EGHVARD-2
SMALL HYDROPOWER PROJECT IN ARMENIA

Project Design Document
(Version 01)

Prepared by Fichtner GmbH & Co. KG and
Project Office Armenia
Project EuropeAid/111523/C/SV/Multi-Lot No. 2

April 2007
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## Revision history of this document

<table>
<thead>
<tr>
<th>Version Number</th>
<th>Date</th>
<th>Description and reason of revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>21 January 2003</td>
<td>Initial adoption</td>
</tr>
</tbody>
</table>
| 02             | 8 July 2005     | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.  
• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at [http://cdm.unfccc.int/Reference/Documents](http://cdm.unfccc.int/Reference/Documents). |
| 03             | 22 December 2006| • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM. |
SECTION A. General description of small-scale Project Activity

A.1 Title of the small-scale Project Activity:
Eghvard-2 Small Hydropower Plant in Armenia
Version: I
Dated: January 10, 2007

A.2 Description of the small-scale Project Activity:

The project background

Under the Soviet central planning system, Armenia had developed a modern industrial sector, supplying machine tools, textiles, and other manufactured goods to sister republics in exchange for raw materials and primary energy. Many of the industries and productions were highly energy intensive, which led to the further development of Armenian energy system. For a relatively small country Armenian energy sector became well developed, with large and versatile electricity production capacities, extensive electricity distribution and transmission networks. However, the energy sector was heavily dependent on fossil fuel imports due to lack of locally available primary energy sources.

Since 1991, after the USSR collapse as well as economic blockade and frequent damages of gas mains, Armenia went through a severe fuel and energy crisis. On the way of overcoming the transition period hardships it became obvious that Armenia has serious energy security issues to be addressed. Thus, diversification of Armenian energy mix towards larger share of local renewables (hydro, solar, wind and biomass) becomes an important step to increase the country’s energy security.

Since hydropower is Armenia’s most significant indigenous energy source, and has considerable development potential, commissioning of new hydro generating capacities is aimed to reduce Armenia’s energy dependence on imported fuels and secures sustainable development of the sector.

The purpose of the Project Activity

The proposed project aims to install and operate a small-scale hydropower plant with a total capacity of 9.31 MW on the spillway of Arzni-Shamiram irrigation canal in the Aragatsotn district of the Republic of Armenia. The overall objective of the project is to meet the increasing national demand for power by generating clean renewable energy and to sell it to the Electric Network of Armenia CJSC through a power purchase agreement contract with duration of 15 years. The project also aimed to register the Eghvard-2 SHPP under the CDM.

Reduction of GHG by the proposed Project Activity

The Eghvard-2 small hydropower project uses hydropower technology to convert the potential energy available in the channel water flow into mechanical energy and then to electricity. Two Pelton type turbines, standard for this head and commonly used worldwide will be applied. The

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1 A power supply company which operates the Armenian national grid. More information is available at: [www.snvur.am/elnet.htm](http://www.snvur.am/elnet.htm)

2 In accordance with Article 59 of the Law on Energy of RA, as well as Decision N20n of 09.02.2004 and Decision N167n of 08.11.2005 by Public Services Regulatory Commission (PSRC) of RA, the National grid of Armenia is liable to purchase the electricity generated by small-scale (up to 10 MW) hydro power plants for 15 years, starting from the date of entry into force the electrical energy generation license provided to the project. More information on PSRC and its Decisions is available at: [www.psrc.am](http://www.psrc.am)
annual generation of 18.21 GWh of electrical energy will directly reduce the GHG emissions resulting from the use of fossil fuels at thermal power plants that are currently in operation in Armenia. Generated power will be transformed to match the nearest grid sub-station for proper interconnection with the National Grid.

Measures undertaken as part of the Project Activity

A Pre-feasibility Study of the project was developed by “Arpa-Sevan Nakhagits” CJSC in March 2005. The Feasibility Study of the project is being developed by the same company and in February 2007 was 50% completed. The Project Activity possesses already all approvals required at the current stage of development including construction permit provided by the Public Services Regulatory Commission (PSRC) on August 3, 2006 (Decision N105a), which is valid for three years starting from the permit issuance day as well as water use permit N0701 provided by the Water Resources Management Agency on April 1, 2005 and valid until August 21, 2006. The project owner has initiated already preparatory activities, including the purchasing of 4.312 tons of steel pipes (d=1400x24mm, L=6200mm).

Contribution of the Project Activity to sustainable development

On September 16, 2003, the Ministry of Foreign Affairs of the Republic of Armenia submitted a notification to the UNFCCC Secretariat on the assignment of the Ministry of Nature Protection of the Republic of Armenia as Designated National Authority (DNA) for CDM in Armenia.

The Ministry of Nature Protection of Armenia acting as the DNA is currently in the process of developing the “Procedure for submission and approval of CDM project documents”. One of the most important parts of the Procedure will be National CDM Sustainability Criteria which will allow evaluating the contribution of the proposed project activities to the country’s sustainable development. Presently, the following main sustainable development criteria have been drafted and stipulated by the Armenian DNA for evaluation of CDM project activities: social, environmental, economic, and political.

The project participants believe that the proposed project will contribute to the country's sustainable development in the following way:

Social Criteria - The project has positive effect on social development

Generation of permanent and temporary employment opportunities: The project leads to creating direct and indirect employment for skilled and unskilled labour both during construction and operation of the plant. The construction stage will take 36 months considering severe weather and working conditions and involve around 50 persons. For operation of the plant around 7 persons will be permanently employed and receive salaries on a regular basis.

Professional and intellectual capacity building: Materialization of the proposed project under the CDM will not only raise the professional skills of builders and engineers involved in construction works, but also contribute to increasing the awareness of Project Proponents and other local involved parties on the CDM specificities.

Contribution to energy security: Implementation of the project allows the diversification of power generation sources in the country, thus, decreasing its dependence on imported natural gas and increasing the share of renewable power generation based on local energy resources. Achieving sufficient capacity on the grid could in its turn contribute to the retirement of the Armenian NPP.

Besides above mentioned positive social impacts the proposed Project Activity will result in none of the following negative externalities:
Environmental Criteria – The project leads to positive or decreased negative environmental effects.

No hazard to ecosystem: Since the power plant will be constructed on the spillway of the existing Arzni-Shamiram irrigation canal, no negative environmental impact on biodiversity or fishery is expected. Moreover, the project does not envisage construction of a reservoir and thus avoids submersion of adjacent territory as well as emission of CH₄ associated with stagnation of water in a reservoir.

Reduction of harmful emissions: The project will generate clean renewable energy which otherwise would have been generated by alternate fossil fuel based power plants, thus, contributing to reduction in specific emissions including SO₂, NOₓ, and particulates associated with power generation by displacing fossil fuels consumption.

No deforestation and degradation of natural resources: Furthermore, since the project utilizes environmentally save technologies, it does not result in degradation of any natural resources or health standards. Project realization does not involve any detrimental effect on forestry since there is no natural forestry at construction site.

Thus, the project causes no negative impact on the surrounding environment contributing to environmental well-being.

Economic Criteria – The project has positive effects on the economic development of the country.

Attraction of capital and contribution to the economic development of the local community: The implementation of the project comprises an investment of around 9.3 mln. USD (partially foreign) which otherwise would not happen in the absence of the project. This investment will partially benefit the region providing roads and other infrastructure facilities in the vicinity as a part of project construction. Moreover, municipality funds of Aragatsotn district will increase due to tax collection from land as well as other relevant fees.

Contribution to reliability of energy supply: The electricity generated by Egvard-2 SHPP will be fed into the National Grid through local distribution or transformation sub-station, thereby improving quality and reliability of electricity supply to the local consumers as well as contributing to the reduction of power losses in the electric network due to the distributed generation effect. This in its turn will provide better conditions for local industries and economy in proximity of the project site, thereby resulting in greater local employment. The Project Activity also leads to a diversification of the national energy supply and contributes to the energy security of the country.

The Project Activity will also create direct and indirect job opportunities for the local community during construction and operation.

Policy Criteria – The project has positive effects on achievements of national, regional and sectoral priority objectives.

The proposed Project Activity conforms with the national policy on the development of the energy sector emphasizing the promotion of new renewable energy capacities. These principles are outlined in the following laws and strategic papers:

- The Law of RA on Energy (adopted on 07.03.2001) and amendments to the law;
- The Law of RA on Energy Saving and Renewable Energy (adopted on 09.11.2004);
A.3. Project participants:

<table>
<thead>
<tr>
<th>Name of Party involved (*)</th>
<th>Private and/or public entity(ies) project participants (*)</th>
<th>Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)</th>
</tr>
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<tbody>
<tr>
<td>Republic of Armenia (host)</td>
<td>“Bur Group” Limited Liability Company</td>
<td>No</td>
</tr>
<tr>
<td>Germany</td>
<td>“Fichtner Carbon Management GmbH” Private entity</td>
<td>No</td>
</tr>
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</table>

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.

The Project Activity is developed and owned by BUR GROUP LLC, a limited liability company under Armenian legislation, which was registered by the State Registry of RA in 2000. The company’s main activity is the construction and operation of energy units as well as production of electricity. The company’s location is: 4 Tigran Mets St, Yerevan, Armenia.

A.4. Technical description of the small-scale Project Activity:

The Eghvard-2 Small Hydropower Project mainly consists of the headworks with appurtenant structures, an embedded penstock and the powerhouse with the hydro-mechanical and electrical equipment. The plant will be located at the beginning of the spillway, approx. 5 km up to the village Ohanavan.

The spillway has a length of 7,000 m and provides a gross head of about 370 m. The headwater level is equal to 1706.0 masl, the downstream water level is equal to 1340.0 masl. The discharge capacity of the spillway is equal to 14 m³/s. The channel is of rectangular shape. It has a width of 4 m and a depth of 2 m.

