KOYULHISAR HYDRO ELECTRICITY POWER PLANT

Document Prepared By Turkuaz Carbon Finance

Project Title	Koyulhisar Hydro Electricity Power Plant
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1 PROJECT DETAILS

1.1 Summary Description of Project

As stated on Turkey's 9th Official Development Plan published by the State Planning Organization, mainly due to the rapid growth rate of the Turkish economy (up to 8 % in some years), the primary electricity demand is expected to increase by 8.1 % each year over the period 2007 to 2013[1].

Taking this into account, Bereket Enerji Üretim San. ve Tic. A. Ş. is planning to construct Koyulhisar Hydro Electric Power Plant (HPP) on the Kelkit Stream, within the jurisdiction of Koyulhisar Town of Sivas Province. The purpose of the project is electricity production using the potential energy of Kelkit Stream as a renewable resource. Therefore, the electricity is going to be produced without causing airborne pollutants or Green House Gas (GHG) emissions. The construction and operation of the Koyulhisar Hydro Electric Power Plant (HPP) will be delaying the addition of conventional thermal power plants to the Turkish National Electricity Grid.

The set capacity of Koyulhisar HPP is 63 MW, with 3 turbines of 21 MW each . One of these three turbines is installed as a standby unit, intended to operate only whenever one of the other two turbines will not be operating for the purpose of maintenance and repair. Based on the available water and the capacity of the total capacity of the project, the project is indicated to be to produce 262,365 MWh of electricity per year, according to its feasibility report. The number indicated in the feasibility report is based on the average water availability of the past 50 years, and does not take into account the highly possible impacts of the climate change over the water availability. Such impacts are well documented in both the IPCC reports[2], Worldbank studies[3] and in the scientific articles published related to Turkey[4], and its water resources[5]. Based on these articles , we have estimated about 16% production loss, approximately one month loss in the dry season , due to water being spared for irrigation purposes at the upstream reservoir of the government owned Kılıçkaya Dam, and approximately one month loss

[1] Turkey's 9th Official Development Plan (2007 to 2013)" published by SPO (http://ekutup.dpt.gov.tr/plan/ix/9developmentplan.pdf).

[2] Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008: Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.© 2008, Intergovernmental Panel on Climate Change ISBN: 978-92-9169-123-4.

[3] Danilenko A., Dickson, E., Jacobsen, M.,Climate Change and Urban Water Utilities: Challenges & Opportunities, Water Working Notes, Note No. 24, April 2010,(Water Working Notes are published by the Water Sector Board of the Sustainable Development Network of the World Bank Group.) 84 pp.

[4] Mengü, G. P., Sensoy, S., Akkuzu, E., 2008, Effects of Global Climate Change on Agriculture and Water Resources, BALWOIS 2008 – Ohrid, Republic of Macedonia – 27, 31 May 2008.

[5] Tahmiscioğlu, M.S., Karaca, Ö., Özdemir, A.D., Özgüler, H., , 2006, Possible Effect of The Global Clımate Change on Water Resources and Floods in Turkey, International Conference on Climate Change and the Middle East Past, Present and Future 20-23 November 2006, ITU, Istanbul/TURKEY.

during the relatively wet season due to the unexpected torrential rains that would trigger mass flows and cause the blockage of the open canals and halt the production. This is also reflected in the production's seasonality: the production is seasonal being relatively less in dry season (from late September to early spring) compared to the rest of the year. Also due to the active tectonic structure of the project area there are frequent mass flows that block the canals and hinder the continuity of the electricity production. Therefore summing up the peak season productivity and the low season productivity the annual average electricity production is expected to be a maximum of around 220,000 MWh. Based on Turkey's Combined Margin Emission Factor of 0.52826 tCO_{2e}/MWh, the project is expected to produce 116,217 tonnes of CO_{2e} GHG reductions each year.

The environmental impacts of the project will be kept at a minimum level and all the regulations that are in act in the host country, Turkey, will be obeyed during the construction and operation stages of the Koyulhisar HPP project. At the planning stage these impacts have been investigated and were presented to the Sivas Provincial Directorate of the Ministry of Environment and Forestry (MoEF), in the form of a project introductory file[6] (an equivalent to a Pre-EIA report). The report was examined by the Provincial Directorate of the MoEF and it was decided that a detailed Environmental Impact Assessment study was not needed for the project[7]. Considering that the project will be using the water resource that is also essential for the aquatic life in the area, there will be a fish ladder (fish passage way)[8] within the regulator for the downstream and upstream movement of the fish, to facilitate fish migration. The fish passage will be active at the end of 2011 (based on the blue prints dated 24 July 2009). Since the project is designed as a run off river type power plant, the minimum water (considered as 4m^3/s in the revised feasibility report) necessary for the sustainability of the aquatic life in the river will always be released.

