Parameter:	**A_{BL}**
Data 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).
Source of data used:	To be specified for each CPA
Value applied:	To be specified for each CPA; For new reservoirs, this value is zero
Justification of the choice of data or description of measurement methods and procedures actually applied :	To be specified for each CPA
Any comment:	Only for CPAs that result in new reservoirs and CPAs that result in the increase of existing reservoirs

Data / Parameter:	EF_{Res}
Data unit:	$kgCO_2e/MWh$
Description:	Default emission factor for emissions from reservoirs of hydro power plants
Source of data used:	Decision by EB23
Value applied:	90 $kgCO_2e/MWh$
Justification of the choice of data or description of measurement methods and procedures actually applied :	n/a
Any comment:	Only for CPAs that result in new reservoirs or CPAs that result in the increase of existing reservoirs

Data / Parameter:	$EG_{historical}$
Data unit:	MWh
Description:	Annual average historical net electricity generation by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data used:	To be specified for each CPA
Value applied:	To be specified for each CPA
Justification of the choice of data or description of measurement methods and procedures actually applied :	To be specified for each CPA
Any comment:	Only for CPAs that involve capacity addition to an existing renewable energy plant/unit

Data / Parameter:	$\sigma_{historical}$
Data unit:	MWh/yr
Description:	Standard deviation of the annual average historical net electricity generation supplied to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data used:	Calculation
Value applied:	To be specified for each CPA
Justification of the choice of data or description of measurement methods and procedures actually applied :	n/a
Any comment:	Only for CPAs that involve capacity addition to an existing renewable energy plant/unit

E.7. Application of the monitoring methodology and description of the monitoring plan:

D.7.1. Data and parameters to be monitored by each SSC-CPA:

Data / Parameter:	$\mathbf{EG_{BL,y}}$(in case of capacity addition projects the parameter is called $\mathbf{EG_{PJ,facility,y}}$)
Data unit:	MWh/y
Description:	Quantity of net electricity supplied by the project to the grid in year *y*
Source of data to be used:	To be specified for each CPA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified for each CPA
Description of measurement methods and procedures to be applied:	Measurements will be undertaken using energy meters certified to national or IEC standards. Monitoring will be continuous with hourly measurement and at least monthly recording.
QA/QC procedures to be applied:	Calibration will be undertaken as prescribed in paragraph 17 c) of "General Guidelines to SSC CDM Methodologies" version 17, i.e. calibrated according to the national standards and reference points or IEC standards and recalibrated (or calibration validity and accuracy confirmed through test routines) at appropriate intervals according to national regulations. If applicable, measurement results will be cross-checked with records for sold/purchased electricity(e.g. invoices/receipts).
Any comment:	

Data / Parameter:	$\mathbf{FC_{i,m,y}}$ $\mathbf{FC_{i,k,y}}$
Data unit:	Mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power unit *m* or *k* in year *y*
Source of data to be used:	Latest official data obtained from the grid's transmission service operator CDEC-SIC and/or the National Energy Commission (CNE).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	Data obtained from official sources. The data will be updated yearly using the latest available information. Information will be used for calculating the simple adjusted OM and the BM annually during the first crediting period.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

Data / Parameter:	$\mathbf{NCV_{i,y}}$
Data unit:	GJ / mass or volume unit

Description:	Net calorific value (energy content) of fossil fuel type *i*in year *y*
Source of data to be used:	(a) Values provided by the fuel supplier of the power plants in invoices; or (b) Regional or national average defaults; or (c) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories; or the latest update thereof.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	The data will be updated yearly using the latest available information. Information will be used for calculating the simple adjusted OM annually during the first crediting period. It will also be used for calculating the parameter $EF_{EL,m,y}$ of the annual BM calculation.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	In Chile it is uncommon that option (a) is available, and option (b) is published by the National Committee of Energy on the yearly energy balances. If option (b) is used and only GCV are available, the values will be corrected following the guidance of 2006 IPCC Guidelines for National Greenhouse Gas Inventories (vol. 2, p 1.16): “for coal and oil, the NCV is about 5 percent less than the GCV For most forms of natural and manufactured gas, the NCV is about 10 percent less” or the latest update thereof.

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data to be used:	(a) Values provided by the fuel supplier of the power plants in invoices; or (b) Regional or national average defaults; or (c) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories; or the latest update thereof.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	The data will be updated yearly using the latest available information. Information will be used for calculating the simple adjusted OM and the BM annually.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

Data / Parameter:	**$EF_{CO2,m,i,y}$ $EF_{CO2,k,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* used in power unit *m* or *k* in year *y*
Source of data to be used:	(a) Values provided by the fuel supplier of the power plants in invoices; or (b) Regional or national average defaults; or (c) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories; or the latest update thereof.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	The data will be updated yearly using the latest available information. Information will be used for calculating the simple adjusted OM and the BM annually.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