The basic project idea is to use the available head of 361.0 m for power generation instead of energy dissipation by means of a spillway. The Eghvard-2 SHPP could produce power and energy during the season, when the water is planned to be spilled and dissipated at the spillway.

The main hydropower structures to be established are:

- Headworks
- Penstock 6,200m long
- Powerhouse with appurtenant structures
- Hydro-mechanical equipment
- Electrical equipment
- Transmission line
- Tailrace channel

The headworks consist of a head pond with water-intake. The head pond shall be constructed near the existing access road.

A short connecting channel conveys the water from the Arzni-Shamoram irrigation canal towards the head pond. The channel is of rectangular shape with a width of 3 m and a depth of 2 m. The bottom of the channel is at 1704.5 masl.

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3 masl – meter above sea level
The head pond has a rectangular shape in plan view. The pond is 18 m long, 4.4 m wide, and has a depth of 2.1 m. The normal operation level of the head pond is 1706.1 masl. The pond is equipped with two vertical slide gates which convey the water to the penstock.

In case of sudden closure of the turbine in the powerhouse, a surge in the canal is expected. The upsurge in the canal was calculated to be approx. 0.2 m. In such an event, the flow in the Lori Irrigation canal still has to be discharged. A gate was foreseen in the existing Lori irrigation canal approximately 3 m downstream of the connecting channel. The gate is designed as a flap gate with a width of 2.5 m and a height of 2.5 m. The flow should be spilled over a flap gate conveying the flow to the downstream part of the Lori irrigation canal. The design discharge of 2 m³/s is spilled with an overflow height at the gate of approx. 0.53 m. Consequently, the flap gate should be lowered immediately when the turbine generator unit shuts down and the upsurge in the canal is caused. The operation of the flap gate should be automated.

In order to avoid any sudden discharges and uncontrolled flow from Arzni-Shamoram irrigation canal, there is an emergency spillway which has 14 length and 2 m width to convey the water into the spillway by the pipe.

The waterway alignment is constructed along the left bank of the spillway under consideration of the optimum penstock diameter, calculated to 1.4 m. At the starting section of the closed conduit the penstock is laid in concrete. The penstock of approx. 6200 m long shall be constructed along the spillway as embedded penstock. The penstock is planned to be laid approx. 1 m below the ground surface for frost safe depth. The penstock is laid on bedding material.

The embedded part of the penstock is constructed in a trench with a depth of 2.6 m and a width of 2.2 m. After fixing of the penstock the excavated material shall be filled back.

The powerhouse is located downstream the spillway. The main dimensions of the powerhouse are determined by the size of the hydro-mechanical equipment and from operation, assembly and dismantling conditions in the powerhouse. Furthermore the transportation of the equipment by the machine hall crane was considered. The erection site is adjacent to the powerhouse. The dimensions in the plan-view are 15 m x 30 m. The powerhouse comprises also rooms for operation personnel and lavatory arrangements.

The most appropriate solution for the hydro-mechanical equipment was found to be two vertical Pelton turbines each with four nozzles with a design discharge of 3.2 m³/s.

The powerhouse area covers a space of 15 m x 30 m and is protected by a fence. On the spot the switchyard with an area 6 m x 10 m is located, where the transformer of 6.3/35 kVA type is planned to be placed.

The connection to the grid is through a new double 35 kV transmission line to the existing transmission lines “Eghvard”. The line is planned to be constructed around Ohanavan village and to be connected to the existing high voltage line. The total length of the new 35 kV transmission line is equal to approximately 10 km.

It is foreseen to connect the plant to the national grid of RA with one 35 kV over-head line. For the transfer of 6 kV generator voltage to the 35 kV over-head line it is planned to construct a substation of 6/35 kV nearby the HPP Building. Two power transformers each of 4500 kVA with a 6 kV/35 kV circuit breaker will provide the connection to the national grid of RA.

Other technical parameters of the plant are as follows:

- The design discharge for Eghvard-2 SHPP was selected as 3.2 m³/s;
- Minimum discharge - 0.096 m³/s;
- Annual flow through HPP - 22.45 mln m³;
- Net head - 347.19 m;
- Head losses at design discharge - 13.91 m;
Installed capacity - 9.31 MW;
Annual electricity generation - 18.21 GWh.

A tailrace canal of about 20 m length conveys the turbined water back to the spillway. The tailrace is designed as open channel. The tailrace canal has a rectangular section. The bed width is 3 m and the depth is 1.3 m, the bed slope is 0.026. The velocity in the tailrace canal shall be 0.97 m/s at design discharge with a water depth of 1.1 m.

There is no need for a fish pass, since the SHPP will be constructed on an irrigation canal.

A detailed scheme of the project is introduced in Appendix I of the present document.

A.4.1. Location of the small-scale Project Activity:

Eghvard-2 SHPP project is located in the Aragatsotn district, a western district of the Republic of Armenia.

A.4.1.1. Host Party(ies):
Republic of Armenia

A.4.1.2. Region/State/Province etc.:
Aragatsotn District (Marz)

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

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale Project Activity:

Eghvard-2 SHPP project is located in the Aragatsotn district, a western district of the Republic of Armenia (RA). It is surrounded by Shirak and Lori districts in the North, Kotayk district in the East, Armavir district in the South-East, the City of Yerevan in the South-West and Turkey in the West.

The Aragatsotn district includes the highest mountain of Armenia, Aragats, which is characterized by steep slopes towards the high altitude plateaus of Aragats and Kotayk districts. The Aragats Mountain is surrounded by the Pambak Mountains to the North. The eastern part of the district is bordered by the Geghama Mountains. In-between there is a high plateau, which is cut by the canyon of the Kasakh River.

The Arzni-Shamiram irrigation canal crosses the Qasakh River and irrigates the lands on the right bank plateau of the Qasakh River. The water is taken from the Qasakh River via the tunnel downstream the Aparan Reservoir. From the irrigation system a spillway conveys water from the upper irrigation system to the Arzni-Shamiram irrigation canal.

The headworks are planned on an elevation of about 1706.1 masl, at the beginning of the spillway and the powerhouse will be located at an altitude of about 1342.0 masl, at the end of the spillway near the village Karby.
A.4.2. Type and category(ies) and technology/measure of the small-scale Project Activity:

Type and Category

In accordance with the provisions of the Appendix B to the UNFCCC’s published Simplified Modalities and Procedures for Small-Scale CDM Project Activities, the proposed Project Activity falls under Type 1 - Renewable Energy Projects, Category D – Grid Connected Renewable Energy Generation, since it utilizes the hydro potential for power generation and exports the generated power to the grid at a capacity of less than 15 MW.

Technology

The Egvard-2 Small Hydropower Project uses hydropower technology to convert the potential energy available in the water flow into mechanical energy using hydro turbines and then to electrical energy using alternators. The Pelton type turbine, standard for this head and commonly used worldwide will be applied. The generated power will be transformed to match the nearest grid sub-station for proper interconnection with the National Grid.

Technology transfer

Environmentally safe and sound technologies will be utilized for the project materialization. Negative consequences of civil works will be eliminated in the shortest time after SHPP commissioning. Technologies approved in Armenia for the construction of similar hydraulic engineering objects will be utilized during plant construction.
The project will source mechanical equipment most likely from the Czech Republic. Hydropower technology is already widely used in the Republic of Armenia.

### A.4.3 Estimated amount of emission reductions over the chosen crediting period:

In accordance with the provisions of the indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activities, emission reductions by the Project Activity are mainly attributable to the electric energy fed to the national grid and the content of fossil fuel based generation in the grid system. The electric energy generation will replace an equivalent amount of electricity produced mainly by thermal power plants serving the national grid.

The anticipated crediting period for Eghvard-2 HPP is 7 years with an extension by a further 2 x 7 years. In total the Project Activity intends to generate and claim CERs over a maximum of 21 years. Total annual GHG emissions reductions due to the Project Activity are estimated as 8,741\(^*\) tCO\(_2\)e, or 61,178\(^*\) tCO\(_2\)e over the first 7 years of the 21 year crediting period.

<table>
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<tr>
<th>Years</th>
<th>Annual estimation of emission reductions in tonnes CO(_2)e</th>
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<tr>
<td>1 (2009)</td>
<td>8,741(^*)</td>
</tr>
<tr>
<td>2 (2010)</td>
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<td>4 (2012)</td>
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<td>5 (2013)</td>
<td>8,741(^*)</td>
</tr>
<tr>
<td>6 (2014)</td>
<td>8,741(^*)</td>
</tr>
<tr>
<td>7 (2015)</td>
<td>8,741(^*)</td>
</tr>
</tbody>
</table>

Total estimated reductions for first crediting period (7 years) (tonnes of CO\(_2\)e) 61,178

Annual average over first crediting period of estimated reductions (tonnes of CO\(_2\)e) 8,741\(^*\)

Annual reductions for second and third crediting period (year 8 to 21) (tonnes of CO\(_2\)e) 8,741\(^**\)

Total estimated reductions maximum possible crediting periods (21 years) (tonnes of CO\(_2\)e) 183,561\(^**\)

Total number of the crediting years 7 years times 3

\(^*\) Values for 1\(^{st}\) Crediting period (years 1 to 7) are only indicative based on preliminary EFy ad electricity.

\(^**\) Values for 2\(^{nd}\) and 3\(^{rd}\) Crediting period (years 8 to 21) are only indicative based on equal EFy ad generation.

### A.4.4 Public funding of the small-scale Project Activity:

No public funding from Parties included in Annex I to the Convention, including Official Development Assistance (ODA), is involved in financing this Project Activity.