The Major milestones at the project development history can be summarized as shown in the following table (Table 1):

[6] The Project Introductory File (PIF) in the original language is presented to the validating DOE.
[7] The EIA Exemption certificate is presented to the validating DOE and can be found as Annex -3.
[8] The plans of the fish ladder are provided to the validated

Table 1: Major Milestones of Koyulhisar HPP

Date	Milestone	Reference
24/09/2003	The Project is acquired from State Water Affairs(DSI)	DSI WEB site[9]
28/06/2004	The initial Feasibility Approved by DSI	Approval letter of DSI
18/01/2005	Water Usage Agreement co-signed with DSI	DSI Water usage Agreement
02/10/2005	Electricity Production Licence issued by Energy Market Regulatory Agency (EMRA)	EMRA Licence
01/06/2005	EIA Exemption Certificate issued	See Annex-3
07/08/2006	Financial Closure and Investment Decision date	Credit Agreement(first Trench)
23/10/2006	Invitation letters sent to Village heads for a Local Stakeholders Meeting	Invitation Letters
13/11/2006	Stake Holder Consultation Meeting Held at Kılıçpınar Village	Meeting Minutes
05/01/2009	Carbon Finance considered	Board Decision
06/01/2009	Construction Started	NHS Record
03/09/2009	Application for the addition of the third unit and approval of revised feasibility	Application Letter to DSI
August 2009	Final version of Revised Feasibility released	Feasibility Report
17/11/2009	The First two units of the project became operational (Project Start Date)	Provisional Acceptance Protocol by MoENR
17/11/2009	Application for licence Revision to EMRA	Application Letter to EMRA
02/09/2011	Turkuaz Contracted for Carbon Finance	Contract
10/09/2011	Validating DOE Contracted	Mail Order
19/09/2011	PDD submitted to DOE	E-mail

[9] http://www2.dsi.gov.tr/skatablo/Tablo2.htm (please search for Koyulhisar the application date is indicated on the column before last column.)

5-6/10/2011	Site Visit for Validation	DOE Testimonial
Awaiting Approval	DSI Approval For Revised feasibility	Approval Letter

The Koyulhisar HPP is to be constructed at the downstream of two state owned dams, namely: Kılıçkaya Dam (124 MW) and Çamlıgöze Dam (33MW)[10] that were constructed for irrigation and energy production purposes around 90s. The project will be collecting the water that leaves the spillway of Çamlıgöze Dam. The water will be collected and kept up to 5 hours behind the spill weir regulator of the Koyulhisar HPP. The water will then be transferred to a set of open canals and tunnels that will bring the water to a head pond from which it will be loaded to the penstock that will bring pass the water to the power house where it will reach the 3 vertical axis Francis turbines with 21 MW capacity each. The electricity will be produced by the two of these three turbines as one of the turbines is a stand-by unit. The spill weir regulator will be located at an altitude of 724m and the tail water of Koyulhisar will be at an altitude of 623 m. This will bring a head difference of approximately 101 m.

How the project activity will be operating is shown schematically below in Figure 1:

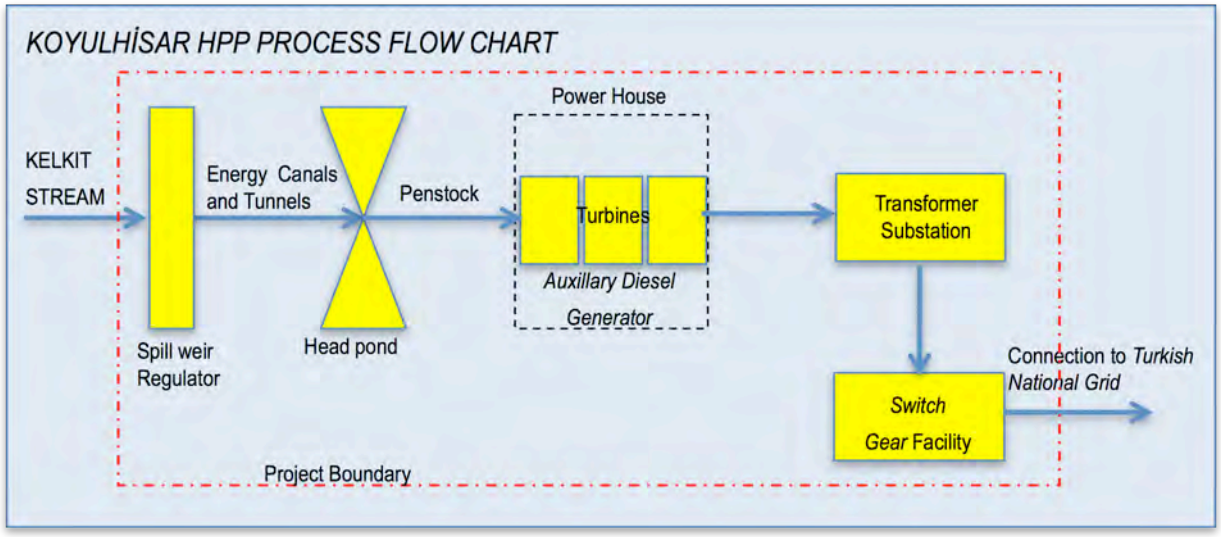

Figure 1: Flow chart showing the basic operational principles of the project activity.

[10] http://www2.dsi.gov.tr/bolge/dsi19/sivas.htm#kilickaya

1.2 Sectoral Scope and Project Type

The project category is Sectoral Scope 1: Energy industries (renewable-/non - renewable sources). The project type is grid connected electricity generation from renewable sources. The project is a non-grouped, stand alone project.

