



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

**Grid-Connected Electricity Generation From
Renewable Resources:**

**FEKE II 69.58 MW
Hydroelectric Power Plant**

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**SECTION A. General description of project activity****A.1. Title of the project activity:**

Title: FEKE II 69.58 MW HYDROELECTRIC POWER PLANT

Version: 03.1

Date: 15/06/2010

A.2. Description of the project activity:

Feke II Hydroelectric power plant project is located at the south of Turkey, in the Mediterranean Region, on the Goksu Creek, a main branch of Seyhan River, within the province of Adana, about 9 km southwest of Feke I district.

Feke I and Feke II projects were first developed by General Directorate of DSI (State Hydraulic Works) as a single project, to generate energy by utilizing the water potential of Goksu Branch in Seyhan Basin. However it was seen during the feasibility studies that the project would cause whole of Feke district to be covered with water, therefore the project was divided into Feke I and Feke II projects which are developed as individual projects.

Akkur Enerji Uretim Sanayi ve Ticaret A.S. has been awarded the project after bidding by the Turkish Energy Market Regulatory Authority (EMRA) and won the rights of the license for a period of 49 years.

The project consists of compressed concrete dam with a crest length of 256 meters and a height of 60 meters from the riverbed; 317 meters long derivation tunnel, upstream and downstream cofferdams, spillway, 171 meters long penstock, a powerhouse of 44 by 32 meters dimensions and 2 vertical axis Francis turbines with a gross head of 63 meters. The maximum capacity of the dam surface is 2.47 km².

Feke II HEPP project will have an installed capacity of 69.58 MW and is expected to have an annual generation of about 223.410 GWh of electricity. Electricity generated by the power plant will be delivered to the grid by a 7 km long 154 kV, 795 MCM overhead transmission line.

Main goals of the proposed project include;

- Utilize the hydroelectric potential of Turkey in the southern part of Turkey, in order to meet increasing electricity demand and guarantee the energy security. The increasing electricity demand is 8.1 % in 2007 (<http://www.teias.gov.tr/apkuretimplani/veriler>). If reserve energy capacity is below 2% (3814 GWh) the energy security is endangered.
- Increase share of HEPPs in electricity generation mix of Turkey and reduce GHG emissions.
- Contribute to economic development by creating direct and indirect job opportunities during construction and operation phases.
- Reduce import dependency on fossil fuel weighed electricity sector and diversify generation mix through use of local resources.
- Project does not include irrigation of lands; however DSI (State Hydro Works) has the priority to use the dam waters for irrigation.



Project will contribute to sustainable development in the region through creating new job opportunities during construction and operational phase. More than 320 people will be employed during construction stage, which shall take about 3 years. Project will also create employment opportunities for about 20 people during operation stage. In addition to direct and indirect job opportunities, project is also expected to increase income of fishermen in the region, increase the agricultural income of the local community and support the development Adana region.

Considering the contribution of the project on local and national economy, environment and local community, project will have positive influences on sustainable development in the region and in Turkey. The Feki District ranks as 797th among 872 districts in Turkey in terms of socio-economic development index and classified in group 6 which shows the least developed districts. The population centers are wide apart in this region. Population intensity is about 17 persons/km², one of the low population density Districts of Adana. As a result of transmigration, the population drops continuously and with the effect of poorness in investments to the city, the population of people at working age decreases. Average population increase has been 7.7% from the Feki District according to study of State Planning Organization¹. Main economic activity in the region is agriculture and main agricultural products are fruits and nuts. About 89% of the population works in agriculture and 9% works in service sector whereas ratio of population working in industrial sector is less than 2%.

Major milestones of project activity is given below:

Activity	Date
Issuance of Generation License	17/05/2007
Establishment of Plant Facilities	01/05/2008
Access Road Construction	01/06/2008
Start of Tunnel Construction	01/07/2008
Start of Dam Construction	01/12/2008
Start of Powerhouse Construction	01/12/2008
Start of EM Installation	01/01/2009
Start of Energy Transmission Line Construction	01/05/2009
Approval and Commissioning	01/07/2011
Expected Monitoring Period	Annual

A.3. Project participants:

Name of Party involved (*) (Host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant
Turkey (Host)	Akkur Enerji Elektrik Üretim AŞ. Global Tan Energy Ltd.	No

¹ Socioeconomical Development Index of Districts', State Planning Organization, 2004 (page 135)

**A.4. Technical description of the project activity:****A.4.1. Location of the project activity:**

The project site lies between 35° 51' 41.7" - 35 ° 52' 2.2" E longitudes and 37° 44' 35.9" - 37° 44' 52.6"N latitudes. The closest settlement is the Feke Village, about 10 km north of the project site, within the province of Adana.

A.4.1.1. Host Party(ies):

Although Turkey, the Host Country, passed legislation in Parliament on February 5th 2009 to ratify the Kyoto Protocol - Turkey does not have a quantitative emission reduction limit likely until post 2012 and as such is therefore in the interim period continues to be eligible for voluntary emission reduction projects.

A.4.1.2. Region/State/Province etc.:

Adana Province

A.4.1.3. City/Town/Community etc.:

Feke District,

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project site lies between 35° 51' 41.7" - 35 ° 52' 2.2" E longitudes and 37° 44' 35.9" - 37° 44' 52.6"N latitudes. The closest settlement is the Feke Village, about 10 km north of the project site, within the province of Adana. The project lies on the Goksu creek basin, which is a branch of Seyhan River.

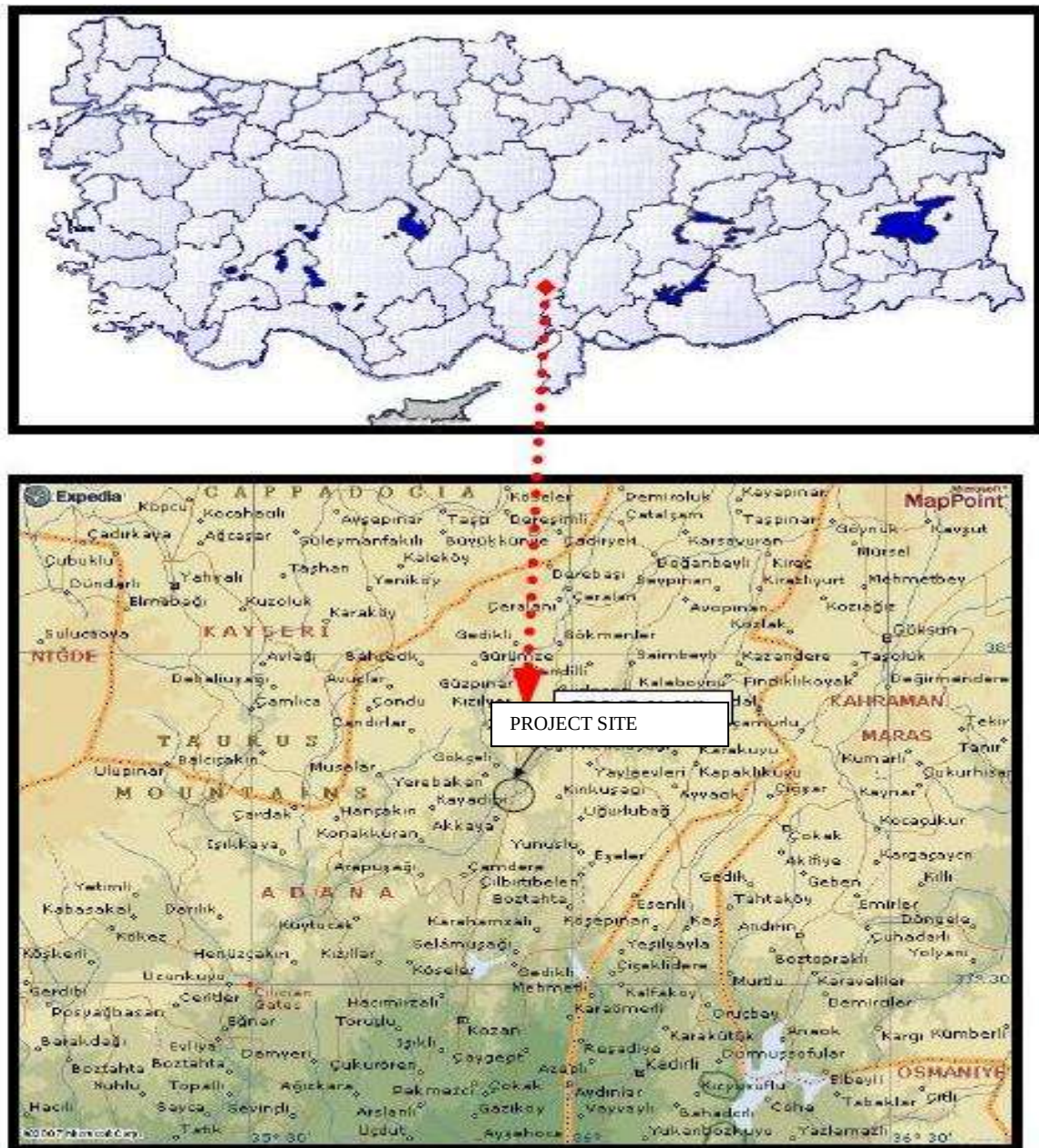
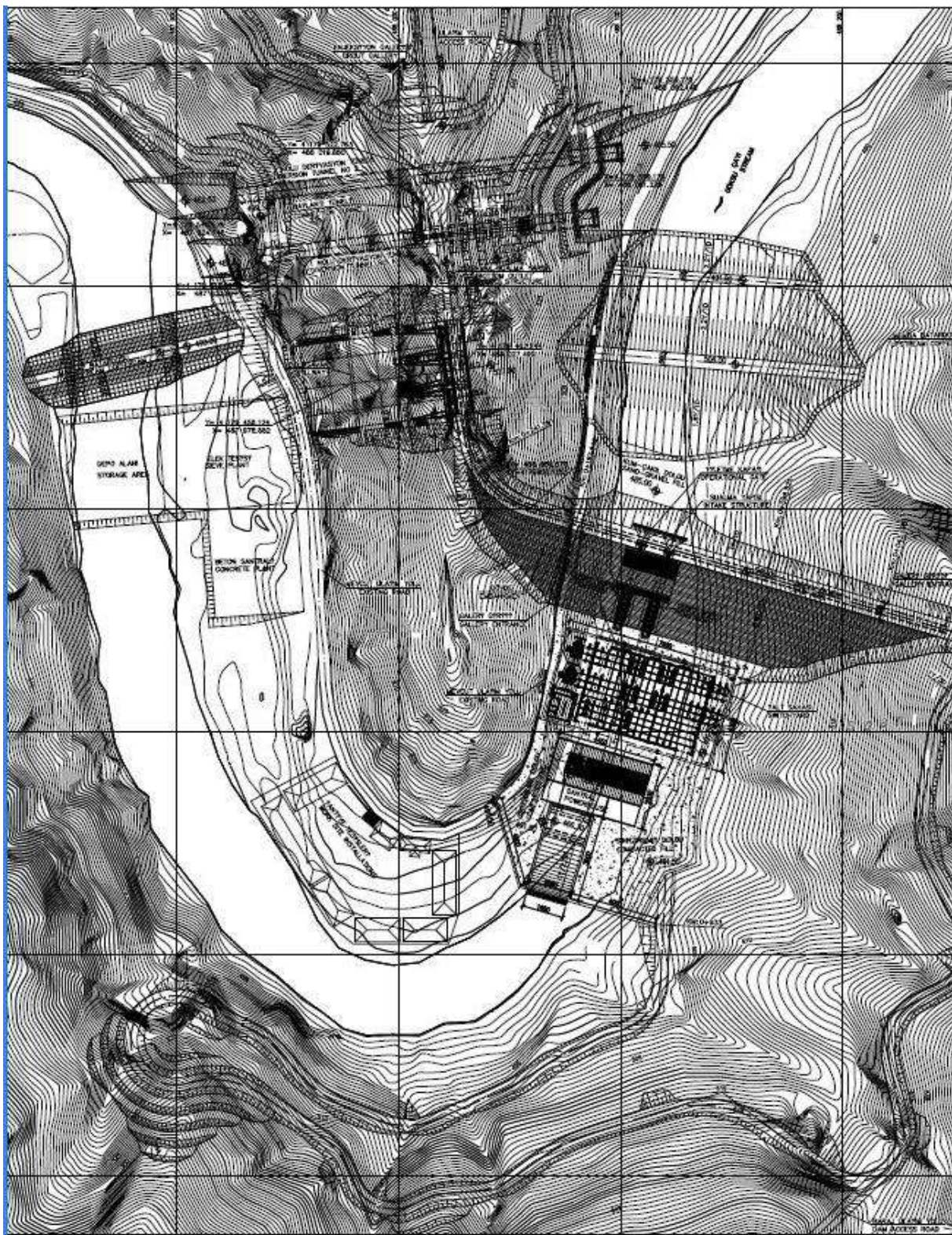


