Proposed standardized baseline submission form (Version 03.0)

To be used by a designated national authority (DNA) when submitting a proposed standardized baseline in accordance with the "Procedure: Development, revision, clarification and update of standardized baselines" (CDM-EB63-A28-PROC).

INFORMATION TO BE COMPLETED BY THE DNA	
Title of the proposed standardized baseline:	**Grid Emission Factor for the Electricity System of the Republic of Armenia for 2016**
Name(s) of the Party or Parties to which the proposed standardized baseline applies:	Republic of Armenia
DNA submitting this form:	Ministry of Nature Protection of Republic of Armenia
Is the proposed standardized baseline submitted by a single Party or group of Parties? *(If the Party had 10 or fewer registered CDM project activities as of 31 December 2010, or each Party of the group of Parties had 10 or fewer registered CDM project activities as of 31 December 2010, has the Party or each Party of the group of Parties used the option to omit the assessment report more than twice in past submissions of a proposed standardized baseline?)*	**X** Single Party ☐ Group of Parties

Attachments:

X Additional documentation supporting the submission (e.g. relevant data, statistics, studies, calculation tables, quality control report, etc.), where applicable

X Data used to establish the proposed standardized baseline in a sector-specific data template

☐ An assessment report prepared by a designated operational entity (DOE)

☐ Letters of approval of all the DNAs of the Parties to which the proposed standardized baseline applies, where the standardized baseline applies to a group of Parties

Name of authorized officer signing for the DNA:	Mr. Aram Gabrielyan, UNFCCC Focal Point in Armenia 
Date (DD/MM/YYYY) and signature for the DNA:	July 17, 2017
Contact information of the focal point(s) of the DNA: *(Names, e-mail addresses and phone contacts for procedural and technical communication on the submission)*	Mr. Aram Gabrielyan UNFCCC National Focal Point Tel.: (37410) 583932 (ext 20), Fax: (37410) 583933 Web: www.nature-ic.am , E-mail: aramgabrielyan@yahoo.com; aram@nature.am
Name(s) of the proponent(s) of the proposed standardized baseline:	

Affiliation of the proponent(s): *(The definition of "admitted observer organization" can be found at https://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf)*	**X** Party ☐ Project Participant (PP) ☐ International Industry Organization ☐ Admitted Observer Organization
Contact information of the focal point(s) of the proponent(s): *(Names, e-mail addresses and phone contacts for procedural and technical communication on the submission. This section does not need to be completed if the DNA(s) is(are) the proponent(s) of the proposed standardized baseline.)*	
INFORMATION TO BE COMPLETED BY THE SECRETARIAT AND THE PROPONENT(S)	
Further inputs requested from the proponent(s) on the proposed standardized baseline: ***(List of additional information and/or modifications that are required to prepare a draft standardized baseline, if applicable.)***	
Response from the proponent(s): ***(If there are changes in the proposed standardized baseline form as a result of changes carried out, submit the changes in the highlighted text).***	

Proposed standardized baseline submission form
CDM-PSB-FORM (Version 03.0)

Title: "Calculation of Grid Emission Factor for the Electricity System of RA for 2016"

Submission date (*dd/mm/yyyy)***: 26 June 2017**

Version number: 01.0

Approaches

Check below all the approaches used to develop the proposed standardized baseline and state the version and/or the reference (number, title, version) if applicable.

☐ The approach contained in the "Guidelines for the establishment of sector specific standardized baselines" (Version: _____)

☐ A methodological approach contained in an approved, proposed new or revised baseline and monitoring methodology (reference:_____)

X A methodological approach contained in an approved, proposed new or revised methodological tool (reference: version 5.0 of the "Tool to calculate the emission factor for an electricity system")

☐ The approach contained in the "Guideline: Establishment of standardized baselines for afforestation and reforestation project activities under the CDM" (version: _____)

Combination of the approaches (if applicable)

Provide a justification for the necessity and the appropriateness of the combination if more than one approach was used for the development of the proposed standardized baseline.