### A.4.5 Confirmation that the small-scale Project Activity is not a debundled component of a large scale Project Activity:

Based on the information provided in Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, the proposed Project Activity is not a debundled component of a larger Project Activity, since the project participants have not registered and operated or applied to register any another small-scale CDM activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years and;
CDM – Executive Board

- Whose project boundary is within 1 km of project boundary of the small scale Project Activity at the closest point.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale Project Activity:

The following baseline and monitoring methodology approved for small-scale CDM project activities is used for the proposed project: “AMS-I.D. - Grid connected renewable electricity generation” (Version N10; December 23, 2006). For more information regarding the methodology, please refer to the following link: [http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html](http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html)

The approved consolidated methodology for the calculation of the combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) is “ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version N06; May 19, 2006). For more information regarding the methodology, please refer to the following link: [http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html](http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html)

B.2 Justification of the choice of the project category:

The proposed Project Activity envisages the construction of a hydro power plant with a total installed capacity of 9.31 MW, which does not exceed a 15 MW maximum output capacity limit set by the COP/MOP for small-scale renewable energy project activities. Hence the Project Activity can be qualified as a small-scale one, which falls under Type I – Renewable Energy Generation.

The Eghvard-2 SHPP project proposes generation of renewable electricity and its direct supply to the National grid, which is fed by both fossil fuel fired plants operating mainly on natural gas and non-fossil fuel based generating plants. Moreover, the activity does not involve switching from fossil fuels to renewable energy at the site of the plant. Hence the Project Activity falls under the category I.D. according to the Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities.

According to the technical information specified in the Pre-feasibility Study of Eghvard-2 SHPP project, either designed capacity of the penstock or total available head does not secure capacity of SHPP higher than 10 MW. More detailed information on the project technical aspects is introduced in Section A of the present PDD.

The only possible option for ensuring higher capacity of the power plant for a short-term period (peak power) is construction and operation of a storage pool (reservoir). However, this choice is not eligible under the current Armenian legislation, since it will affect working condition of the Arzni-Shamiram irrigation canal.

Thus, the proposed Project Activity will remain under the 15 MW limit for small-scale Project Activity types, as they are specified in Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM Project Activities, during every year of the crediting period.

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4 More detailed information on application of the methodology is provided in Section B.6 of the present PDD  
5 Second session of the Conference of the Parties serving as the Meeting of the Parties (COP/MOP) to the Kyoto Protocol, Nairobi, November 2006, Decision - /CMP.2, “Further guidance relating to the clean development mechanism” Paragraph 28 a  
6 Article 31 of Water Code of Armenia. This Article states that public benefits (e.g. irrigation of agricultural lands) should prevail over private inters (e.g. electricity generation by SHPP)
B.3. Description of the project boundary:

According to the information provided in the Appendix B of simplified modalities & procedures for small-scale CDM project activities (paragraph 6 of simplified methodology AMS I.D. Version 10: 23 December 2006), the **project boundary** for a small-scale hydroelectric project that provides electricity to a grid encompasses the physical, geographical site of the renewable generation source. Hence, for the Project Activity under consideration, the project boundary encompasses the project site where the main structures and installations such as headworks, penstock, powerhouse, power evacuation system, etc. are to be installed.

For the purpose of determining the build margin (BM) and operating margin (OM) emission factor and the combined margin grid emission factor of the Armenian electricity grid, a (regional) **project electricity system** is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly, a **connected electric system**, e.g. national or international, is defined as a (regional) electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints (AMC0002).

Taking into consideration the provisions of the ACM0002 methodology, the Armenian Grid is selected as the system boundary due to the following reasons:

- Clearer guidelines from the DNA on how to draw the boundary in Armenia is not available.
- There are no significant transmission constraints in Armenia as a small country. Therefore, the entire power system of the Republic of Armenia can be reasonably considered as the **project electricity system**.

The interconnected electricity system of the Republic of Armenia is shown on Figure 1.

According to this definition, all power sources supplying the grid of Armenia are included in the project boundary for the baseline (see Table 1). Hence, the project boundary for the baseline
will include all the direct emissions related to the electricity produced by the power plants that will be displaced by the Eghvard-2 SHPP project. This involves emissions from displaced fossil fuel use at thermal power plants providing electricity to the national grid.

The project applies for ex-ante determination of the Operating Margin (OM) emission factor with reference period 2003 to 2005. Some of the thermal power stations were out of operation in this reference period, and their emissions are therefore not applicable and included to the baseline determination. As the only Greenhouse Gas CO₂ is considered for the baseline, and hence the baseline is conservative. The project applies for ex-post determination of Build Margin (BM) emission factor.

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<th>Source</th>
<th>Gas</th>
<th>Included?</th>
<th>Justification / Explanation</th>
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<td>1 Yerevan CHP</td>
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<td>Operating, within project boundary</td>
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<td>2 Hrazdan CHP and CPP</td>
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<td>3 Vanadzor CHP</td>
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<td>Nuclear Power Plant in operation, but CO₂ emissions not applicable</td>
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</tr>
<tr>
<td>15 Dzora HPP*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Ayrum HPP*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Small HPPs (1950 – 1954)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 Small HPPs (1970ies)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 Small HPPs (1997 – 2005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All power sources 1. to 19.</td>
<td>CH₄</td>
<td>no</td>
<td>Not relevant</td>
</tr>
<tr>
<td>All power sources 1. to 19.</td>
<td>N₂O</td>
<td>no</td>
<td>Not relevant</td>
</tr>
</tbody>
</table>

*) power source not in operation in ex-ante baseline period 2003 to 2005

**Table 1:** Description of sources and gases included in the project boundary for the Baseline

Conforming to the guidelines and rules for small-scale project activities, the emissions related to production, transport and distribution of the fuel used in the power plants in the baseline are not included in the project boundary, as these do not occur at the physical and geographical site of the project. For the same reason the emissions related to the transport and distribution of electricity are also excluded from the project boundary.
B.4 Description of baseline and its development:

According to the selected methodology AMS.-I.D (Version N10; December 23, 2006), the baseline for the proposed project category is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO₂e/kWh) calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered

OR

(b) The weighted average emissions (in kg CO₂e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The first option provided has been chosen for this Project Activity, since the project will displace mostly fossil-fuel generating sources which are at the margin of the electricity generation system. According to the Armenian Energy Sector Development Strategies⁷, the majority of new generating capacities to be put into operation in the nearest future will primarily constitute fossil-fuel based power plants. Particularly, the launch of two new thermal power plants, a 208 MW combined cycle unit at Yerevan TPP and a 440 MW gas turbine unit at Hrazdan TPP (Unit 5) is outlined for the 2008-2009 period. Whereas, the construction of large hydro power plants envisaged in the Strategy most likely will be initiated after 2013. Thus, the proposed small-scale CDM project which comprises a small hydro power plant will supply electricity to the grid that is currently fed partially by TPPs with future plans overwhelmingly in favor of fossil fuel based generating facilities.

According to ACM0002 for project activities that do not modify or retrofit an existing electricity generation facility, the baseline scenario is the following:

- Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described below.

The CM baseline emissions factor (EFy) is calculated as the average of the operating margin emissions factor and the build margin emissions factor. This is obtained through the following steps:

**STEP 1. Calculate the Operating Margin emission factor(s) (EFOM,y)**

The methodology ACM0002 provides the following four options for the calculation of the Operating Margin emission factor (EFOM,y):

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

For the proposed Project Activity option (b) of the Consolidated Methodology for Grid Connected Projects (Simple adjusted Operating Margin) will be applied. This is because low-cost must run resources constitute more than 50% of the total grid generation (see Figure 1).8

![Figure 1: Power Generation Structure of the Armenian Energy System](image)

Figure 1: Power Generation Structure of the Armenian Energy System

Detailed data to apply option (c) is not available. Since the Project is using an ex-ante OM, a 3-year data vintage is used based on the most recent statistics available at the time of PDD submission, which are the statistics from the Ministry of Energy and the PSRC. Detailed data on individual plants serving the system has been analysed and proceeded (see Annex 3). Then, from the fuel consumption of the relevant sources in the Armenian Power Grid and the electricity generation by these sources, the average emissions from 2003 to 2005 are obtained; these are divided by the total amount of energy generated, to give the emission rate per MWh. The Simple adjusted OM emission factor of the Armenian Power Grid is then calculated as 0.62 tCO₂e /MWh (refer to Annex 3 for details).

**STEP 2. Calculate the Build Margin emission factor (EFBM,y)**

According to ACM0002, the BM calculation is defined as the generation-weighted average emissions factor of a sample of power plants. The project chooses ex-post determination of the BM for each year in which its generation actually occurs. The BM average emissions factor of

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8 Source: “Analysis of technical and economic indices of the Armenian power energy system for 2005”, Ministry of Energy of RA, “Settlement Center” CJSC, Yerevan, 2005. More detailed information on power generation structure can be found in Annex III.
the Armenian Power Grid is estimated to be in the project’s first crediting period 0.35 tCO$_2$e /MWh (refer to Annex 3 for details). However, this BM has to be determined ex-post for each year of operation.

**STEP 3. Calculate the baseline emission factor EFy (Combined Margin)**

With the weights $W_{OM}$ and $W_{BM}$ 50% by default, the preliminary CM is obtained as 0.48 tCO$_2$e /MWh (refer to Annex 3 for details). The data used for the calculation of combined margins is shown in Annex 3 of this document. The CM grid CO$_2$-emission factor when multiplied with the electricity generated by the Project Activity equals the baseline CO$_2$ emissions that without the CDM Project Activity would be emitted.

**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 small-scale CDM Project Activity:**

The following steps are used to demonstrate the additionality of the project according to the latest version of the “Tool for the demonstration and assessment of additionality” agreed by the Executive Board (Version 02 from 28 November 2005).

**Step 0. Preliminary screening based on the starting date of the Project Activity**

This step is not applicable because the crediting period of the Project Activity will start from or after the date of registration.

