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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Construction of Sumgayit Combined Cycle Power Plant
Version 11
9/11/2012

A.2. Description of the project activity:

The proposed CDM project activity involves construction of a new Combined Cycle Gas Power Plant (CCGT) on the territory of the former Combined Heat and Power Plant ”TETs-1 Sumgayitskaya” in the city of Sumgayit near the coast of the Caspian Sea in the Azerbaijan Republic. The units of the former ”TETs-1 Sumgayitskaya” had reached the end of their technical lifetime in 2001, they have thus been taken out of service in 2002 and written off in 2004.

The new CCGT has total capacity of 525 MW consisting of two gas turbines of V94.2 type together with its generators, two heat recovery boilers and steam turbine generator with its generator. The new CCGT was commissioned in December 2008, it uses only natural gas as fuel and has been expected to export approximately 3,543 GWh supplied directly to the Azeri electricity grid. The new CCGT has operated as base-load plant with an expected capacity factor not exceeding 80.0% annually.

The project activity contributes to the reduction of CO_2 emissions by substituting more carbon intensive electricity generation elsewhere on the Azeri electricity grid. As per approved methodology AM0029 (Version 03), the baseline emission factor chosen is the emission factor of the build margin. This is estimated to be 0.6022tCO_{2e}/MWh for year 2006. The project activity is expected to reduce CO_2 emissions by 774,430tCO_{2e} per annum or 7,744,300tCO_{2e} in a 10 year crediting period. It is demonstrated that the most plausible alternative baseline scenario to the proposed project activity is the reconstruction of the former Combined Heat and Power Plant ”TETs-1 Sumgayitskaya” and installation of two 300 MW condensing steam turbines running on heavy fuel oil (mazut). The modern CCGT technology is characterised by higher efficiency: the estimated efficiency of the new plant is 52.71% compared to an average efficiency of 43% of the baseline scenario technology. The modern CCGT technology is also characterised by a lower carbon emission factor of 0.3709tCO_{2e}/MWh [1]compared to the carbon emission factor of the baseline scenario technology and fuel of 0.6324tCO_{2e}/MWh. The methodology allows for choosing the least of (a) build margin (0.6022tCO_{2e}/MWh), (b) combined margin (0.6078tCO_{2e}/MWh) and (c) emission factor of the baseline technology (0.6324tCO_{2e}/MWh) for emissions calculations. Since, out of three the build margin is the lowest value, it has been chosen as the baseline emission factor for emission reduction calculations.

The new CCGT power-generating unit comprises two V94.2 gas turbines and generators, two waste-heat boilers producing low-pressure and high-pressure steam by means of flue gases of the gas turbines, and steam turbine with its own generator. Follows a summary of the technical characteristics of the plant:

[1] The Project Emission Factor has been determined using the same formula as in the case of Baseline Technology Emission Factor (Option c). This has been done for comparison purposes only.

- Total capacity, MW 525
- Efficiency, % 52.71%
- Capacity Factor (%) 80.0%
- Primary and start up fuel natural gas

In the view of project participants, this project activity contributes to sustainable development in several ways:

(1) Social and Technological development:

- The proposed project activity leads to poverty alleviation by generating employment at various stages of development of the project. At the time of development of the project both skilled and un-skilled labor were employed for completing civil works associated with the project. About 700 people were engaged in construction and assembling operations during the construction period. After the completion of the project, once the commercial operation begun, the project employs professionals, skilled and unskilled personnel to manage the day to day operations of the project. The number of people employed during the operation and maintenance of the plant was 190, of which around 50 people were in charge of operation of the plant; around 50 people in charge of maintenance; and the remaining 90 people in charge of administration, back-office, accounting, canteen etc. Many employees of "TETs-1 Sumgayitskaya" who lost their jobs when the plant shut down were offered an opportunity to come back to work on the CCGT plant.
- The German company SIEMENS, which has been awarded the construction contract, has provided training to personnel of the Sumgayit plant and JSC "Azerenerji". This way Azerbaijan has also benefited from transfer of technology and technological know-how.
- The project activity leads to improved power supply conditions in the north Azerbaijan region for both domestic and commercial consumers. For the domestic consumers it means better quality of life and for the commercial consumers it means better infrastructural support (high quality power) for their commercial activities.

(2) Economic development:

- The project activity contributes to meeting the increasing electricity demand in Azerbaijan. Due to the recent startup of the Baki-Tbilisi–Cheyhan pipeline, power demand in Azerbaijan has expected to grow during the next years. Because of the country's inefficient distribution network, Azerbaijan must import some of its power from Russia, Turkey, Iran, and Georgia to make up for transmission losses (7% of total generation in 2004). On average, Azerbaijan imported roughly 2.1 billion kWh, slightly under 10% of its total consumption.
- The worldwide known German company SIEMENS was awarded the construction contract. Thus, state of the art technology, including highly efficient new boilers and turbines, has been imported to Azerbaijan.
- The generated electricity is fed to the Azeri electricity grid. The injection of power in the national grid improves the power quality in the local region (frequency, voltage level, availability during peak hours).

(3) Environmental benefits:

- Generation from the project activity displaces more carbon intensive generation from the grid, which especially in the peak hour is heavy fuel oil and natural gas in rather inefficient thermal power plants. The proposed project activity leads in the reduction of GHG emissions (CO_2), other emissions (SO_x, NO_x) and other particulate/solid emissions typical of heavy fuel oil-based thermal power plants.

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 participants (Yes/No)
Azerbaijan	JSC “Azerenerji“	No
United Kingdom	BNP Paribas	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Azerbaijan Republic

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

Sumqayit Sahari region of Azerbaijan Republic

A.4.1.3. City/Town/Community etc:

Sumgayit (or Sumqayit) City

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

The CCGT is located on the territory of the former Combined Heat and Power Plant ”TETs-1 Sumgayitskaya” in the outskirts of the city of Sumgayit near the coast of the Caspian Sea in the Azerbaijan Republic. The distance between Sumgayit (or Sumqayit) City and Baku is around 39 km.

Latitude: 40.6034°N
Longitude: 49.6332°E

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

The CDM project activity considered in this PDD is from the sectoral scope 1: Energy Industries (renewable/ non-renewable sources)

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

The new CCGT has a total capacity of 525 MW consisting of two gas turbines of V94.2 type together with its generators, two heat recovery boilers and steam turbine generator with its generator. The plant was put into operation and synchronised with the grid in June 2008 for test runs. The plant was run for six months under experimental condition (under varying load) and was commissioned and fully transferred to JSC "Azerenerji" in December 2008. The plant uses natural gas as the only fuel and is expected to export 3,543 GWh of electricity to the Azeri electricity grid.

State of the art technology has been imported in Azerbaijan. The worldwide known German company SIEMENS has been awarded the construction contract. The new equipment and its installation, operation and maintenance has required both new and existing staff to receive additional training on the new technologies employed.

The lifetime of the equipment installed at the Sumgayit CCGT is 25 years, as demonstrated by the technical specifications of the SIEMENS turbines, which is beyond the crediting period chosen of 10 years. Additionally, Sumgayit personnel have been trained by SIEMENS for operation and maintenance of several components of the plant. Procedures are also in place to guarantee that emergencies, problems and breakdowns are dealt with in an efficient manner.

The technical characteristics and engineering data of the plant are presented in the table below.

General parameters	
Total capacity	525MW
Net installed capacity	506.8MW
Fuel	Natural gas
Unboiled water	Water from Jeyranbatan water storage
Gas turbines	
Type	Siemens V 94-2 Turbo
Gas turbines generators	
Type	TLRI 115/36
Steam turbine	
Type	Double cylinder
Steam turbine generators	
Type	TLRI 115/52
HRSG	
Type	CMI HRSG-Horizontal
Auxiliary equipment	
Condenser	
Type	S.Con 3000-30 x 76.5
Condensate pumps	
Type	WKTB 7/1+3-Vertikal
Feed water pumps	
Type	HGC 5/6
By pass deaerator	
Type	Horizontal
Deaerator pump	
Type	MTCB 125/03 10.2 22.6
Circulating cooling sea water pumps	
Type	Vertikal
Closed chemically treated cooling water pumps	
Type	KRC-300/400-108/CN

The foundations of the new Sumgayit CCGT plant were officially laid on 12 August 2005. Actual construction works started on 9 September 2005. The plant was commissioned in December 2008. The exact chronology of events (with significant milestones) leading to the implementation of the project has been provided in section B.5 and Annex 5 of the PDD.

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

Total ex-ante estimate of emission reduction by the proposed CDM project activity are estimated at 7,744,300 tCO_{2e} over the chosen crediting period of 10 years. Note that the numbers provided here are only ex-ante estimate and actual emission reductions may be different depending upon the actual electricity generation levels of the new CCGT.

Year	Annual estimation of emission reductions in tonnes of CO_{2e}
Year 1 (2012/2013)	774,430
Year 2 (2013/2014)	774,430
Year 3 (2014/2015)	774,430
Year 4 (2015/2016)	774,430
Year 5 (2016/2017)	774,430
Year 6 (2017/2018)	774,430
Year 7 (2018/2019)	774,430
Year 8 (2019/2020)	774,430
Year 9 (2020/2021)	774,430
Year 10 (2021/2022)	774,430
Total estimated reductions (tonnes of CO_{2e})	**7,744,300**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_{2e})	**774,430**

A.4.5. Public funding of the project activity:

The project activity is financed solely through own equity of JSC “Azerenerji” and loans from a commercial international bank. The project activity has not received any public funding.

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 following references have been applied to the project activity:

- Approved Baseline Methodology: AM0029: “Baseline methodology for grid connected electricity generation plants using natural gas” Version 03
- Approved Monitoring Methodology AM0029: “Baseline methodology for grid connected electricity generation plants using natural gas” Version 03
- Tool for the demonstration and assessment of additionality. Version 06.1.0.
- Tool to calculate the emission factor for an electricity system. Version 02.2.1

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

The proposed CDM project activity meets all the applicability conditions as outlined in the applied methodology AM0029:

Criteria 1. The project activity is the construction and operation of new natural gas fired grid-connected electricity generation.

The CDM project activity: 'Construction of Sumgayit Combined Cycle Power Plant' is connected to the national power grid of Azerbaijan. The new CCGT plant is constructed on the territory of an old plant, which has been closed down in 2004. Furthermore, the project is not going to use gas sourced from LNG as there is no LNG supply or production in Azerbaijan for the following two reasons: (a) Azerbaijan is a net exporter of gas and has no reason to import gas through an LNG route, which is applicable to those countries that don't have access to natural gas through pipelines or indigenous sources, (b) There is no LNG terminal for gas import in the Caspian sea or in the region from where Azerbaijan could have potentially imported LNG from[2].

Conclusion: the proposed CDM project meets the applicability criteria.

Criteria 2. The geographical/physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and estimating the baseline emissions is publicly available.

The geographical and physical boundary of the baseline grid is the national electricity grid of the Azerbaijan Republic, as within this grid, power can be transferred without any transmission constraint. Imports of electricity from Russia, Turkey, Iran, and Georgia are taken into account in the baseline grid and are considered to have a nil carbon emission factor as required by the "Tool to calculate the emission factor for an electricity system" (to which the applied methodology AM0029 makes reference to). The data pertaining to the grid, the power plants connected to the grid, their fuel consumption, and their respective CO_2 emissions leading to the emission coefficient of the grid have been made available by JSC "Azerenerji".

Conclusion: the proposed CDM project meets the applicability criteria

Criteria 3. Natural Gas is sufficiently available in the region or country, e.g. future gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of natural gas in the project activity.

The domestic gas supply supersedes the gas demand in the country (please see picture below) nullifying any potential threat that the gas usage by the new Sumgayit power plant will disrupt gas supply to any other domestic industry/consumer. Furthermore, it is worth adding that abundant national resources of natural gas allow Azerbaijan to supply natural gas to Russia. Yet, in the unlikely event of domestic resources being insufficient, the link with Russia will allow Azerbaijan to import gas from Russia.

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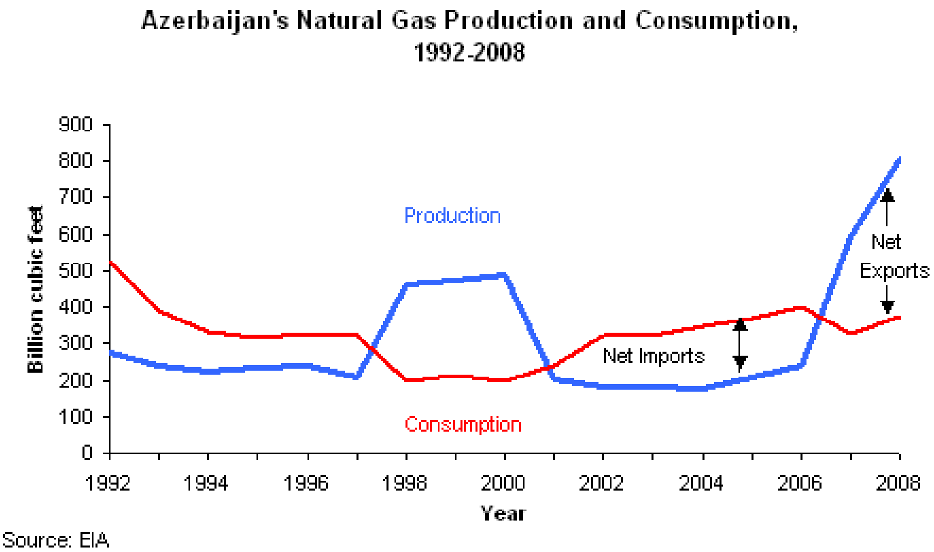
[2] Reference: http://www.globallnginfo.com/World%20LNG%20Plants%20&%20Terminals.pdf (Please note there is no LNG terminal in the Caspian Sea or in Azerbaijan)

Picture Title: Azerbaijan's Natural Gas Production and Consumption from 1992 to 2008



Source: http://www.eia.doe.gov/emeu/cabs/Azerbaijan/NaturalGas.html

It was predicted at the time of starting of the CDM project activity that domestic natural gas production in the Azerbaijan Republic would increase by more than three times compared to its level in 2004 by 2007-08. Below translated extract from the SOCAR (State Oil Company of Azerbaijan Republic) 2004 Annual Report (page 25) states :

«"The dynamics of natural gas production in Azerebaijan for 1921-2004 is shown in the graph number 6. As you can see from the diagram the highest point of gas production in the republic was in 1982 (14,9 bln cubic meters). Later the production went down to 6,4 bln in 1994. After this year the speed of decrease of the gas production stopped and even in some cases the production increased. According to the forecast the gas production will go up starting from 2006 and in 2007 will reach the record level that was in 1982 and will go up in upcoming years" »

It can therefore be concluded that natural gas is sufficiently available in the country and future natural gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of natural gas in this project activity.

Conclusion: the proposed CDM project meets the applicability criteria
The baseline methodology AM0029 is being used in conjunction with the approved monitoring methodology AM0029.

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

The following boundary has been identified to account for emissions associated with the project activity and the baseline emissions and to also account for any leakages associated with the project activity.

The project boundary:

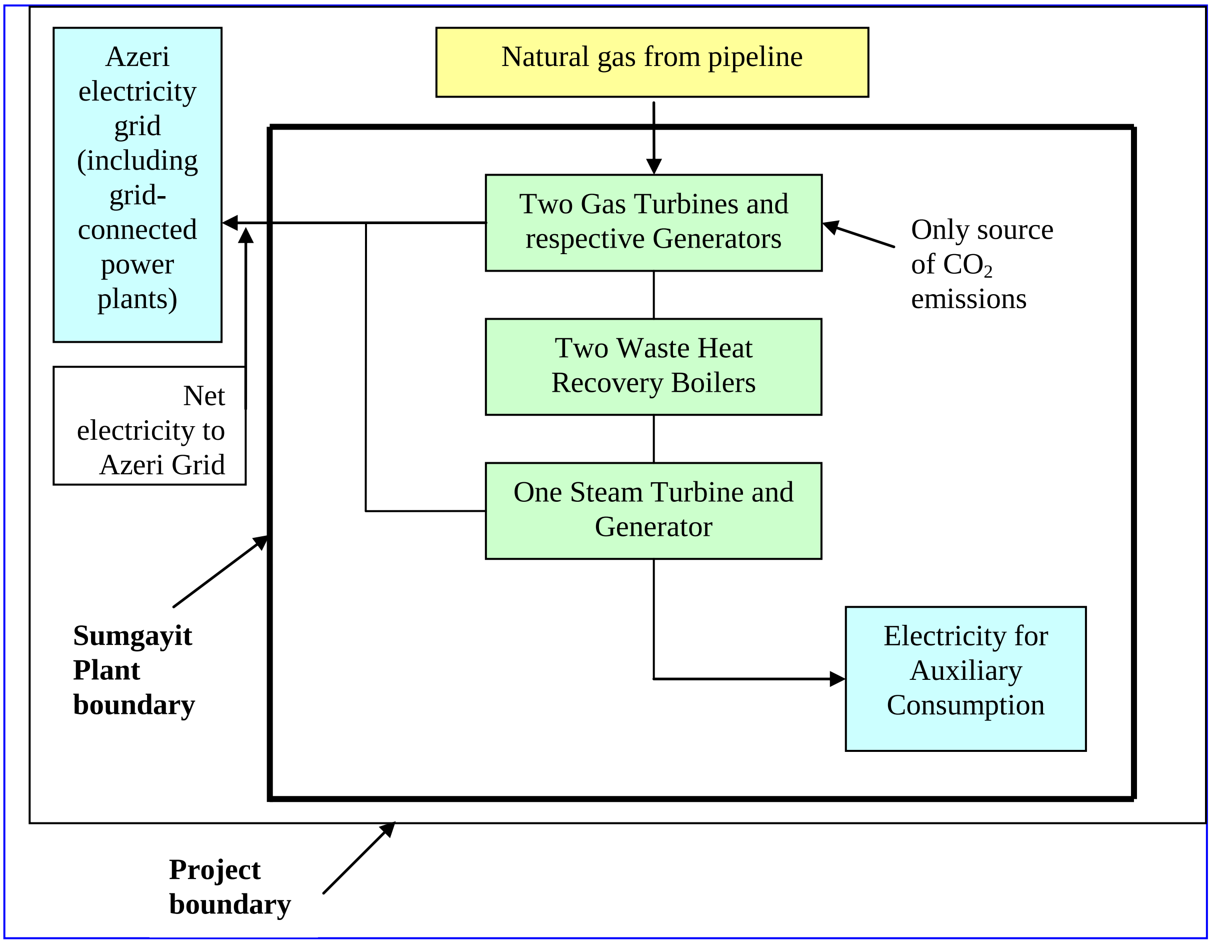
The spatial extent of the project boundary includes the project site of the CCGT and all power plants connected physically to the baseline grid as defined in "Tool to calculate emission factor from an electricity system".