Figure 1. Location of the project site





The Feke District has a uneven topography and subject to landslide. Project site is about 2.8 and 4 km away from nearest settlements (Akkaya and Kısacıklı Villages).

The project boundaries involves both public, private and forest lands. Main elements of the project are located on public land. There exists no significant modern agricultural or animal breeding activity in the villages. Most of the agricultural lands are used for vegetable or fruit growing. There exist some lands around the project structures but most of them are not suitable for agricultural activity.

A.4.2. Category(ies) of project activity:

Proposed project activity is a large-scale project activity involves electricity generation from renewable sources therefore it is categorized in the sectoral scope 1 “Energy Industry – Renewable -/Non-renewable Sources” according to the UNFCCC definition².

It is an independent project with its own dam and its own powerhouse. It is not part of a grouped project. Since the project delivers more than 5,000 tons CO₂e and less than 1,000,000 tons of CO₂e per year, it is neither a micro project nor a mega project.

A.4.3. Technology to be employed by the project activity:

Hydroelectric power plants are structures that generate electricity utilizing energy of flowing water. Project consists of two vertical axes Francis turbines and generators which are used to transform the potential energy of water to mechanical energy at the first stage and later into electrical energy. The characteristics of the Feke II project are as follows:

LOCATION:	GÖKSU RIVER/FEKE DISTRICT/ADANA PROVINCE
DESIGN DISCHARGE:	127.50 M ³ /SEC
LENGTH OF TUNNEL:	317 M
AVERAGE NATURAL FLOW	51.17 M ³ /SEC
GROSS HEAD:	63 M
RIVERBED HEIGHT	485 M
CREST HEIGHT	545 M
TOTAL INSTALLED CAPACITY:	69.58 MW
RESERVOIR VOLUME	1610.5 HM ³
MAX. RESERVOIR SURFACE AREA	2.477 KM ²
NUMBER OF UNITS:	2 EACH
TURBINE TYPE:	FRANCIS TYPE – VERTICAL AXIS
TURBINE MANUFACTURER:	ECIDI
GENERATOR TYPE:	3 PHASE SYNCHRONOUS WITH 0.98 EFFICIENCY
LENGTH OF ENERGY TRANSMISSION LINE:	7 KM
ENERGY TRANSMISSION LINE CAPACITY:	154 KV
NUMBER OF PENSTOCKS:	1
LENGTH OF PENSTOCK:	171 M
AVERAGE ANNUAL POWER GENERATION:	223.410 GWH
GRID CONNECTION	THE GRID CONNECTION SHALL BE PROVIDED BY MEANS OF A 7 KM LONG 795 MCM ENERGY TRANSMISSION LINE TO FEKE I TRANSFORMER

² <http://cdm.unfccc.int/DOE/scopes.html>



SUBSTATION,

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

Years	Annual estimation of emission reductions in tones of CO₂ e
2011 (01.07.2011 – 31.12.2011)	61,102
2012	122,205
2013	122,205
2014	122,205
2015	122,205
2016	122,205
2017	122,205
2018	122,205
2019	122,205
2020	122,205
2021	61,103
Total emission reductions (Tones of CO₂ e)	1,222,050
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tones of CO₂e)	122,205

Table 1. Estimated amount of emission reduction

Project net emission reduction calculation has been based on expected electricity generation, and considering project emissions. The highest risk in achieving the estimated GHG reduction is failure of the project to generate the estimated electricity which may exist either due to decrease in river flow or increase in demand for water for other activities.

A.4.5. Public funding of the project activity:

No public funding or ODA is used for the project.

**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

The United Nations approved consolidated baseline methodology applicable to this project is ACM0002 “Consolidated methodology for grid-connected electricity generation from renewable sources”, Version 10³.

ACM0002 refers to the following tools:

- “Tool for the demonstration and assessment of additionality”, Version 05.2,⁴ and
- “Tool to calculate the emission factor for an electricity system”, Version 02⁵.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The choice of methodology ACM0002, is justified as the project activity meets its applicability criteria:

- Feke II 69.58 MW Hydroelectric Power Plant Project involves installation of a new grid connected renewable electricity generation plant,,
- The project does not involve switching from fossil fuel use to renewable energy at the site of the project activity; and
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available.
- Project involves formation of a new reservoir with power density is higher than 4 W/m². (28.09 W/ m²)

Since there exists no delineation of project electricity system or connected electricity systems by DNA, following criteria has been used to determine the existence of significant transmission constraints:

- In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year.
- The transmission line is operated at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

³ http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_YOYKBRCBIK7TSPSB7MQT75SPX75PE8

⁴ http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

⁵ See: http://cdm.unfccc.int/methodologies/Tools/EB35_repan12_Tool_grid_emission.pdf

Since the project output is fed to the Turkish electricity grid which does not involve any distinct electricity systems that applies different price, first criteria defined above is not applicable. Also, since the transmission line between the proposed project and nearest substation is built within the scope of the project and there exist no information on grid capacity utilization, second criteria is also inapplicable. Based on assessment above, it is difficult to conclude with a significant transmission constraint or grid boundary. Since there is no dispatch grid system in Turkey, the project boundary is considered as the National Electricity Grid of Turkey according to applied tool. The geographical and physical boundaries of the Turkish grid and location of the power plants are well identified as given diagram below.

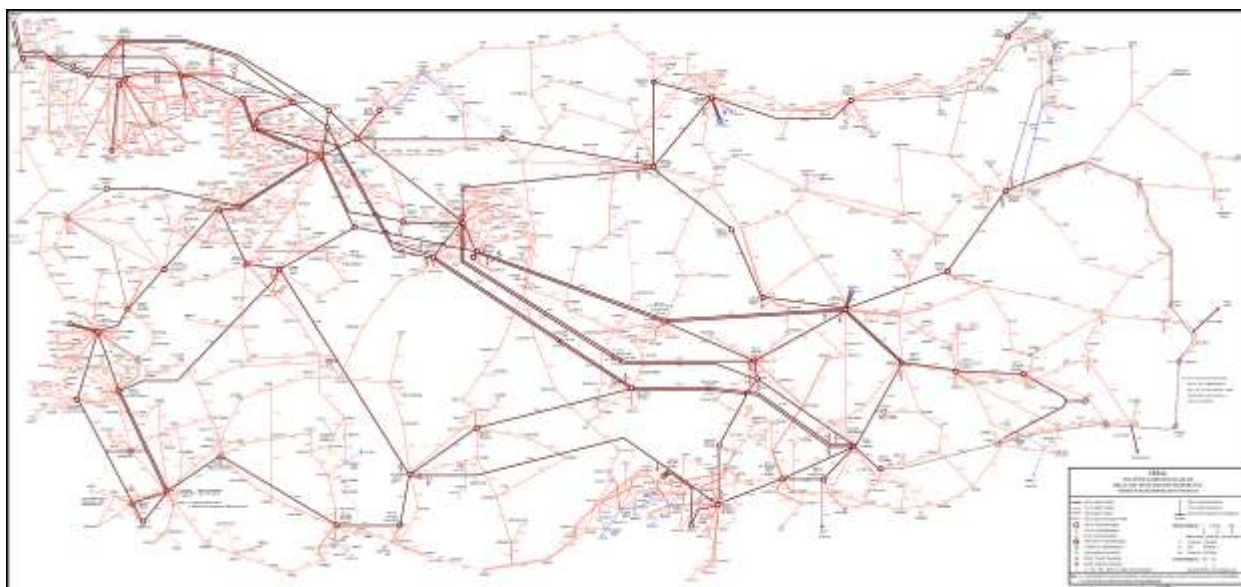


Figure 3. Turkish Electricity Grid⁶

B.3. Description of the sources and gases included in the project boundary:

GHG gases included in the project boundary and used in calculation of emission reduction by the project activity are given in table below.

	Source	Gas	Included?	Justification/Explanation
Baseline	Electricity generation in baseline (Turkey Grid)	CO ₂	Yes	Main Emission Source
		CH ₄	No	Minor emission source. Excluded for simplification
		N ₂ O	No	Minor emission source. Excluded for simplification
Project Activity	Emission from the reservoir of the proposed project.	CO ₂	No	Minor emission source. Excluded for simplification

⁶ <http://www.teias.gov.tr/eBulten/makaleler/2008/t%C3%BCrkiye%20elektrik%20sistemi.pdf>



		CH ₄	Yes	CH ₄ emissions have been considered in the project boundary. However, since the power density is higher than 10W/m ² , it has been taken as “0” as per the applied methodology.
		N ₂ O	No	Minor emission source. Excluded for simplification

Table 2. GHG gases included in the project boundary

The project boundary is limited by the National Electricity Grid of Turkey. The Geographical and physical boundaries of the Turkish grid and location of the power plants are clear. Import data obtained from the relevant government agencies (EUAS - Turkish Electricity Generation Corp., TEIAS – Turkish Electricity Transmission Corp., Ministry of Energy and Natural Resources) have been included in the calculations of the combined margin emissions.