**Step 1. Identification of alternatives to the Project Activity consistent with current laws and regulations**

**Sub-step 1a. Define alternatives to the Project Activity:**

The following two alternatives are considered to the project:

*Alternative 1:* The proposed Project Activity without consideration of CDM: construction of a new Eghvard-2 HPP connected to the grid, but not undertaken as a CDM Project Activity but as a normal project investment.

*Alternative 2:* Continuation of the current situation. Electricity will continued to be generated by the existing generation mix operating of the grid.

**Sub-step 1b. Enforcement of applicable laws and regulations:**

All mentioned alternatives are in compliance with current laws and regulations of the Republic of Armenia. *Alternative 2* is currently practised, and could continue to be practised.

**Step 2. Investment Analysis**

**Sub-step 2a: Determine appropriate analysis method**

Three options can be applied to conduct the investment analysis. They are: the simple cost analysis (Option I), the investment comparison analysis (Option II) and the benchmark analysis (Option III).

The simple cost analysis is not applicable since the Project Activity will generate economic benefits other than CDM-related income through the electricity sale to the power grid.

**Sub-step 2b: Options II and III – Application of investment comparison and benchmark analyses**

The likelihood of the development of this project, as opposed to the continuation of the transit of grid electricity from the current electricity generation mix (i.e. its baseline) will be determined by
comparing the project IRR (without carbon) with benchmark rates required by an investor, that are in the range of at least 10% for IRR.

**Sub-step 2c: Calculation and comparison of financial indicators**

Table 2 shows the basic parameters used for financial indicators' base case calculation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical data</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installed capacity</td>
<td>MW</td>
<td>9.31</td>
</tr>
<tr>
<td>Power generation</td>
<td>mln kWh [GWh]</td>
<td>18.21</td>
</tr>
<tr>
<td>Commissioning of Eghvard-2 HPP</td>
<td>Year</td>
<td>2009</td>
</tr>
<tr>
<td><strong>Expenditures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital expenditures (CAPEX)</td>
<td>mln US$</td>
<td>9.34</td>
</tr>
<tr>
<td>CAPEX disbursement</td>
<td>Years 2007-2008</td>
<td>40%/60%</td>
</tr>
<tr>
<td>Operational expenditures (OPEX)</td>
<td>1,000 US$ / yr</td>
<td>93</td>
</tr>
<tr>
<td>Project lifetime (technology)</td>
<td>years</td>
<td>40</td>
</tr>
<tr>
<td><strong>Revenues</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed tariff for 16 years</td>
<td>US$/MWh</td>
<td>30.0 *)</td>
</tr>
<tr>
<td>Discounting rate</td>
<td>%</td>
<td>10%</td>
</tr>
</tbody>
</table>

*) after 15 years, a cost-based tariff should be applied; in the base case, this is assumed at constant level 30.0 US$/MWh

**Table 2: Detailed Parameters used for financial calculation**

There are no transparent benchmarks to represent standard returns in the market as suggested by the Tool for the demonstration and assessment of additionality like Government bond rates available for Armenia. Also a company internal benchmark cannot be transparently documented. For emerging markets as Armenia with high risk profile a reasonable threshold for the weighted average capital cost (WACC) is 10%, and assumed as benchmark for the IRR, and as discounting rate to calculate the Levelized electricity generation cost.

The financial analysis results are shown in Table 3. As shown in the table, without carbon credits the project’s IRR in the base case is 2.8% which is lower than the assumed benchmark rate of 10%. The determined IRR of 2.8% therefore indicates that in comparison to other alternatives investments, the project is not financially attractive to a rational investor.

Also, the Levelized electricity generation cost of 63.1 US$/MWh are clearly above the benchmark level of the weighted average power station tariff (=average generation cost) of 27.4 US$/MWh. The determined Levelized electricity generation cost therefore also clearly indicates that in comparison to other alternatives, the project is not the least cost solution.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Indicator</th>
<th>Option II Levelized electricity generation cost</th>
<th>Option III Internal Rate of Return (IRR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Proposed Project Activity without CDM</td>
<td></td>
<td>63.1</td>
<td>2.8%</td>
</tr>
<tr>
<td>2: Continuation of current situation of power supply from grid power stations</td>
<td></td>
<td>27.4 *)</td>
<td>10% **)</td>
</tr>
</tbody>
</table>

*) Weighted average power station tariff for 2005 was 10,715 AMD / kWh.
**) Assumed benchmark for WACC.

**Table 3: Comparison of financial indicators**

**Sub-step 2d: Sensitivity analysis**

A sensitivity analysis was conducted by altering the following parameters:

- Capital expenditures (CAPEX)
Electricity tariff
Electricity generation
Discounting rate

The above four parameters were varied in the range of -20% - +20%. The variation for the electricity tariff was only carried out in the cash-flow model after the 16th operation year, because for the first 15 years it is fixed to 30 US$/MWh. The results (Table 4 and Table 5) show that even under very favourable circumstances the Project IRR is still lower than the benchmark. Also Levelized electricity generation cost is always above the benchmark values at all varied parameters. Therefore it could be concluded that the assumption that the project (without carbon) is not financially attractive is robust to positive parameter changes.

<table>
<thead>
<tr>
<th>Varied parameter</th>
<th>-20%</th>
<th>Base case</th>
<th>+20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital expenditures (CAPEX)</td>
<td>4.2%</td>
<td>2.8%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Electricity tariff</td>
<td>2.5%</td>
<td>3.0%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Electricity generation</td>
<td>1.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discounting rate</td>
<td></td>
<td></td>
<td>Discounting rate has no impact on IRR</td>
</tr>
</tbody>
</table>

Table 4: IRR at varied parameters

<table>
<thead>
<tr>
<th>Varied parameter</th>
<th>-20%</th>
<th>Base case (0%)</th>
<th>+20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital expenditures (CAPEX)</td>
<td>51.5</td>
<td>63.1</td>
<td>74.7</td>
</tr>
<tr>
<td>Electricity tariff</td>
<td>78.8</td>
<td>52.6</td>
<td></td>
</tr>
<tr>
<td>Electricity generation</td>
<td>53.3</td>
<td>63.1</td>
<td>52.6</td>
</tr>
</tbody>
</table>

Table 5: Levelized electricity generation cost at varied parameters

Step 3. Barrier Analysis

Sub-step 3a. Identify the barriers that would prevent the implementation of type of the Project Activity

Despite the clear wish of the Republic of Armenia to promote the use of renewable electricity generation by a guaranteed tariff of 30 US$/MWh, without CDM this project itself lacks funding due to the unfavourable economic characteristics. The project thus faces considerable financing barriers. As a CDM project, the required loan financing through international financiers can be acquired much both because the increased IRR as well as some hard currency revenue stream.

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed Project Activity)

This investment situation in Armenia generally is risky and investment-hostile, and therefore would favour at the moment Alternative 2 “Continuation of the current situation”, which requires no investment. Alternative 2 “Continuation of the current situation” actually takes place even with the identified barrier prevailing. This barrier therefore also clearly indicates that “Eghvard-2 Hydroelectric Power Plant" is not the baseline scenario.

Step 4. Common Practice Analysis

Sub-step 4a. Analyse other activities similar to the proposed activity

Hydro power stations in operation in Armenia are as indicated in *) power source not in operation in ex-ante baseline period 2003 to 2005
Table number 5 to 19 with a total installed capacity of approx. 1,074 MW (see CDM Baseline Study for Grid-connected Electricity Generation from Renewable Sources in the Republic of Armenia). The HPPs have been implemented between the years 1932 and 2006. Several further HPPs of various sizes are planned to be implemented in Armenia.

The situation shows that there is some experience with the type of hydroelectric technology in the country as such that would be beneficial for securing a proper technology handling and safe operation of the plant. So HPPs are common practise in Armenia, but the projects currently implemented without CDM yield more favourable economics with more favourable IRRs.

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

This section has been addressed in Sub-step 4 a)

### Step 5. Impact of CDM registration

As discussed in the Step 2 & 3 of the additionality analysis above, the project is not considered financially attractive without the CDM and thus faces enormous financial barriers. The impacts of registration of the project as a CDM project are as follows:

- CDM revenues make the project more attractive from an investment point of view by increasing the IRR, and decreasing its Levelized electricity generation cost.
- An additional revenue stream into the project is generated, in the form of CDM revenue, provides greater certainty of cash flow into the project, and reduces this risk.

Table shows the impact of additional CDM revenues at CER prices (net after transaction cost) of 7, 10 and 20 €/CER (~ 8.75, 12.5 and 25 US$/CER). The Project Activity intends to sell its generated CERs to the European market for EU Emission Trading System compliance, where prices underlie daily fluctuation but levels generally are higher than in bilateral ERPAs.

The selected indicators IRR and Levelized electricity generation cost are even with CDM below the benchmarks. However, CDM will make the Project Activity feasible for the project owner because of the additional income a loan can be attracted.

**Conclusion:** The Test for Additionality showed that the proposed Project Activity is not a baseline scenario, thus the Project is additional to what would have happened otherwise.

<table>
<thead>
<tr>
<th>Varied parameter</th>
<th>Internal Rate of Return (IRR) %</th>
<th>Levelized electricity generation cost US$/MWhe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Activity without CDM</td>
<td>2.8</td>
<td>63.1</td>
</tr>
<tr>
<td>Project Activity with CDM @ 7 €/CER</td>
<td>3.7</td>
<td>59.3</td>
</tr>
<tr>
<td>Project Activity with CDM @ 10 €/CER</td>
<td>4.1</td>
<td>57.7</td>
</tr>
<tr>
<td>Project Activity with CDM @ 20 €/CER</td>
<td>5.4</td>
<td>52.3</td>
</tr>
</tbody>
</table>

Table 6: Economic indicators with CDM under consideration

### B.6. Emission reductions:

**B.6.1. Explanation of methodological choices:**

The Eghvard-2 SHPP project has an installed capacity of 9.31 MW and proposes generation of renewable electricity and its direct supply to the National grid of Armenia, which is fed by both fossil fuel fired plants operating mainly on natural gas (Hrazdan TPP and Yerevan TPP) and non-fossil fuel based generating plants (e.g. Metsamor NPP, Sevan-Hrazdan HPPC, etc.). Hence, all requirements for the use of simplified baseline methodology AMS-I.D (Version N10) are satisfied.
In accordance with the provisions of the above-mentioned methodology, the approved consolidated methodology “ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version N06; May 19, 2006) is used for calculation of a combined margin (CM).

