

# YOKUSLU-KALKANDERE HYDROELECTRIC POWER PLANT (KALKANDERE HEPP)



Document Prepared by Gaia Carbon Finance



<b>Project Title</b>	Yokuslu-Kalkandere Hydroelectric Power Plant (Kalkandere HEPP)
<b>Version</b>	04
<b>Date of Issue</b>	21.05.2012
<b>Project ID</b>	!
<b>Monitoring Period</b>	01 Jan 2011 – 31 Dec 2011
<b>Prepared By</b>	GAIA Finansal Danismanlik Hizmetleri Tic. Ltd. Sti. (GAIA CARBON FINANCE)
<b>Contact</b>	SANKO Holding: ISKO SUBESİ ORG. SAN. BOL. 3.CADDE INEGOL/BURSA/TURKEY +90 224 2807700 <a href="mailto:info@sankoenerji.com.tr">info@sankoenerji.com.tr</a>
	GAIA CARBON FINANCE: Halaskargazi Cad. Zafer Sok. Manuel Apt. No:11/4 Sisli 34371 Istanbul/TURKEY +90 212 224 04 50 <a href="mailto:info@gaiacf.com">info@gaiacf.com</a>

<sup>1</sup> The project has not been registered to VCS Database yet. Therefore, "Project ID" is not available at this stage.

## Table of Contents

1	Project Details .....	3
1.1	Summary Description of Project.....	3
1.2	Sectoral Scope and Project Type.....	5
1.3	Project Proponent .....	5
1.4	Other Entities Involved in the Project.....	5
1.5	Project Start Date.....	5
1.6	Project Crediting Period .....	5
1.7	Project Location .....	5
1.8	Title and Reference of Methodology .....	5
2	Implementation Status.....	6
2.1	Implementation Status of the Project Activity.....	6
2.2	Deviations from the Monitoring Plan .....	7
2.3	Grouped Project .....	7
3	Data and Parameters .....	7
3.1	Data and Parameters Available at Validation .....	7
3.2	Data and Parameters Monitored.....	8
3.3	Description of the Monitoring Plan .....	10
4	Quantification of GHG Emission Reductions and Removals .....	11
4.1	Baseline Emissions .....	11
4.2	Project Emissions.....	13
4.3	Leakage.....	14
4.4	Summary of GHG Emission Reductions and Removals.....	14
5	Additional Information.....	15

## 1 PROJECT DETAILS

### 1.1 Summary Description of Project

The Yokuslu-Kalkandere Hydroelectric Power Plant (Kalkandere HEPP) consists of the construction of a greenfield one weir and two run-of-river hydroelectric power plants located in the Iyidere river basin, in Turkey’s Eastern Black sea Region. Total installed capacity of the project will be 43,47MWm / 42,33MWe.

The plant has been designed to generate electricity by utilizing the 100.2 m of head between the tail water level of the upstream existing Cevizlik HEPP and the Incirlik HEPP project which is under project stage and will be located downstream.

The water diverted from the weir will be transferred to “Kalkandere Power House” through a tunnel. The total installed capacity of the turbines in Kalkandere Power House is 35.79 MWm. The water will be transferred to “Kizilagac Power House” through another tunnel. The total installed capacity of this plant is 7.68 MWm.

The main purpose of the project is to generate approximately 179,050 MWh/year of electricity to supply the national grid using a renewable resource and tapping the significant hydropower potential in the region. The project activity reduces greenhouse gases (GHGs) emissions that would have otherwise occurred in the absence of the project activity by avoiding electricity generation from fossil fuel sources. The average annual emission reductions of the proposed Project for the initial crediting period are estimated to be 100,089 tons of CO<sub>2</sub>e (tCO<sub>2</sub>e).

