

# OTLUCA HPP RUN-OF-RIVER HYDRO PROJECT

Document Prepared By FutureCamp Turkey

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## 1 PROJECT DETAILS

### 1.1 Summary Description of Project

Otluca HPPs is a 48.768 MWm, 47.7 MWe<sup>1</sup> run-of-river hydro power plant project. It consists of three sub-projects (Otluca-1, Boğuntu, Otluca-2) which are located at the upstream part of the Anamur River in Anamur district. The sub-projects are described as follows:

**Otluca-1** is a medium head plant using a weir structure to divert Anamur river water into an intake structure with three de-sanding basins. From there it enters a tunnel of about 3.8 km length followed by an open canal of about 500 m length and followed again by a tunnel of about 2.2 km length until the water reaches a headpond. An intake from this pond takes it through a 507 m long penstock to the powerhouse. The combined capacity of the 3 turbines is 37.539.MWe.

**Boğuntu** uses the water of the Boğuntu River (tributary of the Anamur River) and is a medium head structure with the same system as Otluca 1. It has one de-sanding basin, starts with 162 m long open canal and continues with a 1.5 km long headrace tunnel to a headpond. The penstock is about 94 m long and leads with a head of 67.6 m to a power plant with 3 turbines. The installed capacity is 3.801 MWe.

The weir of **Otluca-2** is located only some 500 m downstream from where Otluca 1 and Boğuntu Projects feed the water back into the Anamur River. Otluca-2 diverts the water again to an intake structure and into three settlement ponds before it enters the conveyance system consisting out of 2 tunnels and 2 canals of an overall length of 1,547 m, out of which 1,137 m are tunnel. The water arrives at a headpond and feeds through a 57 m long penstock the powerhouse with 29.4 m head and 3 turbines. The combined installed capacity of 6.360 MWe.

The purpose of the Project is to export the generated electricity to the regional grid, thereby contributing to the Turkey's electricity demand and rapidly growing economy. Since the Project generates electricity from renewable energy resources, it makes a significant contribution to climate protection. According to the validated VCS-PD, the Project was expected to generate 224,000 MWh of electricity annually, and to reduce 123,003 tonnes of CO<sub>2</sub> emissions per year, according to the validated VCS-PD.

This first monitoring period covers the 28 months from 07/04/2011 to 31/07/2013 (both days included). Total emission reductions achieved in this period are **241,701.5** tons of CO<sub>2</sub>e.

### 1.2 Sectoral Scope and Project Type

Sectoral Scope: Energy (Renewable / Non-Renewable), Not a Grouped Project

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<sup>1</sup> See; Otluca Provisional Acceptance Letter

### 1.3 Project Proponent

The HPP is operated and owned by Beyobası Enerji Üretimi A.Ş. Otluca is also VCS project proponent and for contact please refer to the directions given below.

**Table 1:** Project Contact Data-Otluca

Organization:	Beyobası Enerji Üretimi A.Ş
Street/P.O.Box:	Koza Sok.
Building:	No:22 GOP
City:	Ankara
State/Region:	N/A
Postcode/ZIP:	06700
Country:	Turkey
Personal Contact:	Mustafa Kemal GÜNGÖR
Direct FAX:	0090 0312 441 68 14
Direct tel:	0090 312 408 10 00
Personal e-mail:	akfen@akfen.com.tr ; mgungor@akfen.com.tr

The project documentation at hand was defined by Beyobası in cooperation with FutureCamp Türkiye. FutureCamp Türkiye is not a participant of the project.

**Table 2:** Contact Data of PD Consultant

Organization:	FutureCamp İklim ve Enerji Ltd.
Street/P.O.Box:	Cetin Emec Bulvarı
Building:	Beste Apartmanı 19/18 Cankaya
City:	Ankara
State/Region:	Ankara

Postcode/ZIP:	06460
Country:	Turkey
Personal Contact:	Engin Mert
Direct FAX:	0090 312 480 88 10
Direct tel:	0090 312 481 21 42
Personal e-mail:	<a href="mailto:info@futurecamp.com.tr">info@futurecamp.com.tr</a>

#### 1.4 Other Entities Involved in the Project

No other entities are involved in the project.