ACM0002 offers 2 options to calculate both the Operating Margin (OM) and the Build Margin (BM) for the first crediting period, either ex-ante (Option 1) based on the most recent information available, or ex-post (Option 2) for the year in which actual project generation and associated emission reductions occur. This Project Activity applies for ex-ante determination of OM and ex-post determination of BM.

**STEP 1: Operating Margin emission factor**

The operating Margin emission factor(s) \( EF_{OM,y} \) can be calculated based on one of the four following methods:

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

A dispatch data analysis (c) could not be applied, because a respective program and information was not available. Low-cost/must run resources (hydropower and nuclear) constitute in the 5 recent years 2001 to 2005 on average more than 70\% of the power generation in the Republic of Armenia (see Figure 1 in Section B.4). Therefore the Simple OM method (a) is not applicable and Simple adjusted OM has to be applied.

The calculation of Simple adjusted OM emission factor \( EF_{OM\_simple\_adjusted,y} \), is based on the following formulae:

\[
EF_{OM\_simple\_adjusted,y} = (1 - \lambda_y) \frac{\sum_{j,k} F_{i,j,k} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \Lambda_y \frac{\sum_{k} F_{i,k} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}} \quad (tCO_2e/GWh)
\]

Where:

- \( \lambda_y \) is the share of hours in year \( y \) (in \%) for which low-cost/must-run sources are on the margin,
- \( \sum_{i,j} F_{i,j\_ou\_k\_y} \) is the amount of fuel \( i \) (in mass or volume unit) consumed by relevant power sources \( j \) (analogous for sources \( k \)) in year(s) \( y \),
- \( COEF_{i,j\_ou\_k\_y} \) is the CO\(_2\)e coefficient of fuel \( i \) (tCO\(_2\)e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources \( j \) (analogous for sources \( k \)) and the percent oxidation of the fuel in year(s) \( y \) and,
- \( \sum_{j\_ou\_k\_y} GEN_{j\_ou\_k\_y} \) is the electricity (MWh) delivered to the grid by source \( j \) (analogous for sources \( k \)).

It is assumed here that all the low-cost/must-run plants produce zero net emissions.

\[
\sum_{i,j,k} F_{i,j,k} \cdot COEF_{i,k} = 0 \quad (tCO_2e/GWh)
\]

The Simple adjusted OM (b) method in Armenia yields equivalent results than the Simple OM (a), because the hours per year for which low-cost/must run sources are on margin is 0, and
therefore also $\lambda_Y$ according ACM 0002 /1/ is 0. The ex-ante Simple adjusted OM (b) as average 2003 to 2005 is calculated as 0.62 tCO$_2$/MWh.

**STEP 2 Build Margin emission factors**

The Build Margin emission Factor $EF_{BM,Y}$ is projected *ex-post* based on the available information on the future development of Armenia’s power sector. Around the years 2008/9 the commissioning of combined cycle units at Yerevan TPP (208 MW) and at Hrazdan TPP (440 MW) is scheduled. According to the estimates in the baseline study enclosed (see Annex 3), these new Units could provide 30% to 50% of all power generated in Armenia. Modern combined cycle power plants achieve at least an efficiency of 50% in condensing mode, and respectively their emission rate with natural gas firing will not exceed 0.40 tCO$_2$/MWh. The medium-term Build Margin (BM) after commissioning of Yerevan and Hrazdan combined cycle Units would be largely determined by these and some new small hydropower power plants. With an approximate weighting of 90% new combined cycle units, the Build Margin will develop as follows: ~ 0.35 tCO$_2$/MWh. This *ex-post* Build Margin also more adequately covers the intention of the BM to represent the average emissions of recently commissioned power plants, rather than the *ex-ante* BM that would include plants commissioned already starting in 1967, and therefore a whole lifetime of 40 years for thermal power plants ago. However, this is only a preliminary estimation, and the real Build Margin emission Factor $EF_{BM,Y}$ will be determined *ex-post* for each year of operation.

Given the comparatively small capacity of the Eghvard-2 HPP, this plant has only negligible impact on the Build Margin.

**STEP 3 Baseline Emission Factor (Combined Margin)**

The Baseline Emission Factor $EF_Y$ is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,Y}$) and the Build Margin emission factor ($EF_{BM,Y}$). A 50/50 OM/BM default weighting as applicable for hydropower projects is used. The likely Combined Margin for the first crediting period will be:

$$50\% \times OM \ (ex-ante) + 50\% \times BM \ (ex-post) = 50\% \times 0.62 \ tCO_2/MWh + 50\% \times 0.35 \ tCO_2/MWh = 0.48 \ tCO_2/MWh$$

**Procedures to calculate leakage emissions $L_Y$:**

The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction, fuel handling (extraction, processing, and transport), and land inundation (for hydroelectric projects – see applicability conditions and project emissions above). According to I.D./Version 10, these emission sources need not to be considered as leakage in applying this methodology.

**Procedures to calculate emission reductions $ER_Y$:**

The Project Activity mainly will reduce carbon dioxide through substitution of grid electricity generation by fossil fuel fired power plants by renewable electricity. According to the provisions of ACM0002, the emission reduction $ER_Y$ by the Project Activity during a given year $y$ is the difference between baseline emissions ($BE_Y$), project emissions $PE_Y$ and emissions due to leakage ($L_Y$), as follows:

$$ER_Y = BE_Y - PE_Y - L_Y$$

where the baseline emissions ($BE_Y$ in tCO2) are the product of the baseline emissions factor ($EF_Y$ in tCO2/MWh) calculated in Step 3, times the electricity supplied by the Project Activity to the grid ($EG_Y$ in MWh) minus the baseline electricity supplied to the grid in the case of modified or retrofit facilities ($EG_{Baseline}$ in MWh), as follows:

$$BE_Y = (EG_Y - EG_{Baseline}) \times EF_Y$$
Project emissions PEy are 0, leakage emissions Ly are 0 as mentioned above. The Baseline generation $E_{G_{\text{Baseline}}}$ is 0 because the plant is not a modification or retrofit of an existing facility.

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

This section includes a compilation of information on the data and parameters that are not monitored throughout the crediting period but are determined upfront and thus remain fixed and are available for validation. Since, the proposed project applies for ex-ante Operational Margin determination for the first crediting period. This condition is relevant to all power sector data used to determine the baseline.

This section also includes data that is collected from sources such as official statistics, expert judgment, proprietary data, IPCC, commercial and scientific literature.

<table>
<thead>
<tr>
<th>Data / Parameter:</th>
<th>Network output = net power generation of all power plants for OM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data unit:</td>
<td>GWh$<em>{a}$ = mln kWh$</em>{a}$/year</td>
</tr>
<tr>
<td>Description:</td>
<td>GWh$_{a}$ is the common unit to measure electricity generation, plant’s own consumption, losses and network input.</td>
</tr>
<tr>
<td>Source of data used:</td>
<td>Settlement Center’s annual reports on “Analysis of technical and economic indices of the Armenian power energy system” for 2005.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value applied:</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear Power Plant</td>
<td>1,818.2</td>
<td>2,202.3</td>
<td>2,509.2</td>
</tr>
<tr>
<td>Thermal Power Plants</td>
<td>1,401.1</td>
<td>1,485.6</td>
<td>1,670.9</td>
</tr>
<tr>
<td>Hydro Power Plants</td>
<td>1,969.2</td>
<td>2,003.1</td>
<td>1,762.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,188.5</td>
<td>5,691.0</td>
<td>5,942.8</td>
</tr>
</tbody>
</table>

**Justification of the choice of data or description of measurement methods and procedures actually applied:**

Usual electricity measurement equipment. For more details please see Annex III

**Any comment:**
### Data / Parameter: Total fuel consumption of all thermal power plants for OM

| Description: | m³ is the common unit to measure fuel consumption (natural gas and syngas) and together with net caloric value, to determine energy and carbon content of the fuel. |
| Source of data used: | Public Services Regulatory Commission of Armenia |
| Value applied: | 2003  
Yerevan TPP (natural gas)  
84.757  
86.466  
153.334  
Hrazdan TPP (natural gas)  
407.277  
448.765  
464.671  
Yerevan TPP (syngas)  
21.878  
47.252  
82.933  
Hrazdan TPP (syngas)  
0  
0  
0 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | The fuel consumption was converted into energy units and used for calculations of gross and net generation efficiencies. For more details please see Annex III |
| Any comment: | |

### Data / Parameter: EF _OMy_

<p>| Description: | Operational Margin Emission Factor |
| Source of data used: | CDM Baseline Study for Grid-connected Electricity Generation from Renewable Sources in the Republic of Armenia |
| Value applied: | 0.62 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | For more details please see Annex III |
| Any comment: | |</p>
<table>
<thead>
<tr>
<th>Data / Parameter</th>
<th>Description</th>
<th>Source of data used</th>
<th>Value applied</th>
<th>Justification of the choice of data or description of measurement methods and procedures actually applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF&lt;sub&gt;C&lt;/sub&gt;</td>
<td>Natural gas</td>
<td>Revised 1996 IPCC Guidelines for National GHG Inventories</td>
<td>15.3 t C/TJ</td>
<td>IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Volume 3, Table 1-1 pag 1.11. Natural gas (dry)</td>
</tr>
<tr>
<td>OXID</td>
<td>Oxidation factor for natural gas (Fraction of Carbon Oxidised)</td>
<td>Revised 1996 IPCC Guidelines for National GHG Inventories</td>
<td>0.995</td>
<td>Revised 1996 IPCC Guidelines for National GHG Inventories, Reference Manual, Volume 3, Table 1-6, p. 1.29</td>
</tr>
</tbody>
</table>