#### **Project Technology:**

The following table shows a full detail of the Kalkandere Power Plant’s technical specifications:

Property	Unit	Amount
Catchment Area	km <sup>2</sup>	881.70
Average Discharge	m <sup>3</sup> /s	29.52
Design Discharge	m <sup>3</sup> /s	50.00
Regulator Crest Elevation	m	220.00
Regulator Thalweg Elevation	m	214.00
Flood Water Level	m	224.92
<b>Flushing Gate</b>		
Crest Elevation	m	214.00
Foundation Elevation	m	213.50
Crest Length	m	4.00
Number of Gates		2
Gate Size	m x m x m	3.00 x 3.00 x 4.00
<b>Settling Basin</b>		
Width	m	3.00 X 4.00
Settled Particular Size	mm	0.30
<b>Settling Tunnel</b>		
Type		underground tunnel
Number of Tunnels		3
Inner Diameter	m	4.00
Thickness of Concrete	m	0.50
Tunnel Capacity	m <sup>3</sup> /s	16.67
Tunnel Length	m	50.00

<b>Headrace Tunnel</b>		
Type		Circular, concrete lined pressure tunnel
Inner Diameter	m	4.00
Thickness of Concrete	m	0.40
Tunnel Capacity	m <sup>3</sup> /s	50.00
Headrace Tunnel Length	m	6,806.00
<b>Surge Tank</b>		
Type		Varying Cross Section
Top Elevation	m	238.50
Bottom Elevation	m	139.60
Max. Water Level	m	234.67
Minimum Water Level	m	190.25
Inner Diameter	m	4.00 - 16.00
<b>Penstock</b>		
Inner Diameter	m	3.60
Average Steel Thickness	mm	15.50
Length	m	199.85
<b>Powerhouse</b>		
Length	m	46.00
Width	m	17.40
Project Discharge	m <sup>3</sup> /s	50.00
Tailrace Elevation	m	119.00
Turbine Axis Level	m	117.50
Turbine Type		Horizontal Axis Francis
Gross Head	m	100.20
Net Head	m	76.09
Installed Capacity	MW <sub>e</sub>	35.04
Unit Capacity	MW <sub>e</sub>	11.68
Number of Units		3

The turbine and generator manufacturer is Voith Hydro and Indar. The manufacturers are Spain companies, acclaimed for its integrated power plants and power production services. For Kalkandere Power Plant, Voith Hydro, Indar and Siemens has been selected as the equipment provider because of its reliable quality products and technology, which is a grid friendly technology with low maintenance needs as well as low noise and low environmental impacts.

The 1<sup>st</sup> unit of “Kalkandere Power House” was commissioned as of 30 December 2010. The other 2 units were commissioned on 28 January 2011.<sup>2</sup> The “Kizilgac Power House” has not been commissioned yet. The expected commissioning date of Kizilgac Power House is 15 September 2012.

This monitoring period is from 01 January 2011 to 31 December 2011. The total emission reduction of the monitoring period is 77,328.52 tCO<sub>2</sub>e.

<sup>2</sup> The first commissioning date of the project is December 30, 2010. However, the crediting period is started with the first day of 2011.

## 1.2 Sectoral Scope and Project Type

According to Annex A of the Kyoto Protocol, the Project fits in:

**Sectoral Scope Number** : 1

**Sectoral Scope** : Energy Industries -Renewable Energy

## 1.3 Project Proponent

AKIM ENERJİ ÜRETİMİ SANAYİ VE TİCARET A.Ş.  
SANKO Holding –İSKO SUBEŞİ ORG. SAN. BOL. 3.CADDE İNEGOL/BURSA/TURKEY  
+ 90 224 280 77 00

## 1.4 Other Entities Involved in the Project

No other entities.

## 1.5 Project Start Date

The project started commissioning on 30 December 2010, and construction started on 2 January 2009.

## 1.6 Project Crediting Period

The project crediting period is from 01 January 2011 to 31 December 2020. Total crediting period is 10 years.