The CCGT project site comprises gas supply and gas compression inside the plant boundary, boilers, gas and steam turbines and all other power generating equipment, captive consumption units and energy consuming equipment, since a fraction of the generated electricity will be used for auxiliary consumption.

The project boundary also includes power plants connected physically to the baseline grid of the Azerbaijan Republic, as well as imports of electricity to Azerbaijan. The emissions associated with the electricity from the grid (grid emission coefficient calculated as per the guidelines provided in the "Tool to calculate the emission factor for an electricity system") form the baseline emissions, and all the emissions associated with the combustion of fossil fuels at the CCGT form the emissions associated with the project activity.

Outside the boundary:

All the emissions that occur due to the project activity that are outside the project boundary comprise leakages. These mainly comprise upstream emissions in natural gas processing and transportation. As demonstrated later in the PDD – the leakages in the baseline are higher than the leakage in the project scenario; hence, no emissions outside of the project activity are expected from the proposed CDM project activity.



	Source	Gas	Included?	Justification / Explanation
Baseline	Power generation in baseline	CO_2	Yes	Main source of GHG emissions
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative
Project Activity	On-site fuel combustion due to the project activity	CO_2	Yes	Main source of GHG emissions
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification

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

The following steps have been outlined in the applied methodology AM0029 for identification of the baseline scenario:

1. Identify plausible baseline scenario

The plausible baseline scenarios among the existing alternatives have been identified using the following eligibility criteria as recommended by AM0029:

- Realistic and credible scenarios
  These include:
  - Those alternatives for which technology is commercially established and available;
  - Those alternatives which are within the investment capacities of the promoters and/or other parties;
  - Those alternative technologies that are prevailing: power plant technologies that have recently been constructed or are under construction or are being planned.
- Provide outputs or services comparable with the CDM project activity
  These include:
  - Those alternatives that provide similar output in terms of peak vs. base-load power and power quality (in the case of the Sumgayit CCGT, similar output must be considerable amount of base-load power – over 3,000 GWh- not affected by intermittency and variability)
- In compliance with all applicable legal and regulatory requirements
  The alternatives should be in compliance with the national policies on power generation and distribution.
- In selection of the plausible baseline alternative; following two chief criteria needs to be met:
  - The plant is being constructed as a base-load plant; as such only those technologies that could/are used as base-load plant are being considered;
  - The plant size is expected to be in the order of ~500MW as this plant is coming at the site of an older plant, which itself was of this order before being de-commissioned; alternatively construction of several smaller sites would need to be considered..

The following are the various baseline scenarios that are considered in the context of the proposed CDM project activity:

Alternatives	Plausibility
(a) The project activity not implemented as a CDM project activity	
Natural gas power generation using combined cycle system without CDM	**Plausible** • Meets all eligibility conditions listed above; • CCGT is preferred technology for base-load plants; • The fuel (Natural Gas) being used by the project activity is abundantly available in Azerbaijan. The scenario (a) is therefore taken into consideration as a possible baseline scenario:
(b) Power generation using natural gas, but technologies other than the project activity	
Natural gas power generation using gas turbines in simple/open cycle mode	**Not Plausible.** • Does not meet all eligibility conditions: (i) Open Cycle Natural Gas based generation is not suitable for base-load generation. This is because open-cycle natural gas based generation has very low efficiency compared to base-load plant technology – CCGT. The efficiency of open-cycle generation technology is 36.9% (9,757kJ/kWh) while the efficiency of the Sumgayit CCGT is 52.7%, which is 42.8% higher than the efficiency of the open-cycle technology. The

Alternatives	Plausibility
	reference provided clearly indicates that open cycle gas generation, though available for high capacity (~255MW), has very low efficiency – hence not suitable for baseload generation[3]. • In Azerbaijan – open cycle is not being used as base-load technology and this has been confirmed through an official letter by the Senior Management of JSC "Azerenerji". • Also, in Azerbaijan – the open cycle gas generation technology has been employed only of up to a unit size of 25MW (ref: letter of JSC "Azerenerji" management). The scenario of natural gas based open cycle generation is thus **taken out** from consideration as a possible baseline scenario.
Fuel cell technology	Not plausible. • Does not meet all the eligibility conditions: (i) Fuel cell technology is not available in a required size, (ii) It cannot be used as a base-load plant and (iii) It is an extremely expensive technology. The scenario of fuel cell technology is thus **taken out** from consideration as a possible baseline scenario.
Natural gas power generation using steam turbine technology	**Plausible** • The construction of steam turbines for which steam is produced in natural gas based boiler is considered as one of the plausible options. The scenario of steam turbine is thus taken into consideration in the financial analysis..
(c) Power generation technologies using energy sources other than natural gas	
Wind generation	Not Plausible. • Does not meet all the eligibility conditions: (i) Wind generation is not used for baseload power demand Hence, wind generation has been **taken out** from consideration as a possible baseline scenario.
Hydro generation	Not plausible. • Does not meet all the eligibility conditions: (i) Hydro generation is being used as peaking plant (and not for base-load plant) (ii) Also, hydro generation has significant seasonal variation (something not allowed for a baseload plant)[4] (iii) No hydro plants of the same size as the Sumgayit power plant (>500MW) are currently in the power grid of Azerbaijan (as shown in the operating margin calculation) and no hydro plant of the same size is being considered to be installed in the near future.

[3] References: http://en.wikipedia.org/wiki/Gas_turbine http://www.gepower.com/prod_serv/products/gas_turbines_cc/en/f_class/ms9001fa.htm; http://www.china-power-contractor.cn/GE-9FA-255mw-Gas-Turbine-Generator.html;

[4] It should also be noted that the annual average rainfall in Azerbaijan is in the range of 200-300mm in the lowlands and 1,000-1,300mm in the highlands (http://www.atlapedia.com/online/countries/azerbaij.htm). The level of rainfall is very low to support base-load hydro plants; moreover the rainfall in Azerbaijan is unevenly distributed throughout the year.

Alternatives	Plausibility
	Hence, hydro generation has been **taken out** from consideration as a possible baseline scenario
Coal/Lignite based power plant (conventional)	Not plausible. • Does not meet all the eligibility conditions: (i) Coal is not mined in Azerbaijan and is not available as import fuel (ii) Coal has never been used as fuel for power generation in Azerbaijan. • Since, coal is not available for power generation in Azerbaijan and presently there is absolutely no usage of coal for power generation in Azerbaijan – it is not a suitable baseline option. Hence, coal/lignite based power generation has been **taken out** from consideration as a possible baseline scenario
Two power generation using condensing steam turbine technology (turbines of K-300-240-3 type) running mazut.	**Plausible.** • Meets all the eligibility conditions: (i) This technology is tried and tested for Azerbaijan and is being used elsewhere within the country (ii) This technology is being used as a baseload plant (iii) This is same as the technology that was installed at the project site (prior to the de-commissioning of the older technology). Hence, two power generation using condensing steam turbine technology running on heavy fuel oil (Mazut) is taken into consideration in the financial analysis..
(d) Import of electricity from connected grids, including the possibility of new interconnections	
Import of additional 3,543GWh of electricity from Russia and Iran (and to a minor extent from Turkey and Georgia)	Not plausible. • For Azerbaijan, considering its energy-security concern, it is important to have self – generation resources to meet its base-load power demand – which further feeds into the country's long-term economic development. This is because base-load plants need to be based on self-generation and cannot be relied on from power import. • In 2004, Azerbaijan imported 2,373GWh of electricity (roughly 10% of all electricity consumed in the country) and exported 1,008GWh with a total balance of 1,365GWh, slightly under 5 % of its total consumption. Thus, a base-load plant would help obviate the need for power import in the long run. ▪ The "State Program for the Azerbaijan Republic Energy Economy Development (2005-2015)" approved in 2005 provides for enhancement of existing interconnections with Power Grids of Russia and Iran to improve their carrying capacities. However, the strategy does not envisage a massive increase in electricity imports to meet the Azeri growing demand of electricity, due to security of energy supply issues. Thus import of electricity from neighbouring countries has not been taken into consideration as a plausible baseline scenario.

2. Identification of the economically most attractive baseline scenario:

From the above assessment it is concluded that the following options are the plausible alternatives to the proposed project activity:
Option 1 – The project activity not implemented as a CDM project activity
Option 2 – Power generation using condensing steam turbine technology running on heavy fuel oil (mazut)
Option 3 – Power generation using condensing steam turbine technology running on natural gas

Investment analysis:
The methodology prescribes to use investment analysis to identify the economically most attractive baseline scenario alternative. The investment analysis for the proposed CDM project activity is based on cost savings. The rationale for this approach is that both Option 2 and Option 3 use the same technology, and have the same power generation capacity as Option 1; consequently, they would generate the same amount of electricity as Option 1. As such, the revenues for all three options would be similar. Thus, the determining factor in the investment decision would be the amount of costs incurred by the project company and potential costs savings.

Therefore, three options have been juxtaposed with each other, the internal rates of return (IRR) on potential cost savings have been calculated and used as the main financial indicator for comparison in investment analysis results. A detailed financial analysis with plausible options has been carried out in a transparent manner and is given below. The detailed calculations have been made available to the Designated Operational Entity during the validation stage.

The following are the main assumptions for the investment analysis (Table 1 and Table 2):

Table 1 Assumptions for Project Activity

Assumptions for Project Activity	**Option 1. CCGT plant not as CDM**		**Supporting Sources**
Operational			
Efficiency	%	52.71%	Performance Guarantee on actual plant operation in December 2008 (also authenticated by plant efficiency information as given by Siemens)
Plant capacity	MW	525	Project Information (Publication from NewEurope – European News Source)
Auxiliary Consumption	%	3.45%	Calculated based on the total capacity of 525MW and the plant net capacity of 506.8MW (as given in the performance guarantee by Siemens)
Capacity factor	%	80.0%	The upper cap on capacity factor based on seasonal demand of electricity in Azerbaijan and historical maximum capacity factor for any plant in Azerbaijan grid.

Assumptions for Project Activity	Option 1. CCGT plant not as CDM		Supporting Sources
Project Lifetime	Years	25	Feasibility Study Report
Prices			
Price of natural gas (2008 onwards when the plant becomes operational)	USD/ 1000m^3	60	Actual price for JSC "Azerenerji" paid in 2005 (excluding tax). Transportation cost assumed to be 0 as a conservative approach. Price assumed the same for 2008 and onwards.
Costs			
Capital costs (EPC)	Million USD	405.58	2004 value based on the project Feasibility Study; converted into USD[5] and escalated by US CPI Index[6] to 2005 prices (when the investment decision was made).
O&M costs	Million USD/y	10.63	2004 value based on the project Feasibility Study converted into USD[5] and escalated by US CPI Index[6] to 2005 prices (when the investment decision was made). O&M costs assumed constant for 2008 and onwards.

Table 2 Assumptions for baseline options

Assumptions for Baseline option	Option 2 & Option 3. Condensing Steam turbine technology respectively on Mazut and Natural Gas		Supporting Sources
Operational			
Efficiency	%	43%	Based on the observed efficiency for supercritical technologies from several technologies from 1990-2000. Average efficiency has been considered[7].
Plant capacity	MW	525	Assumed the same as in the project scenario (Option 1)
Auxiliary Consumption	%	3.45%	Assumed the same as in the project scenario (Option 1)
Capacity factor	%	80.0%	Assumed the same as in the project scenario (Option 1)

[5] 1 EUR = 1.312 USD based on the exchange rate available from www.oanda.com for the six months period prior to the start date of the CDM project activity
[6] Reference: http://www.usinflationcalculator.com/inflation/consumer-price-index-and-annual-percent-changes-from-1913-to-2008/
[7] Reference: http://nst.e-apbe.ru/book/6.1.4.pdf)

Assumptions for Baseline option	**Option 2 & Option 3. Condensing Steam turbine technology respectively on Mazut and Natural Gas**		**Supporting Sources**
Project Lifetime	Years	25	Assumed the same as in the project scenario (Option 1)
Prices			
Price of gas (2008 onwards when the plant becomes operational) (for Option 3 only)	USD/ $1000m^3$	60	Assumed the same as in the project scenario (Option 1)
Price of mazut (2008 onwards when the plant becomes operational) (for Option 2 only)	USD/ton	69.80	Actual price for JSC "Azerenerji" paid in 2005 (excluding tax) in Old Azerbaijani Manat, converted into USD[8]. Transportation cost is included. Price assumed the same for 2008 and onwards.
Costs			
Capital costs (EPC)	Million USD	236.34	Based on the 2002 price quote for installing one turbine at AzDRES power plant. The 2002 cost was US$38million for technology, which is estimated to be 35% of the overall project cost. The cost of two units (US$76million) has been escalated by US CPI Indexes[6] to reflect 2005 prices (when the investment decision was made).
Other O&M costs	Million USD/y	10.63	Assumed the same as in the project scenario (Option 1). O&M costs assumed constant for 2008 and onwards.

No financial subsidies are available to the state owned JSC "Azerenerji" for the implementation of the Sumgayit power plant.

The investment analysis has been developed for the following combinations:

- Option 1 and Option 2, using the above presented assumptions ('**Base case** 1')
- Option 1 and Option 3, using the above presented assumptions ('**Base case** 2')

The results of the investment analyses are presented below:

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[8] 1 USD = 4,728 AZM (old Azerbaijani Manat). Note: AZM was replaced with the New Old Azerbaijani Manat (AZN) on January 1, 2006. One AZN is equivalent to 5000 AZM.

	Base case 1 (Option 1 vs. Option 2)	Base case 2 (Option 1 vs. Option 3)
Pre-tax project IRR (%)	1.33%	2.49%

Considering that the financial analysis is based on cost savings, the above presented results should be interpreted as follows:

- **Under Base case 1:** the implementation of the proposed project (Option 1) – compared to mazut-fired steam condensing turbine technology (Option 2) – would generate cost savings to JSC “Azerenerji” (due to lower fuel consumption); however, the savings would be marginal (IRR 1.33%).
- **Under Base case 2:** the implementation of the proposed project (Option 1) – compared to natural gas-fired steam condensing turbine technology (Option 3) – would also generate cost savings to JSC “Azerenerji”. The IRR (2.49%) is almost the same as the one of the Base case 1, demonstrating that the cost savings are also marginal.

Taking into account the above analysis, in both Base cases, Option 1 (CCGT plant) represents an undesirable project compared to the alternative of using different fuels with a steam condensing turbine technology, as the cost savings associated with Option 1 are marginal. In addition, project NPVs have been calculated, using the benchmark for investment in Azerbaijan of 14.95% (as explained in the section below). Results are presented below.

	Base case 1 (Option 1 vs. Option 2	Base case 2 (Option 1 vs. Option 3)
Pre-tax project NPV (US$ thousand)	-$101,589	-$94,562

In Base cases 1 and 2, the financial analysis returns a negative NPV, which reinforces the observation above. Specifically, that the proposed project (Option 1 - CCGT) is a not a financially attractive choice when compared to the implementation of a steam condensing turbine technology (regardless whether run on mazut – Option 2, or on natural gas –Option 3).

Following the analysis performed under Base case 1 and Base case 2, it is not possible to clearly indicate which alternative – whether Option 2 or Option 3 - can be deemed the economically most attractive baseline scenario. Therefore, another analysis has been carried out – **Base case 3** – where these two alternatives (Option 2 and Option 3) have been juxtaposed, using the assumptions presented in tables above, and financial indicators have been determined on potential cost savings.

Taking into account that under the Base case 3, Option 2 and Option 3 employ the same technology (steam condensing turbine technology) with the same technical parameters and financial assumptions (i.e. capital and operating cost), but use different fuels, the calculated cost savings are associated only with difference in fuel consumption.

Based on the analysis, JSC “Azerenerji” would incur higher fuel costs under Option 3 than in Option 2 to generate the same amount of electricity. In other words, implementing a steam condensing turbine technology run on mazut (Option 2) would generate higher cost savings for JSC "Azerenerji", when compared to the same technology but run on natural gas (Option 3).

This is demonstrated by calculations of financial indicators: the IRR value could not be determined, whereas the NPV is positive ($7,027,000), meaning that a steam condensing turbine technology run on mazut (Option 2) is more attractive than the same technology but run on natural gas (Option 3).

Furthermore, a sensitivity analyses have been performed to confirm the conclusion of the investment analyses, described above, i.e. that the proposed project remains the least financially attractive (and consequently, least plausible) scenario. As such, the sensitivity analysis has been performed only for the Base case 1 (Option 1 vs. Option 2) and Base case 2 (Option 1 vs. Option 3).
Note: Base case 3 was developed with a sole purpose to determine which out of two alternatives to the project (Option 2 or Option 3) could be deemed the most plausible.

Sensitivity analysis:
The sensitivity analysis of the financial indicators has been performed by subjecting them to reasonable variation in the critical parameters:

- **Scenario 1:** Price of respective fuel (+/- 10%, Scenario 1a and Scenario 1b respectively)
- **Scenario 2:** O&M costs (+/- 10%, Scenario 2a and Scenario 2b respectively)
- **Scenario 3:** Capital cost (+/- 10%, Scenario 3a and Scenario 3b respectively)
- **Scenario 4:** Efficiency (+/- 10%, Scenario 4a and Scenario 4b respectively)

In addition to the above variations, the following two scenarios have been developed:

- **Scenario 5:** using the assumptions for the Option 1 and Option 2 as presented in the Tables 1 and 2 above, **except** prices for natural gas and mazut.
  Rationale: In this analysis, US (EIA) projected prices have been applied as a reference for world fuel prices, since at the time of decision-making, Azerbaijan was expected to increase domestic (subsidised) energy prices to the levels of world market prices (IMF Country Report No. 05/17). NB: the EIA is a publicly available trustworthy source with long-term price projections with the required granularity of data (annual price forecasts). In this Scenario 5, fuel prices are predicted to change every year.
- **Scenario 6:** using the assumptions for Option 1 and Option 2 as presented in the tables above, **except** CAPEX for the Option 1. Rationale: the capital cost of the proposed project is almost double compared to other options; meaning it is a key barrier for JSC "Azerenerji".