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

This project follows the methodology described in the ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”. Selected methodology has been applied together with the “tool to calculate the emission factor for an electricity system, version 02” and “tool for assessment and demonstration of additionality, version 5.2”.

The baseline scenario has been identified as “*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 in the “Tool to calculate the emission factor for an electricity system”*”

Turkish electricity generation is composed mainly of thermal power plants. The share of hydroelectric power plants has decreased significantly in recent years, due to the reduction of the economically feasible hydraulic resources. Since Turkey is an advanced developing country, there is an increasing demand for electricity which is fully expected to continue in the foreseeable future.

The trend in Turkey to date, given the historically slow development of alternative energy resources, is to build an increasing number of thermal power plants in the future, to cover the annual growth in energy consumption demand. As such, Turkey as an advanced developing nation has to date dealt with energy security by constructing high capacity coal and natural gas power plants. The development of thermal power plants has been also encouraged by the abundance of economically accessible lignite.

In the absence of the proposed project activity, same amount of electricity is required to be supplied via either the current power plants or by an increased number of thermal power plants⁷, thus increasing GHG emissions.

⁷ <http://www.epdk.gov.tr/lisans/elektrik/lisansdatabase/verilentesistipi.asp>

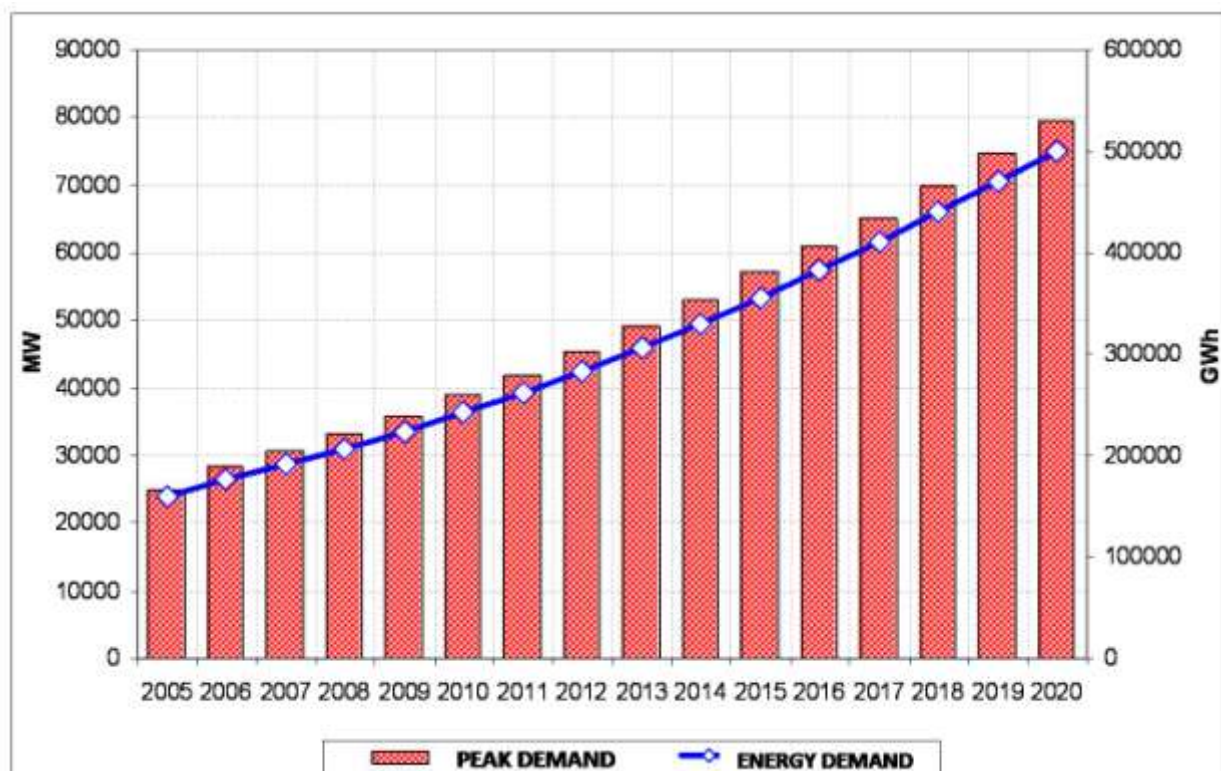


Figure 3. Peak Load and consumption projection for Turkish electricity system between 2005-2020⁸

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

According to the applied methodology (ACM0002) baseline scenario for the project has been defined as “generation of equal amount of electricity by the power plants connected to the grid”. Emission factor for the baseline scenario has been calculated according to the combined margin approach as defined by the selected methodology. Within this framework, project is expected to generate about 223,410 GWh of electricity and reduce about 137,368 tCO₂ annually, through replacing the electricity that would need to be supplied via the National grid in the absence of the project activity. Additionality of the proposed project has been assessed according to the applied tool for demonstration of additionality as shown in following steps.

Step 1 - Identification of Alternatives to the project activity consistent with current laws and regulations

⁸ <http://www.teias.gov.tr/apkuretimplani/veriler.htm>

**Sub-step 1a - Define alternatives to the project activity:**

Most realistic and reliable alternatives to the project activity are:

1. Proposed project not undertaken as a VER project activity
2. Continuation of the current situation-supply of equal amount of electricity in the grid by the grid connected power plants
3. Construction of a thermal power plant with the same installed capacity or the same annual power output.

First alternative, which is the implementation of the project without carbon revenue is not financially attractive as discussed in investment analysis section below. The Second alternative (Scenario 2) is the baseline scenario and implementation of the proposed project as a VER activity would be additional to this scenario. In the absence of project activity, it is assumed that same amount of electricity would be provided by the grid connected power plants. Since the electricity demand is increasing, in order to meet this demand, new power plants must be built which uses fossil fuels or renewable sources. When we review the licenses issued by EMRA, it is seen that weight of thermal power plants will continue to increase in the overall electricity mix of Turkey thus increasing electricity sector emissions⁹. Proposed project will provide zero emission electricity and reduce significant amount of GHG compared to baseline scenario.

Last alternative is considered a significant alternative to the project activity since the growth of thermal power plants has increased and is expected to continue to disproportionately increase in the future due to demand for electricity predicted to increase by near 100% from the current level of approximately 40,000 MW to 79,000 MW by year 2020.

Outcome of Step 1a

Three realistic alternatives have been identified for the project scenario as defined above. In the absence of proposed VER activity, most likely scenarios will be

- Supply of electricity by the grid which requires addition of new power plants or ;
- Implementation of a thermal power plant to deliver electricity in order to meet the electricity demand.

Sub-step 1b. Consistency with mandatory laws and regulation

The following applicable mandatory laws and regulations have been identified:

1. Electricity Market Law¹⁰
2. Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity Energy¹¹
3. Energy Efficiency Law¹²

⁹ <http://www.epdk.gov.tr/lisans/elektrik/lisansdatabase/verilentesistipi.asp>

¹⁰ Law number 4628, enactment date 03/03/2001 <http://www.epdk.gov.tr/english/regulations/electricity.htm>

¹¹ Law number 5346, enactment date 18/05/2005 <http://www.eie.gov.tr/duyurular/YEK/LawonRenewableEnergyReources.pdf>



4. Forest Law¹³
5. Environment Law¹⁴

The resultant alternatives to the project as outlined in Step (1a) are in compliance with the applicable laws and regulations which is assessed by EMRA before issuing license. The renewable energy generation license for Feke-II HEPP has been issued considering Electricity Law and Law on utilization of Renewable Energy Resources for the purpose of generating electricity energy. The proposed project is also within the scope of and in compliance with Energy Efficiency Law (Article 2 of Part One). Environment Law is also satisfied in terms of sustainable development principles and EIA conducted for the proposed project activity. Finally, Forest Law which specifies that forest areas can be allocated by Ministry of Environment and Forestry to institutions or individuals for energy plants if the project implementation serves common good for public.

Outcome of Step 1b

Mandatory legislation and regulations for each alternative are taken into account in sub-step 1b. Based on the above analysis, the proposed project activity is not the only alternative amongst the project participants that is in compliance with mandatory regulations. Therefore, the proposed VER project activity is considered as additional.

Step 2 - Investment analysis

The investment analysis has been done in order to make an economic and financial evaluation of the project. No public funding or ODA are available in Turkey for finance of this type of projects. Although loan agreement were not in place at the time of the investment decision, Feke II project was assumed to be financed 50% by loan based on assumption of the company at time of investment decision.. The expected average generation has been taken as 223.410 GWh during the investment analysis.

Sub-step 2a - Determine appropriate analysis method

There are three options for the determination of analysis method which are:

- Simple Cost Analysis
- Investment Comparison Analysis and
- Benchmark Analysis

Since Project generates economic benefits from sales of electricity, the simple cost analysis is not applicable. Also, since the baseline of the project is generation of electricity by the grid, no alternative investment is considered at issue. So, it has been decided to use benchmark analysis for evaluation of the project investment.

Sub-step 2b. Option III. Apply benchmark Analysis

¹² Law number 5627, enactment date 02/05/2007

http://www.eie.gov.tr/english/announcements/EV_kanunu/EnVer_kanunu_tercume_revize2707.doc

¹³ Law number 6831, enactment date 31/08/1956

¹⁴ Law number 2872. Published in official gazette No. 18132 on 11/08/'83



According to the “Tool for the demonstration and assessment of additionality”, a relevant benchmark for an equity IRR can be derived from government bond rates increased by a suitable risk premium (to reflect private investment and/or project type). For benchmark analysis of the project, Eurobond rates from web page¹⁵ of a government bank available on 17/05/2007 (project start date) have been used as given in table below.

Bond	Maturity Date	Currency	Rate
US900123AL40	15.01.2030	USD	6.83

Table 3. Government bond rates used for the benchmark analysis.

Sub-step 2c. Calculation and comparison of financial indicators

Parameters	Unit	Data Value
Installed Capacity	MW	69.58
Grid Connected output	GWh	223.410
Capital Investment	Million €	77,9956
Income tax rate	%	20
Loan	%	50
Tariff	€ Cents/kWh	5.5
Expected VERs price	€/ tCO ₂ e	7

Table 4. Main financial parameters used for investment analysis

IRR of Feka II HEPP has been calculated as 8.81 % based on the parameters given above including the carbon revenue which corresponds to 7.38% in the absence of carbon revenue. Date of investment decision has been identified as the date of license issuance (17/05/2007) and exchange ratios have been selected accordingly. Analysis has been made for a period of 20 years starting from first significant payments for the project. Electricity tariff has been used as €5.5 Cent/kWh although this is the maximum amount and floor price is €5.0 Cents/kWh as given in renewable energy law. Annual generation has been taken as 223.410 GWh. This IRR value represents the most optimistic scenario in terms of capital investment, electricity sales price and electricity generation. The analysis has been performed for 20 years operation period and residual value of the assets at the end of analysis period has been added as required by the methodology. Value added tax (VAT) has been included in investment cost for all domestic goods and services as indicated by regulation¹⁶ and deducted in cash flow.