## 1.7 Project Location

The Project site is located in Turkey, in Eastern Black Sea, at western part of Rize province, in the municipality of Kalkandere, and in the center of the Kalkandere district.. It is also located in İyidere river basin. The project is in the order from headwaters thorough the downstream, Tozköy, Dereköy and Cevizlik dams basin. Power house of the project are located as following:

Kalkandere Powerhouse between 40° 53' 47" North latitudes and 40° 25' 45" -East longitudes,

## 1.8 Title and Reference of Methodology

Approved consolidated baseline and monitoring methodology ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources, Version 12"<sup>3</sup> was applied. In addition, as referred in the methodology, "Tool to calculate the emission factor for an electricity system, Version 02"<sup>4</sup> was applied.

---

<sup>3</sup> <http://cdm.unfccc.int/methodologies/DB/C505BVV9P8VSNV3LTK1BP3OR24Y5L/view.html>

<sup>4</sup> <http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.pdf>

## 2 IMPLEMENTATION STATUS

### 2.1 Implementation Status of the Project Activity

The construction of the project started on 02.01.2009. The first unit of “Kalkandere Power House” started operation on 30 December 2011. The other two units were commissioned on 28 January 2011. Please see the table below for the important dates for the implementation of the project activity:

Events and action	Date
First VER consideration	July 23 <sup>rd</sup> 2004
First Feasibility report	October 2004
First contacts with PDD consultants	October 2007
Last Feasibility report	November 2007
EIA is not required decision	November 23 <sup>rd</sup> 2007
Contact with a PDD consultant	April 25 <sup>th</sup> 2008
Contact with a DOE	June 1 <sup>st</sup> , 2008
First discussions with financial institutions	September 2008
Investment Decision	October 10 <sup>th</sup> 2008
Contract signature for the construction works of Kalkandere	January 2 <sup>nd</sup> 2009
Contract signature for the electromechanical equipments Contract signature for electrical works	May 7 <sup>th</sup> 2009
Stakeholder consultation	June 20 <sup>th</sup> 2009
EIA approval (by the Ministry of Environment and Forestry)	July 2009
Start of PDD elaboration	April 2010
Start of VER validation	June 2010
Commissioning of the first unit of Kalkandere power plant	November 30 <sup>th</sup> , 2010
Project start date	January 1 <sup>st</sup> , 2011
Commissioning of the other two units of Kalkandere power plant	January 28 <sup>th</sup> , 2011
Construction start of Kizilagac	January 2011
Expected commissioning of the Kizilagac power plant	15 September 2012

The “Kizilagac Power House” has not commissioned yet. The construction works still continue. The expected commissioning date for Kizilagac Power house is 15 September 2012. The electric generated to TEIAS according to signed agreement with Akım Enerji.

Power plant operated normally during this monitoring period. There have been no emergencies happened to the monitoring system in this monitoring period. No faulty measurement or no measurement differences

between the meters occurred. Therefore, no calibration happened. The electricity generation of the power plant also realized close to the estimation in the PDD.

## 2.2 Deviations from the Monitoring Plan

During the monitoring plan, the following deviations are determined and the monitoring plan is revised:

- The source of the parameter “Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*” was given as “Monthly Meter Reading Protocols” in the VCS PD. However, since TEIAS started to measure the produced electricity remotely, Monthly Meter Reading Protocols are not available. Therefore, the source of the parameter is defined as “Market Financial Settlement Center (PMUM) records which includes the exact electricity productions and tractions. PMUM records are the basis of the invoices made out to TEIAS.
- The source for the cross-check of the amount of produced electricity is also revised as “OSF Forms” which are prepared by TEIAS after the remote measurements of the meters and sent to the plant engineer by e-mail at the end of each month.
- In the VCS PD it is mentioned that “*The Electrical Engineers will receive sufficient and continuous training in terms of monitoring and verification on aspects such as meter’s reading and calibration and reading’s recording, adjustment and reporting every year. If new personnel are hired, they will have to follow up a training program and will be trained in the specific skills required to carry out the Monitoring Plan*” However, the electrical engineers are not trained in terms of meter readings and calibration, since the meter readings are made by TEIAS in every month remotely and the company is not responsible for the calibration of the meters.