The results of sensitivity analysis are given in the tables below:
The benchmark for investment in Azerbaijan has been set as 14.95% (as explained in the section below).

Table 3 Sensitivity analysis results for Base case 1 (Option 1-proposed CCGT project vs. Option 2-mazut steam condensing turbine technology)

Scenario no	Variation description	Benchmark	Analysis IRR	IRR (due to variation in Option 1)	IRR (due to variation in Option 2)
	Base case 1	14.95%	1.3%		
1a	10% increase in fuel base price	14.95%		-2.8%	5.4%

Scenario no	Variation description	Benchmark	Analysis IRR	IRR (due to variation in Option 1)	IRR (due to variation in Option 2)
1b	10% decrease in fuel base price	14.95%		4.8%	-3.7%
2a	10% increase in OPEX	14.95%		0.4%	2.2%
2b	10% decrease in OPEX	14.95%		2.2%	0.4%
3a	10% increase in CAPEX	14.95%		-0.1%	2.5%
3b	10% decrease in CAPEX	14.95%		3.5%	0.4%
4a	10% increase in efficiency	14.95%		4.5%	-3.2%
4b	10% decrease in efficiency	14.95%		-3.3%	5.9%
5	World fuel prices	14.95%	2.9%		
6	20% decrease in project CAPEX	14.95%	7.3%		

Table 4 Sensitivity analysis results for Base case 2 (Option 1-proposed CCGT project vs. Option 3-natural gas steam condensing turbine technology)

Scenario no	Variation description	Benchmark	Analysis IRR	IRR (due to variation in Option 1)	IRR (due to variation in Option 3)
	Base case 2	14.95%	2.5%		
1a	10% increase in NG price	14.95%	3.3%		
1b	10% decrease in NG price	14.95%	1.7%		
2a	10% increase in OPEX	14.95%		1.6%	3.4%
2b	10% decrease in OPEX	14.95%		3.4%	1.6%
3a	10% increase in CAPEX	14.95%		0.9%	3.8%
3b	10% decrease in CAPEX	14.95%		4.9%	1.5%
4a	10% increase in efficiency	14.95%		5.6%	-1.9%
4b	10% decrease in efficiency	14.95%		-1.9%	7.0%
6	20% decrease in project CAPEX	14.95%	9.1%		

The sensitivity analyses confirm the conclusion reached through the investment analyses: although the implementation of the project – compared to a potential implementation of steam condensing turbine technology (regardless whether run on mazut or natural gas) – would generate cost savings, they are small.

Furthermore, sensitivity analyses showed that, when the project is compared to Option 3 (NG baseline technology), in most cases it looks slightly more financially attractive than in the case of comparing it to Option 2 (mazut baseline technology), as demonstrated by generally higher IRR results in Base case 2 table than in Base case 1 table above. Reason being that under Option 3, more fuel would need to be consumed (due to lower technology efficiency and fuel calorific value than in Option 2); therefore, the potential cost savings if the project was implemented would be relatively higher.

Moreover, for a decision-making process, these potential cost savings need to be considered in a wider perspective, such as: the required upfront cost (CAPEX) to implement the proposed project (Option 1) and the prospect of revenue from electricity sales.

The CAPEX of the project equals 405mln USD, which is almost double the cost of the baseline.

The electricity prices in Azerbaijan are regulated by the state. Article 10 of the Law of Azerbaijan Republic on Electrical Power Industry provides pricing (tariffs) mechanism for power generation aiming at cost recovering and ensuring the profitability and development of power projects. However, as stated in the IMF report (IMF Country Report No. 05/17):
"Not only are current electricity tariffs insufficient to cover operating, maintenance, and underpriced input costs and provide funds for necessary investments in the sector, a low level of collection on payments due, estimated at 34 percent in 2002, compounds the plight of the electricity sector."

The impact of potential revenue has been analyzed separately. The pre-tax project IRR and NPV have been calculated using revenue, CAPEX and OPEX associated with the CCGT plant. Assuming that the collection rate is 100% (which is conservative) and applying the actual 2005 wholesale electricity price (i.e. 15USD/MWh), the electricity sales revenue does not improve project attractiveness, as the significant project cost (fuel cost and operating costs, and high capital investment) results in a negative IRR (-8.2%) and negative project NPV (NPV= -$350,039,000).

Having said that, from the project company's investment point of view, Option 2 would be the most plausible scenario, as it would be cheaper than Option 1 (in terms of CAPEX), and Option 3 (in terms of fuel cost – as demonstrated in Base case 3 analysis).

Therefore, it is concluded that ***Option 2***: *"Power generation using condensing steam turbine technology running on heavy fuel oil (mazut)* is the economically most attractive baseline scenario.

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):

Explanations are given on how the CDM component was widely taken into account during the period leading to the investment decision and the start date of the project activity (i.e. 23/05/2005, when the contract to procure equipment from Siemens was signed).

Seriousness of CDM Consideration and Chronology of events as per EB46 requirement has been provided in Annex 5 of the PDD in detail. Below a Summary of the key events that demonstrate CDM seriousness has been presented.

Seriousness of CDM Consideration regarding the start date of the project activity (i.e. 23/05/2005):

- Requirements of EB 46, paragraph 5 (a) Demonstration of CDM awareness and benefits of CDM as decisive factor to consider the project activity:
    - The main contact person for the Sumgayit project, Mr. Abdulkhalik was very well aware of CDM and had been attending CDM conferences since March 2003, which is more than two years before the start of the project activity.
    - The feasibility report commissioned by Enprima Consulting, published in April 2004, had also emphasized that JSC "Azerenerji" should undertake clean energy/fuel technology

adoption at Sumgayit and harness the opportunities offered by CDM to offset financial barriers associated with the project.
  - It was in May 2004 that the president of JSC "Azerenerji" issued an official document 'Power of Attorney' to Mr. Abdulkhalik Heydarov for him to be legally responsible to undertake CDM projects in Azerbaijan. This document was issued more than one year before the start of the project activity. The official and legally enforceable 'Power of Attorney' and several subsequent steps and internal/external discussions within JSC "Azerenerji" are the indicators of CDM being decisive factor for undertaking the Sumgayit project.
  - It must be noted that the JSC "Azerenerji" was already in discussion with BNP Paribas, one of the debt financier to the project activity, at the time of project financing through potential carbon financing. Within a year from the start of the project activity – JSC "Azerenerji" appointed BNP Paribas for seeking carbon financing for their projects.
- Requirements of EB 46, paragraph 5 (b) Demonstration of continuing real actions being undertaken to secure CDM status for the project in parallel with its implementation:
  - The project proponent had undertaken continued steps to secure the CDM status for the project activity. This includes undertaking stakeholder consultation (November 28, 2005), appointment of a carbon financing agency (September 2006), and having validation conducted (November 2007) for the project – in parallel with the implementation of the project activity.

As per the selected methodology, the project proponent is required to establish that the GHG reductions due to project activity are additional to those that would have occurred in absence of the project activity. The methodology requires performing the following steps, as per the 'Tool for the demonstration and assessment of additionality (Version 06.1.0):

- Step 1: Benchmark investment analysis (Step 2 of the Additionality tool)
- Step 2: Common practice analysis (Step 4 of the Additionality tool)
- Step 3: Impact of CDM registration (Step 5 of the Additionality tool – yet, this step has been removed from the tool in version 3, as such it is not discussed in this PDD).

Steps 1 and 2 have been applied and described below.

Step 1. Benchmark investment analysis
The following paragraphs demonstrate that that the proposed CDM project activity has been deemed unlikely to be financially attractive. As required by the methodology sub-steps 2b (Option III: Apply benchmark analysis), 2c (Calculation and comparison of financial indicators) and 2d (Sensitivity Analysis) of the latest version 06.1.0 of the "Tool for demonstration assessment and of additionality" have been applied.

Sub step 2b of the Additionality tool: Option III: Apply benchmark analysis
For determining the benchmark, the project proponent has taken into consideration all the financial parameters relevant to the project activity and has also conducted sensitivity analysis to gauge the impact of probable realistic fluctuation in key parameters. The project Internal Rate of Return (IRR) has been chosen as the main financial indicator most appropriate for the analysis of the profitability of power plant investments. The IRR is commonly used by JSC "Azerenerji" to evaluate the profitability of power investments in Azerbaijan. The IRR is also one of the known financial indicators used by banks, financial institutions and project developers for making investment decisions worldwide.

Rate of Interest in Azerbaijan:

The credit situation in Azerbaijan has not been strong ever since its constitution after the collapse of the USSR in 1991. Several retail investors lost their lifetime of savings that were lying in the national banks at that time, and hence the investors have been very wary of long term investments and deposits in the country. The situation has been steadily improving.

However, the typical government bonds (instruments used by banks to raise financing) like ST Bills (Short-term bills) or NBA Notes (National Bank of Azerbaijan) are for less than one year period. Given the investment duration required for energy project (typically more than 5 years and up to 10 or more years) –the short term government instruments for deriving the benchmark rate of interest have not been used. A more relevant rate of interest offered in Azerbaijan is by national banks of Azerbaijan for credits and deposits in foreign currency for over 5 year period.

In the context of the project investment analysis (pre-tax project IRR), the average rate of interest offered in Azerbaijan for credits and deposits in foreign currencies has been chosen as a suitable benchmark. The summary for monthly interest rates has been provided in Annex 6:

The benchmark chosen	Interest Rate
Average Interest Rate on **Deposits** in foreign currency (based on 18 months prior to financial closure, i.e. May 2005)	14.95%

The above rate of return for deposits at 14.95% represents the risk free rate of return for long term investment in higher quality government ST bills.

Sub step 2c of the Additionality tool: Calculation and comparison of financial indicators

The financial indicators have been calculated and presented in Section B.4.

The financial internal rate of return of the project activity without CDM revenues (Option 1) compared to the baseline (Option 2) is 1.3%, which is much lower than the benchmark of 14.95%. Even when considering the potential future increases in fuel prices, as to match international prices (Scenario 5), the investment analysis still does not cross the benchmark (2.9% compared to 14.95%).

Furthermore, as discussed above in Section B.4., the potential cost savings associated with the project need to be considered in a wider perspective, such as: the required upfront cost (CAPEX) to implement the proposed project and the prospect of revenue from electricity sales:

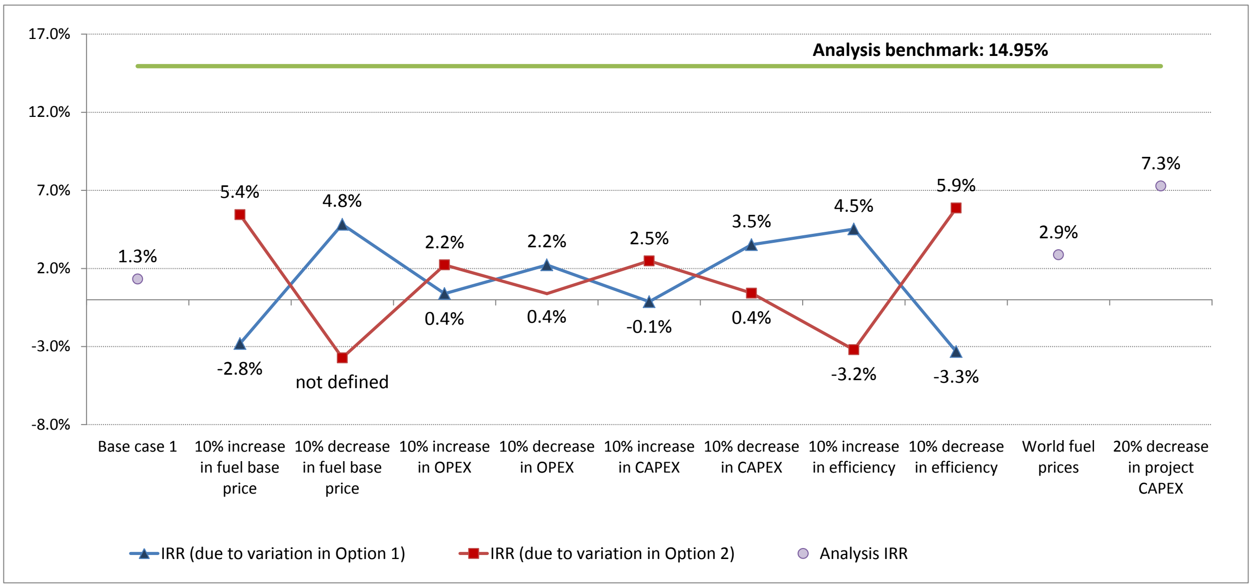
- the initial investment cost is very high (almost double the baseline cost): the Sumgayit CCGT plant uses state of the art Western technology and is characterized by a high efficiency of 52.71%.
- the electricity sales revenue does not make the project more attractive, not to mention it crossing the investment benchmark (as explained above).

Sub step 2d. Sensitivity analysis

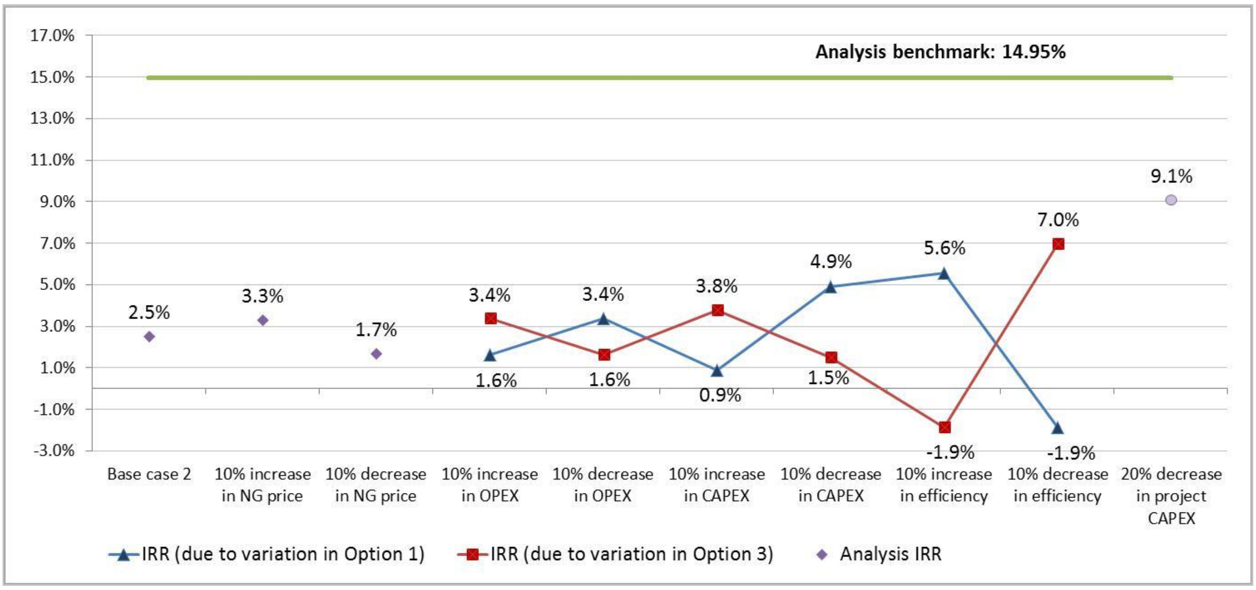
The sensitivity analysis has been also completed in the Section B.4., under the Identification of the financially most attractive option, wherein it was established that for up to 10% of the variation in the key parameters, the project without CERs remains financially unviable vis-à-vis the baseline options as well as the investment benchmark of 14.95% identified for power projects in Azerbaijan.

The results of sensitivity analysis and benchmark analysis are given in the figures below:

For Base case 1 (project versus mazut-run baseline technology)



For Base case 2 (project versus natural gas-run baseline technology)



Step 2. Common practice analysis

The AM0029 requires to apply Step 4 (common practice analysis) of the latest version of the "Tool for demonstration assessment and of additionality" (so-called Additionality tool). While performing the common practice analysis, "Guidelines on common practice" (Version 02.0) (so-called Guidelines) have been taken into consideration.

The common practice analysis has been conducted as an extra credibility check for the proposed CDM project activity's additionality.

Sub-step 4a of the Additionality tool: Analyze other activities similar to the proposed project activity:

As per the Guidelines, the stepped approach is followed, namely:

> **Step 1:** calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity

The capacity of the proposed CDM project activity is 525MW and estimated output (electricity available for sale) is 3,552GWh/year/ Therefore, the applicable capacity or output range as +/-50% equal 263-788MW or1,776-5,328GWh/year, accordingly.

> **Step 2:** identify similar projects (both CDM and non-CDM)

Similar project activities to the proposed CDM project activity need to meet a set of criteria (Table 5)

Table 5 Identification of similar projects to the proposed CDM project activity

Condition specified in the Guidelines	Result
The projects are located in the applicable geographical area;	As per the Guidelines, the applicable geographical area for this analysis is the entire host country. In the case of the proposed CDM project activity this is Azerbaijan.
The projects apply the same measure as the proposed project activity;	As allowed by the definition of "measure" in the Guidelines, similar projects should include switch of technology with change of energy source including energy efficiency improvement as well as use of renewable energies. The proposed CDM project activity involves construction of new base-load power plant in place of older decommissioned units.
The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;	In the case of the proposed CDM project activity natural gas is the fuel.
The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;	In the case of the proposed CDM project activity, plants would produce electricity and deliver it to the gird of Azerbaijan.