#### 1.5 Project Start Date

07/04/2011

#### 1.6 Project Crediting Period

Biggest part of the Otluca (Otluca 1) was started in operation April 2011., Otluca 2 was started in operation 13/07/2011 and Boğuntu was started in operation 16/09/2011. Related Documents are provided to the DOE. Earliest date is set as starting date of the project which is 07.04.2011.

Start: 07/04/2011

End: 06/04/2021

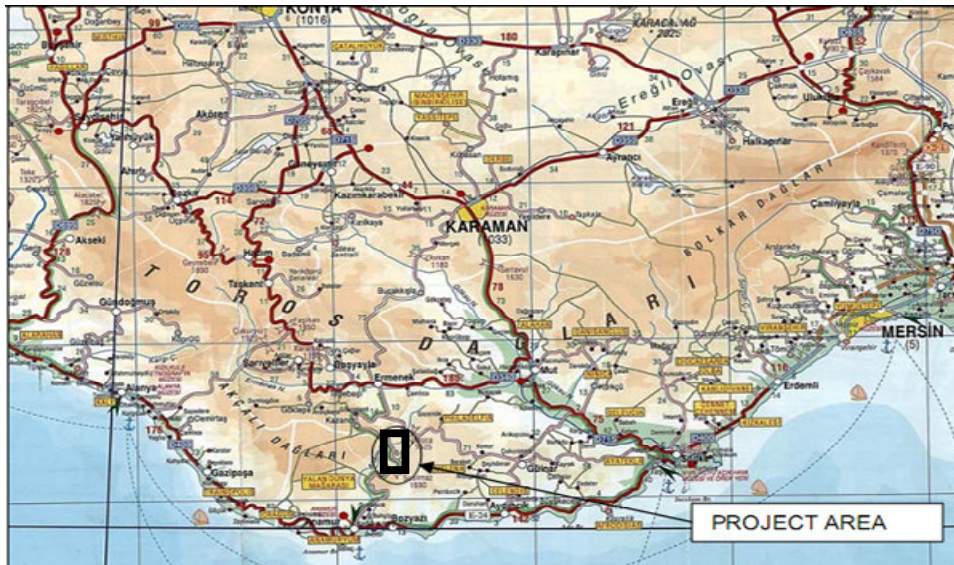
10-years two-times renewed crediting period.

#### 1.7 Project Location

The project is located on the upstream part of Anamur River in Taşeli Plateau in southern Turkey, Anamur district, Mersin province. The geographical coordinates of the Weir and the Power plant are as follows:

**Table 3:** Geographical coordinates of the Weir and the Power plant

	Otluca-1 Weir	Otluca-1 HPP	Otluca-2 Weir	Otluca-2 HPP	Boğuntu Weir	Boğuntu HPP
Lat.	36° 18' 13.753" N	36° 15' 34.491" N	36° 15' 24.103" N	36° 14' 29.794" N	36° 16' 28.971" N	36° 15' 44.067" N
Long.	32° 46' 45.825" E	32° 49' 21.043" E	32° 49' 19.383" E	32° 49' 34.932" E	32° 49' 56.593" E	32° 49' 21.903" E



**Figure 1:** Location of the project

### 1.8 Title and Reference of Methodology

“Consolidated baseline methodology for grid connected electricity generation from renewable sources” (ACM0002 version 12.1.0)

The above methodology is hereafter referred to as the “Baseline Methodology”. The Baseline Methodology is used in conjunction with the approved monitoring methodology ACM0002 version 12.1.0 (subsequently referred to as “Monitoring Methodology”).

The monitoring report also draws upon the:

- “Tool for assessment and demonstration of additionality”, Version 5.2
- “Tool to calculate the emission factor for an electricity system”, Version 2.2.0

## 2 IMPLEMENTATION STATUS

### 2.1 Implementation Status of the Project Activity

Otluca HPP started to generate and provide electricity to the Turkish National Grid on 07/04/2011. During the monitoring period, there was no event or situation that occurred, which may impact the applicability of the methodology.