## 2.3 Grouped Project

N/A

# 3 DATA AND PARAMETERS

## 3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	EF <sub>grid,CM<sub>y</sub></sub>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Baseline emission factor: the combined emission factor of the project grid system.” Tool to calculate the emission factor for an electricity system”
Source of data:	Validated VCS Project Description (Version 08) of the Project.
Value applied:	0.559
Purpose of the data:	Used for baseline emission calculation.
Any comment:	EF <sub>grid,CM<sub>y</sub></sub> value (0.559 tCO <sub>2</sub> /MWh) is valid for the duration of the crediting period.

3.2 Data and Parameters Monitored

Data Unit / Parameter:	$EG_{\text{facility},y}$
Data unit:	MWh
Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid in year $y$
Source of data:	PMUM (Market Financial Settlement Center) records (Meter reading records of main meters are cross-checked)
Description of measurement methods and procedures to be applied:	Two sets of meters measuring continuously then calculate the net electricity generation supplied by the project to grid.
Frequency of monitoring/recording:	Measuring continuously/ recording monthly
Value monitored:	Electricity generation figure is 138,333.67 MWh for 2011 (from January 1 <sup>st</sup> 2011 to December 31 <sup>st</sup> 2011)
Monitoring equipment:	<p>The model of the meters (The meters installed at Kalkandere power house) is Actaris SL761A and the serial numbers of the meters are 53087889 for main meter and 53087890 for the check meter (The meters of Kizilagac power house has not been installed yet. There will also be 2 meters in the Kizilagac power house)</p> <p>The meters are firsthand and the supplier company commits that these meters fully conforms or exceeds all relevant IEC standards including those dealing with electronic metering equipment IEC61036 for class 1 equipment and IEC60687 for class 0.2S equipment. There is no possibility for human error in the measurement of the electricity. All the measurements and calculations are done via tested meters.</p>
QA/QC procedures to be applied:	<p>Cross check measurements results with records for sold electricity.</p> <p>Calibration of all the meters will be undertaken at required intervals and faulty meters will be duly replaced immediately.</p>
Calculation method:	$EG_{\text{Facility},y} = EG_{\text{export},y} - EG_{\text{import},y}$
Any comment:	-
Data Unit / Parameter:	$Cap_{PJ}$
Data unit:	MWe
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data:	Project site

Description of measurement methods and procedures to be applied:	The installed capacity will be determined based on recognized standards.
Frequency of monitoring/recording:	Yearly
Value monitored:	35,04 (3 x 11.68 MWe) <sup>5</sup>
Monitoring equipment:	The data is monitored from the electricity generation license which was granted by Energy Market Regulatory Authority. The company has not made any change on the project design up to know and therefore, there is no increase or decrease in the installed capacity of the power plant.
QA/QC procedures to be applied:	-
Calculation method:	The installed capacity figure is 35.04 MWe (3 x 11.68 MWe) for Kalkandere Power House and 7.29 MW (3 x 2.43 MWe). The total installed capacity of the project is 42.33 MWe.
Any comment:	-
Data Unit / Parameter:	A <sub>PJ</sub>
Data unit:	m <sup>2</sup>
Description:	Area of the regulation pond measured in the surface of the water, after the implementation of the project activity, when is full
Source of data:	Project site
Description of measurement methods and procedures to be applied:	Measured from topographical surveys, maps, satellite pictures, etc
Frequency of monitoring/recording:	Yearly
Value monitored:	11,442 m <sup>2</sup>
Monitoring equipment:	-
QA/QC procedures to be applied:	The reservoir area mentioned above (11,442 m <sup>2</sup> ) is the maximum reservoir area at 224.92 m altitude. This water level only occurs at the Q500 flood discharge.
Calculation method:	-
Any comment:	Please see Appendix-I for the reservoir area details.

<sup>5</sup> The total licensed installed capacity of the Project is 42.33 MWe. However, since the second part of the Project (Kizilagac Power house) has not commissioned yet, only the installed capacity of Kalkandere power house is monitored.)

### 3.3 Description of the Monitoring Plan

The purpose of the monitoring plan is to ensure that the monitoring and calculation of emission reductions of the proposed Project within the crediting period is complete, consistent, clear and accurate.