New or revised methodology or methodological tool (if applicable)

This section is applicable to the following situations:

1. *If there is no approved methodology or methodological tool available that can be used for the development of the proposed standardized baseline, and if the proponent wishes develop a new methodological approach by submitting a new methodology or methodological tool or revise the approach contained in an approved methodology or methodological tool, and/or*

2. *If there is no approved methodology available to be used together with the proposed standardized baseline for the estimation of emission reductions, and the proponents wishes to develop new methodology or revise the existing approved methodology.*

Check below how the new or revised methodology or methodological tool is/was submitted for approval by the CDM Executive Board and for what purpose in accordance with the "Procedure: development, revision and clarification of baseline and monitoring methodologies and methodological tools". In this case, indicate below the title of the new or revised methodology or methodological tool if applicable:

- *New or revised methodology or methodological tool*[1]*:*

  ☐ New methodology (title:_____)

  ☐ Revised methodology (title: _____)

  ☐ New methodological tool (title: _____)

  ☐ Revised methodological tool (title:_____)

- *Purpose:*

  ☐ For using the methodological approach in new/revised methodology/methodological tool for development of the proposed standardized baseline

  ☐ For using the new/revised methodology together with the proposed standardized baseline to estimate emission reductions

- *Process:*

  ☐ Methodology(ies)/methodological tool is/was proposed through the bottom-up process

  ☐ Request the secretariat to seek a mandate from the CDM Executive Board for its top-down development (if this option is selected, provide justification below)

  (Justification:_____)

Elements to be standardized

Check below all the elements to be standardized by the proposed standardized baseline:

☐ Additionality

☐ Baseline/baseline land-use scenario

X Baseline emission/removal parameter

☐ Land eligibility (applicable only to afforestation and reforestation project activities)

[1] The proposed new or revised methodology or methodological tool for the purpose of developing a proposed standardized baseline, or the proposed new or revised methodology or methodological tool that will be used together with the proposed standardized baseline, may be submitted to the secretariat at the same time with the proposed standardized baseline in accordance with the "Procedure: development, revision and clarification of baseline and monitoring methodologies and methodological tools".

SECTION C: PROPOSED STANDARDIZED BASELINE DEVELOPED USING A METHODOLOGICAL APPROACH CONTAINED IN AN APPROVED OR PROPOSED NEW OR REVISED METHODOLOGICAL TOOL

Complete this section only when the proposed standardized baseline is developed using a methodological approach contained in the valid version of an approved methodological tool or in a proposed new or revised methodological tool (an example of this is the application of the "Tool to calculate the emission factor for an electricity system" to estimate the CO2 emission factor of an electricity grid).

Applicability of the proposed standardized baseline

State the host country(ies) or region(s) within a host country to which the proposed standardized baseline is applicable. In case of region(s) within a host country, document transparently the geographical boundaries of the region (e.g. provinces, electric grids, etc.).

The CDM project activities to be implemented in Republic of Armenia can use this standardized baseline if the CDM approved methodology that is applied to the project activity requires determination of CO2 emission factor(s) through the application of the Tool, for the determination of baseline emissions, project emissions and/or leakage emissions

Baseline parameter standardization

Explain how the methodological approach contained in the valid version of the approved methodological tool or in the proposed new or revised methodological tool was applied to standardize the baseline parameter (e.g. baseline emission factor). Document all underlying data, data sources, assumptions, calculation steps and outcomes in a clear and transparent manner.

The grid emission factor for the electricity system of the Republic of Armenia (Armenia) for 2016 has been calculated in line with provisions and recommendations provided in the version 5.0 of the "Tool to calculate the emission factor for an electricity system" (Tool) and based on information and data obtained by DNA from public sources and respective state authorities of Armenia.

Step 1: Identify the relevant electricity systems

The national power distribution grid of Armenia covers all the country and is identified as the project electricity system for the purposed of grid emission factor calculation. The Armenian power system maintains power exchange with the national electricity grid of Iran and Georgia. In such a way, Iranian and Georgian national grids are considered as the connected electricity systems. For the purpose of determining the operating margin emission factor the Tool proposes four options to determine the CO2 emission factor(s) for net electricity imports from a connected electricity system. Within the scopes of this study option (a) i.e. 0 tones CO_2 per MWh is selected.

STEP 2. Choose whether to include off-grid power plants in the project electricity system

Option I of the Tool i.e. "Only grid power plants are included in the calculation" is selected; hence, off-grid power plants are not included in the project electricity system.

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

According to the definition used in the Tool, low-cost/must-run resources are defined as power plants with low marginal generation costs or dispatched independently of the daily or seasonal load of the grid. They include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. In accordance with this definition, within the scope of this study, all power plants except for four large thermal power

plants (Yerevan TPP, Hrazdan TPP, Hrazdan TPP Unit N5 and CCGT Unit at Yerevan TPP) are selected as low-cost / must-run power plants.