Condition specified in the Guidelines	**Result**
The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;	Calculated applicable capacity or output range as +/-50% equal 263-788MW or 1,776-5,328GWh/year, accordingly
The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.	The PDD was published for stakeholder consultation on 1 Dec 2007 to 30 Dec 2007. The start date of the proposed project activity is 23 May 2005. Thus similar projects should have started commercial operation before 23 May 2005.

Based on the historical installed capacity structure (as used to calculate combined and build emission factors), there is only one power plant, which meets all the criteria of similar projects as discussed above in Table 5. It is Shimal CCGT (commissioned in 2002, 400MW of installed capacity).

> **Step 3:** within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.

Shimal CCGT is considered in further analysis (N_{all} = 1)

> **Step 4:** within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff}

Shimal CCGT uses the same technology. No other power plant is considered in the analysis.

> **Step 5:** calculate factor F=1-Ndiff/Nall representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

The factor F is 1.

According to Guidelines, the proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and N_{all}-N_{diff} is greater than 3. However, in the case of above analysis, although factor F is higher than 0.2, the difference between N_{all} and N_{diff} is lower than 3 (i.e. N_{all}-N_{diff} = 1). **Therefore, since the project does not meet both conditions of the common practice, it can be said that the project is not a common practice within the sector.**

Sub-step 4b of the Additionality tool: Discuss any similar Options that are occurring

Shimal CCGT[9] plant does not reflect the common practice in the country for the following reason: Comparing financial incentives available to Shimal CCGT plant and to Sumgayit CCGT power plant, not only Shimal CCGT had very attractive and extremely low interest rate (i.e. 0.75%; as part of ODA funding), but the loan repayment period for Shimal CCGT is 4 times the average loan repayment period available to Sumgayit CCGT (i.e. 40 years).

Thus, availability of low interest rate – long term loan (as ODA financing) to Shimal CCGT plant reflects that Shimal CCGT does not contribute to common practice consideration for CCGT plants in Azerbaijan.

Based on the additionality analysis performed above it is concluded that the proposed CDM project activity is additional and its implementation is only possible within the CDM framework.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The following section explains the methodological choices made for the calculation of

- Baseline Emissions
- Project Emissions
- Leakage Emissions
- Emission reductions

<u>Baseline Emissions</u>

As stated by the methodology AM0029: "Baseline emissions are calculated by multiplying the electricity generated in the project plant ($EG_{PJ,y}$) with a baseline CO_2 emission factor ($EF_{BL,CO2,y}$), as follows:

$$BE_y = EG_{PJ,y} * EF_{BL,CO2,y} \quad (2)$$

The electricity generated in the project plant ($EG_{PJ,y}$) is the net electricity entering the national electricity grid. Ex-ante it is estimated based on the expected capacity factor of the plant; ex-post it is going to be based on the actual electricity being exported by the plant to the Azeri grid.

For construction of large new power capacity additions under the CDM, there is a considerable uncertainty relating to which type of other power generation is substituted by the power generation of the project plant. As a result of the project, the construction of an alternative power generation technology(s) could be avoided, or the construction of a series of other power plants could simply be delayed. Furthermore if the project were installed sooner than these other projects might have been constructed, its near-term impact could be largely to reduce electricity generation in existing plants. This depends on many factors and assumptions (e.g. whether there is a supply deficit) that are difficult to determine and

[9] Note, Shimal is the Azeri name, whereas in Russian the same plant is called Severnaya.

that change over time. In order to address this uncertainty in a conservative manner, project participants shall use for $EF_{BL,CO2,y}$ the lowest emission factor among the following three options:

For the first crediting period:

Option 1	The build margin, calculated according to the "Tool to calculate the emission factor for an electricity system"
Option 2	The combined margin, calculated according to "Tool to calculate the emission factor for an electricity system", using a 50/50 OM/BM weight
Option 3	The emission factor of the technology (and fuel) identified as the most likely baseline scenario under "Identification of the baseline scenario" above, and calculated as follows $$EF_{BL,CO2}(tCO2e/Mwh) = \frac{COEF_{BL}}{\eta_{BL}} * 3.6GJ/MWh \qquad (3)$$

Where:

$COEF_{BL}$	the fuel emission coefficient (tCO2e/GJ), based on national average fuel data, if available, otherwise IPCC defaults can be used
η_{BL}	the energy efficiency of the technology, as estimated in the baseline scenario analysis above

The methodology further prescribes that this determination will be made once at the validation stage based on an ex ante assessment, once again at the start of each subsequent crediting period (if applicable). If either option 1 (BM) or option 2 (CM) are selected, they will be estimated ex post, as described in the "Tool to calculate the emission factor for an electricity system".

According to methodology AM0029, all the three Options must be calculated before a selection is done among the three options. In the case of this proposed CDM project activity, the three potential Options are the following:

Option 1. The build margin, calculated according to the "Tool to calculate the emission factor for an electricity system" for Azerbaijan for year 2006 (latest year, for which data are available)

Option 2. The combined margin, calculated according to the "Tool to calculate the emission factor for an electricity system", using a 50/50 OM/BM weight. Operating margin data for years 2006, 2005, 2004 for Azerbaijan are used.

Option 3. The emission factor of the combustion turbine technology running on heavy fuel oil (mazut) identified as the most likely baseline scenario under "Identification of the baseline scenario".

The following are the results of calculations:

Option 1. The build margin results to be equal to 0.6022tCO_{2e}/MWh.

Option 2. The combined margin results to be equal to 0.6078tCO_{2e}/MWh

Option 3. The emission factor of the condensing steam turbine technology results to be equal to 0.6324tCO_{2e}/MWh

Thus, the lowest emission factor amongst the three Options above is under Option 1. Therefore the emission factor of **0.6022tCO_2e/MWh** is chosen to be the baseline emission factor ($EF_{BL,CO2,y}$) for the calculations of the ex-ante emission reductions for the proposed CDM project activity.

As a result, the equation (2) changes to $BE_y = EG_{PJ,y} * EF_{BM,y}$

Detailed calculations of the three Options can be found in Annex 3, Baseline Information.

Project Emissions

In line with the methodology, the proposed project activity is on-site combustion of natural gas to generate electricity and, therefore, the CO_2 emissions from electricity generation (PE_y) are calculated as follows:

$$PE_y = \sum FC_{f,y} * COEF_{f,y} \qquad (1)$$

Where:

- $FC_{f,y}$: is the total volume of natural gas or other fuel ‘f’ combusted in the project plant or other start-up fuel (m^3 or similar) in year(s) ‘y’
- *f*: stands for natural gas (NG) or diesel (d)
- $COEF_{f,y}$ is the CO_2 emission coefficient (tCO_2/m^3 or similar) in year(s) for each fuel and is obtained as:

$$COEF_{f,y} = \sum NCV_{f,y} * EF_{CO2,f,y} * OXID_f$$

Where:

$NCV_{f,y}$	is the net calorific value (energy content) per volume unit of natural gas in year ‘y’ (GJ/m^3) as determined from the fuel supplier, wherever possible, otherwise from local or national data
$EF_{CO2,f,y}$	is the CO_2 emission factor per unit of energy of natural gas in year ‘y’ (tCO_2/GJ) as determined from the fuel supplier, wherever possible, otherwise from local or national data
$OXID_f$	is the oxidation factor of natural gas (as per latest IPCC guidelines)
f	stands for natural gas (NG) or diesel (d)

For start up fuels, IPCC default calorific values and CO_2 emission factors are acceptable, if local or national estimates are unavailable.

Detailed calculations of the Project Emissions are presented in Annex 3, Baseline Information.

Leakage Emissions

As per the methodology, leakage may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary. This includes mainly fugitive CH_4 emissions and CO_2 emissions from associated fuel combustion and flaring. In this methodology, the following leakage emission sources shall be considered.

- Fugitive CH_4 emissions, associated with fuel extraction, processing, liquefaction, transportation, regasification and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity.

- In the case LNG is used in the project plant: CO_2 emissions from fuel combustion or electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system.

In the proposed CDM project activity LNG is not used and therefore only fugitive CH_4 emissions and CO_2 emissions from associated combustion and flaring are considered.

Fugitive methane emissions

For the purpose of estimating fugitive CH_4 emissions, the quantity of natural gas consumed by the project in year y is multiplied by an emission factor for fugitive CH_4 emissions ($EF_{NG,upstream,CH4}$) from natural gas consumption, and subtracted from the emissions occurring from fossil fuels used in the absence of the project activity, as follows:

$$LE_{CH4,y} = \left[FC_y * NCV_y * EF_{NG,upstream,CH4} - EG_{PJ,y} * EF_{BL,upstream,CH4}\right] * GWP_{CH4} \quad (5)$$

Where:

$LE_{CH4,y}$	Leakage emissions due to fugitive upstream CH_4 emissions in the year y in tCO_{2e}
FC_y	Quantity of natural gas combusted in the project plant during the year y in m^3
$NCV_{NG,y}$	Average net calorific value of the natural gas combusted during the year y in GJ/m^3
$EF_{NG,upstream,CH4}$	Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution and in the case of LNG, liquefaction, transportation, regasification and compression in to a transmission or distribution system, in tCH_4 per GJ fuel supplied to final consumers
$EG_{PJ,y}$	Electricity generation in the project plant during the year in MWh
$EF_{BL,upstream,CH4}$	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in tCH_4 per MWh electricity generation in the project plant, as defined below
GWP_{CH4}	Global warming potential of methane valid for the relevant commitment period

The emission factor for upstream fugitive CH_4 emissions occurring in the absence of the project activity ($EF_{BL, upstream, CH4}$) has been calculated consistently with the baseline emission factor ($EF_{BL,CO2}$) calculated above. The lowest baseline emission factor has been found to be the one calculated as per build margin method, so the same calculation procedure has been adopted to calculate $EF_{BL, upstream, CH4}$.

$$EF_{BL,upstream,CH4} = \frac{\sum_j FF_{j,k} * EF_{k,upstream,CH4}}{\sum_j EG_j} \quad \text{(Option 1 in the methodology)}$$

Where:

$EF_{BL,upstreamCH4}$	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in tCH_4 per MWh electricity generation in the project plant
j	Plants included in the build margin
$FF_{j,k}$	Quantity of fuel type k (a coal or oil type) combusted in power plant j included in the build margin
$EF_{k,upstreamCH4}$	Emission factor for upstream fugitive methane emissions from production of the fuel type k (a coal or oil type) in tCH_4 per MJ fuel produced
EG_j	Electricity generation in the plant j included in the build margin in MWh/a

The default values used in the project activity are as follows:

Parameter	Default value	Remarks
Emission factor for fugitive CH_4 upstream emissions for Gas	$921tCH_4$ / PJ	As per the Table 2 of the methodology AM0029, 296 CH_4/PJ is applicable for rest of the world and $921tCH_4$/PJ is applicable for Eastern Europe and former USSR. As Azerbaijan is part of the erstwhile USSR the $921tCH_4$/PJ is chosen.
Emission factor for fugitive CH_4 upstream emissions for Oil	$4.1tCH_4$ / PJ	As per the Table 2 of the methodology AM0029. This value includes oil production, transport, refining and storage.
Global warming potential of CH_4	21	According to 1996 Revised IPCC Guidelines

The default emission factor for fugitive emission is chosen as given in the methodology as Azerbaijan doesn't publish or provide this information as part of their national communication (as it is not calculated).

It should be noted that the choice of fugitive emission factor is not important in calculations of the leakage emissions as the fugitive emission factor would apply equally to both the baseline and the project scenario.

By applying the formulae above, the value of leakage emissions due to fugitive upstream CH_4 emissions ($LE_{CH4,y}$) results to be negative, because leakage emissions in the baseline scenario (535,287tCO_{2e}) are higher than leakage emissions in the project scenario (486,004tCO_{2e}). Therefore, leakage emissions are omitted for the purpose of calculation of Emissions Reductions.

Detailed calculations of the Leakage Emissions can be found in Annex 3, Baseline Information.

Emission reductions

To calculate the emission reductions the project participant shall apply the following equation:

$$ER_y = BE_y - PE_y - LE_y \qquad (6)$$

Where:

ER_y	Emissions reductions in year y (tCO_{2e})
BE_y	Emissions in the baseline scenario in year y (tCO_{2e})
PE_y	Emissions in the project scenario in year y (tCO_{2e})
LE_y	Leakage in year y (tCO_{2e})

B.6.2. Data and parameters that are available at validation:

The following are data and parameters that are not monitored throughout the crediting period but are determined only once. Thus, they remain fixed throughout the chosen crediting period and are available when validation is undertaken.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_{2e}
Description:	The global warming potential of methane
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied	IPCC 2006; if during the crediting period – this value changes the same would be incorporated in the CDM PDD
Any comment:	-

Data / Parameter:	$\mathbf{EF_{CM,y}}$
Data unit:	tCO_2/MWh
Description:	The combined margin emission factor calculated according to the “Tool to calculate the emission factor for an electricity system”
Source of data to be used:	JSC “Azerenerji” provided the plant level fuel consumption and electricity production data. The NCV and EF of fuels were provided by JSC “Azerenerji” based on the information available to them from the fuel supplier. The final value was calculated based on the methodological tool.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.6078
Description of measurement methods and procedures to be applied:	The combined margin emission factor has been calculated for 2004-2006 as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin Emission factor ($EF_{BM,y}$): $EF_y = w_{OM} . EF_{OM,y} + w_{BM} . EF_{BM,y}$

	where the weights w_{OM} and w_{BM} by default are 50% (i.e., w_{OM} and w_{BM} =0.5) The Operating Margin (OM) emission factor was calculated for each year by determining the simple OM .The simple OM was calculated according to the "Tool to calculate the emission factor for an electricity system" as the generation weighed average emissions per electricity unit ($tC0_2$/MWh) of all generating sources serving the system, not including low cost and must-run power plants. Details of the plants selected for deriving simple operating margin and calculation of simple operating margin are given in Annex 3.
QA/QC procedures to be applied:	JSC "Azerenerji" will be in charge of recalculating the operating margin using data on power plants built in Azerbaijan. The same spreadsheets for calculating the operating margin as those used during PDD preparation will be used. In case IPCC 2006 Guidelines are updated, the new figures on carbon content of fuels and oxidation factors will be used.
Any comment:	This parameters has been calculated in order to determine the EFBL,CO2,y, as mentioned in Section B.6.1.

Data / Parameter:	**$EF_{NG,Upstream,CH4}$**
Data unit:	tCH_4/PJ
Description:	Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution (Easter Europe and Former USRR)
Source of data to be used:	AM0029 Version 03 (Table 2)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	921
Description of measurement methods and procedures to be applied:	The parameter is to be monitored once a year.
QA/QC procedures to be applied:	Data taken from an authentic source
Any comment:	

Data / Parameter:	**$EF_{oil,Upstream,CH4}$**
Data unit:	tCH_4/PJ
Description:	Emission factor for upstream fugitive methane emissions of oil from production, transport, refining and storage (World).
Source of data to be used:	AM0029 Version 03 (Table 2)
Value of data applied	4.1

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	No direct information was available for mazut, so the value for oil has been taken. The parameter is to be monitored once a year.
QA/QC procedures to be applied:	Data taken from an authentic source
Any comment:	-

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

Baseline emissions

Baseline emission factor selection	Unit	Value
Build Margin	tCO_{2e}/MWh	0.6022
Combined Margin	tCO_{2e}/MWh	0.6078
Condensing steam turbine technology running on Mazut	tCO_{2e}/MWh	0.6324
Lowest of the three (Build Margin)	tCO_{2e}/MWh	0.6022

Baseline scenario emissions	Unit	Value
Baseline coefficient	tCO_{2e}/MWh	0.6022
Baseline Net Electricity Production	MWh	3,552,000
Baseline scenario emissions	tCO_{2e}	2,138,896

The estimated baseline emissions by taking the build margin as the baseline emission factor are 2,138,896 tCO_{2e} per annum.

Project emissions

Project scenario emissions	Unit	Value
Annual fuel consumption (natural gas)	1000 m^3	724,597
Project coefficient (natural gas)	$tCO_{2e}/1000m^3$	1.88
Project Scenario Emissions	tCO_{2e}	1,364,466

The project activity emissions are estimated to be 1,364,466tCO_{2e} per annum.

As required by the methodology; the baseline emissions (also baseline leakages) are calculated based on the net power generation, while the project emissions (also project leakages) are calculated based on the gross generation. This is conservative.

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

The project activity has applied for a crediting period of 10 years. Total ex-ante estimate of emission reduction by the proposed CDM project activity are estimated at 7,744,300tCO_{2e} over the chosen crediting period.

Year	Estimation of project activity emissions (tonnes of CO_{2e})	Estimation of baseline emissions (tonnes of CO_{2e})	Estimation of leakages (tonnes of CO_{2e})	Estimation of overall emissions reduction (tonnes of CO_{2e})
Year 1 (2012/2013)	1,364,466	2,138,896	0	774,430
Year 2 (2013/2014)	1,364,466	2,138,896	0	774,430
Year 3 (2014/2015)	1,364,466	2,138,896	0	774,430
Year 4 (2015/2016)	1,364,466	2,138,896	0	774,430
Year 5 (2016/2017)	1,364,466	2,138,896	0	774,430
Year 6 (2017/2018)	1,364,466	2,138,896	0	774,430
Year 7 (2018/2019)	1,364,466	2,138,896	0	774,430
Year 8 (2019/2020)	1,364,466	2,138,896	0	774,430
Year 9 (2020/2021)	1,364,466	2,138,896	0	774,430
Year 10 (2021/2022)	1,364,466	2,138,896	0	774,430
Total (tonnes of CO_{2e})	**13,644,660**	**21,388,960**	**0**	**7,744,300**

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

Title: Approved monitoring methodology AM0029 (Version 3) "Grid Connected Electricity Generation Plants using Non-Renewable and Less GHG Intensive Fuel."

The methodology AM0029 requires that the lowest emission factor among three provided options is used (build margin, combined margin or the emission factor of the technology chosen in the baseline scenario). As per methodology, this determination needs to be made once at the validation stage based on an *ex ante* assessment, and once again at the start of each subsequent crediting period (if applicable). For the proposed CDM project activity, the determination is made at validation stage only and the build margin (BM) is selected as the baseline emission factor. The methodology states, that if either option 1 (BM) or option 2 (CM) are selected, they will be estimated *ex post*, as described in the "Tool to calculate the emission factor for an electricity system". Thus, the data and factors used for the determination of the build margin for this project activity will be updated each year.