The project is operated by Akim Enerji which ensures the overall site management in accordance with Turkish Laws and technology providers' guidelines.

The monitoring has been performed in-house by the project proponent:

1. Plant Engineer is responsible for the control of the electricity supplied to the grid and imported from the grid with TEIAS. The electricity measurements are made by TEIAS remotely and the plant engineer is informed by TEIAS by e-mail regarding the electricity measurements by an e-mail each month. (An excel sheet called "OSF Form – Dengeleme Birimi Sayaç Değerleri Formu" which includes the hourly electricity generations and imports is sent to the plant engineer from TEIAS.) The plant engineer checks these electricity measurement records and reports to the Operations Manager of the plant.
2. Accounting Manager is in charge of providing the electricity sales receipts to the Operations Manager of the plant.
3. Operations Manager is the VER coordinator. He is in charge of:
  - a. Ensuring that instrumentations and devices are available and properly suited to perform efficiently the monitoring.
  - b. Communicating and coordinating the monitoring tasks of all business units.
  - c. Developing, executing, analyzing and improving the VER Monitoring/Reporting Procedures. This includes the crosschecking and consolidation (with multiple sources whenever possible) of the data obtained from the plant engineer and the accounting manager. He also records this operation properly to be able to provide it to the DOE during the verification process.
  - d. Calculating and reporting the emission reductions, and

In order to verify the generated units of emission reductions, the VER coordinator, Operation Manager reports the all necessary data to the head quarter of the company, in which the following important aspects include:

- Year
- Net electricity supplied by the project activity to the grid (in MWh)
- Annual gross electricity generation(in MWh)
- Annual electricity consumption (in MWh)
- Calculation of the emissions reductions: ERs per year (in tCO<sub>2</sub>e/yr) produced from the activity of the project

Each year, the monitoring report is submitted to DOE for the verification. The report covers the monitoring of grid-connected power generation, check report; report on calculation of the emission reductions and records of monitoring instrument repair and calibration, etc.

Data is recorded for each crediting period and maintained at least 2 years after its end. The company will establish a dedicated maintenance system to ensure the data availability for the required period.

#### **Measuring**

TEIAS obtains the readings from the meters remotely and reports them in a spread sheet (for measurement control and will store the data discharged from the meters electronically) to the Plant engineer.

The project's electricity production is fed into the grid through a transformer station which is used by Kizilagac Power Plant and Kalkandere Power Plant.

In line with the EMRA requirements, the company purchased and installed two electricity meters to the Kalkandere Power Plant. (The meters of Kizilagac plant has not installed yet)

Serial Number	Main meter : 53087889 Check meter : 53087890
Brand	ACTARIS
Model	SL 761A
Standard/Class	0.2s

The recalibration of these equipments will be done in line with the equipment requirements but recalibration periods are defined by national metrology institutes country by country and in Turkey this period is defined as 10 years.<sup>6</sup>

As mentioned above there are two sets of meters in the transformer station. (The meters are electronic meters with an accuracy class of 0.2.) One of is the main meter for measuring and the other is the check meter for control. Both of these meters are metering the energy in two directions (consumption and production). If there is a measuring difference between these two meters and one of the parties (TEIAS or the company) requests for calibration of the meters, in this case, the meters will be calibrated without waiting for the periodic calibration date. (TEIAS System Usage Agreement, Art 3, B./2./b) )<sup>7</sup> This calibration process is done by another third party under the control of TEIAS. The company is not responsible for calibration of the meters in Turkey according to the local standards.

All production figures which are subject to sales to the grid are agreed with PMUM (Market Financial Reconciliation Centre). These figures can be accessed from PMUM's web site by the seller. Therefore, net electricity production figures<sup>8</sup> announced by PMUM will be used in emission calculation figures. These figures will also be cross checked with the production and internal electricity usage figures provided from the OSF forms which are provided to the company by TEIAS after the remote measurement of the meters.