Considering the Government bond rates (6.83%) and estimated country risk premiums which are around 9.41% for Turkey¹⁷, it can be concluded that expected return on investment for these types of projects should be above 16.24% for reasonable investors. Considering that Equity IRR of the project is much

¹⁵ <http://www.ziraat.com.tr/tr/bankamiz/faiz-ve-ucretler/asp/eurobond.aspx>

¹⁶ http://www.alomaliye.com/kdv_23.htm

¹⁷ <http://www.stern.nyu.edu/~adamodar/pc/archives/ctryprem06.xls> (accessed on 19/02/2010)



lower than benchmark value for the given parameters, it is concluded that project is not financially attractive.

When we include the carbon revenue in the cash flow, IRR increases about 1.5% (for €5.5 cents tariff) and the project becomes more attractive for the investors as coupled with the view that energy sale prices that can be achieved from the project will likely increase in future years. Expectation that the floor electricity prices will increase is the risk for investors whereas realization of this expectation will increase the premium. For Feke-II HEPP, in order to reach the benchmark value, average tariff should be around €8.5 cents together with the carbon revenue.

Sub-step 2d - Sensitivity Analysis

Sensitivity analysis has been carried out for three main parameters identified;

- Investment Cost
- Operating Cost
- Electricity Sales revenue

For a range of $\pm 10\%$ fluctuations in parameters above, below table has been obtained, for €5.5 cents tariff without carbon revenue..

	% Fluctuation						
	-20	-10	-5	0	5	10	20
Investment Cost	11.28	9.17	8.24	7.38	6.58	5.83	4.47
Operating Cost	7.80	7.59	7.48	7.38	7.27	7.16	6.95
Electricity Income	3.69	5.60	6.50	7.38	8.23	9.05	10.64

Table 5. Sensitivity analysis for Feke II project (excluding carbon revenue)

Outcome of Step 2:

The investment and sensitivity analysis shows that the VER revenues will improve the financial indicators of the project and make the project more attractive for investors and funding institutions. Considering that figures above are based on highest governmental guarantee price rather than average price, optimistic estimations for yearly generation and that those figures do not reflect the risk for investment, role of carbon income is a most significant number to enable the project to proceed and favorable investment and funding decision taken.

For the proposed project, equity IRR has been calculated as 7.38% for the parameters given which is much lower than the benchmark IRR 16.24% for the alternative investment scenario.

Based on the analysis and information above, it is concluded that project is not the most attractive option considering alternative investment opportunities. Therefore project is considered as additional to the baseline scenario.

Step 3. Barrier analysis

Barrier analysis section is not applied as per the tool.

Step 4. Common Practice Analysis

Sub-step 4a. Analysis of other activities similar to the proposed project activity

According to the TEIAS statistics¹⁸, share of HEPPs in total installed capacity of Turkey is about 32.8% whereas share of HEPPs in total generation is only 18.7%. However, when we examine the historical data, it is observed that total installed capacity of thermal power plants has shown a rapid growth in parallel with the demand for electricity whereas hydroelectric power generation has grown at a far slower rate - the energy generation proportion decreasing from 40% historically to the current levels as shown in the figure below^{19,20}.

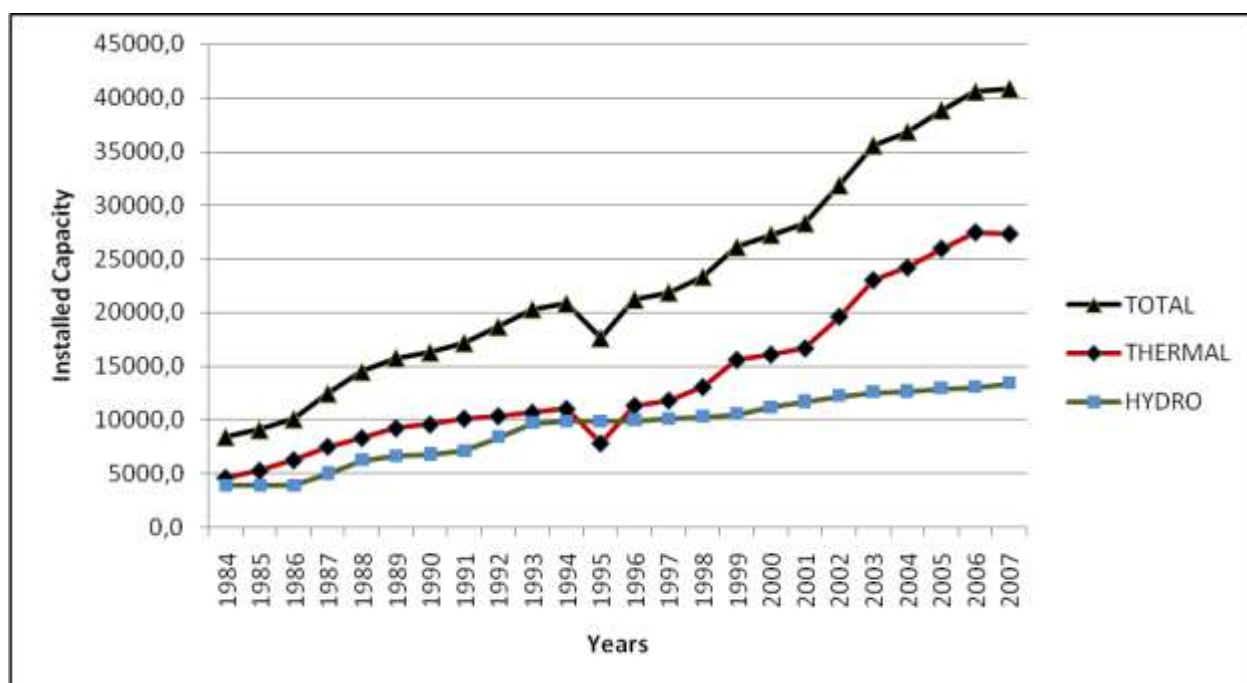


Figure 4. Annual Development of Turkey's Installed Capacity

Sub-step 4b. Discuss any similar options that are occurring:

The main reason behind the decrease in share of hydro electricity power is due to the changes in government's economic policy which intends to encourage private companies to invest in energy generation and lower the weight of government on energy generation as a part of privatization efforts. On the other hand, private companies have mainly preferred to invest in thermal power plants which can be

¹⁸ <http://www.teias.gov.tr/ist2007/1.xls>

¹⁹ <http://www.teias.gov.tr/ist2007/32.xls>

²⁰ IEA Turkey Country Report, 2005



commissioned in shorter time periods, require lower initial investment and uses conventional technologies. Installed capacity of thermal power plants owned by generation companies has increased from 123.4 MW in 1996 to 10,688.8 MW in 2007 whereas the total capacity of hydro electricity power plants has only increased from 75.3 MW to 1,345 MW (including auto producers, generation companies, Build-Operate-Transfer (BOT) plants and concessionary companies) in the same period which shows that private companies find more attractive to invest in thermal power plants^{21,22,23}.

When we look at the distribution of hydro power capacity by utilities, it is seen that total generation capacity of the hydroelectric power plants owned by generation companies is 1,326 GWh by end of 2007²⁴ which corresponds to 0.69% of the total generation capacity (191,558.1 GWh) of Turkey at that time. However, a detailed review of these has shown that majority of these plants have been initially licensed/implemented as Autoproducer or BOT power plants but later licenses have been revised as Generation Company License during liberalization of Turkish Electricity Market and some of them have been built using VER revenue (See Annex 8 for details). When these plants are excluded, the sum of remaining power plants corresponds to less than 0.003% of total installed capacity at time of investment decision.

Besides the fact that each project is different and has unique characteristics, information (Investment Model, incentives, investment & finance cost or IRR) about these plants is not publicly available. Therefore a reliable comparison of these plants would not result in a reliable outcome. Figure below demonstrates that recently built hydroelectric power plants are not as efficient as the previous ones and serve as a good example to the point issued in previous statement. The figure also shows the fluctuation in electricity generation which poses high investment risk especially for run-off-river type hepps.

²¹ [http://www.teias.gov.tr/ist2007/5\(1984-05\).xls](http://www.teias.gov.tr/ist2007/5(1984-05).xls)

²² <http://www.teias.gov.tr/ist2006/8.xls>

²³ <http://www.teias.gov.tr/ist2007/8.xls>

²⁴ <http://www.teias.gov.tr/projeksiyon/KAPASITEPROJEKSIYONU2008.pdf> (page 120)

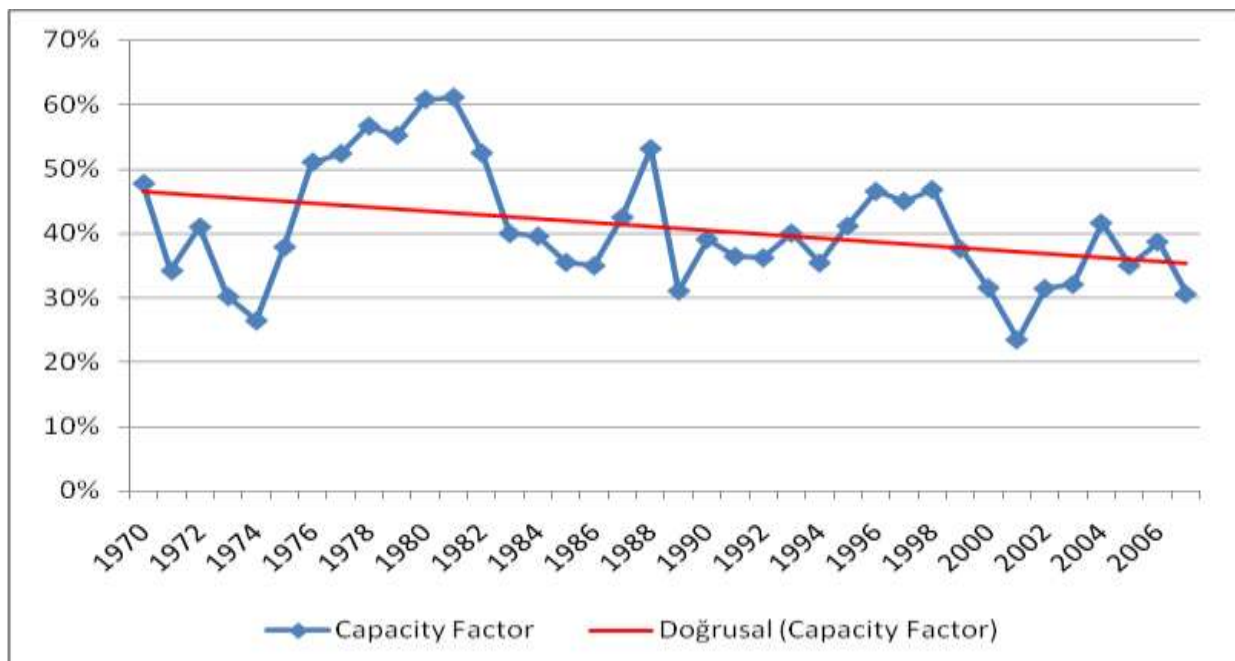


Figure 5. Evolution of Capacity(Plant Load) Factor of HEPPs in Turkey.Hata! Yer işareti tanımlanmamış.'Hata! Yer işareti tanımlanmamış.