### 2.2 Project Description Deviations

There is no project description deviations.

## 2.3 Grouped Project

N/A

## 3 DATA AND PARAMETERS

### 3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	<b>EF<sub>grid,CM,y</sub></b>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Combined margin CO <sub>2</sub> emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data:	As per "Tool to calculate the emission factor for an electricity system"
Value applied:	<b>0.5491 tCO<sub>2</sub>/MWh</b>
Purpose of the data:	For calculation emission factor
Any comment:	

Data Unit / Parameter:	<b>Gross electricity generation</b>
Data unit:	MWh
Description:	Gross Electricity supplied to the grid by relevant sources (2006-2008)
Source of data:	Turkish Electricity Transmission Company (TEİAŞ), Annual Development of Turkey's Gross Electricity Generation of Primary Energy Resources (1975-2008) TEİAŞ, see; <a href="http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/32(75-08).xls">http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/32(75-08).xls</a>
Value applied:	131,681,100 MWh; 154,982,500 MWh; 163,919,400 MWh
Purpose of the data:	Combined Margin Calculations
Any comment:	TEİAŞ is the national electricity transmission company, which makes available the official data of all power plants in Turkey.

Data Unit / Parameter:	<b>Net Electricity Generation</b>
Data unit:	MWh
Description:	Net electricity fed into the grid. Used for the calculation of the net/gross relation (Including Import and Export figures)
Source of data:	Turkish Electricity Transmission Company (TEİAŞ), Annual Development of Electricity Generation-Consumption and Losses in Turkey (1984-2008) TEİAŞ, see <a href="http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/30(84-08).xls">http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/30(84-08).xls</a>
Value applied:	169,543.1 GWh; 183,339.7 GWh; 189,761.9 GWh
Purpose of the data:	Combined Margin Calculations
Any comment:	<p>This data is used to find relation between the gross and net electricity delivered to the grid by fossil fuel fired power plants.</p> <p>Import and Export data is used to identify total net electricity fed into the grid in the years of 2006, 2007 and 2008.</p> <p>TEİAŞ is the national electricity transmission company, which makes available the official data of all power plants in Turkey.</p>

Data Unit / Parameter:	<b>Sample Group for BM emission factor</b>
Data unit:	Name of the plants, MW capacities, fuel types, annual electricity generations and dates of commissioning.
Description:	Most recent power plants which compromise 20% of total generation
Source of data:	<p>Annual Development of Fuels Consumed in Thermal Power Plants in Turkey by the Electric Utilities, TEİAŞ:</p> <p>For plants in 2004: <a href="http://www.teias.gov.tr/KAPASITE%20PROJEKSIYONU%202005.pdf">http://www.teias.gov.tr/KAPASITE%20PROJEKSIYONU%202005.pdf</a></p> <p>For plants in 2005: <a href="http://www.teias.gov.tr/KAPASITE%20PROJEKSIYONU%202005.pdf">http://www.teias.gov.tr/KAPASITE%20PROJEKSIYONU%202005.pdf</a></p>

	<p><a href="#">ONU%202006.pdf</a></p> <p>For plants in 2006:  <a href="http://www.teias.gov.tr/KAPASITE%20PROJEKSIYONU%202007.pdf">http://www.teias.gov.tr/KAPASITE%20PROJEKSIYONU%202007.pdf</a></p> <p>For plants in 2007:  <a href="http://www.teias.gov.tr/KAPASITEPROJEKSIYONU2008.pdf">http://www.teias.gov.tr/KAPASITEPROJEKSIYONU2008.pdf</a></p> <p>For plants in 2008:  <a href="http://www.teias.gov.tr/KAPASITEPROJEKSIYONU2009.pdf">http://www.teias.gov.tr/KAPASITEPROJEKSIYONU2009.pdf</a></p>
Value applied:	See Validated VCS-PD
Purpose of the data:	Combined Margin Calculations
Any comment:	TEİAŞ is the national electricity transmission company, which makes available the official data of all power plants in Turkey. The latest data available during PD preparation was for 2008.