Based on the statistic information provided by the Ministry of Energy Infrastructures and Natural Resources of RA during the period of 2012-2016, low-cost/must-run (LCMR) resources constituted more than 50% of the total grid generation in average of the five most recent years. Additionally, based on information on hourly load data provided by the Ministry, it was identified that averages load by LCMR resources is higher than average lowest annual system load (LASL) over the three years. Hence, following the procedure for application of operational margin methods provided in the Tool, "Simple adjusted OM" was selected for calculation of the operating margin emission factor.

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

In order to evaluate Operational Margin, net quantity of electricity (mln kWh) generated and delivered to the grid by all power units serving the system need to be identified as well as CO_2 emission factor (tCO_2/MWh) of power units operated on fossil fuels need to be calculated. Information on net generation of electricity by all power plants (both LCMR and no LCMR) the Armenia power system in 2014-2016 is presented in the table below. According to the Tool, electricity import is also considered in calculation of Simple adjusted OM.

POWER PLANT	Delivered electricity (mln kWh)			Type of fuel
	2014	2015	2016	
No LCMR				
Hrazdan Thermal Power Plant	905.23	507.85	409.26	natural gas
Unit 5 of Hrazdan Thermal Power Plant	827.59	615.73	668.63	natural gas
Yerevan Thermal Power Plant	-	-	-	natural gas
CCGT Unit at Yerevan TPP	1398.77	1541.26	1380.76	natural gas
LCMR				
Metzamor NPP	2265.64	2571.10	2194.85	nuclear
Sevan-Hrazdan CHPPs (IEC)	465.33	444.31	395.60	hydro
ContourGlobal Hydro Cascade	826.60	909.57	981.80	hydro
Small Hydro Power Plants	670.56	818.68	940.11	hydro
Lori-1 Wind Power Plant	3.70	3.38	1.61	wind
Wind Power Plant	-	0.01	0.05	wind
Energy Center at YSMU – CHP Unit	14.54	12.33	6.33	natural gas
ArmRoscogeneration CJSC – CHP Unit	11.47	9.03	11.59	natural gas
Import	204.85	172.82	263.53	
TOTAL with Import	**7594.26**	**6876.50**	**7254.13**	
LCMR Plants	4257.84	4768.41	4531.95	
Low-cost/must-run plants + import	4462.69	4941.24	4795.48	

In the table below results of calculation of emission factors for no LCMR power plants for 2014-2016 is presented.

POWER PLANT	Year	Fuel consumption $FC_{i,m,y}$	Net calorific value of fuel $NCV_{i,y}$	Emission factor $EFco_{2,i,y}$	Emission factor
		$1000nm^3$	**$GJ/1000nm^3$**	**tCO_2/GJ**	**tCO_2/MWh**
Hrazdan TPP	2014	275583	34.710	0.054	0.57
	2015	162509	34.773	0.054	0.6
	2016	129544	34.278	0.054	0.59
Unit N5 at Hrazdan TPP	2014	210883	34.759	0.054	0.48
	2015	148592	35.165	0.054	0.46
	2016	164951	34.503	0.054	0.46

CCGT at Yerevan TPP	2014	305644	34.583	0.054	0.41
	2015	336813	34.554	0.054	0.41
	2016	303887	34.378	0.054	0.41

In the table below results of calculation of emission factors for LCMR power plants for 2014-2016 is presented.

POWER PLANT	Year	Fuel consumption $FC_{i,m,y}$	Net calorific value of fuel $NCV_{i,y}$	Emission factor $EFco_{2,i,y}$	Emission factor
		1000nm^3	GJ/1000nm^3	tCO_2/GJ	tCO_2/MWh
Metzamor NPP, Large and Small HPPs, Lori-1 WPP	2014	0	0	0	0
	2015	0	0	0	0
	2016	0	0	0	0
Energy Center at YSMU – CHP Unit	2014	4309	34.790	0.054	0.56
	2015	3878	34.823	0.054	0.59
	2016	2116	34.272	0.054	0.62
ArmRoscogeneration CJSC – CHP Unit	2014	3125	34.869	0.054	0.52
	2015	2576	34.620	0.054	0.54
	2016	3227	34.290	0.054	0.52

Calculation of lambda factor is performed in accordance with the procedure set by the Tool and based on chronological (hourly) power generation data for each plant/unit provided by the Ministry.