Outcome of Step 4:

Given the past and continuing weight and presence of government influence, as mentioned and illustrated from the above facts, it is seen clearly that there exists no similar activity in the region implemented without considering carbon revenue. Also, considering that most of the existing HEPP projects have been built by government agencies and weight of hydropower plants in Turkey's installed capacity is decreasing, it is concluded that the proposed project is not considered as a common practice

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Emission factor has been calculated in a conservative manner as requested by the methodology. Basic assumptions made are;

- Emission factor will remain same over the crediting period,
- Emission factor of fuels sources is "0" or the lowest value in the references when there is no information.

The additionality assessment of the project activity has been demonstrated using the latest version of the 'Tool for assessment and demonstration of additionality'.

According the "Tool to calculate the emission factor for an electricity system", ver.2, the following four methods are applicable to calculate the operating margin:



- a) Simple OM,
- b) Simple adjusted OM,
- c) Dispatch Data Analysis OM and
- d) Average OM.

Since the fuel consumption data is not available for each power plant, method (d) is eliminated. Also due to insufficient data available, methods (b) and (c) are not considered and thus (a) simple OM method is used in calculations. The following table is used for demonstrating the share of low cost/must run resources.

Year	Total Generation (GWh)	Low-Cost, Must-Run Resources (GWh)	Share of Low-Cost, Must-Run Resources
1975	15,623	6,124	39%
1976	18,283	8,536	47%
1977	20,565	8,791	43%
1978	21,726	9,472	44%
1979	22,522	10,433	46%
1980	23,275	11,484	49%
1981	24,673	12,726	52%
1982	26,552	14,167	53%
1983	27,347	11,343	41%
1984	30,614	13,448	44%
1985	34,219	12,051	35%
1986	39,695	11,916	30%
1987	44,353	18,676	42%
1988	48,049	29,018	60%
1989	52,043	18,002	35%
1990	57,543	23,228	40%
1991	60,246	22,803	38%
1992	67,342	26,685	40%
1993	73,808	34,085	46%
1994	78,322	30,716	39%
1995	86,247	35,849	42%
1996	94,862	40,734	43%
1997	103,296	40,193	39%
1998	111,022	42,574	38%
1999	116,440	34,984	30%
2000	124,922	31,208	25%
2001	122,725	24,392	20%
2002	129,400	34,010	26%
2003	140,581	35,595	25%
2004	150,698	46,339	31%
2005	161,956	39,836	25%
2006	176,300	44,619	25%
2007	191,558	36,576	19%
2008	198,418	34,499	17%
Average			37%

Table 6. Breakdown by source of electricity generation(1975-2008)²⁵**B.6.2. Data and parameters that are available at validation:**

Data / Parameter:	EG_{y, Total}
Data unit:	MWh
Description:	Net Electricity generated by power plants in Turkey
Source of data used:	TEIAS web page (http://www.teias.gov.tr/istatistik2008/30(84-08).xls)
Value applied:	169,543.1 GWh for 2006, 183,339.7 GWh for 2007, 189,761.9 GWh for 2008
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used for emission reduction calculation(for calculation of OM, Net-to-Gross electricity ratio and share of low-cost must-run sources)
Any comment:	

Data / Parameter:	EF_{CO₂, i, y i}																
Data unit:	tCO ₂ /TJ																
Description:	CO ₂ emission factor of fossil fuel type “i” in year “y”																
Source of data used:	-For EF of fossil fuels, IPCC values at the lower limit has been used.																
Value applied:	<table border="1"> <thead> <tr> <th>Fuel Source</th><th>EF(tCO₂/Tj)</th></tr> </thead> <tbody> <tr> <td>Coal</td><td>89.5</td></tr> <tr> <td>Lignite</td><td>90.9</td></tr> <tr> <td>Fuel Oil</td><td>75.5</td></tr> <tr> <td>Diesel</td><td>72.6</td></tr> <tr> <td>LPG</td><td>61.6</td></tr> <tr> <td>Naphta</td><td>69.3</td></tr> <tr> <td>Natural Gas</td><td>54.3</td></tr> </tbody> </table>	Fuel Source	EF(tCO ₂ /Tj)	Coal	89.5	Lignite	90.9	Fuel Oil	75.5	Diesel	72.6	LPG	61.6	Naphta	69.3	Natural Gas	54.3
Fuel Source	EF(tCO ₂ /Tj)																
Coal	89.5																
Lignite	90.9																
Fuel Oil	75.5																
Diesel	72.6																
LPG	61.6																
Naphta	69.3																
Natural Gas	54.3																
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0002, IPCC default values at lower limit of 95% confidence interval can be used. Although, the actual emission reduction is expected to be higher due to high EF of fuels consumed in existing power plants, IPCC values have been used for conservativeness as requested by the methodology.																
Any comment:																	

²⁵ [http://www.teias.gov.tr/istatistik2008/32\(75-08\).xls](http://www.teias.gov.tr/istatistik2008/32(75-08).xls)



Data / Parameter:	FC_{i,y}
Data unit:	Tons or 1000m ³ for gases
Description:	Amount of fuels consumed by thermal power plants for electricity generation in terms of fossil fuel type i in year y
Source of data used:	TEIAS web page (http://www.teias.gov.tr/istatistik2008/44.xls)
Value applied:	Given in table in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used for OM calculation
Any comment:	

Data / Parameter:	$\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit m in year y
Source of data used:	Annex I of “Tool To Calculate Emission Factor For An Electricity System”
Value applied:	Given in table in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used for BM calculation
Any comment:	

Data / Parameter:	NCV
Data unit:	Tj/kt
Description:	Net Calorific Values of Fuel combusted in power plants.
Source of data used:	TEIAS web page (http://www.teias.gov.tr/istatistik2008/46.xls and http://www.teias.gov.tr/istatistik2008/44.xls)
Value applied:	Given in table in Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used for OM and BM calculation. Values have been calculated by dividing total heating values of fuels consumed in thermal power plants by amount of fuel consumption for that year and weighted average of the values has been used in calculation of OM and BM.
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:



As per the tool, the following six steps for calculation of emission reductions have been applied:

Step 1. Identification of the relevant electrical power system

According to the “Tool to calculate the emission factor for an electricity system”, Version 02, a project electricity system has to be defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity, and that can be dispatched without significant transmission constraints. Therefore, in this project activity the project electricity system includes the project site and all power plants attached to the Interconnected Turkish National Grid, which has an installed capacity of 41,817.2 MW and gross generation about 198,418.0 by 2008^{26,27}.

For imports from connected electricity systems located in another host country (ies), the emission factor is taken as “0” tCO₂/MWh as requested by the methodology.

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

Option I has been chosen by the project developer hence only grid power plants are included in calculations.

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

The Simple Operating Margin (OM) emission factor ($EF_{grid, OM, y}$) is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all the generating plants serving the system, excluding low-cost/must-run power plants. As electricity generation from solar and low cost biomass facilities is insignificant and there are no nuclear plants in Turkey, the only low cost /must run plants considered are hydroelectric, wind and geothermal facilities.

The tool gives two options for the calculation of $EF_{grid, OM, y}$:

- **Ex-ante option**
A 3-year generation-weighted average, based on the most recent data available at the time of submission of the VER-PDD to the DOE for validation, without the requirement to monitor and recalculate the emissions factor during the crediting period, or
- **Ex-post option**
The year in which the project activity displaces grid electricity, with the requirement that the emissions factor to be updated annually during monitoring.

For this project the ex-ante approach is selected. Data for calculating the three year average is obtained from the period 2006 – 2008, the most recent data available at the time of PDD submission to the DOE.

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

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost / must run plants / units. The Simple OM has been calculated using option B which is based on

²⁶ <http://www.teias.gov.tr/istatistik2008/6.xls>

²⁷ [http://www.teias.gov.tr/istatistik2008/20\(2006-2008\).xls](http://www.teias.gov.tr/istatistik2008/20(2006-2008).xls)



Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system. Option B has been selected since;

- Generation and CO₂ data for individual power units are not available
- Only renewables are considered as low cost/must run resources
- Off-Grid power plants are not included in calculations.

As fuel consumption and average efficiency data for each power plant / unit are not available, Option B is used for simple OM calculation. Under Option B, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost / must run power plants / units, and based on fuel type(s), and total fuel consumption of the project electricity system, as follows:

$$EF_{\text{grid, OM, y}} = \frac{FC_{i, y}}{EG_y} \quad (1)$$

where:

$EF_{\text{grid, OM, y}}$	Simple operating margin CO ₂ emission factor in year “y” (tCO ₂ /GWh)
$FC_{i, y}$	Amount of fossil fuel type “i” consumed in the project electricity system in year “y” (mass or volume unit)
$NCV_{i, y}$	Net calorific value (energy content) of fossil fuel type “i” in year “y” (GJ / mass or volume unit)
$EF_{\text{CO}_2, i}$	CO ₂ emission factor of fossil fuel type “i” in year “y” (tCO ₂ /GJ)
EG_y	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” (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year “y”
y	Either the 3 most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex-ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

For the calculation of the Simple OM, the amount of fuel consumption ($FC_{i, y}$) and heating values of fuels are taken from website of TEIAS^{28,29}, the official source of related data. Fuel consumption values for the relevant years are given in table below:

Fuel Type	FC _{i,y} unit [Ton, except for Natural Gas (NG) (1000 m ³)]			
	2008	2007	2006	Total
Hard Coal	6,270,008	6,029,143	5,617,863	17,917,014
Lignite	66,374,20	61,223,821	50,583,810	178,181,751

²⁸ <http://www.teias.gov.tr/istatistik2008/44.xls>

²⁹ <http://www.teias.gov.tr/istatistik2008/46.xls>



Fuel Oil	2,173,371	2,250,686	1,746,370	6,170,427
Diesel Oil	131,206	50,233	61,501	242,940
LPG	0	0	33	33
Naphtha	10,606	11,441	13,453	35,500
Natural Gas	21,607,635	20,457,793	17,034,548	59,099,976

Table 9. Fuel Consumption in thermal power plants

The NCV of the fuels consumed have been calculated using data from the TEIAS web page. The emission factors required for calculation of CO₂ emission coefficient have been obtained through IPCC 2006 guidelines for GHG inventories for fuels. Details of the data used for the calculations are given in Annex 3.