Data Unit / Parameter:	<b>EF<sub>CO<sub>2</sub>,i,y</sub></b>
Data unit:	tCO <sub>2</sub> /GJ
Description:	Emission factor for fuel type i
Source of data:	<p>IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the IPCC Guidelines on National GHG Inventories. See</p> <p><a href="http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf">http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf</a></p>
Value applied:	See Validated VCS-PD
Purpose of the data:	Combined Margin Calculations
Any comment:	

Data Unit / Parameter:	<b>η<sub>m,y</sub></b>
Data unit:	-

Description:	Average energy conversion efficiency of power unit m in year y
Source of data:	Annex I the "Tool to calculate the emission factor for an electricity system"
Value applied:	See Validated VCS-PD
Purpose of the data:	Combined Margin Calculations
Any comment:	

Data Unit / Parameter:	$HV_{i,y}$
Data unit:	Mass or volume unit
Description:	Heating Values of fuels consumed for electricity generation in the years of 2006, 2007 and 2008
Source of data:	Heating Values Of Fuels Consumed In Thermal Power Plants In Turkey By The Electric Utilities, TEİAŞ. See: <a href="http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/46.xls">http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/46.xls</a>
Value applied:	There is no national NVC data in Turkey. However, TEİAŞ announces Heating values of fuels. This data is used to calculate annual NCVs for each fuel type.
Purpose of the data:	Combined Margin Calculations
Any comment:	TEİAŞ is the national electricity transmission company, which makes available the official data of all power plants in Turkey.

Data Unit / Parameter:	$FC_{i,y}$
Data unit:	Mass or volume unit
Description:	Fuels consumed for electricity generation in the years of 2006, 2007 and 2008
Source of data:	Annual Development of Fuels Consumed In Thermal Power Plants In Turkey By The Electric Utilities, TEİAŞ. See: <a href="http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/46.xls">http://www.teias.gov.tr/T%C3%BCrkiyeElektrik%C4%B0statistikleri/istatistik2008/46.xls</a>

	4%B0statistikleri/istatistik2008/44.xls
Value applied:	See Validated VCS-PD
Purpose of the data:	Combined Margin Calculations
Any comment:	TEİAŞ is the national electricity transmission company, which makes available the official data of all power plants in Turkey.

Data Unit / Parameter:	<b>NCVi,y</b>
Data unit:	TJ/kton, TJ/million m <sup>3</sup>
Description:	Net Calorific Value of fuel types in the years of 2006, 2007 and 2008
Source of data:	Calculated by using HVi,y to FCi,y as Net Calorific Values of fuel types are not directly available in Turkey.
Value applied:	See Validated VCS-PD
Purpose of the data:	Combined Margin Calculations
Any comment:	TEİAŞ is the national electricity transmission company, which makes available the official data of power plants in Turkey.

### 3.2 Data and Parameters Monitored

Data Unit / Parameter:	<b>EG<sub>facility,y</sub></b>
Data unit:	MWh/yr
Description:	Quantity of Net electricity generation supplied by the project plant/unit to the grid in year y
Source of data:	The data from the Electricity Meters are the basis for the settlement notification of PMUM. Data are gathered electronically from the meters by TEIAS and stored in secured website of PMUM, which is accessible to project developer with a private password. For monitoring, the monthly settlement notification of PMUM shall be used as source of data.