Any comment for EF<sub>C</sub>: To express the results as carbon dioxide (CO₂), total carbon oxidised should be multiplied by the molecular weight ratio of CO₂ to C: 44/12 = 3.67, where 44 - molecular weight of CO₂ and 12 - atomic mass of carbon. EF<sub>CO₂</sub> = 56.1 t CO₂/TJ (Revised 1996 IPCC Guidelines for NGHGI)

Any comment for OXID: Data / Parameter: OXID

Any comment for CF<sub>Gcal/GWh</sub>: General Conversion Factors for Energy

Any comment for CF<sub>Gcal/TJ</sub>: General Conversion Factors for Energy
measurement methods and procedures actually applied:

Any comment: General Conversion Factor for Energy

### Data / Parameter: \( \text{LCV}_{\text{EF}} \)

<table>
<thead>
<tr>
<th>Data unit:</th>
<th>kcal / kg of EF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Lower heating value of Equivalent Fuel (Coal Equivalent)</td>
</tr>
<tr>
<td>Source of data used:</td>
<td>European Nuclear Society</td>
</tr>
<tr>
<td>Value applied:</td>
<td>7000</td>
</tr>
</tbody>
</table>

Justification of the choice of data or description of measurement methods and procedures actually applied:
The data obtained from the official web site of European Nuclear Society at:
http://www.euronuclear.org/info/encyclopedia/coalequivalent.htm

Any comment: Equivalent Fuel or Coal Equivalent is the one of most commonly used energy units on the territory of the former USSR countries (CIS), particularly, in Armenia. Most of the official reports on total or specific fuel consumption of the Armenian TPPs provide data in grams, kilograms or tones of EF.

### Data / Parameter: \( \text{EF}_{\text{CO2, Syngas}} \)

<table>
<thead>
<tr>
<th>Data unit:</th>
<th>kg ( \text{CO}_2 )/ m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Carbon dioxide emission factor per unit of volume of syngas</td>
</tr>
<tr>
<td>Source of data used:</td>
<td>“Nairt Factory” CJSC</td>
</tr>
<tr>
<td>Value applied:</td>
<td>0.7473</td>
</tr>
</tbody>
</table>

Justification of the choice of data or description of measurement methods and procedures actually applied:
The carbon dioxide emission factor for syngas is calculated by specialists of the Environmental Department of “Nairt Factory” CJSC for TACIS Project. Emission factor of syngas is strongly depends on gas composition, which, in its turn depends on processing procedures. Thus, only company’s experts judgment and estimation can provide objective information on gas emission factor.

Any comment: General activity of the company is manufacture of polychloroprene, carbinol syrup, caustic soda, liquid chlorine, monocarboxylic acids. During processing procedure syngas (a by-product) is being produced due to technological utilization of natural gas. The company supplies almost all syngas to Yerevan TPP, where it is utilized for electricity and heat production.

---

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

The ex-ante calculation of the emission reductions is based on the projection of the net electricity generation of the Project Activity \( E_y \) of 18.21 mln kWh/yr, and the ex-ante baseline emission factor \( F_y \) for the first crediting period.

**Ex-ante calculation of project emissions \( P_y \):**

If power density of the project is greater than 10W/m²: \( P_y = 0 \).
**Ex-ante calculation of baseline emissions BEy:**

\[
BEy = (EGy - EG_{Baseline}) \times EFy
\]

*\(EG_{Baseline} = 0\)*

*\(EFy = 0.48\).*

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline emissions BEy</th>
<th>Electricity generation EGy</th>
<th>Combined Margin emission factor EFy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t CO₂e/yr</td>
<td>mln kWh/yr</td>
<td>t CO₂e/MWh</td>
</tr>
<tr>
<td>2009 to 2015 (year 1 to 7)</td>
<td>8,741(*)</td>
<td>18.21(**)</td>
<td>0.48 (*)</td>
</tr>
<tr>
<td>2016 to 2029 (years 8 to 21)</td>
<td>8,741(*)</td>
<td>18.21(**)</td>
<td>0.48 (*)</td>
</tr>
</tbody>
</table>

*) Values only indicative based of *ex-post* determination of BM EFy.

**) Values only indicative because actual generation will be measured and monitored each year.

**Table 7**: Projected baseline emissions of Project Activity

**Ex-ante calculation of leakage emissions Ly**: not applicable

**Ex-ante calculation of emission reductions ERy**: The formulae according ACM0002 are applied:

\[
ERy = BEy - PEy - Ly
\]

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimation of Project Activity emissions PEy</th>
<th>Estimation of baseline emissions BEy</th>
<th>Estimation of leakage Ly</th>
<th>Estimation of overall emission reductions ERy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t CO₂e</td>
<td>t CO₂e</td>
<td>t CO₂e</td>
<td>t CO₂e</td>
</tr>
<tr>
<td>2010 to 2017 (year 1-7)</td>
<td>0</td>
<td>8,741(*)</td>
<td>0</td>
<td>8,741(*)</td>
</tr>
<tr>
<td>2017 to 2030 (years 8 to 21)</td>
<td>0</td>
<td>8,741(*)</td>
<td>0</td>
<td>8,741(*)</td>
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<tr>
<td>Total 1st crediting period</td>
<td>0</td>
<td>61,187(*)</td>
<td>0</td>
<td>61,187(*)</td>
</tr>
<tr>
<td>Total all crediting periods</td>
<td>0</td>
<td>183,561(*)</td>
<td>0</td>
<td>183,561(*)</td>
</tr>
</tbody>
</table>

*) Values only indicative based of *ex-post* determination of BM EFy.

**Table 8**: Ex-ante estimation of overall emissions reductions of Project Activity

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

**B.7.1 Data and parameters monitored:**

(Copy this table for each data and parameter)

<table>
<thead>
<tr>
<th>Data / Parameter:</th>
<th>EGy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data unit:</td>
<td>MWh</td>
</tr>
<tr>
<td>Description:</td>
<td>Electricity delivered by the Project to the grid in year y</td>
</tr>
<tr>
<td>Source of data to be used:</td>
<td>Cumulative reading of electricity meters installed at the power plant</td>
</tr>
<tr>
<td>Value of data:</td>
<td>18.21 GWh / year</td>
</tr>
<tr>
<td>Description of measurement methods and procedures to be applied:</td>
<td>The electricity quantity is directly measured by measuring equipment (digital sealed kilowatt hour (kWh) meter) and verified with invoices or receipts from the grid company.</td>
</tr>
<tr>
<td>Responsible person:</td>
<td>monitoring officer</td>
</tr>
<tr>
<td>Calibration:</td>
<td>according to meter supplier information</td>
</tr>
<tr>
<td>Measurement periodicity:</td>
<td>continuosly</td>
</tr>
<tr>
<td>QA/QC procedures to be applied:</td>
<td>Explained in Section B.7.2</td>
</tr>
</tbody>
</table>
Any comment:

Detailed information on the rest parameters to be monitored is presented in Annex IV of the present PDD.

**Data collection for updated Baseline Study**

The “CDM Baseline Study for Grid-connected Electricity Generation from Renewable Sources in the Republic of Armenia” conducted by Fichtner/Fraunhofer-ISI/Linden/CESI Consortium within the framework of EC/TACIS project in June 2006 served as a key source for the project baseline calculation. However, Build Margin has to be determined as report and the study has to be updated for subsequent periods after year 7 and year 14. Updated information baseline and data will be collected for each power generation plant/unit that is connected to the electricity grid at that time. Ultimately, these data will be used for recalculation of Operational Margin, Build Margin and, consequently the Combined Margin CO₂-grid emission factor as indicated in Section B.6.3.

<table>
<thead>
<tr>
<th>B.7.2 Description of the monitoring plan:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The monitoring plan of the project sets out a number of tasks to ensure that all aspects of the project operation and subsequent GHG emission reductions are controlled, properly measured, archived and reported. This requires an ongoing monitoring of the operation of Eghvard-2 SHPP to secure plant performance according to its design and ensure that real and measurable Certified Emission Reductions (CERs) can be claimed and issued.</td>
</tr>
</tbody>
</table>

Since the project monitoring is proposed to be undertaken by project owner, a qualified specialist will be appointed and trained to fulfill the duties of Monitoring Officer, whose main task is to regularly monitor actual data on the Eghvard-2 SHPP in compliance with the approved monitoring methodology and plan. The officer will be responsible for development of reports on operation of the hydropower plant including information on power generation, power delivery, collection of power sale receipts or invoices, etc. Along with the information received form plant measuring equipment, data on actual amount of electricity supplied to the national grid will be obtained from “Settlement Center” CJSC and compared with the project data in order to conduct further double check of the measurements and their verification.

Based on collected and verified information the calculation of GHG emission reductions and incorporating of the outcomes into Monitoring Report will be carried out by Fichtner Carbon Management GmbH. After the calculation of actual emission reductions all relevant information will be archived and brought in compliance with the format suitable for further audit (verification) by contracted Designated Operational Entity. Figure 2 demonstrates a basic structure of the proposed monitoring system.

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* Settlement Center” CJSC, the state-owned company, which executes registration and measuring of power generation and supply through the country, based on commercial meters indicators. For more information on the company please see Annex III.
The Project Company as well as Chief Engineer will be instructed for implementing the monitoring process before the hydro plants be put into operation to assure that they have fully understood their responsibilities and the requirements of the monitoring plan.