1.3 Project Proponent

Project Proponent	Role and Responsibility	Contact Information
Bereket Enerji Üretim San. ve Tic. A. Ş.	Project Owner – Implementation of the Project	15 Mayıs Mh.. 832 Sk. No:2 K:2 75. Yıl Esnaf Sarayı DENİZLİ T : +90 258 242 27 76 F : +90 258 265 15 85

1.4 Other Entities Involved in the Project

Other Entities Involved	Role and Responsibility	Contact Information
Turkuaz Karbon Varlık Yönetimi Enerji Proje ve Dan. San. İth. İhr. Ltd. Şti.	Preparation of the Project Description Document	Turan Güneş Bulvarı 100/3 06550 Çankaya ANKARA Tel:90.312 438 45 00 (pbx) Fax:+90.312 438 46 00 info@turkuazkarbon.com

1.5 Project Start Date

Project Start Date is: 17.11.2009.

1.6 Project Crediting Period

The project crediting period is 10 years: 17.11.2009-16.11.2019 (both days inclusive). The crediting period is renewable twice.

1.7 Project Location

The project is located at the Central Anatolian geographical region of Turkey at the Sivas Province. The coordinates of the power house is as follows and as indicated on the location Map below (Figure 2):

Coordinates of the Power House:
Latitude: 40º16”13,48’ North

Longitude: 37º50”55,58’ East

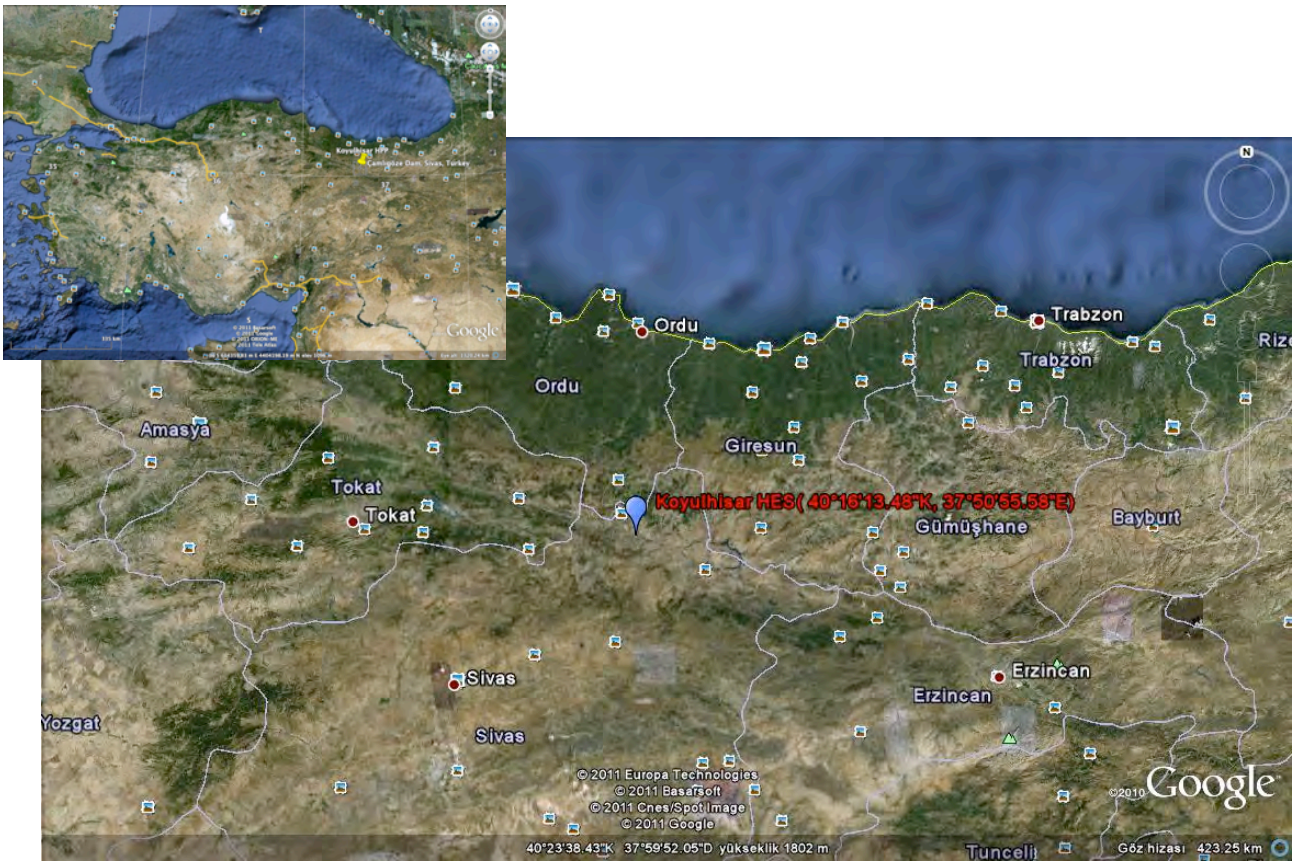

Figure 2: Google Earth Satellite imagery showing the location of the project area. Project is indicated with the blue balloon on the map.

1.8 Title and Reference of Methodology

The following UNFFCC methodology and its related tools are utilised:

Approved consolidated baseline and monitoring methodology ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources.” Version 12.1.0.