<p>Description of measurement methods and procedures to be applied:</p>	<p>Two electricity meters is placed at the substation. One is the main meter Aktaris SL761A071 model with serial number 53099076) and the other one is the backup meter (Actaris SL761A071with serial number 53099077). The meters have the accuracy of 0.2s. First Calibrating date of the meters is 16.12.2010. These meters are sealed by distribution company and intervention by project proponent is not possible.</p> <p>The meters are reading electricity supplied to the system and withdrawn from the system separately, the net electricity amount supplied to the grid will be calculated by electricity supplied minus electricity withdrawn which will be taken from monthly settlement notifications. Two meters will backup each other. These meters will be chosen according to national regulations and approved and sealed by TEIAS at start up of the plant. Maintenance and calibration of the metering devices will be made by TEIAS periodically. In addition to invoices and metering devices, the electricity delivered to the grid can be cross checked through TEIAS web page (<a href="https://dgpys.pmum.gov.tr/dgpys/">https://dgpys.pmum.gov.tr/dgpys/</a>) using the ID and password of the project owner. All records will be kept for at least two years as requested by the applied methodology. All meters kept the data for four months in case of any breakdown.<sup>2</sup> If any meter is found to be out of calibration, accurate energy amounts shall be deteced via substitute counter group since registry values of the main counter group is the same as of the substitute group in the last measurement.<sup>3</sup></p>
<p>Frequency of monitoring/recording:</p>	<p>The primary and back-up measurement devices measure, read and record various data such as electricity generated and consumed, in real-time. The measurements and recordings are made continuously. The readings are performed in monthly intervals.</p> <p>There is no sampling involved.</p>
<p>Value monitored:</p>	<p>440,177.62 MWh</p>

<sup>2</sup> [http://www.epdk.org.tr/documents/10157/81c16fc9-7777-46d6-a1bf-15c5ac8795c7\\_article\\_6\\_page2](http://www.epdk.org.tr/documents/10157/81c16fc9-7777-46d6-a1bf-15c5ac8795c7_article_6_page2)

<sup>3</sup> See; <http://www.teias.gov.tr/sistemkullanim1.doc> page 3

<p>Monitoring equipment:</p>	<p><b>Calibration frequency:</b> According to the Article 9 of the relevant regulation<sup>4</sup>, periodical inspections of “gauges for electric, water, coal gas, natural gas and, current and voltage measuring transformers will be made once in 10 years”. This is in line with the monitoring plan and national requirements. TEIAS will decide when to carry out the next calibration. The Project owner has no control over or access to the measurement devices and is not entitled to perform any type of maintenance or calibration.</p> <p><b>Date of last calibration:</b></p> <p>Last calibration date is 16.12.2010. Calibration tests are performed by ITRON FRANCE. In addition to the first calibration TEİAŞ was performed tests on the both main and backup meters. The date of the test is 11.03.2011. Frequency of the tests is determined by TEİAŞ and the test mentioned above is the first test performed on the meters. Also in the test report prepared by the TEİAŞ it is stated that meters are in line with the IEC/TSE 62053-22 standard.</p> <p><b>Responsible personnel:</b> TEIAS is responsible for monitoring and ensuring that the measurement devices satisfy the requirements. TEIAS is also responsible for the calibration of the measurement devices. In case of any detected problem (e.g. failure of one of the measurement devices, inconsistency between the readings of the primary and the back-up meter etc.), the plant manager in the name of the Project owner is responsible for coordinating the necessary maintenance and calibration procedure with TEIAS.</p>
<p>QA/QC procedures to be applied:</p>	<p>Maintenance and calibration of the metering devices will be made by TEIAS periodically. If there is a significant difference between the readings of two devices, maintenance and tests of the metering devices and the associated equipment will be done before waiting for the periodical maintenance.</p>
<p>Calculation method:</p>	<p>The net electricity amount supplied to the grid will be calculated by electricity supplied minus</p>

<sup>4</sup> See; Measurement and Measuring Tools Inspection Regulation”, Date: 24/07/1994, Official Gazette Number: 22000

	electricity withdrawn.
Any comment:	

Data Unit / Parameter:	<b>Cap<sub>PJ</sub></b>
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data:	Equipment specifications that described in the equipment contracts
Description of measurement methods and procedures to be applied:	Cross-checking of instrument specifications of the installed turbines/generators (MW) and the indication in the PD.
Frequency of monitoring/recording:	Yearly
Value monitored:	46,017,000
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	

Data Unit / Parameter:	<b>A<sub>PJ</sub></b>
Data unit:	m <sup>2</sup>
Description:	Area of the reservoir measured with topographic drawings in the surface of the water, after implementation of the project activity, when reservoir full
Source of data:	Technical drawings from consultants
Description of measurement methods and procedures to be applied:	Measured from topographical surveys or maps
Frequency of monitoring/recording:	Yearly
Value monitored:	49,464 m <sup>2</sup>
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A

Any comment:	
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### 3.3 Description of the Monitoring Plan

As described above, the relevant data that has to be monitored is the electricity supplied to the grid ( $EG_y$ ) per year, the installed capacity of the hydro power plant and the area of the reservoir.