Data / Parameter:	**$EG_{m,y}$**
Data unit:	MWh
Description:	Net electricity generated by power plant/unit *m* in year *y*
Source of data to be used:	Latest official data obtained from the grid's transmission service operator CDEC-SIC and/or the National Energy Commission (CNE).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	Data obtained from official sources. The data will be updated yearly using the latest available information. Information will be used for calculating the simple adjusted OM and the BM annually during the first crediting period.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

Data / Parameter:	**$EG_{k,y}$**
Data unit:	MWh
Description:	Net electricity generated by power plant/unit *k* in year *y*
Source of data to be used:	Latest official data obtained from the grid's transmission service operator CDEC-SIC and/or the National Energy Commission (CNE).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	Data obtained from official sources. The data will be updated yearly using the latest available information. Information will be used for calculating the simple adjusted OM and the BM annually during the first crediting period.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

Data / Parameter:	**$\eta_{m,y}$**
Data unit:	-
Description:	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data to be used:	a) Documented manufacturer's specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or b) Data from the utility, the dispatch centre or official records; or c) The following default values as per Annex 1 of the EF tool (if available for the type of power plant): **Generation Technology** — **New units (after 2000)** **Coal** — - Subcritical — 39% Supercritical — 45% Ultra-supercritical — 50% IGCC — 50% FBS — - CFBS — 40% PFBS — 41.5% **Oil** — - Steam turbine — 39% Open cycle — 39.5% Combined cycle — 46% **Natural gas** — - Steam turbine — 37.5% Open cycle — 39.5% Combined cycle — 60%
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods	The data for newly commissioned power plants will be updated yearly using the latest available information. The indicators for each power plant do not change

and procedures to be applied:	for the crediting period. However, if in any given year sufficient information becomes available on fuel consumption of the respective power plant, the preferred method for estimating the EF of that power plant will be calculated on the basis of option A1 instead as a preferred calculation option. Information will be used for calculating the simple adjusted OM and the BM annually.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

Data / Parameter:	$\eta_{k,y}$
Data unit:	-
Description:	Average net energy conversion efficiency of power unit *k* in year *y*
Source of data to be used:	d) Documented manufacturer's specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or e) Data from the utility, the dispatch centre or official records; or f) The following default values as per Annex 1 of the EF tool (if available for the type of power plant): **Generation Technology** — **New units (after 2000)** **Coal** — - Subcritical — 39% Supercritical — 45% Ultra-supercritical — 50% IGCC — 50% FBS — - CFBS — 40% PFBS — 41.5% **Oil** — - Steam turbine — 39% Open cycle — 39.5% Combined cycle — 46% **Natural gas** — - Steam turbine — 37.5% Open cycle — 39.5% Combined cycle — 60%
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	The data for newly commissioned power plants will be updated yearly using the latest available information. The indicators for each power plant do not change for the crediting period. However, if in any given year sufficient information becomes available on fuel consumption of the respective power plant, the preferred method for estimating the EF of that power plant will be calculated on the basis of option A1 instead as a preferred calculation option. Information will be used for calculating the simple adjusted OM and the BM annually.

QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

Data / Parameter:	$\mathbf{EG_{grid,h,y}}$
Data unit:	MWh
Description:	The total electricity generation of the electricity grid in hour *h* of year *y*.
Source of data to be used:	Latest official data obtained from the grid's transmission service operator CDEC-SIC and/or the National Energy Commission (CNE).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified in the CPA-DD
Description of measurement methods and procedures to be applied:	Data obtained from official sources. The data will be updated yearly using the latest available information. Information will be used for calculating λ_y for the calculation of the simple adjusted OM annually during the first crediting period.
QA/QC procedures to be applied:	Information is collected from official sources and therefore no QA/QC procedures will be applied by the project participants.
Any comment:	-

The following parameters only have to be reported for CPAs that result in new reservoirs and CPAs that result in the increase of existing reservoirs.

Data / Parameter:	$\mathbf{TEG_y}$
Data unit:	MWh/yr
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified for each CPA
Description of measurement methods and procedures to be applied:	Measurements will be undertaken using energy meters certified to national or IEC standards. Monitoring will be continuous with hourly measurement and at least monthly recording.
QA/QC procedures to be applied:	Calibration will be undertaken as prescribed in paragraph 17 c) of "General Guidelines to SSC CDM Methodologies" version 17, i.e. calibrated according to the national standards and reference points or IEC standards and recalibrated (or calibration validity and accuracy confirmed through test routines) at appropriate intervals according to national regulations. If applicable, measurement results will be cross-checked with records for sold/purchased electricity(e.g. invoices/receipts).