## 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

### 4.1 Baseline Emissions

Accordingly the baseline emissions  $BE_y$  are calculated as following:

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

Where:

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

<sup>6</sup> <http://www.mevzuat.adalet.gov.tr/html/21179.html>

<sup>7</sup> [www.teias.gov.tr/sistemkullanim1.doc](http://www.teias.gov.tr/sistemkullanim1.doc)

<sup>8</sup> Net electricity production figure = Electricity generation (operation base) – Electricity traction from grid

- EG<sub>PJ,y</sub> Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the VCS project activity in year y(MWh/yr)
- EF<sub>grid,CM,y</sub> 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”
- Y Refers to a given year

Since the project is an installation of a new grid-connected renewable power plant, the baseline scenario is formulated in ACM0002, Version 12: “Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the Combined Margin (CM) calculations described below”.

The baseline emission factor is the weighted average of the Operating Margin Emission Factor and Build Margin Emission Factor. The ACM0002 / Version 12 guideline recommends equal weight values for hydropower projects as seen in the formula below:

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

Where:

EF <sub>grid,BM,y</sub>	=	Build margin CO <sub>2</sub> emission factor in year y (tCO <sub>2</sub> /MWh)
EF <sub>grid,OM,y</sub>	=	Operating margin CO <sub>2</sub> emission factor in year y (tCO <sub>2</sub> /MWh)
W <sub>OM</sub>	=	Weighting of operating margin emissions factor (%)
W <sub>BM</sub>	=	Weighting of build margin emissions factor (%)

The default values recommended by “Methodological tool (Version 02) Tool to calculate the emission factor for an electricity system” for W<sub>OM</sub> and W<sub>BM</sub> for activities other than wind and solar power generation projects are 0.5 and 0.5, respectively.

$$EF_{grid, CM, y} = 0.661 \times 0.5 + 0.457 \times 0.5$$

Therefore resulting EF<sub>grid,CM,y</sub> is 0.559 tCO<sub>2</sub>/MWh

The total electricity generations, the electricity traction from the grid and the net electricity supplied to the grid are as follows:<sup>9</sup>

Kalkandere HEPP Electricity Generations - 2011			
Date	Electricity Supply (kWh)	Electricity Traction from Grid (kWh)	Net Electricity Supplied to the Grid (kWh)*
Jan-11	2,050,950	34,790	2,016,160
Feb-11	5,214,530	15,830	5,198,700
Mar-11	8,967,470	10,770	8,956,700
Apr-11	19,007,170	740	19,006,430
May-11	26,031,840	1,370	26,030,470
Jun-11	24,453,030	510	24,452,520
Jul-11	12,635,430	2,260	12,633,170
Aug-11	7,380,920	10,850	7,370,070

<sup>9</sup> The emission reductions are calculated based monthly PMUM (Market Financial Settlement Center) Records.

Sep-11	6,608,880	16,910	6,591,970
Oct-11	12,659,880	2,620	12,657,260
Nov-11	7,872,750	12,480	7,860,270
Dec-11	5,581,950	22,000	5,559,950
<b>Total</b>	<b>138,464,800</b>	<b>131,130</b>	<b>138,333,670</b>

\*\* Net Electricity Supplied to the grid = Electricity supply - Electricity traction from grid

**Table 1:** Electricity generation readings of the Kalkandere HEPP from 1<sup>st</sup> January 2011 to 31<sup>st</sup> December 2011

The total annual electricity generation of the project is estimated as 179,050 MWh/year and the estimated annual electricity generation for Kalkandere Power house is 150,670 MWh. Since the Kizilagac part of the project has not commissioned yet, the expected electricity generation of 28,380 MWh/year from Kizilagac part did not realize in 2011. Also, the electricity generation of Kalkandere power house realized as 138,333 MWh and this figure is 8% less than the estimated figure. However, there is not an efficiency problem in the power house and this less electricity generation resulted from the periodical volatility of the water flow in the river.