**$EG_y$ :**

These data are subject to the accounting quality systems of both parties to the power purchase agreement, TEIAS and Beyobası Elektrik Üretim A.Ş. With this, no additional structures or processes have to be implemented to insure the availability of necessary data for monitoring.

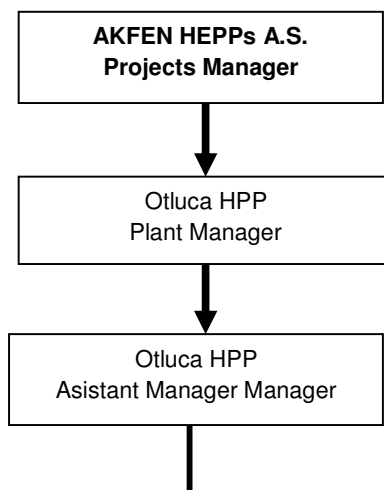
At the end of one monitoring period, which is planned to generally last one year, the data from the monthly meter reading records by PMUM (Market Financial Settlement Centre) will be added up to the yearly electricity generation and multiplied with the combined margin emission factor with the help of an excel spreadsheet that also contains the combined margin calculation. Thus, the complete baseline approach is always transparent and traceable.

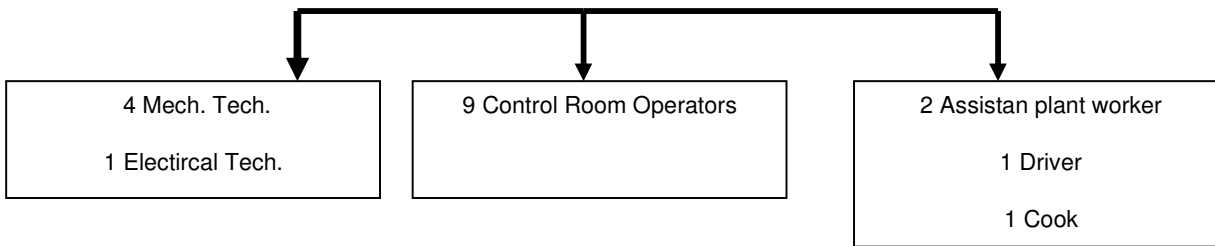
Technicians in Otluca HPP daily reads meters and keeps record for electricity generation amount and reports to management. These records can be used for monitoring in case of any problem will arise in meters.

**$Cap_{PJ}$  and  $A_{PJ}$**

These data will be stated for monitoring yearly Power density of the project is greater than 10 W/m<sup>2</sup> so there is no GHG emission due to project activity which is explained under section 4.3.

Currently 20 people are working in the plant. Currently the following information on staff and responsibilities at Otluca HPP can be seen below:





**Figure 2:** Organisation chart

All data monitored under the monitoring plan will be kept in electronic form and hard copy for 2 years after the end of the crediting period.

#### 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

##### 4.1 Baseline Emissions

As per ACM0002 baseline emissions include only CO<sub>2</sub> emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. This is calculated as per formula 6:

$$BE_y = (EG_{PJ,y}) \times EF_{grid,CM,y} \quad (6)$$

Where:

$BE_y$  = Baseline emissions in year y (tCO<sub>2</sub>/yr).

$EG_{PJ,y}$  = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$  = Combined margin CO<sub>2</sub> emission factor for grid connected power generation in year y calculated using the latest version of the .Tool to calculate the emission factor for an electricity system. (tCO<sub>2</sub>/MWh)

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

The project activity is the installation of a new grid-connected renewable power plant, thus  $EG_{PJ,y} = EG_{facility,y}$  (ACM0002 page 9, equation 7).