	COEF (tCO₂/kt)	Consumption (2006 - 2008) (tons or 1000m³)	Total Emission (2006 - 2008) (tCO₂)
Coal	1,985	17,917,014	35,571,662
Lignite	625	178,181,751	111,311,693
Fuel Oil	3,013	6,170,427	18,590,041
Diesel Oil	3,093	242,940	751,393
LPG	-	33	0
Naphtha	3,040	35,500	107,934
Natural Gas	1,992	59,099,976	117,716,966
Total Emissions			284,049,689

Table 10. Calculation of emission factors for fuels

Net electricity generated and supplied to the Grid by thermal plants has been calculated using data obtained from the TEIAS web page³⁰. The ratio between gross and net generation has been calculated first, and assuming that the same ratio is valid for thermal plants; gross generation by thermal power plants has been multiplied by this ratio in order to find net generation by thermal plants. The calculation of EF_{grid,OM, y} requires the inclusion of electricity imports with an emission factor of 0 tCO₂/GWh. By including the imports in the electricity production this requirement is fulfilled. Summing up this with the imported electricity, total supply excluding low cost / must run sources are determined as given in table below.

Year	Gross Generation	Net Generation	Net/Gross	Gross Gen. Thermal³¹	Net Gen. Thermal	Import	Total Supply to the Grid
2006	176,299	169,543	0.962	131,835	126,783	573	127,356
2007	191,558	183,340	0.957	155,196	148,537	864	149,401
2008	198,418	189,762	0.956	164,139	156,979	789	157,768
Total Net Thermal Gen.					432,298	2,227	434,525

³⁰ [http://www.teias.gov.tr/istatistik2008/30\(84-08\).xls](http://www.teias.gov.tr/istatistik2008/30(84-08).xls)

³¹ <http://www.teias.gov.tr/istatistik2008/13.xls>

**Table 71. Gross/Net electricity generation by Turkish Grid**

Having calculated the total fuels emissions and net generation by thermal power plants as given in previous two tables, The $EF_{grid, OM, y}$ is calculated by simply dividing total emission by total net thermal electricity generation as defined in equation (1) above;

$$EF_{grid, OM, y} = 284,049,689 \text{ tCO}_2 / 434,524,925 \text{ MWh} \\ = 0.654 \text{ tCO}_2/\text{MWh}.$$

Step 5. Identifying the cohort of the power units to be included in the build margin.

The sample group of power units (m) used to calculate the build margin consists of whichever is larger of:

- The set of five power units that have been built most recently, and
- The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently³².

Option (b) has been chosen to identify this cohort of power units to be included in the build margin, since it is larger (in terms of power generation) than the result of (a).

The list of the most recent capacity additions to the grid and their average and actual generation capacities are available at the TEİAŞ web page^{33,34,35,36,37}. For determination of plants that comprise 20% of the system's generation, gross generation in year 2008 which is 198,418 GWh has been taken as reference and its 20% has been determined as about 39,684 GWh. Since 20% of the most recent year's generation falls partly on capacity of a plant, this plant was fully included in the calculations as requested by the methodological tool applied. Thus, total capacity included in BM calculation has increased to 45,776 GWh which reduces again to 44,237.3 GWh after excluding plants benefitting from VER revenue.

Step 6. Calculate the build margin emission factor

The Build Margin emission factor $EF_{grid, BM, y}$ is calculated as the generation-weighted average emission factor of a sample of power plants “m” for a specific year, as follows:

$$EF_{grid, BM, y} = \sum EG_{m,y} \cdot EF_{EL,m,y} / \sum EG_{m,y} \quad (2)$$

Where:

$EF_{grid, BM, y}$ = Build margin CO₂ emission factor in year “y” (tCO₂/MWh)

32 If 20% falls on partial capacity of a unit, that unit is fully included in the calculation

33 <http://www.teias.gov.tr/istat2004/7.xls>

34 <http://www.teias.gov.tr/istatistik2005/7.xls>

35 <http://www.teias.gov.tr/ist2006/8.xls>

36 <http://www.teias.gov.tr/ist2007/8.xls>

41 <http://www.teias.gov.tr/istatistik2008/8.xls>



- $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit “m” in year “y” (MWh)
 $EF_{EL,m,y}$ = CO₂ emission factor of power unit “m” in year “y” (tCO₂/MWh)
 m = Power units included in the build margin
 y = Most recent historical year for which power generation data is available

“Tool to Calculate the Emission Factor for an Electricity System” has been used for plant efficiency data although this approach is very conservative. Since tool does not contain any specific data for plants with LPG, Naphta etc. all of the plants consuming liquid fuels have been considered as open cycle plants. Plants using lignite and coal have been assumed as suing subcritical technology, whereas natural gas plants have been assumed as combined cycle plants. The assumptions have been based on TEIAS statistics which gives heating values of fuels consumed in thermal power plants^{38,39} and corresponding electricity generation^{40, 41} which shows that values used are very conservative compared to actual situation.

	EF CO ₂ (tCO ₂ /Tj)	Generation Efficiency	EF (tCO ₂ /MWh)
Coal	89.50	39.0%	0.826
Lignite	90.90	39.0%	0.839
Fuel Oil	75.50	39.5%	0.688
Diesel	72.60	39.5%	0.662
LPG	63.07	39.5%	0.561
Naphtha	73.33	39.5%	0.632
Natural Gas	56.10	60.0%	0.326

Table 82. Calculation of emission factor from most recent power plants

The build margin emission factor has been determined for the most recent capacity additions as shown in table below. For electricity generation from renewables and solid wastes, the emission factors have been taken as being “zero” since data is not available and the contribution of these plants is insignificant. The Build margin emission factor in the last column has been determined by multiplying each EF value with the corresponding electricity generation value for that fuel and dividing it by the total generation by the most recent capacity additions.

Fuel Source	Generation (MWh)	Percent Generation	EF	Emission by Source
Coal	1,125	2.5%	0.826	929
Lignite	11,482	25.1%	0.839	9.634

³⁸ <http://www.teias.gov.tr/ist2007/45.xls>

³⁹ <http://www.teias.gov.tr/ist2007/45.xls>

⁴⁰ [http://www.teias.gov.tr/ist2007/36\(06-07\).xls](http://www.teias.gov.tr/ist2007/36(06-07).xls)

⁴¹ [http://www.teias.gov.tr/ist2007/35\(2001-2005\).xls](http://www.teias.gov.tr/ist2007/35(2001-2005).xls)



Fuel Oil	208	0.5%	0.688	143
Diesel oil	2	0.0%	0.662	1
LPG	50	0.1%	0.561	28
Naphtha	0	0.0%	0.632	-
Natural Gas	26,907	58.8%	0.326	8.766
Renewable and wastes	85	0.2%	0.000	0.00
Solid	5	0.0%	0.000	0.00
Total Renewable	5,912	12.9%	0.000	0.00
TOTAL	45,776	100.0%		19,503
Capacity Built by VER				
Revenue	1,539			
Net Capacity Addition	44,237.3			

Table 93. Most recent capacity additions corresponding to 20% by fuel source

PROJECT	TYPE	INSTALLED CAPACITY (MW)	GENERATION CAPACITY (GWh)	STANDARD
ANEMON	WPP	30,4	92	GS
BARES	WPP	30	105	VER+
DOGAL				
ENERJI(BURGAZ)	WPP	14,9	48	GS
KARAKURT	WPP	10,8	28	GS
MARE MANASTIR	WPP	39,2	129	GS
ŞAMLI	WPP	21	104	GS
DATCA	WPP	8,1	24	GS
CATALCA	WPP	60	210	GS
YUNTDAG	WPP	42,5	161	GS
LODOS	WPP	24	85	GS
SAYALAR	WPP	30,6	97	GS
SEBENOBA	WPP	21,2	100	GS
DEGIRMENUSTU*	HEPP	25,7	69	VCS
HAMZALI	HEPP	16,7	117	GS
CALDERE	HEPP	8,7	35	VCS
KARGILIK	HEPP	23,9	83	VCS
KALEALTI	HEPP	15	52	VCS
Total		422,7	1.539	

Table 10. List of plants identified as VER projects

Finally, by summing up the weighted EF values, overall build margin emission factor have been calculated as:

$$EF_{\text{grid, BM, y}} = 19,503 \text{ tCO}_2 / (45,776.3 - 1,539) \text{ GWh}$$



$$= 0.441 \text{ tCO}_2/\text{GWh}$$

STEP 7 - Calculate the combined margin(CM) emission factor

Based on ACM0002, weighted average baseline emission factor is calculated as follows;

$$EF_{\text{grid, CM, y}} = w_{\text{OM}} * EF_{\text{grid, OM, y}} + w_{\text{BM}} * EF_{\text{grid, BM, y}} \quad (3)$$

Where:

$EF_{\text{grid, BM, y}}$ = Build margin CO₂ emission factor in year “y” (tCO₂/MWh) as calculated from equation (2) above.

$EF_{\text{grid, OM, y}}$ = Operating margin CO₂ emission factor in year “y” (tCO₂/MWh) as calculated from equation (1) above.

w_{OM} = Weighting of operating margin emissions factor (%)

w_{BM} = Weighting of build margin emissions factor (%)

The default values of the weights, w_{OM} and w_{BM} , as recommended by the selected methodology are 0.5 for both components. These default values have been used in calculating CM emission factor together without rounding the values of EF_{OM} and EF_{BM} .

Based on the formula above (3), baseline emission factor is calculated as;

$$EF_{\text{grid, CM, y}} = 0.5 * 0.654 + 0.5 * 0.441 = 0.547$$

The combined margin emission factor is therefore **0.547 tCO₂/MWh**. Emission factor will remain same during the first crediting period as recommended by the methodology ACM0002, version 10.

The *ex-ante* emission reductions (ER_y) are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (4)$$

Where:

ER_y = Emission reductions in year y (tCO₂)

BE_y = Baseline emissions in year y (tCO₂)

PE_y = Project Emissions in year y (tCO₂)



LE_y = Leakage emissions in year y (tCO₂)

Baseline emissions

Baseline emission is calculated according to the formula

$$\begin{aligned} BE_y &= EG_y \times EF_y \\ &= 223.410 \text{ GWh} \times 547 \text{ tCO}_2/\text{GWh} \\ &= 122,205 \text{ tCO}_2 \end{aligned}$$

Where:

EG_y = Net electricity delivered to the grid by the project activity in year y excluding transmission losses of the grid.

EF_y = Emission factor calculated according to selected methodology

Project emissions

The proposed project activity involves the generation of electricity by a hydroelectric power plant which has power density higher than 10W/m², therefore emissions from reservoir is ignored as per the applied methodology.