In addition, data and parameters used for the calculation of project emissions and project-activity related leakage emissions will be updated each year at the time of monitoring and verification.

B.7.1. Data and parameters monitored:

Data / Parameter:	**$EF_{BM,y}$**
Data unit:	tCO_2/MWh
Description:	The build margin emission factor calculated according to the "Tool to calculate the emission factor for an electricity system"
Source of data to be used:	JSC "Azerenerji" provided the plant level fuel consumption and electricity production data. The NCV and EF of fuels were provided by JSC "Azerenerji" based on the information available to them from the fuel supplier. The final value was calculated based on the methodological tool.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.6022
Description of measurement methods and procedures to be applied:	The build margin emission factor has been calculated based on the most recent information available on plants already built for sample group *m*, consisting of the most recently built power plant capacity additions in the electricity system that comprise 20% of the system generation. The information on the most recently built plants has been sourced from JSC "Azerenerji". The IPCC 2006 Guidelines was used for carbon content of fuels used by the power plants considered in the build margin. Details of the plants selected for deriving build margin and calculation of build margin are given in Annex 3. Build Margin will be calculated every year based on the latest available information prior each CDM project verification.
QA/QC procedures to be applied:	JSC "Azerenerji" will be in charge of recalculating the build margin using data on power plants built in Azerbaijan. The same spreadsheets for calculating the build margin as those used during PDD preparation will be used. In case IPCC 2006 Guidelines are updated, the new figures on carbon content of fuels and oxidation factors will be used.
Any comment	-

Data / Parameter:	**$FC_{NG,y}$**
Data unit:	Nm^3
Description:	Annual quantity of natural gas consumed by the Sumgayit Power Plant.
Source of data to be used:	Gas flow meter reading from the two gas meters installed at the point where the gas pipelines enter the territory of Sumgayit power plant.
Value of data applied for the purpose of	724,597,000

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The total fuel consumption will be monitored using the gas flow meters installed at the point where the gas pipelines enter the territory of the Sumgayit Power Plant. Two parallel gas meters are installed. The meters installed are calibrated as per the manufacturer's manual. The information of gas consumption would be taken directly from the meters. Calculation procedures as applicable for the meter class used shall also be applied. Quantity of natural gas would be monitored continuously. However, from the point of view of CDM project activity – it would be recorded and reported on a daily basis, and compiled weekly, monthly, quarterly and annually
QA/QC procedures to be applied:	In case of an interruption, mishandling or breaking of one of the gas meters located at the entrance of gas boilers and auxiliary boilers could be used. The data collected from the gas meters would be cross checked with the data on sale of natural gas from the natural gas provider (AzeriGas) The meter specification has been presented at the time of validation. Gas flow meters will be installed as per the manufacturer's specification. All the gas meters installed at the gas distribution station and those installed at the Sumgayit gas turbines are calibrated every three years. The calibration is made by the State Agency on Standardization, Metrology and Patents, which issues a calibration certificate for three years
Any comment:	-

Data / Parameter:	**$FC_{D,y}$**
Data unit:	Tons
Description:	Annual quantity of diesel oil (emergency fuel) consumed by the project activity
Source of data to be used:	Measurement of fuel capacity at the diesel tank and or the invoices for the purchase of diesel by the Sumgayit Power Plant.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	Diesel oil is measured at the diesel oil tank. The total fuel consumption will be monitored both at the supplier of diesel (that will be transported via trucks) and project end for cross-verification. Quantity of diesel consumed would be monitored continuously. However, from the point of view of CDM project activity – it would be reported monthly and compiled annually
QA/QC procedures to	Diesel oil will be consumed only in case of emergency shut downs and fires.

be applied:	The capacity of the two diesel tanks at the plant is 2m^3 and 0.35m^3. The tanks are always full. If diesel is used from the tanks, total consumption of diesel can be measured. Additional diesel will be brought by truck: invoices from the diesel supplier will be used as source of data. The information will be cross checked.
Any comment:	-

Data / Parameter:	**$EG_{PJ,y}$**
Data unit:	MWh
Description:	Net electricity exported to grid by the project activity
Source of data to be used:	Data measured and recorded from energy meters installed in the plant and in substations. Since the net electricity being exported from the grid is measured – the value can be directly employed for calculation of baseline emissions.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3,552,000
Description of measurement methods and procedures to be applied:	Meters are installed by SIEMENS and sealed by Gosenergonadzor (agency included in the Ministry of the Industry and Power of the Azerbaijan Republic) and Gosstandard. The meters installed on the lines exporting electricity to the national electricity grid would be used to measure the net electricity exported to the grid; currently seven lines (2 lines at 220kV and 7 lines at 110kV) export electricity to the grid. The sum of electricity exported to the grid from all these seven lines would give the overall electricity exported by the Sumgayit power plant to the grid. All meters have an accuracy of 0.2. The data from all these meters is available on real time basis and would be measured at the same time at which the data from the natural gas meters is measured to ensure that there is a very high level of match in the calculation of the baseline and project emissions. The meter specification has been presented at the time of validation. Net electricity generated would be monitored continuously. However, from the point of view of CDM project activity – it would be reported monthly and compiled annually
QA/QC procedures to be applied:	The electricity meters are calibrated every three years. The calibration and sealing of meters is made by the State Agency on Standardization, Metrology and Patents, which issues a calibration certificate for three years. The responsibility for the management and maintenance of electricity meters lies with JSC “Azerenerji”. The meter value would be cross checked with the electricity sales receipt.
Any comment:	Data measured and recorded from Energy meters installed in the plant and in Substations. Since the net electricity being exported from the grid is measured

	– the value can be directly employed for calculation of baseline emissions.

Data / Parameter:	**NCV_d**
Data unit:	GJ/t
Description:	The net calorific value (energy content) per ton of diesel oil
Source of data to be used:	EIA default calorific value of diesel oil
Value of data applied for the purpose of calculating expected emission reductions in section B.5	43.333
Description of measurement methods and procedures to be applied::	The data is taken from EIA. It is the most reliable source of data available to date. During the course of the project activity (throughout the CDM crediting period) – the net calorific value of diesel would be used as recorded through the project activity. The sequence for source of data depending upon their availability would be as given below: 1. Supplier provided data 2. Local country data 3. Country specific defaults Further, as suggested in the methodology AM0029 (Version 03) – the NCV of diesel may be taken as provided by IPCC (default values). At the end of the year – for calculation of emission reductions ex-post – the NCV shall be calculated using the NCVs available for a given year. The parameter is to be monitored fortnightly.
QA/QC procedures to be applied:	The value of NCV would be cross-checked with the NCV as stated by the IPCC or other authentic references to ensure that the applied NCV of diesel is comparable with the published value of NCV for diesel.
Any comment:	**-**

Data / Parameter:	**NCV_m**
Data unit:	GJ/t
Description:	Net Calorific Value of Mazut
Source of data to be used:	JSC “Azerenerji”
Value of data applied for the purpose of calculating expected emission reductions in section B.5	41.415

Description of measurement methods and procedures to be applied:	The data are provided by JSC “Azerenerji” from direct measurements of the calorific value of Azeri mazut. During the course of the project activity (throughout the CDM crediting period) – the net calorific value of Mazut would be used as recorded by JSC “Azerenerji”. The sequence for source of data depending upon their availability would be as given below: 1. Supplier provided data 2. Local country data 3. Country specific defaults The parameter is to be monitored fortnightly. At the end of the year – for calculation of emission reductions ex-post. The NCV value shall be calculated using the NCV value available for the year During the course of the project activity – Mazut would not be used as the Sumgayit CCGT plant only uses natural gas for power generation.
QA/QC procedures to be applied:	The value of NCV would be cross-checked with the NCV as stated by the IPCC or other authentic references to ensure that the NCV of heavy fuel oil (Mazut) is comparable with the published value of NCV of mazut.
Any comment:	-

Data / Parameter:	**$NCV_{NG,y}$**
Data unit:	GJ/ m3
Description:	Net Calorific Value of Natural Gas
Source of data to be used:	JSC “Azerenerji”
Value of data applied for the purpose of calculating expected emission reductions in section B.5	34.68
Description of measurement methods and procedures to be applied:	The data are provided by JSC “Azerenerji” from direct measurements of the calorific value of Azeri natural gas. During the course of the project activity (throughout the CDM crediting period) – the net calorific value of Natural Gas would be used as recorded by JSC “Azerenerji”. The sequence for source of data depending upon their availability would be as given below: 1. Supplier provided data 2. Local country data 3. Country specific defaults At the end of the year – for calculation of emission reductions ex-post – the

	NCV shall be calculated using the NCVs available for a given year. The parameter is to be monitored fortnightly.
QA/QC procedures to be applied:	The value of NCV would be cross-checked with the NCV as stated by the IPCC or other authentic references to ensure that the applied NCV of natural gas is comparable with the published value of NCV of natural gas.
Any comment:	-

Data / Parameter:	**$OXID_{NG}$**
Data unit:	-
Description:	Oxidation Factor of Natural Gas
Source of data to be used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2 Energy. Chapeter 2 Stationary combustion. P 2.6.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.00 or 100%
Description of measurement methods and procedures to be applied:	The value applied is from a publicly accessible source: the IPCC, and has a high level of reliability. The oxidation factor of Natural Gas will be updated annually based on the current IPCC default value.
QA/QC procedures to be applied:	Data taken from a reliable and trustworthy source.
Any comment:	

Data / Parameter:	**$OXID_{oil}$**
Data unit:	-
Description:	Oxidation Factor of oil and oil products, including mazut and diesel oil
Source of data to be used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2 Energy. Chapeter 2 Stationary combustion. P 2.6.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.00 or 100%
Description of measurement methods and procedures to be applied:	The value applied is from a publicly accessible source (IPCC) and has a high level of reliability. The oxidation factor of Natural Gas would be updated annually based on the then current IPCC default value.
QA/QC procedures to be applied:	Data taken from an authentic source.
Any comment:	-

Data / Parameter:	$EF_{CO2,NG, y}$
Data unit:	tCO_2/GJ
Description:	Emission factor of natural gas
Source of data to be used:	IPCC 2006 Guidelines (Volume 2 Chapter 2)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0543
Description of measurement methods and procedures to be applied:	The data is sourced from IPCC 2006 Guidelines. Stationary Combustion. Table.2.2 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf (lower value of emission factor). This is a reliable and publicly available source. The emission factor of natural gas would be updated annually based on the then current IPCC default value.
QA/QC procedures to be applied:	Data taken from an authentic source.
Any comment:	-

Data / Parameter:	$EF_{CO2,Mazut,y,}$
Data unit:	tCO_2/GJ
Description:	Emission factor of mazut
Source of data to be used:	IPCC 2006 Guidelines (Volume 2 Chapter 2)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0755
Description of measurement methods and procedures to be applied:	The data is sourced from IPCC 2006 Guidelines. Stationary Combustion. Table.2.2 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf (lower value of emission factor). This is a reliable and publicly available source. No direct information was available for mazut (heavy fuel oil), therefore the value for residual fuel oil has been taken.

	The emission factor of mazut would be updated annually based on the then current IPCC default value.
QA/QC procedures to be applied:	Data taken from an authentic source.
Any comment:	-

Data / Parameter:	$EF_{CO2,d,y}$
Data unit:	tCO_2/GJ
Description:	Emission factor of diesel oil
Source of data to be used:	IPCC 2006 Guidelines (Volume 2 Chapter 2)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0726
Description of measurement methods and procedures to be applied:	The data is sourced from IPCC 2006 Guidelines. Stationary Combustion. Table.2.2 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf (lower value of emission factor) This is a reliable and publicly available source. The emission factor of diesel oil would be updated annually based on then current IPCC default value.
QA/QC procedures to be applied:	Data taken from an authentic source.
Any comment:	-

B.7.2. Description of the monitoring plan:

The Monitoring Plan defines a project-specific standard against which the project's performance and conformance with all relevant criteria will be monitored and verified. It includes developing suitable data collection methods and data interpretation techniques for monitoring and verification of GHG emissions with specific focus on technical performance parameters. The monitoring plan includes the following information:

- Measures to be implemented for monitoring all parameters required
- Measures to safeguard proper installation and maintenance of monitoring equipment (including procedures for calibration of meters).
- Measures to be implemented for ensuring data quality
- Internal audit procedure in case of problems with metering devices
- The responsibility for monitoring and measurement
- The reporting procedure

Parameters monitored
The following parameters will be monitored as follows:

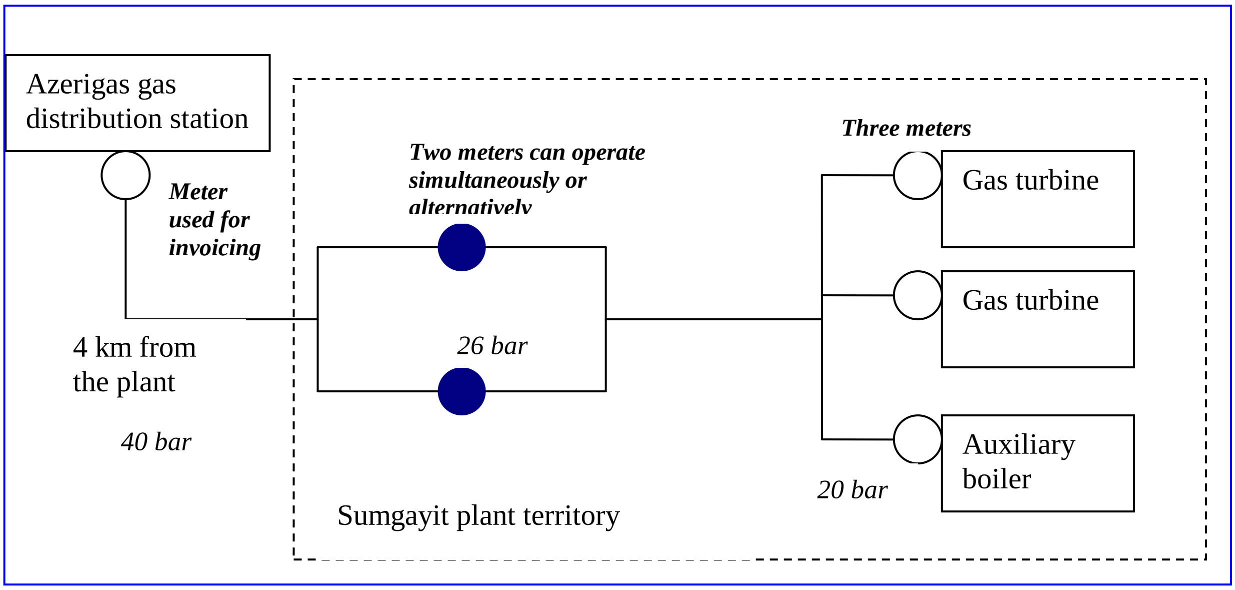
- *Carbon emission factor of the Azeri electricity grid*

The build margin, operating margin and combined margin emission factor will be calculated *ex post* at the time of yearly monitoring and verification of emissions reductions. These factors will be calculated based on the most recent information available to JSC "Azerenerji" on the power plants connected to the Azeri grid. In case the Designated National Authority publishes data on the build margin, operating margin and the combined margin of the Azeri electricity grid, then the latter data will be used. JSC "Azerenerji" will be in charge of recalculating the emission factors using data on power plants built in Azerbaijan. In case IPCC 2006 Guidelines are updated, the new figures on carbon content of fuels and oxidation factors will be used.

- *Natural gas usage*

The following parameters will be monitored at the gas receiving station: the calorific value of natural gas and the flow of natural gas to the Sumgayit station. Natural gas is supplied by the company Azerigas. Gas flow meters used to monitor the quantity of gas being imported to the Sumgayit territory is shown in the figure below. These are the two gas meters installed where the gas enters the territory of Sumgayit. (see picture below). The meters will have an accuracy of 0.1% (as indicated in the meter specification)

Plan of gas meters:



In the picture above, the gas meters indicated in blue shall be used to monitor the overall gas consumed by the power plant

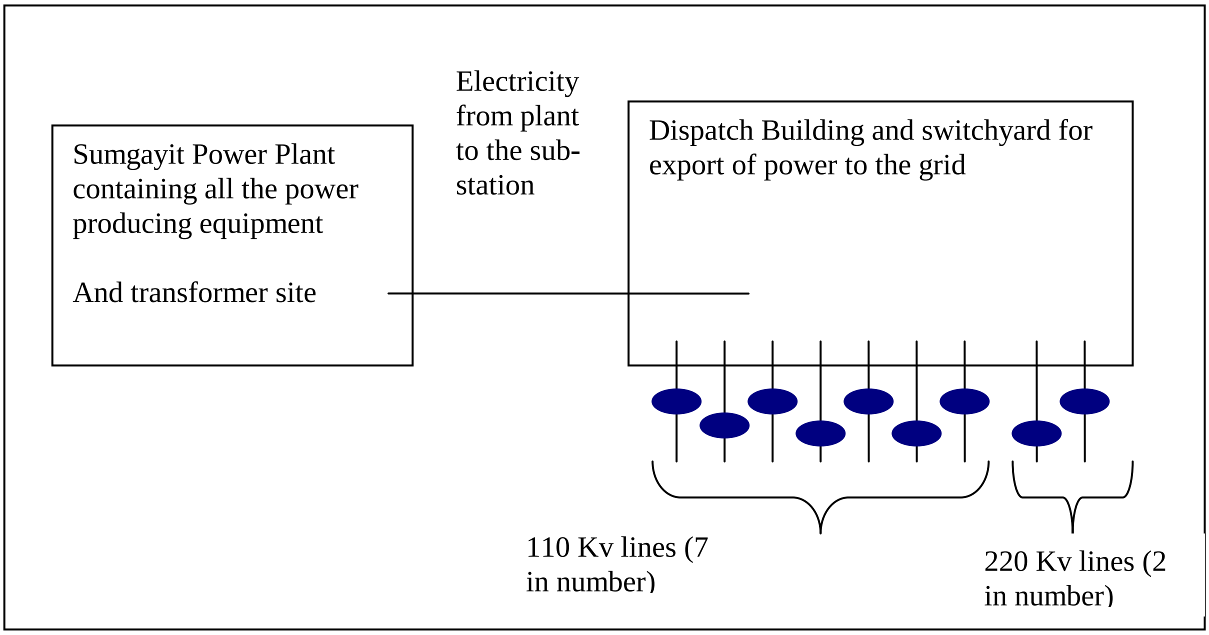
- *Diesel oil usage*

In exceptional circumstances such as emergencies and fires if the reserve fuel (diesel oil) will be used in the Sumgayit CCGT; data on diesel oil consumption and calorific value and carbon content of diesel will be properly recorded and monitored. However, the use of diesel oil is not to produce electricity to export to the grid, but to run the essential plant auxiliaries in the eventuality that both the gas turbines are out of operation and also no power can be imported from the grid. Such insistences are not expected to happen more than once in 10 years.