The Approved Methodology refers to the following tools:

“Tool for the demonstration and assessment of additionality” (Version 05.2.1)

“Tool to calculate the emission factor for an electricity system”. (Version 02.2.1)

"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 02)

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The project start date is 17 November 2009. Since that date, there is no special event that may have impact on monitoring of GHG emission reductions. The following table summarizes the project milestones:

Table 2: Significant dates for the the project monitoring period:

Date	Milestone
11.11.2011	Final Validation Report
17.11.2009	Date of commissioning of the plant
13.08.2009	Calibration date of meters (Main Meter-S.n. 53030781 and the control meter-S.n. 53030782)
12.08.2019	End of Calibration validity
31.10.2011	End of the first monitoring period
16.11.2019	End of first crediting period

2.2 Deviations from the Monitoring Plan

There are no deviations from the validated monitoring plan.

2.3 Grouped Project

The Koyulhisar HEPP Project is not a grouped project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

The following are the data and parameters available at validation:

Data / Parameter:	$FC_{i,y}$
Data unit:	Volume Unit (cubic meter)
Description:	Amount of fuel *i* consumed by relevant power plants in Turkey in years, 2007, 2008, 2009
Source of data:	Official publications at the Turkish Electricity Transmission Company (TEIAŞ) Web Site (http://www.teias.gov.tr/istatistik2009/44.xls)
Measurement procedures (if any):	-
Monitoring frequency:	once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation
Value applied:	Please see Annex 2-Table-1
QA/QC Procedures	-
Justification of choice of data or description of measurement methods and procedures applied:	Data used is taken from the TEİAŞ website, which is the website of the Turkish Electricity Distribution Company. The data published on the TEİAŞ website is the most up-to date and reliable data available for the Turkish grid.
Any comment:	Data used for the calculation of $EF_{grid,OM,Simple,y}$

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/Mass or Volume Unit
Description:	Net Calorific Values for fossil fuel type *i* in

	year ,*for the years* 2007, 2008 and 2009
Source of data:	Regional or national average default values that are reliable and documented in national energy statistics of the Turkish Electricity Transmission Company Web Site (http://www.teias.gov.tr/istatistik2009/46.xls http://www.teias.gov.tr/istatistik2009/44.xls)
Measurement procedures (if any):	-
Monitoring frequency:	For Simple OM : Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation For BM: For the first crediting period, once for the *ex ante* and for the second and third crediting period, only once *ex ante* at the start of the second crediting period
Value applied:	Please see Annex-2-Table-1b
QA/QC Procedures	-
Justification of choice of data or description of measurement methods and procedures applied:	Data used is taken from the TEİAŞ website, which is the website of the Turkish Electricity Distribution Company. The data published on the TEİAŞ website is the most up-to date and reliable data available for the Turkish grid.
Any comment:	Data used for the calculation of $EF_{grid,OM,Simple,y}$. As data on the NCV is not published directly on the TEİAŞ website, this data is calculated using the heating values of fuels and the volume or mass of fuels consumed for each year.

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:	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 2006 IPCC Guidelines on National GHG Inventories
Measurement procedures (if any):	-
Monitoring frequency:	For Simple OM : Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation For BM: For the first crediting period, once for the *ex ante* and for the second and third crediting period, only once *ex ante* at the start of the second crediting period
QA/QC Procedures	-
Value applied:	Please see Annex 2-Table-2.
Justification of choice of data or description of measurement methods and procedures applied:	According to the "Tool to calculate the emission factor for an electricity system" version 02.2.1 , if values provided by the fuel supplier of the power plants in invoices or regional or national average defaults values are not available the IPCC default values at the lower limit of uncertainty must be used.
Any comment:	Data used both for the calculation of $EF_{grid,OM,Simple,y}$ and $EF_{EL,m,y}$

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Net electricity generated in the project electricity system in other words, net

	electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year y
Source of data:	Turkish Electricity Transmission Company Web Site www.teias.gov.tr/istatistik2009/37(06-09).xls www.teias.gov.tr/istatistik2009/30(84-09).xls
Measurement procedures (if any):	-
Monitoring frequency:	For Simple OM : Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation For BM: For the first crediting period, once for the *ex ante* and for the second and third crediting period, only once *ex ante* at the start of the second crediting period
QA/QC Procedures	-
Value applied:	Please see Annex 2-Table 3 and Table 4.
Justification of choice of data or description of measurement methods and procedures applied:	Data used is taken from the TEİAŞ website, which is the website of the Turkish Electricity Distribution Company. The data published on the TEİAŞ website is the most up-to-date and reliable data available for the Turkish grid.
Any comment:	Data used for the calculation of $EF_{grid,OM,Simple,y}$

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh

Description:	Net electricity generated and delivered to the grid by power unit m in year y
Source of data:	Turkish Electricity Transmission Company Web Site (www.teias.gov.tr). Statistical Reports are taken for the years 2004 and 2005 and capacity projection reports are used for the years 2007, 2008 and 2009.
Measurement procedures (if any):	-
Monitoring frequency:	For Simple OM : Once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation For BM: For the first crediting period, once for the *ex ante* and for the second and third crediting period, only once *ex ante* at the start of the second crediting period
QA/QC Procedures	-
Value applied:	Please see Annex 2-Table 8.
Justification of choice of data or description of measurement methods and procedures applied:	Data used is taken from the TEİAŞ website, which is the website of the Turkish Electricity Distribution Company. The data published on the TEİAŞ website is the most up-to-date and reliable data available for the Turkish grid.
Any comment:	Data used for the calculation of $EF_{grid,BM,y}$