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

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

Where:

PD = Power density of the project activity (W/m²)

Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W)

Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero

A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m²)

A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m²). For new reservoirs, this value is zero

For Feke II HEPP,

Cap_{PJ} = 69,580,000 W

Cap_{BL} = 0.0 W

A_{PJ} = 2,477,000 (m²)

A_{BL} = 0.0 (m²)

Therefore PD is calculated as ;



$$PD = \frac{69580000 - 0}{2477000 - 0}$$

$$PD = 28.09 \text{ W/m}^2$$

Leakage

The energy generating equipment is not transferred from or to another activity. Therefore leakage is also considered as “0”.

$$LE_y = 0$$

As a result: Total Emission Reduction is;

$$ER_y = BE_y = 122,205 \text{ tCO}_2$$

B.6.4 Summary of the ex-ante estimation of emission reductions:

Years	Annual estimation of emission reductions in tones of CO ₂ e
2011 (01.07.2011 – 31.12.2011)	61,102
2012	122,205
2013	122,205
2014	122,205
2015	122,205
2016	122,205
2017	122,205
2018	122,205
2019	122,205
2020	122,205
2021	61,103
Total emission reductions (Tones of CO₂ e)	1,222,050
Total number of crediting years	10
Annual average over the crediting period of (tones of CO₂e)	122,205

Table 11. Estimated emission reduction by the proposed project

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

Monitoring plan has been applied according to the selected methodology (ACM0002). According to the applied methodology, all data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data will be monitored if not indicated otherwise in the tables below. All measurements will be conducted with calibrated measurement equipment according to relevant standards



Data / Parameter:	EG_{facility, y}
Data unit:	GWh/year
Description:	Net Electricity generated and delivered to grid by Feke II power plant in year y
Source of data to be used:	Metering devices used in power plants, monthly records signed by TEİAŞ and plants manager and invoices will be used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Estimated annual generation forming the basis for emission reduction calculation is 223.410 GWh
Description of measurement methods and procedures to be applied:	Generation data will be recorded by two metering devices continuously. These records will provide the data for the monthly invoicing to TEİAŞ. Each month, an officer from TEİAŞ and the plant manager/electricity technician of the plant will record the reading and sign. This record will form the basis for monthly invoicing.
QA/QC procedures to be applied:	Two calibrated ammeters will backup each other. Maintenance and calibration of the metering devices will be made by TEİAŞ periodically. If there is a noticeable 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.
Any comment:	

Data / Parameter:	Cap_{pr}
Data unit:	W
Description:	Installed capacity of hydro power plant after the implementation of project activity
Source of data to be used:	Project Site
Measurement Procedure	N/A
Monitoring Frequency	Yearly
QA/QC procedures to be applied:	-
Any comment:	

Data / Parameter:	A_{pr}
Data unit:	m ²
Description:	Area of reservoir measured on the surface of the water, after the implementation of the project activity, when reservoir is full.
Source of data to be used:	Project site
Measurement Procedure	Measured from topographical surveys or maps.
Monitoring Frequency	Yearly
QA/QC procedures to be applied:	-



Any comment:	Maximum area is already calculated in the feasibility report and considered in calculations. Annual measurements are not expected to be higher than this value.
B.7.2. Description of the monitoring plan:	

Monitoring is a key procedure to verify the real and measurable emission reductions from the proposed project. To guarantee the proposed project's real, measurable and long-term GHG emission reductions, the monitoring plan is established.

In order to demonstrate the emission reduction, only the required data is the net electricity delivered to the grid by the project activity and internal combustion for the auxiliary diesel generator. Data for the carbon content of the diesel fuel will be calculated from TEIAS web page.

Net electricity generation will be measured and recorded by both TEIAS and project owners for billing purposes therefore no new additional protocol will be needed monitoring emission reduction. Power Plant Manager, will be responsible for the electricity generated, gathering all relevant data and keeping the records. He will be informed about VER concepts and mechanisms and how to monitor and collect the data which will be used for emission reduction calculations.

Generation data collected during crediting period will be submitted to Global Tan Energy who will be responsible for calculating the emission reduction subject to verification: Generation data will be used to prepare monitoring reports which will be used to determine the vintage from the project activity. These reports will be submitted to the duly authorized and appointed Designated Operational Entity 'DOE' before each verification period.

VER Team Members is expected to include the following staff of the HEPP:

Plant Manager: Responsibility for running the HEPP plant and compliance with VER monitoring plan

Electrical Engineer: Responsible for day electrical operations and recording and monitoring of relevant data and periodic reporting

Accounting Manager: Responsible for keeping data about power sales, invoicing and purchasing.
and

Global Tan Energy: Responsible for emission reduction calculations, preparing monitoring report and periodical verification process.

Installation of meter and data monitoring will be carried out according to the regulations by TEIAS. Two metering devices (one of them used as spare) will be used for monitoring the electricity generated by the power plant. Readings will be done using main metering devices and spare metering device will be used for comparison only. Data from metering devices will be recorded by TEIAS monthly and will form the basis for invoicing. In addition to the two metering devices, generation of the HEPP can be cross checked from TEIAS – PMUM web site (<http://pmum.teias.gov.tr>) which is accessible using a password provided to electricity generation companies. Since the data in PMUM web page will show the net electricity generated less transmission loss, in order to match the data, the figures taken from PMUM web site must be multiplied by transmission loss factor of the grid.

The net electricity fed to the grid will be measured continuously and recorded monthly by the TEIAS and plant staff. For consistency, recorded data will be compared with electricity sale receipts.



Calibration of the metering devices will be made by TEIAS and sealed before the commissioning of the power plant. The meters will be calibrated by TEIAS when there is an inconsistency between two devices as defined in the relevant regulations⁴².

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

Baseline Study and monitoring methodology completed in 15/06/2009

By:

Mehmet Kemal Demirkol and Ferit Arsan -

Global Tan Energy Limited (GTE- <http://www.gte.uk.com>)

Telephone: +90 312 472 35 00

Fax: +90 312 472 33 66

E-mail: kemal@gte.uk.com

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

Starting date of project activity is estimated as 01/07/2011.

C.1.2. Expected operational lifetime of the project activity:

The expected operational lifetime of the project is about 45 years as per the license issued. After this period, project will be delivered to government authority at no cost.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

Renewable crediting period is chosen for the project activity.

C.2.1.1. Starting date of the first crediting period:

The crediting period is expected to start in 01/07/2011.

C.2.1.2. Length of the first crediting period:

First crediting period will be valid for 10 years which may be renewed at most two times as per the VCS rules.

⁴² <http://www.epdk.gov.tr/mevzuat/yonetmelik/elektrik/dengeleme/yeni/duyson.doc>

**SECTION D. Environmental impacts****D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

EIA assessment for Feke II HEPP project has been performed by PRD Planlama, Araştırma, and Geliştirme ve Danışmanlık Co. as defined by the regulations. An Environmental Impact Assessment report has been prepared on 21.01.2008. The report has been approved by Ministry of Environment and Forestry (MoEF) on 31 January 2008.

EIA report prepared for the project covers all aspects of the project including capacity, interaction with other plants in the vicinity, natural resources used, waste management, social and economical impacts, technology and materials used, current land use in the region, any historical or protected site within the project boundaries, geological assessment of the project site and any communities affected with the project.

This report has been evaluated by relevant local government agencies and Ministry of Environment and Forestry (MoEF). After evaluation of the project and comments of local agencies, Ministry of Environment and Forestry has concluded that project does not have significant environmental effects and EIA assessment is positive for the project activities. The EIA approval letter has been included as Annex 5 of this document.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

It shall not have any negative effects on the environment because it shall be operated based on national and international regulations. The HEPP will not change any water volume or cause any water pollution. Powerhouse shall be built near the dam so that water shall be released back to Goksu riverbed and any drying up of the riverbed shall not occur. The environmental impacts of the proposed project are not considered to be significant. All necessary permissions including, environmental, health and safety, have been acquired from relevant agencies and all precautions have been applied strictly by Investor Company.

SECTION E. Stakeholders' comments**E.1. Brief description how comments by local stakeholders have been invited and compiled:**

According to Article 9. of the Environmental Impact Assessment Regulation, a stakeholders meeting was held on 09.10.2007, at Karacaoglan Culture Center (Marriage Saloon) of Feke District, a location which was determined together with the Governor. The meeting hours and its location was announced on 04.10.2007 in the national (Aksam) newspaper and the local (Adana 5 Ocak) newspaper.

During the meeting, information on the importance of the project, reasons for selection of the project location, employment, seismic activities and action required for environmental issues has been explained to the participants and stakeholders views, considerations and questions were answered. Since no request for a change in the project was asked, no changes in the project were made.

Participants mostly asked questions about employment and how the expropriation is going to be made. They pointed to the fact that the project shall be useful for the economy of the region as well as the whole country.

The second stakeholder meeting of the project was held on 13th of November 2008 in Kisacikli region of Feke district in Adana. Stakeholders were invited through invitation letters sent by mail, newspaper announcements and thorough village heads.

Since Turkey had not then ratified Kyoto Protocol there was no official DNA in the country. However, as the most relevant government agencies, Ministry of Environment and Forestry and Ministry of Energy and Natural Resources were invited. In addition to local and national authorities, local and national NGOs and were also invited and informed about the meeting by mail.



Figure 5. Newspaper announcement dated 11th of November 2008 for second SC meeting of Feke II HEPP

The meeting was held between 14:00 and 16:00 hours and about one hour were dedicated to the presentation about the project, climate change and carbon markets.

Initial Stakeholder consultation meeting has been recorded to video and minutes have been noted. Comments have also been requested from government agencies and invitees by letters sent by mail.



Figure 6. Stakeholder Meeting / Feke II HEPP

Mr. Guvenc Emre Sener, project manager of Akkur Enerji made the presentations. The project manager gave explanations about the project. Ms. Sevilay Topcu from GTE gave explanations regarding the carbon emissions savings of the renewable energy projects and the carbon trade.

After the presentations and explanations, questions from the participants were answered by Mr. Guvenc Emre Sener, the project manager of Akkur Enerji Uretim A.S.



Figure 7. Stakeholder Meeting / Explanations by Mr. Guvenc Emre Sener

E.2. Summary of the comments received:

The comments from stakeholder have been positive in general. The main concerns raised by the participants were climate change which would occur due to the dams and power plants, so that the rain and snow would decrease. They have seen other examples of hydraulic dams which have caused less rain and snow causing draught. Also they have seen agricultural lands turn into salty lands.

**E.3. Report on how due account was taken of any comments received:**

Akkur Enerji has taken into account all comments and in general replied positively to the concerns and comments by the participants. The project would not affect the climate negatively; otherwise it would never get an approval for the Environmental Impact Assessment report. On the other hand, decrease of rain and river waters are not because of hydro electric power plants, but mostly due to climate change. The change of land into salty lands is not due to dams and hydro power plants but due to excessive irrigation by land owners after the construction of dams and irrigation facilities. Now agricultural people are trained to use less irrigation.

SECTION F. Additional requirements by VCS**F.1. Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction (1.12):**

The project activity involves construction of a large scale hydro electric Power Plant having an installed capacity of 69.58 MW. Since the project activity involves electricity generation from renewable resources, it does not create any GHGs.