The Project Activity does not involve any leakage within the project boundary because no alternate fuel (fossil fuel or any other GHG emitting fuel) can be used to run the turbines and generate electricity.

The generated electricity from the project is sold to the state electricity utility (ENA) for the complete project lifespan, for which the promoter will enter into a long term power purchase agreement (PPA) with the state power utility. Thus throughout the project cycle (crediting period) and beyond the electricity generated from the project will be monitored by both the project proponent and “Settlement Center” CJSC.

The generated electricity, before entering into the grid, at the grid interconnection point will be measured by digital, sealed kilowatt hour (kWh) meter on a monthly basis and will be documented both on paper as well as in electronic form. This generation record will form the basis of payment by ENA to the project proponent. Such records will be maintained and would be made available on demand throughout the crediting period of the project and after it.

**Calibration of Meters & Metering**

In order to secure precise measurement of the electricity delivered to the national grid, the metering instruments at all locations should be calibrated annually according to regulations and their accuracy should correspond to certified values. If there are any substantial discrepancies between the readings of the metering instruments, the instruments will be recalibrated.

**Quality Assurance and Quality Control**

The quality control (QC) and quality assurance (QA) procedures during the monitoring stage will involve:

- Use of electric energy meters with accuracy according to national and international standards;
- Computerized information storage and analysis;
- Double check of information on electricity export by comparing the data obtained from project metering system with the receipts provided by “Settlement Center” CJSC;
- Use of clear and defined procedures for data recording.

The foreseen quality control and quality assurance measures will secure the quality of the data collected. At the same time, the practice of metering electric output is standard for small hydropower projects and does not involve much uncertainty concerning the quality of collected data.
All data records will be archived for a period of 2 years after the credit period to which the records pertain.

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

Baseline data collection began in autumn 2005. The Baseline Study has been developed by Fichtner Germany in co-operation with the Armenian Project Office of EU Funded Tacis-Project “Technical Assistance to Armenia, Azerbaijan, Georgia and Moldova with respect to their Global Climate Change Commitments” EuropeAid/115123/C/SV/Multi/Lot No.2. The Baseline Study was finalized in June 2006.

The Baseline Study for the Armenia power sector is provided in a separate document entitled: “CDM Baseline Study for Grid-connected Electricity Generation from Renewable Sources in the Republic of Armenia”

Date of completing the final draft of this baseline section: 21 June 2006

Name of persons determining baseline and monitoring methodology:

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Artem Kharazyan  
Project Coordinator for Armenian Office  
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**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:**

01/01/2008 – expected date for commissioning of construction works

**C.1.2 Expected operational lifetime of the Project Activity:**

30y - 0m

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

The proposed Project Activity will use a renewable crediting period as detailed in C.2.1

**C.2.1 Renewable crediting period**

3 x 7y = 21y

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

01/01/2010 (expected)

**C.2.1.2 Length of the first crediting period:**

7y-0m
C.2.2. Fixed crediting period:

C.2.2.1. Starting date:
N/A

C.2.2.2. Length:
N/A

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the Project Activity:

According to RA Law on Environmental Impact Expertise (12.12.1995) any project realized in the field of renewable energy is subject to environmental impact expertise. However, the acting legislation does not provide any procedure for preliminary expertise based on Project Design Document or other similar document. Thus, expertise is held based on project technical (engineering) design.

To encourage the implementation of renewable energy projects under the CDM and to minimize transaction costs for small-scale project activities, the Ministry of Nature Protection of Armenia which has been appointed as the Designated National Authority for CDM in Armenia\(^\text{10}\), does not require any formal environmental impact assessment at the PDD stage of a project if its impacts on air atmosphere, water and land are believed to be insignificant. For that purpose the project participants should present in the PDD their vision of positive and negative environmental impacts caused by the proposed Project Activity and make up a conclusion on their significance.

Further on, upon the project approval and before initiation of construction works, the project participants must develops a technical (engineering) design which is subject to mandatory environmental impact expertise. Thus, it is ensured that the project is implemented in compliance with all environmental requirements of the Republic of Armenia.

The project proponent intends to initiate the development of construction design after the full Feasibility Study is ready.

Environmental impacts

The Eghvard-2 SHPP will be constructed on the spillway of the existing Arzni-Shamiram irrigation canal, so no negative environmental impact on biodiversity or fishery is expected. Moreover, the project does not envisage construction of reservoir and thus, avoids submersion of adjacent territory as well as emission of CH\(_4\) associated with stagnation of water in the reservoir. Furthermore, since the project utilizes environmentally save technologies, it does not result in degradation of any natural resources, health standards or water quality. Project realization does not involve any detrimental effect on forestry since there is no natural forestry at the construction site.

\(^10\) Government Decision N-974N of 19.06.2006 on “Implementation of Projects within the framework of the Clean Development Mechanism of the Kyoto Protocol under the United Nations Framework Convention on Climate Change”.
The solid waste during the construction and operation periods will be collected and reused as much as possible. The rest will be carried to the waste residual pits. Therefore, the project will not bring negative impacts for the local environment.

**Possible negative environmental impacts caused by the proposed Project Activity**

Physical impacts to be expected at the site are limited to earth excavation works, dust and noise caused by construction works as well as by traffic on access roads, destruction of soil and excavation of slopes.

Also areas will be needed for dumping of excavated ground and allocation of construction materials. Dust caused by traffic on the access road might affect the vegetation in the vicinity of the construction site.

**Conclusions**

In view of above-mentioned statements it can be concluded that the Project Activity has no significant environmental impacts.

**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:**

The Eghvard-2 SHPP Project uses clean renewable energy to generate electricity. Taking into consideration all possible positive and negative outcomes, the project proponents concluded that the proposed Project Activity has no significant environmental impacts.

However, a comprehensive Environmental Impact Assessment will be conducted upon finalization of the Feasibility Study and the project construction design in order to assure that the project complies with relevant national laws and regulations.

**SECTION E. Stakeholders’ comments**

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

On April 20, 2007, the project participants held a public hearing on Eghvard-2 SHPP CDM project, aimed at presentation and discussion of the project’s technical, environmental, social and economic aspects as well as invitation of stakeholder’s comments on the project activity and document.

In order to keep all the local stakeholders including those who live in remote areas posted on the project implementation, an announcement in AZG Armenian Daily11 national newspapers was placed.

A week before the session, the identified stakeholders were provided with brief versions of the project document in English and Armenia in order to get acquainted with the project activity and provide comments on it.

The public hearing session took place in Golden Tulip Yerevan Hotel and hosted approximately twenty participants. Along with representatives of key ministries, financial institutions, state agencies and CDM DNA of Armenia, managers of private entities as well as local experts on CDM were invited.

The following stakeholders attended the session:

**Ministry of Nature Protection of Armenia (CDM DNA)**

11AZG Armenian Daily (The Nation), http://www.azg.am/
E.2. Summary of the comments received:

The meeting started with a welcome speech of Mr. Kharazyan who greeted all participants and introduced a brief agenda of the event.

After the introductory part, Mr. Kharazyan presented a CDM overview, its background and history, defined a project cycle along with project baseline methodologies, and touched upon the linkage between the baseline and additionality. The presentation also elucidated the CDM project approval procedure in Armenia along with criteria and scheme of projects evaluation and endorsement.

The second part of the presentation was devoted to description of the project activity. In particular, information on project location, engineering data, and availability of necessary documents as well as contribution to the host country sustainable development were provided.

After brief recess a discussion on project activity took place.

The following general questions were asked by the participants:

Vram Tevosyan
CDM – Executive Board

- How economic and financial additionality of the proposed project activity was demonstrated and proved by project participants?

Ashot Poghosyan
- What is the project plant factor (annual hours of operation) and how it was evaluated?

Alik Abrahamyan
- How Certified Emission Reductions to be generated by the project activity were calculated?
- Does the calculation methodology considers specifics of the Armenian energy system where more than 70% of power is generated by "green" hydro power plants and nuclear power plant?
- Have operational regimes of the Armenian thermal power plants been taken into consideration?

Martiros Tsarukyan
- Could emission factor applied for the project change in the nearest future and how such a change can be taken into consideration during project operation?

Aram Gabrielyan
- Will the power plant be operated only during the irrigation season?
- Will the project implementation lead to reduction on non-Kyoto gases such as CO, NOx, etc.?
- Will the project implementation have any harmful environmental effect?

Hovhannes Nasibyan
- Will the Armenian DNA monitor the project implementation in terms of its conformity with the host country Sustainable Development objective?
- What are social benefits of the project?

All questioners raised by participants were addressed by Mr. Kharazyan and Ms. Arzumanya.

At the end of the session the participants positively evaluated the proposed project activity and provided supportive comments on it. In particular, it was stated that the project activity:

- Conforms with the existing legislation of Armenia;
- Will lead to generation of new job opportunities;
- Will not result in displacement of the local population;
- Will not have negative impact on local environment;
- Will contribute to the development of renewable energy and diversification of energy resources in the country;
- The project has led to increased energy security in the region.
- Will lead to attraction of foreign investments, etc.

The representative of Bur Group informed stakeholders on possibility to submit additional comments (if any) on the project activity by email to ssinter@netsoft.am or artemduke@yandex.ru.

Given the fact that representatives of the local communities from Karby and Ohanavan villages located nearby the project site were not able to take part in the public hearing session, project proponent held a separate meeting with them. The meeting aimed at presentation of the project activity, possible consequences of its materialization as well as the result of the public hearing session.

Taking into account that the project activity will not cause any adverse environmental and social impacts on local population and rather will help in improving their quality of life by generation of employment and increasing the quality of energy supply, the project has been given a green signal by the local communities.