Data / Parameter:	$\eta_{m,y}$
Data unit:	-
Description:	Average net energy conversion efficiency of power unit m in year y
Source of data:	The default values provided at the Annex 1 of the "Tool to calculate emission factor for an electricity sector (Version 02.2.1)" are

	used
Measurement procedures (if any):	
Monitoring frequency:	Once for the crediting period
QA/QC Procedures	N/A as the default values provided in Annex 1 are used.
Value applied:	Please see Annex 1 of the "Tool to calculate emission factor for an electricity sector (Version 02.2.1)"
Justification of choice of data or description of measurement methods and procedures applied:	According to the "tool to calculate emission factor for an electricity system if documented manufacturer's specifications or data from the utility, the dispatch centre or official records are not available then the default values given in annex 1 of the tool shall be used. The first two options are not available for the power plants supplying the Turkish grid, therefore the default values are used.
Any comment:	Data used for the calculation of EFgrid,BM,y
Data / Parameter:	NCVi,y
Data unit:	GJ per mass or volume unit (GJ/ton)
Description:	Weighted average net calorific value of fuel type i in year y
Measured /Calculated /Default:	Default
Source of data:	IPCC default values at the upper 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
Value(s) of monitored parameter:	43.3 GJ/ton
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Data will be used for Project Emission Calculations. The project emissions are those that are related to the burning of the diesel (fossil fuel) in the auxiliary power generators that produce electricity in the

	absence of the electricity obtained from the grid for self consumption.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Default values are used
Measuring/ Reading/ Recording frequency:	Default IPCC value is used. Any future revision of the IPCC Guidelines will be taken into account
Calculation method (if applicable):	Not Applicable as default value of the IPCC guidelines is utilized
QA/QC procedures applied:	Not Applicable as default value of the IPCC guidelines is utilized
Comments	Applicable as option B of the Methodological tool "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 02) is chosen.

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of fuel type *i* in year *y (I stands for diesel fuel in this case)*
Measured /Calculated /Default:	Default
Source of data:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) of monitored parameter:	74.80 tCO_2/GJ
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Data will be used for Project Emission Calculations

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Default values are used
Measuring/ Reading/ Recording frequency:	Default IPCC value is used. Any future revision of the IPCC Guidelines will be taken into account
Calculation method (if applicable):	Not Applicable as default value of the IPCC guidelines is utilized
QA/QC procedures applied:	Not Applicable as default value of the IPCC guidelines is utilized
Comments	Applicable as option B of the Methodological tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02) is chosen.

3.2 Data and Parameters Monitored

The following are the data and parameters monitored subsequent to validation:

Data / Parameter:	$EG_{PP\text{-self consumption, y}}$
Data unit:	MWh
Description:	Quantity of electricity imported by the power plant from the Grid for self consumption, in year y
Measured /Calculated /Default:	Measured
Source of data:	The Primary source of data will be the Main TEIAS meter recorded at the monthly reading protocols, the column related to electricity obtained from the Grid. The main meter has the serial number: 53030781. The secondary source of data will be the PMUM/MFRC web site screen shots, the column with the heading UECM[11].
Description of measurement methods and procedures to be	Measurements are to be made by electricity meters. That belong to the grid operator TEIAŞ.

[11] UEÇM: Uzlaştırmaya Esas Çekim Miktarı-Amount of Electricity based on Reconciliation.

applied:	The meters are in compliance with the collected data. Data will be used to calculate the net electricity supplied to the grid,
Frequency of monitoring/recording:	Recorded continuously, reported monthly on TEIAS Meter Reading Protocols, Reported annually on the VCS Monitoring Report.
Value applied:	Will be determined at the monitoring stage
Monitoring equipment:	Main Electricity Meter: ACTARIS SL7000-Serial Number: 53030781 Back-up Electricity Meter: ACTARIS SL7000-Serial Number: 53030782 Both meters are in compliance with the communiqué for Metering Devices to be used in the Electricity Market[12]. They have an accuracy class of Class002 indicating an accuracy range of 0,2%.
QA/QC procedures to be applied:	Measurements will be carried out in compliance with the communiqué for Metering Devices to be used in the Electricity Market. The minimum accuracy of the meters are Class02, that is to say should be within the ±0,2% (±0,002) range. The monthly reported meter readings by the main meter with serial number 53030781, will be cross-checked against the back up meter that has the serial number 53030782, if the reading difference is less than ±0,002 (±0,2%) than the meter readings are considered to be OK, if not than the meters will be checked. The monthly reported readings will also be cross checked against the monthly PMUM/MFRC screen shots. The PMUM/MFRC data of electricity sales will also be a proof for quality and reliability of data. The main meter and the control meter reads both the electricty produced and the electricity consumed by the power plant. These readings can be seen on the screen of the meters by changing the reading mod of the meter.
Calculation method:	*Direct continuous measurement*

[12] The latest version of the communiqué (in Turkish) can be found in the following link: http://www.epdk.gov.tr/web/elektrik-piyasasi-dairesi/44

Any comment:	Data will be used to calculate net electricity supplied to the grid.