- *Electricity generated and delivered to the Azeri Grid.*

The net power generated and exported to the grid by the power project will be measured in the plant premises to the best accuracy and will be recorded by the electricity meters installed at these lines. Electricity meters have an accuracy class of 0.2 or better. All meters will be calibrated at regular intervals as prescribed by the manufacturer's manual or the state agency for calibration of these meters. The calibration will substantiate the smooth operations of the project.

Plan of electricity meters:



In the picture above the meters indicate in blue (that measure the net electricity exported to the grid) and are used for invoicing purposes – shall be used for calculation of the baseline emission.

Installation of monitoring equipment

Electricity meters are installed by Siemens and sealed by Gosenergonadzor (agency included in the Ministry of the Industry and Power of the Azerbaijan Republic). All meters have an accuracy class of 0.2. The electricity meters are calibrated every three years. The calibration and sealing of meters is made by the State Agency on Standardization, Metrology and Patents, which issues a calibration certificate for three years.

Gas flow meters will be installed as per the manufacturer's specification. All the gas meters installed at the gas distribution station and those installed at the Sumgayit gas turbines are calibrated every three years. The calibration is made by the State Agency on Standardization, Metrology and Patents, which issues a calibration certificate for three years. This is as per the national standardization requirement. If needed, for the CDM project activity – an increase in frequency of calibration may be requested. However, this is not felt necessary so long as the standardization process is following the national standard, including need to remedy the meters in case of an emergency or abrupt incorrect behaviour of the meters.

Responsibility for monitoring
The responsibility for the management and maintenance of electricity meters lies with JSC "Azerenerji". The responsibility for the management and maintenance of gas meters located at the Sumgayit gas turbines lies within JSC "Azerenerji".

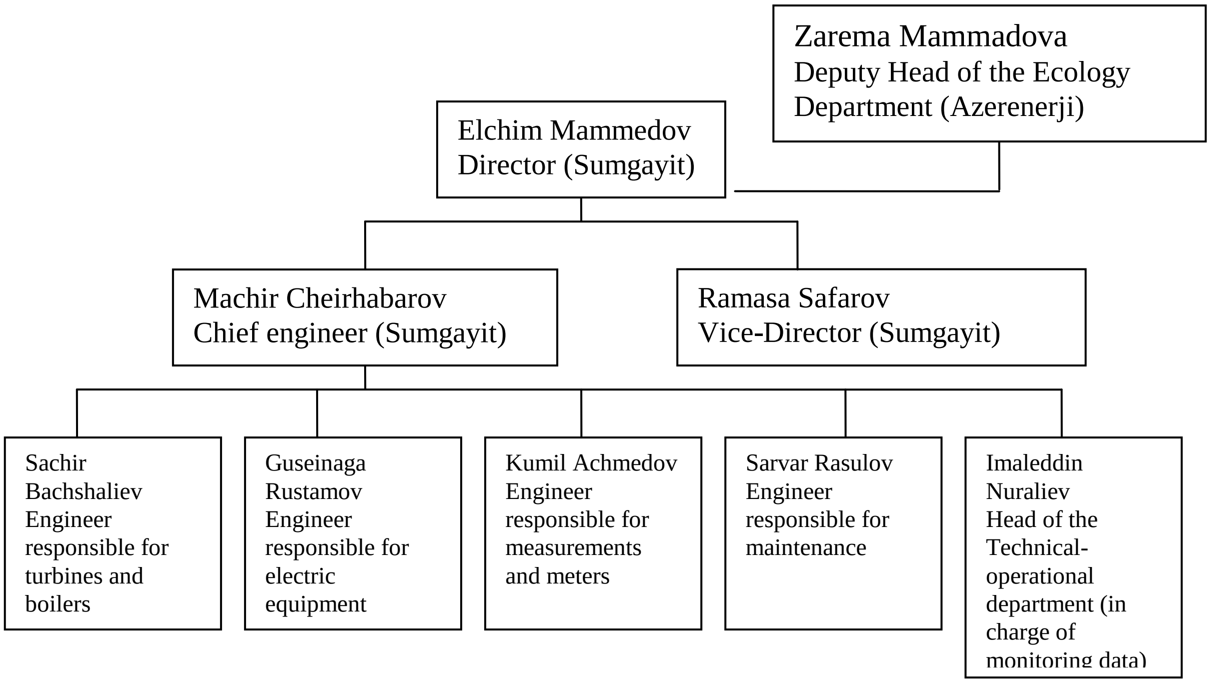
Reporting procedure
The daily electricity generation date is recorded by the operative duty personnel of Operational and Technical Department of the Sumgayit plant. The department prepares a daily report which includes information on total generation of electric power, electricity consumed for own needs of the station, and electricity inputted in the grid.

Upon the beginning of the CDM crediting period, the data on fuel consumption by the Sumgayit Power Plant and the net electricity produced from the plant and exported to the grid would be measured as per the monitoring requirement of the applied CDM monitoring methodology AM0029.

Data storage
Data are metered electronically in a continuous manner. Metered data both at the electronic electricity meters and the electronic gas meters are stored in the memory of the metering devices (data can be downloaded directly from the electronic meter via a USB port). Data are also automatically transmitted from the electronic meters to the computers at the electro-technical laboratories located at the plant. Data are kept in the memory of the computers as well as stored on CDs and kept in the archives of the electro-technical laboratories.

Data Archiving:
All the data collected from the point of CDM project activity would be kept archived for at least two years beyond the last year of the CDM project activity's crediting period.

Monitoring of the project for CDM
The authority and responsibility of management of the Sumgayit power plant lies within the director of the plant. The current director of the Sumgayit power plant is Mr. Elchin Mammadov. The organisational structure of the Sumgayit power plant management is presented below.



The responsibility for the CDM project and the designated contact person for communications with the Designated Operational Entity is Mrs. Zarema Mammadova, whose contact details are included in Annex 1. Mrs. Mammadova is the current Deputy Head of Ecology department of JSC "Azerenerji". During the course of the crediting period of the CDM project any successor of Mrs. Mammadova will be responsible for CDM project coordination (including monitoring and verification of the CDM project).

Data quality & contingency management:
In a remote possibility for interruption, mishandling or breaking of electricity meters. In these cases, the following procedure is followed in order to ensure the quality of data and that no data are missing. The control of the technical conditions of the measurement equipment is made by the personnel of the "electro-technical laboratory" of the Sumgayit station. In case there is an infringement of the seals on the electricity meters, then the data recorded by such meters are automatically invalidated. To supply for the missing data, the data measured by the meters of technical control (i.e. secondary meters installed in the same places as the primary meters and used as back up and cross check meters) will be used. Meters of technical control have the same class of accuracy as the primary meters.

The mishandling of gas meters is highly unlikely, because the measuring and registration devices of the meters are located in closed boxes sealed by the personnel of Azerigas and the Sumgayit station. Once the boxes are sealed, they cannot be interfered with. The following procedure is followed in order to ensure the quality of data and that no data are missing. The control of the technical conditions of the measurement equipment is made by the personnel of Azerigas and of the Sumgayit station. In case there is an infringement of the seals on the gas meters, then the data recorded by such meters are automatically invalidated. To supply for the missing data, the data measured by the other three of the gas meters located at the gas distribution station are used.

Internal audit in case of problems (QAQC procedure)
In case a problem is found with the electricity meters, the electricity laboratory informs the management of the Sumgayit station, which in turn informs Gosenergonadzor (agency included in the Ministry of the Industry and Power of the Azerbaijan Republic) and Azerenerjinadzor (agency within JSC "Azerenerji" in charge of controlling). A working team is immediately created (including personnel of Sumgayit, Gosenergonadzor and Azerenerjinadzor) in order to evaluate the reasons for the mishandling, interruption or infringement of measuring devices. In case the reasons cannot be identified and managed, a new meter is installed, after a calibration and check-up of the meter is carried out by the State Agency on Standardization, Metrology and Patents.

In case a problem is found with the gas meters, operational personnel of the Sumgayit station inform immediately the management of Azerigas. A working team is immediately created (including personnel of Sumgayit and Azerigas) in order to evaluate the reasons for the mishandling, interruption or infringement of measuring devices. In case the reasons cannot be identified and managed, a new meter is installed, after calibration and check-up of meter is done by the State Agency on Standardization, Metrology and Patents.

Procedures for corrective actions
In case of error of a gas or electricity meter, the secondary meter is used (i.e. the backup meters installed for internal use and cross check and not used for invoicing purposes). In case of mishandling of malfunctioning of the meter, the meter is taken out of service, repaired and/or replaced with a new meter as described by the procedures above. During the verification process, the DOE will provide the project participants with correction action requests to improve the quality of monitored data. The project participants will respond to the corrective actions requests as required.

Procedures for emergency cases that cause unintended emissions
Procedures are in place at the plant that is applied in case of emergencies. All relevant personnel is trained by Siemens on procedures to be taken in case of emergencies. In case of electricity network shut downs or fires at the plant, the diesel generators automatically come into operation. The unintended emissions from the consumption of diesel oil used to operate the diesel generators will be monitored.

Calibration of the meters:
Calibration of gas-meters and energy meters is carried out once per three years by the Azerbaijan Republic State Agency on Standardization, Metrology and Study of Patent (SASMSP). All gas-meters are checked on the stands of the State Agency on Standardization, Metrology and Study of Patent before their installation. After the check the gas-meters are sealed up by SASMSP. Gas-meters may be subject to extraordinary check on demand of the State Energysupervision or the Sumgayit Power Plant

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)

Date of completion of the application of the baseline study: 15/03/2009

Contact Information:
ICF International
Sardinia House, 52 Lincoln’s Inn Fields, London, UK
Contact Person: Nina Kaczmarczyk
e-mail: :nkaczmarczyk@icfi.com

The company is not a project participant listed in Annex 1.

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:

23/05/2005
Date when the contract between JSC “Azerenerji” and the equipment supplier and construction company (Siemens) was signed

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

25 years

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

C.2.1. Renewable crediting period

Not chosen

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

Not chosen

C.2.1.2. Length of the first crediting period:

Not chosen

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

The date of submission of a complete request for registration to the EB:UNFCCC.
For the purpose of calculating emissions reductions, it is assumed to be 1 December 2012

C.2.2.2. Length:

10 years, from 01/12/2012 to 30/11/2022

SECTION D. Environmental impacts

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

Generation from the proposed project activity displaces more carbon intensive generation from the grid, which especially in the peak hour is heavy fuel oil and natural gas in rather inefficient thermal power plants. The proposed project activity leads to the reduction of GHG emissions (CO_2), other emissions (SO_x, NO_x) and other particulate/solid emissions typical for heavy fuel oil-based thermal power plants.

The CDM project activity has received the EIA and also the host country approval from the Ministry of Ecology and Environment. This is because the project fulfils the environmental requirements set forth in the country.

The Sumgayit CCGT is classified as category “A” project and implementation of the project is subject to mandatory Environmental Impact Assessment (EIA). The project has attained necessary environmental approvals and the final environmental clearance obtained for the project has been presented to the DOE. The environmental impact assessment clearance is given by Ministry of Ecology and Natural Resources of Azerbaijan Republic upon review of the detailed environmental impact assessment document.

In this document the following issues have been looked upon and only after those were found satisfactorily that the EIA for the project was issued. The checklist below further illustrates the rigorous EIA approval process to which the Sumgayit project was subjected. Also, the fact that currently the plant has been commissioned and is running illustrates that the plant achieved all environmental approvals that it needed to run the plant.

1. Position of the plant and status/impacts on the surrounding area at project pre-implementation phase:

a. Extension of the project, legal boundaries of the project.

b. Physical surroundings: geological characteristics, physical and chemical characteristics of the soil, characteristics of the underground waters.

c. Ecological surroundings: description of woods, plantations, fauna, local rivers, lakes, natural reserves, the Caspian coast. Evaluation of the presence of rare fauna or flora species.

d. Social surroundings: description of the residential area in the vicinity of the project (apartment houses, schools etc.) public transport routes, railway routes, roads etc.

2. Impact during the project construction stage:

a. Aspects on ground works and preparation works.

b. Aspects on building materials (including origin of the building materials and information of the transportation mode of building materials);

c. Aspects on human resources (including number specialized workers and their families);

d. Project implementation schedule including start date of construction works and timetable of construction works

e. Description of expected waste streams and its handling

3. Information on the operational stage of the project:

a. Information on the technologies to be utilised during the operation of the plant (technologies innovative for Azerbaijan will be specified);

b. Information on materials and energy usage during plant operation, including: raw materials (origin of raw materials and their mode of transportation will be specified); water (origin, transportation mode to the plant and a method of use will be specified); energy (type, quantity, origin, transportation mode and a method of use will be specified).

c. Information on resulting end products and waste streams, including: type and quantity of end-product; liquid wastes (type, volume, physical characteristics, proposed methods of clearing of discharges); solid wastes (type, volume, physical characteristics, proposed methods of clearing of discharges); gaseous emissions (type, volume, physical characteristics, proposed methods of clearing/abatement).

4. Project costs:

a. Financial expenses (cost of land and inception); costs of engineering works; costs of labour (including contractors); costs of the technologies applied.

b. Costs of actions undertaken for environmental protection; expected costs of actions for the minimisation of the impacts of the project on the environment; expected cost of indemnifications.

c. Value of negative impacts of the project on the biological environment; value of negative impacts of the project on the social environment (people, communities, standard of living)

It is only after the rigorous assessment of these aspects that the project is granted an EIA NOC; which has already been shared with the validator.

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:

No significant environmental impacts were assessed for the project; more so since the project is being implemented at the sight of an existing thermal plant, which was less efficient and more carbon intensive the current project activity.

SECTION E. Stakeholders' comments

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

The general public as well as the relevant institutional bodies in Azerbajan were duly informed of the intention of JSC "Azerenerji" to develop the Sumgayit CCGT project. Meetings were organised in 2005 to inform relevant stakeholders regarding the Sumgayit CCGT project. The initiation of the construction of the Sumgayit CCGT was officially announced in August 2005 through the official ceremony of "laying the first stone" of the power station. Additionally, the general public is informed of the stage of implementation of the project in the news items posted on JSC "Azerenerji's" website.

The stakeholder meeting and the development of the Sumgayit power plant were extensively covered by the local media (TV, radio, and newspaper). The stakeholder invitation was even publicly announced through radio. The stakeholder meeting was attended by 43 key stakeholders (whose name and addresses have been provided in the minutes of meeting), who were also invited through personal invitation. On the day of the stakeholder meeting Mr. Abdulkhalik Heydarov gave a presentation on CDM component of the Sumgayit project, while the Chief Engineer of Sumgayit Power Plant (Mr. Elchin) gave presentation on the plant itself. All the participants were presented with the PIN of the Sumgayit CCGT project.

The minutes of meeting with detailed question answer session that was conducted during the stakeholder consultation meeting has been provided to the DOE.

E.2. Summary of the comments received:

The minutes of meetings of the stakeholder meeting were made available to the DOE. No negative comments were received for the project.

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

No negative comments were received for the project, and all the stakeholders who attended the meeting supported the implementation of the project. .

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	JSC "Azerenerji "
Street/P.O.Box:	H. Zardabi str. 94
Building:	
City:	Baku
State/Region:	
Postcode/ZIP:	AZ1012
Country:	Azerbaijan
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	Mrs.
Salutation:	
Last Name:	Mammadova
Middle Name:	
First Name:	Zarema
Department:	Ecology Department
Mobile:	
Direct FAX:	(+99412) 430 41 02
Direct tel:	(+99412) 430 02 72
Personal E-Mail:	zmemmedova@azerenerji.gov.az

Note: the postal address given in the table above refers to the actual location (building) of Mrs. Mammadova's office. The official address of JSC "Azerenerji" is:
10, Academician Abdulkerim Alizade street
1005 Baku
Azerbaijan Republic

Organization:	BNP Paribas
Street/P.O.Box:	10, Harewood Avenue
Building:	
City:	London
State/Region:	
Postcode/ZIP:	NW1 6AA
Country:	United Kingdom
Telephone:	+44 207 595 5000
FAX:	+44 207 595 5654

	+44 207 595 2555
E-Mail:	
URL:	
Represented by:	
Title:	Mr.
Salutation:	
Last Name:	Carre
Middle Name:	
First Name:	Francois
Department:	European Gas And Power - Trading And Marketing - Commodity Indexed Trading - London (branch)
Mobile:	
Direct FAX:	+44 207 595 52 51
Direct tel:	+44 207 595 34 18
Personal E-Mail:	francois.carre@bnpparibas.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The proposed project activity does not receive any public funding.

Annex 3

BASELINE INFORMATION

This Annex presents the following information:

- Calculation of the combined margin for the Azeri electricity grid
- Calculation of the emission factor of the technology chosen as baseline
- Calculation of project emissions
- Calculation of leakage emissions

Calculation of the Combined Margin for the Azeri grid (EF_y)

Version 02.2.1 of the "Tool to calculate the emission factor for an electricity system" states that the baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors determined according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available) and made publicly available.