Minutes of the meeting with the local communities are also available on request.
E.3. Report on how due account was taken of any comments received:

No negative comments on the project activity were received from the stakeholders.
## CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

### BUR GROUP LLC

- **Organization**: BUR GROUP LLC
- **Street/P.O.Box**: Tigran Mets St.
- **Building**: 4
- **City**: Yerevan
- **State/Region**: 
- **Postfix/ZIP**: 0001
- **Country**: Republic of Armenia
- **Telephone**: +37410 58-12-44
- **E-Mail**: ssinter@netsoft.am
- **Represented by**: Silva Hambartzumyan
- **Title**: Director
- **Salutation**: Ms.
- **Last Name**: HAMBARTZUMYAN
- **Middle Name**: 
- **First Name**: Silva
- **Department**: 
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- **Direct FAX**: 
- **Direct tel**: +37491 40-77-23
- **Personal E-Mail**: ssinter@netsoft.am

### FICHTNER GmbH & Co. KG

- **Organization**: Project Developer and Participant: FICHTNER GmbH & Co. KG
- **Street/P.O.Box**: Sarweystrasse 3 / P.O.Box 101454
- **Building**: 3
- **City**: Stuttgart
- **State/Region**: Baden Württemberg
- **Postfix/ZIP**: 70191
- **Country**: Germany
- **Telephone**: +49 (0) 711 8995-0
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- **E-Mail**: Laubachj@fichtner.de
- **URL**: http://www.fichtner.de
- **Represented by**: Johannes Laubach
- **Title**: Senior Expert / Project Manager
- **Salutation**: Mr.
- **Last Name**: LAUBACH
- **Middle Name**: 
- **First Name**: Johannes
- **Department**: Energy and Climate Change
- **Mobile**: 
- **Direct FAX**: +49 (0) 711 8995-459
- **Direct tel**: +49 (0) 711 8995-598
- **Personal E-Mail**: ssinter@netsoft.am
<table>
<thead>
<tr>
<th>Organization:</th>
<th>Armenian Project Office of Tacis-Project “Technical Assistance to Armenia, Azerbaijan, Georgia and Moldova with respect to their Global Climate Change Commitments” Project Number: EuropeAid/115123/C/SV/Multi/Lot No.2 carried out by Fichtner/Linden/Fraunhofer ISI/CESI consortium</th>
</tr>
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<tbody>
<tr>
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<td>Republic Square, Governmental Building</td>
</tr>
<tr>
<td>Building:</td>
<td>3</td>
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<td>+37410 58-39-33</td>
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<td>E-Mail:</td>
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</tr>
<tr>
<td>URL:</td>
<td><a href="http://www.cdm.nature-ic.am">http://www.cdm.nature-ic.am</a></td>
</tr>
<tr>
<td>Represented by:</td>
<td>Artem Kharazyan</td>
</tr>
<tr>
<td>Title:</td>
<td>Armenian Project Office Coordinator</td>
</tr>
<tr>
<td>Salutation:</td>
<td>Mr.</td>
</tr>
<tr>
<td>Last Name:</td>
<td>Kharazyan</td>
</tr>
<tr>
<td>Middle Name:</td>
<td>Artem</td>
</tr>
<tr>
<td>First Name:</td>
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<tr>
<td>Direct tel:</td>
<td>+37410 58-39-20</td>
</tr>
<tr>
<td>Personal E-Mail:</td>
<td><a href="mailto:artemduke@yandex.ru">artemduke@yandex.ru</a></td>
</tr>
</tbody>
</table>
Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from parties included in Annex I is available to the Project Activity.
Annex 3

BASELINE INFORMATION

In accordance with the provisions of approved methodology AMS.I.D, calculation of baseline must be based on data from an official source (where available) and made publicly available.

Information from the following official sources has been used for all relevant calculations:

Public Services Regulatory Commission of the Republic of Armenia

PSRC (former Energy Commission of Armenia) was established in on April 3, 1997 by the Order of the President of the Republic of Armenia to implement regulatory and tariff policy in the energy sector of the country. Currently, PSRC carries out regulatory functions in five strategic sectors, namely: electric power, thermal energy, natural gas, water and electronic communications.

The main functions of the commission are as follows: issues generation operational licenses and construction authorizations, sets maximum tariffs for electricity and gas imports, issues licenses for power market service provision activities, sets tariffs for electrical and thermal energy and gas, etc.

More information on PSRC and its main activities is available at: www.psrc.am

Settlement Center” Close Joint-Stock Company

Settlement Center is the state-owned company, which executes registration and measuring of power generation and supply through the country, based on commercial meters indicators, as well as carries out relevant financial calculations and analysis necessary for the settlement of accounts between power generating companies and electricity purchaser – “Armenian Electric Network of Armenia” CJSC.

Settlement Center runs comprehensive and advanced software which allows both simultaneous estimation of more than 40 parameters of the network and power system and archiving the most important data, including half-hourly generation and own consumption for all power plants serving the Armenian energy system.

The current document incorporates information and data on the Armenian energy sector, provided in Settlement Center’s annual reports on “Analysis of technical and economic indices of the Armenian power energy system” for 2005 and 2006.

Ministry of Energy of the Republic of Armenia

The ministry’s primary function is to provide energy security for Armenia, manage and coordinate energy production-related entities, and implement the national policy of energy development, including nuclear, hydropower, thermal, and alternative energy issues.

The current document incorporates information and data on the Armenian energy sector provided in Ministry’s annual report for 2005.

More information on MoE of Armenia is available at: www.minenergy.am

Energy Sector Development Strategies in the Context of Economic Development in Armenia

The primary objective of the Strategy adopted by the Government of Armenia on June 23, 2005, is to formulate strategic goals for the development of the Armenian energy sector till 2025 and identify avenues to achieve those goals, based on the principles adopted by the international community for sustainable development, particularly in energy sector, and guided by the directors of economic development of Armenia.
MONITORING INFORMATION

In compliance with the selected indicative simplified B&M methodology AMS-I.D., the monitoring of small-scale Project Activity shall consist of metering the electricity generated by the renewable technology.

The data to be monitored in order to estimate overall GHG emission reductions due to the Project Activity is introduced in the table below.

According to Paragraph 12 of the selected indicative simplified B&M methodology AMS-I.D, leakage is to be considered if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity, which does not occur in this particular Project Activity. Moreover, no leakage is identified by the project proponents due to the project being run-of-the-river hydroelectric scheme. However, this plan is subject to revision in case of any leakage identification.

Data to be monitored:

<table>
<thead>
<tr>
<th>ID number</th>
<th>Data type</th>
<th>Data variable</th>
<th>Data unit</th>
<th>Measured (m), calculated (c) or estimated (e)</th>
<th>Recording frequency</th>
<th>Proportion of data to be monitored</th>
<th>How will the data be archived? (electronic/paper)</th>
<th>For how long is archived data to be kept?</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electricity generation of the Project supplied to the grid</td>
<td>Electricity output of the Eghvard-2 SHPP project (EGy)</td>
<td>MWh</td>
<td>Measured</td>
<td>Daily</td>
<td>100%</td>
<td>Electronic and paper</td>
<td>During the crediting period +2 years</td>
<td>A computerized system is proposed for regular monitoring and precise measurement of electricity output. All the necessary data will be stored in electronic format and also kept as hard copy in case of computer hazards. As an alternative proof of the power exports to the grid, receipts from “Settlement Center” SCJSC, the state company executing registration and measuring of power generation and supply through the country based on commercial meters indicators, will be used.</td>
</tr>
<tr>
<td>2</td>
<td>CO₂ factor of the grid</td>
<td>EFy</td>
<td>tCO₂/MWh</td>
<td>Calculated</td>
<td>At the validation</td>
<td>100%</td>
<td>Electronic and paper</td>
<td>During the crediting period +2 years</td>
<td>Data will be archived during the credit period</td>
</tr>
<tr>
<td>3</td>
<td>CO₂ Operating Margin</td>
<td>EFOM,y</td>
<td>tCO₂/MWh</td>
<td>Calculated</td>
<td>At the validation</td>
<td>100%</td>
<td>Electronic and paper</td>
<td>During the crediting period +2 years</td>
<td>Data will be archived during the credit period.</td>
</tr>
<tr>
<td>Factor of the grid</td>
<td>Calculation Method</td>
<td>Validation Method</td>
<td>Reporting Method</td>
<td>Crediting Period</td>
<td>Archiving</td>
<td></td>
<td></td>
<td></td>
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<td>-----------------------------------------------------------------------------------</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 CO₂ Build Margin factor of the grid</td>
<td>EF$_{BM,y}$</td>
<td>At the validation</td>
<td>Electronic and paper</td>
<td>During the crediting period +2 years</td>
<td>Data will be archived during the credit period.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Fraction of time during which low-cost/must-run sources are on the margin</td>
<td>λ$_y$</td>
<td>At the validation</td>
<td>Electronic and paper</td>
<td>During the crediting period +2 years</td>
<td>Data will be archived during the credit period.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Annex 4

EGHVARD-2 SHPP SCHEME
Annex 5

Site Photographs
ABBREVIATIONS

BM - Build Margin
CO₂ - Carbon dioxide
CHP – Combined Heat and Power
CH₄ - Methane
CPP – Condensing Power Plant
EIA - Environmental Impact Assessment
EF - Equivalent Fuel
GHG - Greenhouse Gas
IPCC - Inter Governmental Panel on Climate Change
kW - Kilo-Watt
kWh - Kilo Watt Hour
MW - Mega Watt
MoE – Ministry of Energy of Armenia
N₂O - Nitrous oxide
OM - Operating Margin
PPA - Power Purchase Agreement
PDD - Project Design Document
PSRC – Public Services Regulatory Commission of Armenia
UNFCCC - United Nations Framework Conventions on Climate Change
WPP - Wind Power Plant