Any comment:	Applicable only to CPAs with reservoirs with a power density of (PD) greater than 4 W/m^2 and less than or equal to 10 W/m^2

Data / Parameter:	**Cap_{PJ}**
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data to be used:	To be specified for each CPA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified for each CPA
Description of measurement methods and procedures to be applied:	Determined yearly for each CPA based on recognized standards
QA/QC procedures to be applied:	To be specified for each CPA
Any comment:	Only for CPAs that result in new reservoirs and CPAs that result in the increase of existing reservoirs

Data / Parameter:	**A_{PJ}**
Data 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 to be used:	To be specified for each CPA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be specified for each CPA
Description of measurement methods and procedures to be applied:	Measured yearly from topographical surveys, maps, satellite pictures, etc
QA/QC procedures to be applied:	To be specified for each CPA
Any comment:	Only for CPAs that result in new reservoirs and CPAs that result in the increase of existing reservoirs

E.7.2. Description of the monitoring plan for a SSC-CPA:

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Electricity Generation Parameters:
As mentioned in section A.4.4.2 the monitoring plan to be applied is based on the electricity supplied in MWh to the Central Interconnected System (directly or through a transmission/distribution company) by the different CPAs. The collected and recorded data shall be cross-checked with electricity sales invoices.

Each CPA will be equipped with electricity metering equipment that will be maintained in accordance with national regulations. Before the installation of the meters, they should be factory calibrated by the manufacturer. Records of the meter (type, make, model and calibration date) will be retained in the electronic database of the PoA. They will be calibrated according to national standards and reference points or IEC standards and recalibrated (or calibration validity and accuracy confirmed through appropriate test routines) at appropriate intervals according to national regulations.

For each CPA, the CPA implementer is responsible for continuously checking the operation of metering equipment and data and for keeping records of the electricity delivered to the grid, as well as for archiving electricity sales invoices. At least once for every monitoring period the CPA implementer will submit an electronic copy of the operations records and the aggregated data to the coordinating/managing entity. The CME will archive the operations records in an electronic database. The original records will be archived by the CPA implementer in electronic and/or paper form. All records will be archived electronically for the entire crediting period plus two years.

Grid Emission Factor Parameters:
The Grid Emission Factor of the SIC will be calculated yearly for the first seven years by the Coordinating/Managing Entity of the Programme of Activities, possibly assisted by a CDM consultant, and will be used for the calculation of the emission reductions of each individual CPA.

The parameters for the calculation of the grid emission factor will be updated yearly by the Entity using the Simple Adjusted OM method for the calculation. Hence, the Build Margin and Operating Margin will be updated annually, following the ex-post options stated in the “Tool to calculate the emission factor for an electricity system” version 02.2.1.

The sources for the parameters that will be used to calculate the Operating Margin and Build Margin are CDEC-SIC, CNE and IPCC, and/or other public sources, as applicable.

The archiving of the information relating to the calculations of the emission factor of the SIC grid will be performed by the coordinating/managing entity. The records will be archived electronically for the entire crediting period plus two years.
As a conservative approach, when recovering information about a specific power plant, if its fuel consumption is not available the EF shall be developed using the plants’ specific consumption. If neither data is available, the power plant shall be assigned an EF equal to 0 and included in the calculations as such.

Project emissions parameters:
Each CPA is responsible for monitoring its project emissions, when:

- The CPA results in a new reservoir
- The CPA results in the increase of existing reservoirs

The procedures for monitoring and measurements of the relevant parameters as per section E.7.1 above shall be described in detail in the CPA's monitoring procedures that are part of the PoA management & monitoring system, as they are not pertinent to all CPAs in the PoA.

Training needs:
Collecting and monitoring the data are tasks that do not require intensive training since energy bills and official data are going to be monitored for the project income and information from CDEC-SIC is generally available online.

Quality Assessment and Quality Control procedures

The PoA management & monitoring system provides specific quality assessment and quality control (QA/QC) procedures for the parameters relevant for the specific stakeholders. As a minimum, separate monitoring procedures will be developed for:

- the CME
- for CPAs

Moreover, modular elements of the monitoring procedures for CPAs that involve a new reservoir or the extension of an existing reservoir will be available to be added to the basic monitoring procedures.
The monitoring procedures may then be elaborated in further detail as to adapt to the specific existing procedures of each CPA.
The PoA management & monitoring system and particularly the monitoring procedures may be adjusted to improve the QA/QC procedures and practices as more and more experience is gathered within the programme.

The PoA management & monitoring system elaborated and provided to the DOE for validation includes further information on responsibilities, management, quality assurance, means of verification of data, data transferring and data trails. The procedures ensure that no double accounting occurs and that the status of verification can be determined anytime for each CPA.

E.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

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Date of completion: 13/12/2011

Responsible persons, not considered project participants:

Ole Meier-Hahn and Martha Djourdjin

Bridge Builders UG
www.bridge-builders.de

Annex 1

CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

Organization:	Asociación Chilena de Pequeñas y Medianas Centrales Hidroeléctricas A.G. (APEMEC A.G.)
Street/P.O.Box:	El Gobernador # 020 Office N° 403
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State/Region:	Metropolitana
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Represented by:	Pedro Matthei Salvo
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The initial development of the PoA Design Document and the CPA Design Document were financed by the Chilean Economic Development Agency (CORFO).[34]

The PoA itself as described in section A.2 does not receive public funding[35].

[34] CORFO, 2009. Tender for the contracting of services for pre-validation support for a CDM programme of activities for hydropower plants. Provided to the DOE for validation,

[35] ibid

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

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