The operating margin and the build margin are derived from the data published or obtained from the following organisations:

- JSC "Azerenerji" is the state utility that is responsible for running and maintaining all the state run power plants in the country. JSC "Azerenerji" provided information on the Azeri electricity system for the years 2006, 2005 and 2004. The data supplied included:
    - the names of thermal power plants and hydro power plants operating on the Azeri grid;
    - capacity of each plant (in MW);
    - level of electricity supplied to the Azeri grid by each plant in 2006, 2005 and 2004 (in MWh);
    - annual natural gas consumption for each thermal power plant in 2006, 2005 and 2004; (in cubic meters)
    - annual heavy fuel oil consumption for each thermal power plant in 2006, 2005 and 2004 (in tonnes);
    - level of imports of electricity from other grids to the Azeri grid.
- Intergovernmental Panel on Climate Change, "IPCC 2006 Guidelines for National Greenhouse Gas Inventories". Workbook Vol 2. Table 1-2, page 1.6 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf)

STEP 1: Identify the relevant electricity system

For the purpose of determining the electricity emission factors, a project electricity system is 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. The geographical and physical boundary of the baseline grid chosen for this project activity is the national electricity grid of Azerbaijan Republic, this by virtue of the fact that within this grid, power can be transferred without any transmission constraint.

Imports of electricity from Russia, Turkey, Iran, and Georgia are taken into account in the baseline grid and are considered to have a nil carbon emission factor as required by the "Tool to calculate the emission factor for an electricity system" for imports from connected electricity systems located in other host countries. Electricity exports are not subtracted from electricity generation data used for calculating and monitoring the electricity emission factors, as required.

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

Off-grid plants have not been included in the project electricity system.

STEP 3: Select a method to determine the Operating Margin (OM)

According to the "Tool to calculate the emission factor for an electricity system", the Operating Margin calculation must be based on one of the four following methods:
(a) Simple OM, or
(b) Simple adjusted OM
(c) Dispatch data analysis OM
(d) Average OM.

Among the four methods for calculating the OM, the Simple Operating Margin (method a) is chosen.

- The Dispatch Data Analysis OM and the Simple Adjusted OM cannot be selected because of the unavailability of the detailed dispatch data for the Azeri grid.
- The Simple OM (method a) can be applied in Azerbaijan since the low-cost/must run resources (i.e. hydro generation) constitute less than 50% of total grid generation in the average of the five most recent years as shown in the table below. The source of the data used in the following table is JSC "Azerenerji".

Year	2002	2003	2004	2005	2006
Total electricity generation in GWh	18578	21151	21343	22420	23784
Hydro generation in GWh	2020	2469	2756	3008	2513.6
Percentage of low-cost/must run resources in total generation	11%	12%	13%	13%	11%
Average of five years	12%				

The simple OM emission factor can be calculated using either of the two following data vintages for years(s) y:

- Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without 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, requiring the emissions factor to be updated annually during monitoring.

The ex-ante option is chosen.

STEP 4: Calculate the Operating Margin emission factor according to the selected method

The OM is calculated using the Option B provided in the tool, this is because both necessary data for Option A is not available (point a) and Off-grid power plants are not included in the calculation (point c).

- Option B: 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.

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. It is calculated based on data on fuel type, fuel consumption and net electricity generation of each power plant/unit (Option B).

The table below presents all the plants considered for the calculation of the operating margin for 2004, 2005 and 2006. If hydro, geothermal, wind, low-cost biomass, nuclear and solar generation is excluded, then thirteen thermal power plants running on natural gas and/or heavy fuel oil (mazut) are included in the operating margin. It must be noted that some of these plants have not generated electricity in the years 2004, 2005 and 2006. The imports from Russia, Turkey, Georgia and Iran are also included in the calculation of the operating margin. Since the imported electricity comes from other countries, the emission factor of all the imports was assumed to be 0 tonnes of CO_2 per MWh.

The power sources included in the operating margin calculation are highlighted in yellow the table below.

Power Plants	Date Commissioned	Fuel Source	Capacity	Generation (2004)	Generation (2005)	Generation (2006)
			MW	GWh	GWh	GWh
Azerbaijan ThPP	1990	Natural gas/oil	2400	10225.1	10297.5	11600.5
Ali-Bairamli ThPP	1968	Natural gas/oil	1100	5274.9	5559.1	5672.5
“Shimal” CCPP Gas/oil	1960	Natural gas/oil	150	190	122.8	60.1
“Shimal” CCPP only gas	2002	Natural gas	400	2145.4	2526.3	2610.5
“Baku-1” CHPP Gas/oil	1975	Natural gas/oil	100	0	0.0	0.0
“Baku-1” CHPP only gas	2001	Natural gas	106	742.8	719.9	691.1
“Baku-2” CHPP	1953	Natural gas/oil	24	0	0.0	0.0
“Sumgait-1” CHPP	1963	Natural gas/oil	200	0	0.0	0.0
“Sumgait-2” CHPP	1974	Natural gas/oil	220	0	0.0	0.0
“Astara” ThPP (PPP)	2006	Natural gas	87.5	0	0.0	319.8
“Sheki” ThPP (PPP)	2006	Natural gas	87.5	0	0.0	138.0
“Khachmaz” ThPP (PPP)	2006	Natural gas	87.5	0	0.0	57.9
“Babek” GTPP	2006	Natural gas	87.5	0	0.0	120.0

Power Plants	Date Commissioned	Fuel Source	Capacity	Generation (2004)	Generation (2005)	Generation (2006)
			MW	GWh	GWh	GWh
“Mingechevir” HPP	1954	Hydro	401.5	1155.3	1338.7	1208.9
“Shamkir” HPP	1982	Hydro	380	1094.5	1046.3	802.9
“Yenikend” HPP	2003	Hydro	150	323.7	440.8	311.4
“Araz” HPP	1971	Hydro	22	90.7	92.3	101.9
“Varvara” HPP	1957	Hydro	16.5	91.2	89.7	86.3
“Vaykhur” HPP	2006	Hydro	5	0	0.0	2.2
Imports				2373.1	2450.0	1766.2
Total			6,025.0	23,706.7	24,683.4	25,550.2

The operating margin emissions factor ($EF_{OM,\ y}$) has been calculated using a 3 year data vintage. The tables below calculate the relative energy contribution of each thermal plant connected to the grid, calculate the emissions for each plant and develop the simple operating margin for three years: 2004, 2005 and 2006.

The Operating Margin Emission Factors are calculated to be **0.6047**tCO_{2e}/MWh for 2006, **0.6177**tCO_{2e}/MWh for 2005, and **0.6183** tCO_{2e}/MWh for 2004. And the average operating margin for the three years is 0.6236tCO_{2e}/MWh. The tables below have some of the columns removed to fit in the PDD – full excel files with no hidden columns have been provided to the DOE.

Simple Operating Margin for 2006

Sr. No.	Power Plants	Dates commissioned	Fuel Source	Capacity	Generation (2006)	Contribution to total energy mix	Thermal plants generation (2006)	Contribution to thermal energy mix	Heavy fuel oil consumption	Natural gas consumption	NG EF	Residual Fuel Oil EF	Emission factor	Weighted Average Emissions
				MW	GWh	(%)	GWh	(%)	tonnes	1000 m3	tCO2/GJ	tCO2/GJ	tCO2/MWh	tCO2/MWh
1	Azerbaijan ThPP	1990	Natural gas/oil	2400	11600.5	45.40%	11600.5	50.36%	907,815.80	2,627,245.50	0.05	0.08	0.67	0.34
2	Ali-Bairamli ThPP	1968	Natural gas/oil	1100	5672.5	22.20%	5672.5	24.62%	403,355.10	1,628,148.10	0.05	0.08	0.76	0.19
3	“Shimal” CCPP Gas/oil	1960	Natural gas/oil	150	60.1	0.24%	60.1	0.26%	1,666.60	28,295.40	0.05	0.08	0.97	0.00
4	“Shimal” CCPP only gas	2002	Natural gas	400	2610.5	10.22%	2610.5	11.33%	-	507,573.20	0.05	0.08	0.37	0.04
5	“Baku-1” CHPP Gas/oil	1975	Natural gas/oil	100	0.0	0.00%	0.0	0.00%	1,719.50	8,093.40				
6	“Baku-1” CHPP only gas	2001	Natural gas	106	691.1	2.70%	691.1	3.00%	-	242,339.70	0.05	0.08	0.66	0.02
7	“Baku-2” CHPP	1953	Natural gas/oil	24	0.0	0.00%	0.0	0.00%	-	-				
8	“Sumgait-1” CHPP	1963	Natural gas/oil	200	0.0	0.00%	0.0	0.00%	-	-				
9	“Sumgait-2” CHPP	1974	Natural gas/oil	220	0.0	0.00%	0.0	0.00%	-	-				
10	“Astara” ThPP (PPP)	2006	Natural gas	87.5	319.8	1.25%	319.8	1.39%	-	74,223.10	0.05	0.08	0.44	0.01
11	“Sheki” ThPP (PPP)	2006	Natural gas	87.5	138.0	0.54%	138.0	0.60%	-	33,748.10	0.05	0.08	0.46	0.00
12	“Khachmaz” ThPP (PPP)	2006	Natural gas	87.5	57.9	0.23%	57.9	0.25%	-	13,826.20	0.05	0.08	0.45	0.00
13	“Babek” GTPP	2006	Natural gas	87.5	120.0	0.47%	120.0	0.52%	-	62,582.60	0.05	0.08	0.98	0.01
14	“Mingechevir” HPP	1954	Hydro	401.5	1208.9	4.73%								
15	“Shamkir” HPP	1982	Hydro	380	802.9	3.14%								
16	“Yenikend” HPP	2003	Hydro	150	311.4	1.22%								
17	“Araz” HPP	1971	Hydro	22	101.9	0.40%								
18	“Varvara” HPP	1957	Hydro	16.5	86.3	0.34%								
19	“Vaykhur” HPP	2006	Hydro	5	2.2	0.01%								
	Imports				1766.2	6.91%	1766.2							
				6,025.0	25,550.2		23,036.6		1,314,557	5,226,075.3				**0.6047**

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Sources:	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Calculation	Source: Azerenerji		Source: Azerenerji	Source: Azerenerji	2006 IPCC Guidelines	2006 IPCC Guidelines	Calculated	Calculated

Simple Operating Margin for 2005

Sr. No.	Power Plants	Dates commissioned	Fuel Source	Capacity	Generation (2006)	Contribution to total energy mix	Thermal plants generation (2006)	Contribution to thermal energy mix	Heavy fuel oil consumption	Natural gas consumption	NG EF	Residual Fuel Oil EF	Emission factor	Weighted Average Emissions
				MW	GWh	(%)	GWh	(%)	tonnes	1000 m3	tCO2/GJ	tCO2/GJ	tCO2/MWh	tCO2/ MWh
1	Azerbaijan ThPP	1990	Natural gas/oil	2400	10297.5	41.72%	10297.5	47.51%	1,096,730.00	2,161,139.00	0.05	0.08	0.73	0.35
2	Ali-Bairamli ThPP	1968	Natural gas/oil	1100	5559.1	22.52%	5559.1	25.65%	600,098.80	1,328,679.20	0.05	0.08	0.79	0.20
3	“Shimal” CCPP Gas/oil	1960	Natural gas/oil	150	122.8	0.50%	122.8	0.57%	9,252.50	48,059.80	0.05	0.08	0.97	0.01
4	“Shimal” CCPP only gas	2002	Natural gas	400	2526.3	10.23%	2526.3	11.66%	-	496,256.70	0.05	0.08	0.37	0.04
5	“Baku-1” CHPP Gas/oil	1975	Natural gas/oil	100	0.0	0.00%	0.0	0.00%	235.20	3,286.80				
6	“Baku-1” CHPP only gas	2001	Natural gas	106	719.9	2.92%	719.9	3.32%	-	242,903.60	0.05	0.08	0.64	0.02
7	“Baku-2” CHPP	1953	Natural gas/oil	24	0.0	0.00%	0.0	0.00%	-	-				
8	“Sumgait-1” CHPP	1963	Natural gas/oil	200	0.0	0.00%	0.0	0.00%	-	-				
9	“Sumgait-2” CHPP	1974	Natural gas/oil	220	0.0	0.00%	0.0	0.00%	-	-				
10	“Astara” ThPP (PPP)	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
11	“Sheki” ThPP (PPP)	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
12	“Khachmaz” ThPP (PPP)	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
13	“Babek” GTPP	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
14	“Mingechevir” HPP	1954	Hydro	401.5	1338.7	5.42%								
15	“Shamkir” HPP	1982	Hydro	380	1046.3	4.24%								
16	“Yenikend” HPP	2003	Hydro	150	440.8	1.79%								
17	“Araz” HPP	1971	Hydro	22	92.3	0.37%								
18	“Varvara” HPP	1957	Hydro	16.5	89.7	0.36%								
19	“Vaykhur” HPP	2006	Hydro	5	0.0	0.00%								
	Imports				2450.0	9.93%	2450.0							
				6,025.0	24,683.4		21,675.6		1,706,317	4,280,325.1				**0.6177**

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Sources:	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Calculation	Source: Azerenerji		Source: Azerenerji	Source: Azerenerji	2006 IPCC Guidelines	2006 IPCC Guidelines	Calculated	Calculated

Simple Operating Margin for 2004

Sr. No.	Power Plants	Dates commissioned	Fuel Source	Capacity	Generation (2006)	Contribution to total energy mix	Thermal plants generation (2006)	Contribution to thermal energy mix	Heavy fuel oil consumption	Natural gas consumption	NG EF	Residual Fuel Oil EF	Emission factor	Weighted Average Emissions
				MW	GWh	(%)	GWh	(%)	tonnes	1000 m3	tCO2/GJ	tCO2/GJ	tCO2/MWh	tCO2/ MWh
1	Azerbaijan ThPP	1990	Natural gas/oil	2400	10225.1	43.13%	10225.1	48.80%	958,222.00	2,278,332.40	0.05	0.08	0.71	0.35
2	Ali-Bairamli ThPP	1968	Natural gas/oil	1100	5274.9	22.25%	5274.9	25.18%	495,880.80	1,420,992.00	0.05	0.08	0.80	0.20
3	"Shimal" CCPP Gas/oil	1960	Natural gas/oil	150	190.0	0.80%	190.0	0.91%	17,943.30	65,450.70	0.05	0.08	0.94	0.01
4	"Shimal" CCPP only gas	2002	Natural gas	400	2145.4	9.05%	2145.4	10.24%	-	420,600.20	0.05	0.08	0.37	0.04
5	"Baku-1" CHPP Gas/oil	1975	Natural gas/oil	100	0.0	0.00%	0.0	0.00%	172.50	5,468.00				
6	"Baku-1" CHPP only gas	2001	Natural gas	106	742.8	3.13%	742.8	3.55%	-	249,717.70	0.05	0.08	0.63	0.02
7	"Baku-2" CHPP	1953	Natural gas/oil	24	0.0	0.00%	0.0	0.00%	-	-				
8	"Sumgait-1" CHPP	1963	Natural gas/oil	200	0.0	0.00%	0.0	0.00%	-	-				
9	"Sumgait-2" CHPP	1974	Natural gas/oil	220	0.0	0.00%	0.0	0.00%	-	-				
10	"Astara" ThPP (PPP)	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
11	"Sheki" ThPP (PPP)	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
12	"Khachmaz" ThPP (PPP)	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
13	"Babek" GTPP	2006	Natural gas	87.5	0.0	0.00%	0.0	0.00%	-	-				
14	"Mingechevir" HPP	1954	Hydro	401.5	1155.3	4.87%								
15	"Shamkir" HPP	1982	Hydro	380	1094.5	4.62%								
16	"Yenikend" HPP	2003	Hydro	150	323.7	1.37%								
17	"Araz" HPP	1971	Hydro	22	90.7	0.38%								
18	"Varvara" HPP	1957	Hydro	16.5	91.2	0.38%								
19	"Vaykhur" HPP	2006	Hydro	5	0.0	0.00%								
	Imports				2373.1	10.01%	2373.1							
				6,025.0	23,706.7		20,951.3		1,472,219	4,440,561.0				**0.6183**

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Sou	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Calculation	Source: Azerenerji		Source: Azerenerji	Source: Azerenerji	2006 IPCC Guidelines	2006 IPCC Guidelines	Calculated	Calculated

STEP 5: Calculate the Build Margin (BM) emission factor

According to the "Tool to calculate the emission factor for an electricity system", the Build Margin calculation must be the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m*.
The sample group of power units *m* used to calculate the build margin consists of either:
(a) The set of five power units that have been built most recently, or
(b) 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 recently.

As per the option (a) above: The five power plants that have been built most recently are the four thermal power plants "Astara" ThPP, "Sheki" ThPP, "Khachmaz" ThPP, "Babek" GTPP and the hydro power plant "Vaykhur" HPP. The sum of these plants electricity generation is 637.9GWh and it contributes to 2.68% of total Azeri electricity production.

Thus, the stack of plants (from most recent to older ones) is being included in the group of plants for calculating build margin for the project activity (as per option (b) above):

Sr. No.	Power Plants	Dates commissioned (earliest or not known first)	Fuel Source	Capacity	Generation (2006)	Share in Gen. Mix (%)	Cumulative (%) of generation mix
				MW	GWh	%	%
1	"Baku-2" CHPP	1953	Natural gas/oil	24	0.0	0.00%	100.000000%
2	"Mingechevir" HPP	1954	Hydro	401.5	1208.9	5.08%	100.000000%
3	"Varvara" HPP	1957	Hydro	16.5	86.3	0.36%	94.917171%
4	"Shimal" CCPP Gas/oil	1960	Natural gas/oil	150	60.1	0.25%	94.554322%
5	"Sumgait-1" CHPP	1963	Natural gas/oil	200	0.0	0.00%	94.301631%
6	Ali-Bairamli ThPP	1968	Natural gas/oil	1100	5672.5	23.85%	94.301631%
7	"Araz" HPP	1971	Hydro	22	101.9	0.43%	70.451564%
8	"Sumgait-2" CHPP	1974	Natural gas/oil	220	0.0	0.00%	70.023125%
9	"Baku-1" CHPP Gas/oil	1975	Natural gas/oil	100	0.0	0.00%	70.023125%
10	"Shamkir" HPP	1982	Hydro	380	802.9	3.38%	70.023125%
11	Azerbaijan ThPP	1991 (Being rehabilitated since 2005)	Natural gas/oil	2400	11600.5	48.77%	66.647326%
12	"Baku-1" CHPP only gas	2001	Natural gas	106	691.1	2.91%	17.872940%
13	"Shimal" CCPP only gas	2002	Natural gas	400	2610.5	10.98%	14.967205%
14	"Yenikend" HPP	2003	Hydro	150	311.4	1.31%	3.991339%
15	"Astara" ThPP (PPP)	2006	Natural gas	87.5	319.8	1.34%	2.682055%
16	"Sheki" ThPP (PPP)	2006	Natural gas	87.5	138.0	0.58%	1.337454%
17	"Khachmaz" ThPP (PPP)	2006	Natural gas	87.5	57.9	0.24%	0.757232%
18	"Babek" GTPP	2006	Natural gas	87.5	120.0	0.50%	0.513791%
19	"Vaykhur" HPP	2006	Hydro	5	2.2	0.01%	0.009250%

The table above indicates the list of plants being included in the build margin for the calculation of build margin emission factor.