Data / Parameter:	$EG_{PP\text{-}gross,\ y}$
Data unit:	MWh
Description:	Quantity of electricity produced by the power plant , in y
Measured /Calculated /Default:	Measured
Source of data:	The Primary source of data will be the Main TEIAS meter recorded at the monthly reading protocols, the column related to gross electricity supplied to the Grid. The main meter has the serial number: 53030781. The secondary source of data will be the PMUM/MFRC web site screen shots, the column with the heading ISVM[13].
Description of measurement methods and procedures to be applied:	Measurements are to be made by electricity meters. That belong to the grid operator TEIAŞ. The meters are in compliance with the collected data. Data will be used to calculate the net electricity supplied to the grid,
Frequency of monitoring/recording:	Recorded continuously, reported monthly on TEIAS Meter Reading Protocols, Reported annually on the VCS Monitoring Report.
Value applied:	Will be determined at the monitoring stage
Monitoring equipment:	Main Electricity Meter: ACTARIS SL7000-Serial Number: 53030781 Back-up Electricity Meter: ACTARISSL7000-Serial Number: 53030782 Both meters are in compliance with the communiqué for Metering Devices to be used in the Electricity Market[14]. They have an accuracy

[13] ISVM: İletim Sistemine Veriş Miktarı-Amount Supplied to the Grid
[14] The latest version of the communiqué (in Turkish) can be found in the following link: http://www.epdk.gov.tr/web/elektrik-piyasasi-dairesi/44

	class of Class 002 indicating an accuracy range of 0,2%.
QA/QC procedures to be applied:	Measurements will be carried out in compliance with the communiqué for Metering Devices to be used in the Electricity Market. The minimum accuracy of the meters are Class02, that is to say should be within the ±0,2% (±0,002) range. The monthly reported meter readings by the main meter with the serial number 53030781, will be cross-checked against the back up meter, that has the serial number 53030782. if the reading difference is less than ±0,002 (±0,2%) than the meter readings are considered to be OK, if not than the meters will be checked. The monthly reported readings will also be cross checked against the monthly PMUM/MFRC screen shots. The PMUM/MFRC data of electricity sales will also be a proof for quality and reliability of data. The main meter and the back up meter both reads the electricity consumed by the power plant and the electricity supplied to the power plant.
Calculation method:	Direct continuous measurement
Any comment:	Data will be used to calculate net electricity supplied to the grid.

Data / Parameter:	PEFC,j,y
Data unit:	L of diesel per year
Description:	Fossil fuel consumption from auxiliary diesel generators during the year y
Measured /Calculated /Default:	Measured
Source of data:	Onsite logs and measurements
Value(s) of monitored parameter:	-
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Data is utilised to calculate Project Emissions

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Site Manager's log book
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	Fuel consumption will be used to calculate CO2 emissions from the combustion of diesel fuel as set forth in the rules specified in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02)
QA/QC procedures applied:	Measured amount is cross checked with the diesel fuel purchase receipts.

3.3 Description of the Monitoring Plan

The Monitoring Plan for the project consists mainly of the net electricity generation by the project activity. Based on the baseline scenario presented above, this amount of electricity would have been produced by the Turkish National Grid.
The electricity produced will be sold to TEİAŞ. Therefore, TEİAŞ measures the electricity produced by two meters:

1. Main Electricity Meter: ACTARIS SL7000-Serial Number: 53030781
2. Back-up Electricity Meter: ACTARISSL7000-Serial Number: 53030782

These meters are capable of measuring the electricity in two directions. They measure both the electricity produced by the power plant and the electricity consumed by the power plant. The metersare located in the control room of the Power Plant over the line where the power plant gets connected to the Turkish national grid. Those meters will provide official data which will be read and recorded monthly by TEİAŞ officers for invoicing.
The data reading and recording procedure can be described as follows:

- The data is measured by the TEIAS meters and stored in the memory of the meter for a period of 12 months.
- Every hour the command operators read the electricity produced and the electricity consumed by the power plant, and record it to their files. These mannual records are stored and archived.
- They communicate these readings to TEIAS upon request by TEIAS.

- TEIAS is able to see the meter readings remotely.
- TEIAS visits the site monthly (at the first days of the month) and downloads the data stored in the meter's memory, TEIAS produces the monthly reading protocols for the past months and the protocols are both signed by both the Bereket Enerji Üretim A.Ş, and The TEIAS officers.
- These protocols are faxed to the Bereket Enerji Üretim A.Ş. headquarters and the data is also stored there.
- The trade officer of the Enerji Üretim A.Ş. fills in the electricity production data to the PMUM/MFRC system.
- TEIAS determines the overall grid loss and deducts the grid losses from the electrictty producers, and the total amount of electricty amount that is sold is less than the actual amount supplied to the grade. However these losses are outside the project boundary.
- The main meter with the serial number 53030781 measures the data that is used to calculate the emission reductions, and the data recorded by the control meter with the serial number 53030782 is used to check the accuracy of the main meter readings. The difference between the two meter readings needs to be within the range of ±0,2%.
- PMUM-MFRC data is also used to check the accuracy of the meter readings. The difference betwwen the net production and the amount invoiced needs to be within the range of ±4%.