It follows that:

$$BE_y = EG_{\text{facility},y} * EF_{\text{grid,CM}} = 440,177.62 \text{ MWh} * 0.5491 \text{ tCO}_2/\text{MWh} = 241,701.5 \text{ tCO}_2$$

## 4.2 Project Emissions

Project emissions are calculated as follows:

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

Where:

$PE_y$  = Project emissions in year y (tCO<sub>2</sub>e/yr)

$PE_{FF,y}$  = project emissions from fossil fuel consumption in year y (tCO<sub>2</sub>/yr)

$PE_{GP,y}$  = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y

$PE_{HP,y}$  = Project emissions from water reservoirs of hydro power plants in year y (tCO<sub>2</sub>e/yr)

$PE_{FF,y}$  is zero as there will be no fossil fuel consumption to generate electricity and  $PE_{GP,y}$  is zero as the project is not a geothermal project activity.

In order to calculate project emissions from water reservoir of the plant, power density should be calculated. The power density of the project activity (PD) is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \tag{5}$$

PD = Power density of the project activity

Cap<sub>PJ</sub> = Installed capacity of the hydro power plant after the implementation of the project activity

Cap<sub>BL</sub> = Installed capacity of the hydro power plant before the implementation of the project activity (W). For the new hydro power plants, this value is zero

A<sub>PJ</sub> = Area of the reservoir measured in the surface of the water, after the implementation of the project activity when reservoir is full (m<sup>2</sup>)

A<sub>BL</sub> = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m<sup>2</sup>). For new reservoirs, this value is zero.

As the project activity is not extension of another project, Cap<sub>BL</sub> and A<sub>BL</sub> are zero, then

$$PD = \frac{Cap_{PJ}}{A_{PJ}}$$

$A_{PJ}$

As in the case of Otluca HPP this density is well above the 10W/m<sup>2</sup> threshold (~930 W/m<sup>2</sup>; reservoir size: 49,464 m<sup>2</sup>, installed capacity: 46.017 MW), emissions (CH<sub>4</sub> and CO<sub>2</sub>) from the reservoir are zero (ACM0002, page 8). According to the tool (page 7), for the projects having power density more than 10 W/m<sup>2</sup> threshold is zero. Hence, the project emission (PE<sub>y</sub>) is zero.

Emission reductions due to project activity have to be calculated as per formula 11 of ACM0002:

$$ER_y = BE_y - PE_y \tag{11}$$

Where:

ER<sub>y</sub> = Emission reductions in year y (tCO<sub>2</sub>/yr).

BE<sub>y</sub> = Baseline emissions in year y (tCO<sub>2</sub>/yr).

PE<sub>y</sub> = Project emissions in year y (tCO<sub>2</sub>/yr).

Then:

$$ER_y = BE_y$$

### 4.3 Leakage

As described in the methodology ,no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected.

### 4.4 Summary of GHG Emission Reductions and Removals

PE<sub>y</sub> is 0 (see 4.2 above), the emission reduction is equivalent to the determined baseline emissions. Thus emission reductions amount to **241,701.5 tCO<sub>2</sub>**.

**Table 4:** Summary of the Emission Reductions

<b>Total Generation (May 2011-July 2013)</b>	440,177.62 MWh		
<b>Total Emission reductions (May2011-July 2013)</b>	<b>2011 (tCO<sub>2</sub>)</b>	<b>2012 (tCO<sub>2</sub>)</b>	<b>2013 (tCO<sub>2</sub>)</b>
	61,734.3	100,466.1	79,501.2
<b>Project Emissions</b>	0	0	0
<b>Net Emission Reductions</b>	<b>241,701.5 tCO<sub>2</sub></b>		

Expected amount of emission reduction is calculated as 123,003 tCO<sub>2</sub> per year and 10250.25 tCO<sub>2</sub> per month in the validated VCS-PD. As the monitoring period of the project is selected as 28 months, total emission reduction should be 287,007 tCO<sub>2</sub> (28\*10250.25) according to the VCS-PD. However because of the changing rain regimes, total emission reduction of the project cannot achieve the figure stated in the VCS-PD. Project reduces 84.2% of the value stated in the VCS-PD.

## 5 ADDITIONAL INFORMATION