Having selected the cohort of plants to be used for calculation of the build margin, next step is to calculate the build margin emission factor. The build margin emissions factor ($EF_{BM,\ y}$) has been calculated using information available for the year 2006.

The table below shows the Build Margin emission factor for Azerbaijan for the year 2006. The Build Margin Emission Factor is calculated to be **0.6022**tCO_{2e}/MWh.

Build Margin for 2006

Sr. No.	Power Plants	Dates commissioned	Fuel Source	Capacity	Generation (2006)	Contribution to thermal energy mix	Heavy fuel oil consumption	Natural gas consumption	NG EF	Residual Fuel Oil EF	Emission factor	Weighted Average Emissions
				MW	GWh	(%)	tonnes	1000 m3	tCO2/GJ	tCO2/GJ	tCO2/MWh	tCO2/MWh
1	Azerbaijan ThPP	1991	Natural gas/oil	2400	11600.5	73.18%	907,816	2,627,246	0.0543	0.0755	0.67	0.49
2	“Baku-1” CHPP only gas	2001	Natural gas	106	691.1	4.36%	-	242,340	0.0543	0.0755	0.66	0.03
3	“Shimal” CCPP only gas	2002	Natural gas	400	2610.5	16.47%	-	507,573	0.0543	0.0755	0.37	0.06
4	“Yenikend” HPP	2003	Hydro	150	311.4	1.96%	-	-	0.0543	0.0755	-	-
5	“Astara” ThPP (PPP)	2006	Natural gas	87.5	319.8	2.02%	-	74,223	0.0543	0.0755	0.44	0.01
6	“Sheki” ThPP (PPP)	2006	Natural gas	87.5	138.0	0.87%	-	33,748	0.0543	0.0755	0.46	0.00
7	“Khachmaz” ThPP (PPP)	2006	Natural gas	87.5	57.9	0.37%	-	13,826	0.0543	0.0755	0.45	0.00
8	“Babek” GTPP	2006	Natural gas	87.5	120.0	0.76%	-	62,583	0.0543	0.0755	0.98	0.01
9	“Vaykhur” HPP	2006	Hydro	5	2.2	0.01%	-	-	0.0543	0.0755	-	-
				3,411.0	15,851.4		907,816	3,561,538				**0.6022**

A	B	C	D	E	F	G	H	I	J	K	L	M
Sources:	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji		Source: Azerenerji	Source: Azerenerji	2006 IPCC Guidelines	2006 IPCC Guidelines	Calculated	Calculated

STEP 6: Calculate the Combined Margin (CM) emission factor

The combined margin emission factor (EF_y) is calculated as the weighted average of the generation-weighted average of Simple Operating Margin emission factor ($EF_{simpleOM,y}$) and the Build Margin emission factor ($EF_{BM,y}$).

The weights applied to the Operating and the Build Margins are 0.5 as requested by the "Tool to calculate the emission factor for an electricity system". The baseline emission factor is calculated as follows:

Combined Margin Emission Factor = 0.5 x[(2004 Simple Operating Margin x 2004 Generation + 2005 Simple Operating Margin x 2005 Generation + 2006 Simple Operating Margin x 2006 Generation) / (2004 Generation + 2005 Generation + 2006 Generation)] + 0.5 x [2006 Build Margin]

The Combined Margin Factor is calculated in the table below:

Year	Simple Operating Margin (of power sources other than low cost must run resources)	Total Generation in 2004, 2005, 2006	Generation weighted average of Simple Operating margin of 2004, 2005, 2006	Build Margin	Emission coefficient for the grid
	kgCO2/ kWh	GWh	tCO2/MWh	tCO2/ MWh	tCO2/ MWh
2004	0.6183	23706.7			
2005	0.6177	24683.4			
2006	0.6047	25550.2		0.6022	
			0.6134		
Average of operating margin and build margin					0.6078

The Combined Margin Emission Factor is calculated to be **0.6078**tCO_{2e}/MWh.

Calculation of the emission factor of the technology chosen as baseline

The emission factor of the technology identified as the most likely baseline scenario under "Identification of the baseline scenario" is given below:

For this project activity, the technology identified as the most likely baseline scenario is *"Power generation using condensing steam turbine technology running on mazut (heavy fuel oil)"*.

The emission factor of the technology (and fuel) identified is calculated as follows:

$$EF_{BL,CO2}(tco2/Mwh) = \frac{COEF_{BL}}{\eta_{BL}} * 3.6GJ/MWh$$

Where:

$COEF_{BL}$ = the fuel emission coefficient (tCO_{2e}/GJ), based on national average fuel data, if available, otherwise IPCC defaults can be used

η_{BL} = the energy efficiency of the technology, as estimated in the baseline scenario analysis above

$COEF_{BL}$ is calculated as follows:

Parameter	**Value**
Carbon content of fuel in tC/TJ	20.6 (IPCC default for residual fuel oil)
Carbon content of fuel in tCO_{2e}/TJ	75.53
Carbon content of fuel in tCO_{2e}/GJ	0.0755
Fuel specific oxidation factor	1
Carbon content of fuel adjusted with oxidation factor in tCO_{2e}/GJ	0.0755
Energy efficiency of the technology in %	43%
Emission factor of the technology identified as baseline in tCO_2/MWh	0.6324

The emission factor of the technology identified as baseline is therefore equal to **0.6324**tCO_{2e}/MWh.

Calculation of the Project Emissions

Project emissions generated by the project activity through the crediting period has been calculated using the formulae indicated in Section B.6.1. Project emissions will be recalculated yearly ex-post for monitoring and verification purposes. For the purpose of this PDD, the CO_2 emission coefficient of natural gas has been estimated to be **1.88**$tCO_2/1000m^3$ (please see table below).

Net Calorific Value of Natural Gas = 34.68 $GJ/1000m^3$

Sumgayit Emissions (p.a.)			A	B	C	D	E	F	G	H	I	J	M
	Fuel Source	Capacity	Total Generation	Auxiliary Cons.	Eectricity exported to grid	Net Heat Rate	Plant Eff	Natural Gas Consumption	Natural gas consumption	Emission factor of natural gas	Combustion efficiency factor	Fuel emission coefficient	Total annual emissions
		MW	GWh/p.a.	GWh	GWh/p.a.	KJ/kWh	%	MJ	1000 m3	tCO2/GJ	(%)	tCO2/1000m3	tCO2
Sumgayit CCGT	Natural gas	525.00	3,679	127.0	3,552	6,829	52.71%	25,125,256,800	724,597	0.054	1	1.88	1,364,466
Sources:	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	Source: Azerenerji	calculated A-B	Verified against test report	Calculated from heat rate value	Calculated: =C X 10^6/ (D X 10^3)	Calculated: =A X 10^3 X 3.6 / (NCV Gas X Plant Efficiency)	2006 IPCC Guidelines (Vol 2): default EF for natural gas (lower value)	IPCC	Calculated: H x I x NCV	Calcualted: G x J

For the comparison purposes only, the project emission factor expressed in tCO2/MWH has been determined using the same formula as in the case of emission factor of the technology chosen as baseline (as described above). The result is 0.3709tCO_2/MWh, as per table below:

Effective (Weighted COEF	tCO2e/GJ
COEF NG	0.0543

Efficiency of the Project **53%**

Project EF (tCO2e/MWh)	0.3709

Calculation of Leakage Emissions

For the purpose of estimating fugitive CH_4 emissions, as per AM0029 methodology (Version 03), the quantity of natural gas to be consumed by the project in one full year has been multiplied with an emission factor for fugitive CH_4 emissions ($EF_{NG,upstream,CH4}$) from natural gas consumption and subtracted from the leakage emissions occurring from the baseline (leakage emissions in the cohort of plants contributing to the build margin) in the absence of the project activity. These calculations are shown in the table below.

The value of leakage emissions due to fugitive upstream CH_4 emissions ($LE_{CH4,y}$) results to be negative, because leakage emissions in the baseline scenario (535,287tCO_{2e}) are higher than leakage emissions in the project scenario (486,004tCO_{2e}). Therefore leakage emissions are omitted for the purpose of calculation of Emissions Reductions.

Project Leakage	A1	B1	C1	D1	E1	F1	G1
	FC(y) 1000 m3	Net calorific value : NCV(y)	Electricity Generated by	EF(NG,Upstream,CH4) tCH4/PJ	GWP (CH4)	Leakage as per methodology	Leakage (tCO2e)
Sumgayit CCGT	724,597	34.679	3,679	921.00	21.00	23,143	486,004
Source	Azerenerji	Azerenerji	From worksheet Sumgayit Project Emissions	Table 2, AM0029	IPCC 2006	Calculated: A1*B1*D1/10^6	Calculated: E1 * F1

The leakage in the baseline scenario is given in the table below:

	Baseline Leakage (Option 1: Build Margin)	A2	B2	C2	D2	E2	F2	G2	H2	I2	J2	K2
SN	Cohort of Plants in Build Margin Calculation	Fuel Source	GWh	Quantity of Mazut Consumed	Quantity of Gas Consumed (1000 m3)	Energy content of Mazut (PJ)	Energy content of Gas (PJ)	Fugitive Emission (Mazut) tCH4	Fugitive Emission (Natural Gas)	Total Fugitive Emissions (tCH4)	Leakage emission Factor	Total Baseline Leakage (tCO2e)
1	Azerbaijan ThPP	Natural gas/oil	11,600.50	907,816	2,627,246	37.5972	91.1098	154.15	83,912.16	84,066.31		
2	"Baku-1" CHPP only gas	Natural gas	691.10	-	242,340	-	8.4041	-	7,740.14	7,740.14		
3	"Shimal" CCPP only gas	Natural gas	2,610.50	-	507,573	-	17.6021	-	16,211.49	16,211.49		
4	"Yenikend" HPP	Hydro	311.40	-	-	-	-	-	-	-		
5	"Astara" ThPP (PPP)	Natural gas	319.80	-	74,223	-	2.5740	-	2,370.63	2,370.63		
6	"Sheki" ThPP (PPP)	Natural gas	138.00	-	33,748	-	1.1703	-	1,077.89	1,077.89		
7	"Khachmaz" ThPP (PPP)	Natural gas	57.90	-	13,826	-	0.4795	-	441.60	441.60		
8	"Babek" GTPP	Natural gas	120.00	-	62,583	-	2.1703	-	1,998.84	1,998.84		
9	"Vaykhur" HPP	Hydro	2.20	-	-	-	-	-	-	-		
	Total		**15,851.40**	**907,816**	**3,561,538**			**154.15**	**113,752.75**	**113,906.90**	**7.1762**	**535,287**

Emission factor for upstream fugitive methane emissions from production of the fuel type k (a coal or oil type)

Mazut	4.1 tCH4/PJ	Table 2: Default emission factors for fugitive CH4 upstream emissions
Natural Gas	921 tCH4/PJ	Table 2: Default emission factors for fugitive CH4 upstream emissions

Overall Leakage from the project activity **(49,283)** **tCO2e**

The emission factor for leakage has been taken as 921tCH_4/PJ from the Table 2 of the methodology, as this reflects best the geography for the project, as the project is coming up in Azerbaijan, which was erstwhile part of USSR (the factor 921tCH_4/PJ applies for former USSR)

In any case – please note that the fugitive emission factor of methane won't affect the leakage situation (not converting leakages from negative to positive) – as the same fugitive emission factor would apply to both baseline and project scenario.

Annex 4

MONITORING INFORMATION

See section B.7.2

Annex 5
CHRONOLOGY OF EVENTS

Following is the chronology of events that are important for the project activity:

S.N.	Event	Date	Towards (Project/CDM)	Document
01	Certificate of Completion of CDM Training by Mr. Abdulkhalik Heydarov	March 07, 2003	CDM Awareness	Training Certificate
02	Certificate of Completion of CDM Training by Mr. Abdulkhalik Heydarov	March 19, 2003	CDM Awareness	Training Certificate
03	Certificate of Completion of CDM Training by Mr. Abdulkhalik Heydarov	June 18-20, 2003	CDM Awareness	Training Certificate
04	Enprima Consulting Report (Technical Feasibility Report) that first recommended CCGT plant being set up at Sumgayit and suggested that CDM benefit be availed for it to bypass high cost of project financing	April 28, 2004	CDM Awareness of the Sumgayit Power Plant	Report submitted by Enprima
05	Power of Attorney being given to Mr. Abdulkhalik Heydarov for being the legally responsible entity to undertake CDM for emission reduction eligible power plants in Azerbaijan	May 17, 2004	CDM Seriousness for Renewable, Energy Efficiency and CCGT type projects in Azerbaijan (Sumgayit being the first plant to be affected(	Power of Attorney singed by the President of JSC “Azerenerji” and endorsed by the top management of JSC “Azerenerji”
06	Certificate of Completion of CDM Training by Mr. Abdulkhalik Heydarov	July 2-6, 2004	CDM Awareness Also, meets the requirement of EB 41, Annex 46	Training Certificate
07	PIN prepared for the Sumgayit project and submitted to financial institutions	December 2004	CDM seriousness and concrete action Meets the requirement of EB 41, Annex 46	First page of the signed PIN has been attached

S.N.	Event	Date	Towards (Project/CDM)	Document
08	Around this time JSC "Azerenerji" was in touch with the Danish government appointed Jorgen Boldt (as Consultant) to review the Sumgayit CCGT project – Jorgen Boldt sent his comments through FAX and since JSC "Azerenerji" wasn't satisfied with the analysis they decided not to work with Jorgen Boldt	January 21, 2005	CDM Seriousness and concrete actions Also, meets the requirement of EB 41, Annex 46	FAX sent by Jorgen Boldt in both in Russian (and English translation has been attached)
09	First communication by the President of JSC "Azerenerji" to the DNA of Azerbaijan to apply for the host country letter of for the Sumgayit CDM project. Please note that JSC "Azerenerji" doesn't have a formal board of directors, and the President of JSC "Azerenerji" is the key decision maker in JSC "Azerenerji". Thus, the letter of communication from the President of JSC "Azerenerji" serves as the most important document and as per the "Guidance on the Demonstration and Assessment of Prior Consideration of the CDM" (version 04); it helps meet the requirement as laid out in paragraph 6.a. and 6.b. for CDM projects with start date prior to August 02, 2008	May 02, 2005	Meets the requirement for prior CDM consideration as per EB 41, Annex 46. Serves the requirement of both Para 5.a. and 5.b	
10	Loan agreement between JSC "Azerenerji" and the consortium of Banks (BNP Paribas, Societe Generale and Bayerische Landesbank)	May 20, 2005	PROJECT	Loan agreement (signed page has been attached)
11	Contract between JSC "Azerenerji" and Siemens to start work on the Sumgayit CCGT plant (**Start Date of the CDM Project Activity**)	May 23, 2005	PROJECT	Contract Document (signed page has been attached)
12	Stakeholder Consultation (for CDM) - *All the participants were given a copy of PIN of the Sumgayit CDM Project.*	November 28, 2005	CDM Stakeholder consultation meeting	Minutes of meeting of the stakeholder consultation meeting
13	Further communication evidences between JSC "Azerenerji" and Danish Ministry	August 2005	CDM consideration for the project. Concrete action to materialize CDM benefits	Communication attached

S.N.	Event	Date	Towards (Project/CDM)	Document
14	Communications with BNP Paribas for Sumgayit CDM development	November 2006	CDM Consideration	Communication between BNP Paribas and JSC “Azerenerji”
15	Appointment of ICF International for undertaking CDM work for Sumgayit by BNP Paribas (the CER buyer for the project)	March 2007	CDM Consideration and real action	Contract between ICF and BNP Paribas
16	Submission of the PDD for Validation to TUV Rhineland	November 2007	CDM Consideration and real action	Contract with TUV Rhineland and subsequent hosting of the PDD on the website for international stakeholder consultation
17	Site visit by TUV Rhineland to JSC “Azerenerji”	January 2008	CDM Real action	Validated by the validator (Mr. Kurt Seidel who was present for the site visit)
18	Handing over of the Sumgayit power plant from Siemens to JSC “Azerenerji”	December 2008	Performance test	Test report of the performance test is attached

Annex 6

Interest rates – used as source for long term interest rates in foreign currencies in Azerbaijan (Dec 2003 – May 2005):

Average Interest Rates on deposits and credits in foreign currency for over 5 years

Month	Interest Rate on Deposit (over 5 years)	I
Dec-03	14.87%	
Jan-04	14.87%	
Feb-04	14.87%	
Mar-04	14.61%	
Apr-04	15.00%	
May-04	15.00%	
Jun-04	15.00%	
Jul-04	15.00%	
Aug-04	15.00%	
Sep-04	15.00%	
Oct-04	15.00%	
Nov-04	15.00%	
Dec-04	15.00%	
Jan-05	15.00%	
Feb-05	15.00%	
Mar-05	14.98%	
Apr-05	14.96%	
May-05	14.94%	
Avg	**14.95%**	

Source: Azerbaijan Central Bank bulletins (available at http://www.cbar.az/pages/publications-researches/statistic-bulletin).

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