TEİAŞ is responsible for the calibration and maintenance of these meters and thus, ensures the accuracy and quality of the measurements. The quality standards that the meters need to comply is "The ICE/TSE 62053-22: Electricity metering equipment (a.c) – Particular requirements - Part 22: Static meters for active energy (Classes 0,2 S and 0,5 S)" The calibration of the meters is done and the meters will be checked continuously if there is a difference of 0.2 % in the readings of the main and the auxiliary meters, the calibration is repeated.
The meters need to comply with the communiqué for Metering Devices to be used in the Electricity Market[15]., the legislation also describes the calibration frequency as 10 years. If the electricity meters are observed to exhibit a difference of ±0.2 % in the readings, then the meters needs to be recalibrated.

The net electricity produced ($EG_{PP\text{-}net,\ y}$) in year y is calculated by subtracting the total electricity consumed by the hydroelectric power plant ($EG_{PP\text{-}self\ consumption,\ y}$) , from the gross electricity generation ($EG_{PP\text{-}gross,\ y}$) . After obtaining the net electricity production value, the emission reductions will be calculated by multiplying the net electricity with the Combined Margin calculated above.

[15] The latest version of the communiqué (in Turkish) can be found in the following link: http://www.epdk.gov.tr/web/elektrik-piyasasi-dairesi/44

The monitoring will be conducted by the Verified Emission Reduction (VER) Monitoring Team. The VER Team Members, and their position and duties for the monitoring is outlined in the following table (Table 3):

Table 3: Positions and responsibilities of the VER monitoring team members.

Position	Responsibility
Koyulhisar HPP Manager	• Day to day operation of the Koyulhisar HPP, • Compliance of the project activity with the host country rules and regulations • Coordination of the data collection and recording for the VCS monitoring report.
Chief Electrical Engineer	• Day to day follow up of electrical equipment • Recording and monitoring of the electricity generation data
Accounts Manager	• Data keeping for power sales • Invoicing
Chief Mechanical Engineer	• Day to day operation of the power plant • Keeping records of malfunctions and repairs
Turkuaz Karbon Varlık Yönetimi Enerji Proje ve Dan. San. İth. İhr. Ltd. Şti.	• Emission reduction calculations • Scripting of the periodic monitoring report • Follow up of the verification process

The power generation meter readings will be performed by using the main metering devices and the backup metering devices for accuracy checks only. Data from metering devices will be recorded by TEİAŞ on monthly agreed protocols and will form the basis for invoicing. In addition to the readings of the two metering devices, generation data of the Koyulhisar HPP can be cross checked, via the TEİAŞ – PMUM web site (http://pmum.teias.gov.tr) which is accessible by a password available to the electricity generation companies. The electricity generation data at the Market Financial Reconciliation Centre (MFRC/PMUM) web page will exhibit the net electricity generated less transmission loss, to be able to produce comparable numbers , the figures taken from PMUM web site needs to be multiplied by the transmission loss factor of the grid.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The baseline emissions (BE_y) are calculated based on the following formula a:

$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$ Where:

BE_y = Baseline emissions in year y (tCO_2/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_2 emissions factor in year y (tCO_2/MWh)

And

$EG_{PJ,y} = EG_{PP\text{-}net,\ y}$

$EG_{PP\text{-}net,\ y}$ = Quantity of net electricity generation supplied by the project plant to the grid in year y (MWh/y)

The Combined margin CO_2 emissions factor in year y (tCO_2/MWh), $EF_{grid,CM,y,}$ is fixed ex-ante for the duration of the crediting period, and is 0.52826 tCO_{2e}/MWh.

The following table shows the original data as reported in the monthly meter reading records, which are the result from a joint meter reading by TEIAS and Koyulhisar HEPP staff at the end of each month. The meter reading records are signed by both parties and serve as basis for all sub-sequent processes, especially settlement and billing for electricity supplied to the grid. The collected data is kept by Bereket Enerji Üretim A.Ş. during the crediting period and until two years after the last issuance of VCUs for the Koyulhisar HEPP project activity for the crediting period under consideration.

Table 4: Baseline Emissions (17 November 2009 to 31 October 2011-Both days inclusive)

		A-Gross Electricity Production	B-Self Electricity Consumption	C-Net electricity production C=A-B	Baseline Emissions = $EG_{PP-net,y}$ * EF_{CM}	National Grid Emission Factor
	Symbol	$EG_{PP-gross, y}$	$EG_{PP-self\ consumption, y}$	$EG_{PP-net, y}$	BE1	EF_{CM}
YEAR	**Units**	MWh	MWh	MWh	tCO_2e	tCO_2e/MWh
2009	**November**	**9.623,28**	**8,92**	9.614,36	5.078,88	0,528
	December	**12.888,68**	**5,76**	12.882,92	6.805,53	
	Total in 2009	**(17-11-2009 to 31-12-2009)**				**11.884**
2010	**January**	**17.617,33**	**4,19**	17.613,14	9.304,32	
	February	**13.337,53**	**9,81**	13.327,72	7.040,50	
	March	**23.523,91**	**4,42**	23.519,49	12.424,41	
	April	**21.636,54**	**6,15**	21.630,39	11.426,47	
	May	**20.768,58**	**5,49**	20.763,09	10.968,31	
	June	**16.453,98**	**10,20**	16.443,78	8.686,59	
	July	**19.740,68**	**7,73**	19.732,95	10.424,13	
	August	**26.848,59**	**2,38**	26.846,21	14.181,78	
	September	**17.040,44**	**8,51**	17.031,93	8.997,29	
	October	**20.954,86**	**2,37**	20.952,49	11.068,36	
	November	**16.798,36**	**8,42**	16.789,94	8.869,45	
	December	**3.460,52**	**22,81**	3.437,71	1.816,00	
	Total in 2010	**(01-01-2010 to 31-12-2010)**				**115.208**
2011	**January**	**6.613,96**	**17,65**	6.596,31	3.484,57	
	February	**12.740,87**	**8,09**	12.732,78	6.726,22	
	March	**5.534,05**	**22,27**	5.511,78	2.911,65	
	April	**15.229,27**	**9,96**	15.219,31	8.039,75	
	May	**4.359,15**	**25,73**	4.333,42	2.289,17	
	June	**22.717,72**	**4,65**	22.713,07	11.998,41	
	July	**23.926,32**	**3,76**	23.922,56	12.637,33	
	August	**19.646,15**	**9,87**	19.636,28	10.373,06	
	September	**26.403,19**	**2,36**	26.400,83	13.946,50	
	October	**25.673,62**	**2,64**	25.670,98	13.560,95	
	Total in 2011 (01-01-2011 to 31.10-2011)					**85.968**
	Grand Total	**377.863,959**			**213.059**	**213.059**