As a result, based on the above electricity generation figures, baseline emission figure for 2011 is calculated as follows:

$$\begin{aligned}
 BE_{2011} &= EG_{PJ,2011} \times EF_{grid,CM,2011} \\
 &= 138,333 \text{ MWh} \times 0.559 \text{ tCO}_2/\text{MWh} \\
 &= \mathbf{77,328 \text{ tCO}_2}
 \end{aligned}$$

## 4.2 Project Emissions

According to ACM0002 / Version 12 if the power density (PD) of the hydro power plant is above 10 W / m<sup>2</sup>, PE<sub>y</sub> is 0.

The power density of the project activity is calculated as follows:

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

Where:

PD = Power density of the project activity, in W/m<sup>2</sup>

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

Cap<sub>BL</sub> = 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<sub>PJ</sub> = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the 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

Cap<sub>PJ</sub> = 42,330,000 W

Cap<sub>BL</sub> = 0 (Justification: The project is a new hydro power plant)

A<sub>PJ</sub> = 11,442 m<sup>2</sup> (Reservoir area for 224.92 m altitude – Q500)

$A_{BL} = 0$  (Justification: The project is a new hydro power plant)

Therefore;

$$PD = (42,330,000 - 0) / (11,442 - 0) = 3,700 \text{ W/m}^2$$

Since the Power Density of the Project is greater than  $10 \text{ W/m}^2$  even in the 224.92 altitude,  $PE_{2011}$  is assumed to be 0 as suggested in ACM0002 / Version 12.

$$PE_{2011} = 0 \text{ tCO}_2/\text{year}$$

### 4.3 Leakage

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 and transport). These emissions sources are neglected.

Therefore:

$$LE_y = 0 \text{ tCO}_2$$

### 4.4 Summary of GHG Emission Reductions and Removals

Also, according to ACM0002/Version 12 the emission reductions in year  $y$  should be calculated as the following formula

$$ER_y = BE_y - PE_y - LE_y$$

Where:

$ER_y$  = Emission reductions in year  $y$  (t CO<sub>2</sub>e/yr)

$BE_y$  = Baseline emissions in year  $y$  (t CO<sub>2</sub>e /yr)

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

$LE_y$  = Leakage emissions in year  $y$  (t CO<sub>2</sub>/yr)

Since  $PE_y$  and  $LE_y$  are assumed to be 0, emission reductions are equal to baseline emissions.

$$ER_{2011} = BE_{2011}$$

$$ER_{2011} = 77,328 \text{ tCO}_2$$

Please see the tables below for the emission reductions of the project for 2011:

Kalkandere HEPP Emission Reductions - 2011				
Date	Net Electricity Generation (kWh)	Electricity Traction from Grid (kWh)	Net Electricity Supplied to the Grid (kWh)*	Emission Reductions (Tons)**
Jan-11	2,050,950	34,790	2,016,160	1,127
Feb-11	5,214,530	15,830	5,198,700	2,906
Mar-11	8,967,470	10,770	8,956,700	5,007
Apr-11	19,007,170	740	19,006,430	10,625
May-11	26,031,840	1,370	26,030,470	14,551
Jun-11	24,453,030	510	24,452,520	13,669
Jul-11	12,635,430	2,260	12,633,170	7,062
Aug-11	7,380,920	10,850	7,370,070	4,120
Sep-11	6,608,880	16,910	6,591,970	3,685
Oct-11	12,659,880	2,620	12,657,260	7,075
Nov-11	7,872,750	12,480	7,860,270	4,394
Dec-11	5,581,950	22,000	5,559,950	3,108
<b>Total</b>	<b>138,464,800</b>	<b>131,130</b>	<b>138,333,670</b>	<b>77,328.52</b>

\* Net Electricity Supplied to the grid = Net Electricity Generation - Electricity traction from grid

\*\*  $EF_{Grid,CM,y} = 0.559 \text{ tCO}_2/\text{MWh}$

**Table 2:** Emission Reductions of Kalkandere HEPP from 1<sup>st</sup> January 2011 to 31<sup>st</sup> December 2011

## 5 ADDITIONAL INFORMATION

N/A

APPENDIX – I