F.2. Demonstration that the project has not created another form of environmental credits(for example renewable energy certificates(1.13)):

Project owner confirms that the project activity does not create any other form of environmental credits.

F.3. Project rejected under other GHG programs(if applicable (1.14)):

Not Applicable. Project has not applied for any other GHG credit program.

F.4. Ownership- Proof of title (8.1)

The generation license issued by Energy Market Regulatory Authority (EMRA) of Turkey is the proof of the ownership for the plant. GHG emission reductions will also be owned by project owner..

F.5. Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable(8.2)):

Not applicable. Project does not participate in an emissions trading program.

F.6. Commercially sensitive information:

PDD do not include any commercially sensitive information excluded.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	AKKUR ENERJİ ELEKTRİK ÜRETİM AŞ. (Subsidiary of AKENERJİ)
Street/P.O.Box:	Miralay Sefik
Building:	15
City:	Taksim
State/Region:	Istanbul
Postcode/ZIP:	
Country:	Turkey
Telephone:	(0090) 212 249 82 82
FAX:	(0090) 212 249 73 55
E-Mail:	info@akenerji.com.tr
URL:	http://www.akenerji.com.tr
Represented by:	
Title:	Project Coordinator
Salutation:	Mrs.
Last name:	Palabıyık
Middle name:	-
First name:	Özlem
Department:	Strategic Planning&Business Development
Personal e-mail:	opalabiyik@akenerji.com.tr

Organization:	Global Tan Energy Limited
Street/P.O.Box:	Ehlibeyt Mahallesi 1259. Sokak
Building:	7/2
City:	Ankara
State/Region:	-
Country:	Turkey
Telephone:	(0090) 312 472 35 00
FAX:	(0090) 312 472 33 66
E-Mail:	email@gte.uk.com
URL:	www.gte.uk.com
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Demirkol
Middle name:	Kemal
First name:	Mehmet
Department:	Management
Direct FAX:	(0090) 312 472 35 00
Direct tel:	(0090) 312 472 33 66
Personal e-mail:	kemal@gte.uk.com



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NO PUBLIC FUNDING WAS USED FOR FINANCING THE PROJECT ACTIVITIES.

**Annex 3****BASELINE INFORMATION****Data Used in calculation of OM for Turkish Electricity Grid**

	NCV (Tj/kt) (1000m ³ for gas)	EF (tCO ₂ /Tj)	COEF (tCO ₂ /kt)
Coal	22.18	89.5	1.985
Lignite	6.87	90.9	625
Fuel Oil	39.90	75.5	3.013
Diesel Oil	42.60	72.6	3.093
LPG	0.00	61.6	-
Naphtha	43.87	69.3	3.040
Natural Gas	36.68	54.3	1.992

Table 15. Values used in calculation of OM⁴³

	2006	2007	2008	Total Fuel Consumption 2006-2008	Total Emission 2006-2008
Hard Coal	5,617,863	6,029,143	6,270,008	17,917,014	35,571.662
Lignite	50,583,810	61,223,821	66,374,120	178,181,751	111,311.693
Fuel Oil	1,746,370	2,250,686	2,173,371	6,170,427	18,590.041
Diesel Oil	61,501	50,233	131,206	242,940	751.393
LPG	33	0	0	33	0
Naphtha	13,453	11,441	10,606	35,500	107.934
Natural Gas	17,034,548	20,457,793	21,607,635	59,099,976	117,716.966

Table 16. Amount of fuels used for electricity generation⁴⁴**Data Used in calculation of BM for Turkish Electricity Grid**

A	B	D	E
NCV	EF _{CO2}		(=3.6/D/1000*B)

⁴³ 2006 IPCC Guidelines for National Greenhouse Inventories⁴⁴ <http://www.teias.gov.tr/istatistik2008/44.xls>



	(Tj/kt or m ³ for gas)	(tCO ₂ /Tj)	Generation Efficiency	EF ⁴⁵ tCO ₂ /MWh
Coal	22.18	89.5	39.0%	0.826
Lignite	6.87	90.9	39.0%	0.839
Fuel Oil	39.90	75.5	39.5%	0.688
Diesel	42.60	72.6	39.5%	0.662
LPG	0.00	61.6	39.5%	0.561
Naphtha	43.87	69.3	39.5%	0.632
Natural Gas	36.68	54.3	60.0%	0.326

Table 17. Net calorific values, generation efficiency and emission factor data used in calculations

Fuel Source	Electricity Generated (MWh)	EF	Share in Total Generation
Coal	1,125	0.826	2.5%
Lignite	11,482	0.826	25.1%
Fuel Oil	208	0.828	0.5%
Diesel oil	2	0.688	0.0%
LPG	50	0.662	0.1%
Naphtha	0	0.561	0.0%
Natural Gas	26,907	0.416	58.8%
Renewable and wastes	85	0.000	0.2%
Solid	5	0.000	0.0%
Total Renewable	5,912	0.000	12.9%
TURKEY'S TOTAL	45,776,3		100.0%

Table 18. Most recent capacity additions corresponding to 20%.^{46,47,48,49,50}

⁴⁵ IPCC Reference Document on Best Available Techniques for Large Combustion Plants

⁴⁶ <http://www.teias.gov.tr/istat2004/7.xls>

⁴⁷ <http://www.teias.gov.tr/istatistik2005/7.xls>

⁴⁸ <http://www.teias.gov.tr/ist2006/8.xls>

⁴⁹ <http://www.teias.gov.tr/ist2007/8.xls>

⁵⁰ <http://www.teias.gov.tr/istatistik2008/8.xls>



Annex 4

MONITORING INFORMATION

Information about monitoring plan is given in section B.7.2.



Annex 5

EIA APPROVAL CERTIFICATE

 T.C.
ÇEVRE ve ORMAN BAKANLIĞI
ÇEVRESEL ETKİ DEĞERLENDİRMESİ VE PLANLAMA
GENEL MÜDÜRLÜĞÜ

Karar Tarihi: 31.01/2008
Karar No : 1424

ÇED OLUMLU BELGESİ

16.12.2003 tarih ve 25318 sayılı Resmi Gazete’de yayımlanarak yürürlüğe giren Çevresel Etki Değerlendirmesi Yönetmeliği’nin 14. maddesi gereğince; “Feke II Barajı ve Hidroelektrik Santrali” projesi hakkında “Çevresel Etki Değerlendirmesi Olumlu Kararı” verilmiştir.


Fevzi İSBİLİR
Bakan a.
Genel Müdür V.

Proje Sahibi : Akkur Enerji Üretim Tic. ve San A.Ş.
Projenin Yeri : Adana İli, Feke İlçesi,

REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT AND FORESTRY
ENVIRONMENTAL EFFECTS EVALUATION AND PLANNING GENERAL MANAGEMENT

31/01/2008
Decision No: 1424

EIA APPROVED CERTIFICATE

According to Article 14 of the Environmental Impact Assessment Regulation published on official gazette dated 16.12.2003 and numbered 25318, it has been decided that Environmental Impact Assessment is positive for Feke-II Weir and Hydroelectric Power Plant..

Fevzi İSBİLİR
Ass. General Manager
(in the name of the Minister)

Project Owner : Akkur Enerji Üretim ve Ticaret AŞ
Project Location : Adana province, Feke district



Annex 6
GENERATION LICENSE

 T.C.
ENERJİ PİYASASI DÜZENLEME
KURUMU

ÜRETİM LİSANSI

*Bu Lisans kapsamındaki üretim tesisi
Yenilenebilir Enerji Kaynağı kullanmaktadır.*

Lisans No : EÜ/1197-2/859
Tarih : 17/05/2007

Bu Lisans, Akkur Enerji Üretim Ticaret ve Sanayi Anonim Şirketi'ne, Adana İli'nde kurulacak olan Feka II Barajı ve Hidroelektrik Santrali üretim tesisinde 17/05/2007 tarihinden itibaren 49 yıl süreyle, üretim faaliyeti göstermek üzere 4628 sayılı Elektrik Piyasası Kanunu ve ilgili mevzuat uyarınca Enerji Piyasası Düzenleme Kurulu'nun 17/05/2007 tarihli ve 1197-2 sayılı Kararı ile verilmiştir.


Yusuf GUNAY
Başkan



**REPUBLIC OF TURKEY
ENERGY MARKET REGULATORY AUTHORITY**

GENERATION LICENSE

The generation plant within the scope of this license uses renewable energy resources.

License Number :EU/1197-2/859
Date :17/05/2007

This license has been granted to Akkur Enerji Üretim Ticaret ve Sanayi Anonim Şirketi in order to be engaged in Feke II Dam and Hydroelectric Power Plant to be implemented in Adana Province for 49 years starting from 17/05/2007 , by decision of Energy Market REgulatory Authority dated 17/05/2007 and numbered as 1197-2 in accordance with the electricity market law numbered 4628 and relevant regulation.

(Signed and Selaed)



ANNEX 7 INFORMATION ON RESERVOIR AREA

SANTRAL

Toplamda 70 MW kurulu güce sahip olan Feka II Barajı Hidroelektrik Santrali, 35 MW kapasiteli iki üniteden oluşmaktadır. Türbin tipleri düşey eksenli Francis olarak seçilmiştir. 10 yıl tekemürlü taşkın debisi dikkate alınarak belirlenen 495,50 m çevre düzenleme kotuna yerleştirilen santral binası genişliği 29,00 m, boyu ise 44,50 m'dir. Normal işletme durumunda iki ünite çalışırken santral kuyruksuyu kotu 480,0 m'dir. Santral yerinin hemen yanında şalt sahası inşa edilecek, buradan enterkonnekte sisteme bağlantı yapılacaktır.

Faaliyet kapsamında yapılacak üniteler ve özellikleri aşağıda sırasıyla verilmiştir:

Drenaj alanı	: 3530,0 km ²
Yıllık ortalama doğal akım	: 1610,5 hm ³
Yıllık ortalama doğal debi	: 51,17 m ³ /s

BARAJ GÖVDESİ:

Tipi	: Silindirik Sıkıştırılmış Beton Dolgu
Drenaj alanı	: 3530,00 km ²
Yıllık ortalama doğal debi	: 51,17 m ³ /s (1610,50 hm ³ /yıl)
Proje debisi	: 127,50 m ³ /s
Taşkında maksimum su seviyesi	: 543,00 m
Maksimum işletme su seviyesi	: 543,00 m
Minimum işletme su seviyesi	: 529,50 m
Maksimum işletme seviyesinde göl alanı	: 2,477 km ²
Derivasyon debisi	Q ₁₀ : 902,0 m ³ /s
Dolusavak debisi	Q ₁₀₀₀₀ : 2686,0 m ³ /s
Talveg kotu	: 485,00 m
Kret kotu	: 545,00 m
Temel Kotu	: 474,00 m

Excerpt from page 171 of Environmental Impact Assessment Report stating Reservoir Area.

(Maksimum işletme seviyesinde göl alanı: Reservoir area at maximum operation level)