4.2 Project Emissions

There is no project emissions resulting form the reservoir area of the project activity as the power density of the project is greater than 10W/m2. The aerial extent of the reservoir is shown in the reservoir area map (Annex-1). Based on an aerial extend of 1,204,039.77 m2 and a generation capacity of 63,000,000 W, the power density of the project activity calculates as 52.32 W/m2 which is greater than 10 W/m2.

However, there are 4 auxiliary diesel generators in the project area that produce electricity for the operation of gates controling the canals, and two more are installed in the powerhouse and regulator body. These generators are logged to produced 145 kWh of electricity durng the occasional power outages, and this accounts to a diesel consumption of 37 Liters. Converting this diesel consumption into Gigagrams, and using the formula given in the tool for the calculation of diesel consumption, the project emissions related to diesel consumption calculates to be 0,101 tCO2e, as shown in the table below (Table 5):

Table 5: Calculation of project emission related to diesel consumption

Parameter	Value	Unit	
Electricity Production by the Diesel Generator:	145	kWh	
Standby Rating	60	KVA	
	49	kW	
Average load factor during verification period	50%		
Work hours during verification Period at 50%load	6	h	
Diesel consumption per hour	6,1	L	
Total Diesel consumption during verification	37	L	

Project Emissions due to diesel consumption :			
Pe = (FDy) × NCVdiesel x COEFdiesel			
Pe: Project emissions from diesel generator (tCO2)			
FDy : Annual diesel fuel consumption (Litres)			
NCVdiesel: Net Calorific Value for diesel oil (TJ/m3)			
COEFdiesel: CO2 emission coefficient for diesel oil (tCO2/TJ)			
		Units:	Source:
Density of Fuel	0,845	kg/L	
M=dxV	31,265	kg	
Fuel in Gigagrams:	0,000031265	Gg	
$EF_{CO2,i,y}$	74.800	$kgCO_2/TJ$	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
$NCV_{i,y}$	43,3	TJ/Gg	IPCC default values at the upper 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
$COEF_{i,y}$	3.238.840	$kgCO_2/Gg$	**$EF_{CO2,i,y}$** X **$NCV_{i,y}$**
PE=COEFXFuel in Gigagrams	101,262	kgCO2	
PE=	0,101	tCO2	A very low amount that can be neglected

As shown in the above table (Table 5) The projecy emsissions related to auxiliary diesel consumption is very low that it can be neglected.

4.3 Leakage

According to the ACM0002, version 12.1.0 methodology no leakage is expected, as the energy generating equipment is brand new state of the art technology, and is not transferred from another activity. Therefore, the **leakage from the project activity is zero**.

4.4 Summary of GHG Emission Reductions and Removals

The project emissions that result from the combustion of diesel fuel in the auxiliary generators is calculated to be negligable, and the leakage equals also zero, therefore the emission reductions in 2009, 2010 and 2011 are equal to the corresponding baseline emissions.

Below table (Table 6) provides a summary of the project emissions:

Table 6 : A summary of the GHG emission reductions by the project activity.

Emission Reduction Calculations
Koyulhisar Hydroelectric Power Project, Turkey

			VER01		
Data	***Symbol***	***Units***	**2009**	**2010**	**2011**
Net electricity generated	E1	MWh	22.497,28	218.088,84	162.737,32
National Grid Emission Factor	EF_{CS}	tCO_2e/MWh	0,528	0,528	0,528

Baseline Emissions	***Symbol***	***Units***	**2009**	**2010**	**2011**
Koyulhisar HPP Üretim. = E1 * EF_{CS}	BE1	tCO_2e	11.884,41	115.207,61	85.967,62

Project Emissions	***Symbol***	***Units***	**2009**	**2010**	**2011**
N/A	PE	tCO_2e	0	0	0

Leakage	***Symbol***	***Units***	**2009**	**2010**	**2011**
N/A	LE	tCO_2e	0	0	0

Emission Reductions	***Symbol***	***Units***	**2009**	**2010**	**2011**
= BE1 - PE - LE	ER	tCO_2e	**11.884,41**	**115.207,61**	**85.967,52**

TOTAL ERs	213.059

5 ADDITIONAL INFORMATION