In the table below results of calculation of lambda factor and respective Simple adjusted OM for 2014-2016 are presented.

The number of hours for which low-cost/must-run sources are on the margin (hours)	2014	2015	2016
	17	12	24
Lambda factor	0.0019406	0.0013699	0.0027322
Simple adjusted OM emission factor (tCO2/MWh)	**0.475**	**0.458**	**0.452**

Step 5: Calculate the build margin emission factor

Following the procedure for selection of power units m used to calculate the build margin described in the Tool, the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) has been identified along with their annual electricity generation (AEGSET-5-units, in MWh).

In the table below information on installed capacities and cumulative share of power generation of these plants is given for 2014-2016.

The set of five power units (excluding power units registered as CDM project activities) that started to supply electricity to the grid most recently (SET5-units) for 2014-2016

Year	N	POWER PLANT	First year in service	Power generation in 2014, MWh	Cumulative share, %
2014	1	Yegheg SHPP	2014	746.5	0.01
	2	Spitak Jur SHPP	2014	13.6	0.00
	3	Mane SHPP	2014	896.4	0.01
	4	Khachaghbyur-2 SHPP	2014	8056.7	0.11
	5	Khachi Qar SHPP	2014	3878.6	0.05
	TOTAL			**13591.9**	**0.18**

Year	N	POWER PLANT	First year in service	Power generation in 2015, MWh	Cumulative share, %
2015	1	Daranak SHPP	2015	955.7	0.014
	2	Arevis-1 SHPP	2015	477.6	0.007
	3	Nigava SHPP	2015	5351.3	0.080
	4	Gndevanq SHPP	2015	190.5	0.003
	5	Qajaran Wind Power Plant	2015	13.6	0.0002
	TOTAL			**6988.8**	**0.104**
Year	**N**	**POWER PLANT**	**First year in service**	**Power generation in 2015, MWh**	**Cumulative share, %**
2016	1	Seca SHPP	2016	1071.2	0.02
	2	Anapat-1 SHPP	2016	1573.1	0.02
	3	Amberd-3 SHPP	2016	11234.8	0.16
	4	Meghri-1 SHPP	2016	2512.7	0.04
	5	Her-Her SHPP	2016	1351.6	0.02
	TOTAL			**17743.3**	**0.25**

As it is seen form the above table the total power generation of the 5 recently commissioned power plants is much lower than 20% of total power generation of the system.

The next step requires determining the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh), and to identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEGtotal (SET≥20%) and determine their annual electricity generation (AEGSET-≥20%, in MWh);

In the table below information on annual electricity generation as well as share of electricity generation of the plants included in SET≥20% is given.

The set of power units (excluding power units registered as CDM project activities) that started to supply electricity to the grid most recently and that comprise 20% of the system generation (SET≥20%) for 2014-2016

Year	POWER PLANT	First year in service	Fuel	Power generation, MWh	Share of AEG_{total} (%)
2014	Hrazdan TPP Unit N5	2011	NG	857490	11.6
	85 small WPPs and HPPs	2010-2014	HY	301689	4.08
	CCGT Unit at YTPP	2010	NG	1447860	19.59
	TOTAL			**2607041.4**	**35.27**
2015	Hrazdan TPP Unit N5	2011	NG	638368	9.52
	94 small WPPs and HPPs	2010-2015	HY	415337	6.19
	CCGT Unit at YTPP	2010	NG	1594592	23.78
	TOTAL			**2634155.2**	**39.49**
2016	Hrazdan TPP Unit N5	2011	NG	694823	9.93
	105 small WPPs and HPPs	2010-2016	HY	490324	7.01
	CCGT Unit at YTPP	2010	NG	1427313	20.41
	TOTAL			**2612466.8**	**37.35**

As it is seen from the above two tables the group of power units included in $SET_{\geq 20\%}$ comprises the larger annual electricity generation than power plants included in $SET_{5\text{-units}}$ in 2014-2016 period.

Since all power units included in the selected group ($SET_{\geq 20\%}$) started to supply electricity to the grid no more than 10 years ago, the set of power plants in the latter table is used for calculation of the Build Margin.

In the below emission factors for plants included in Build Margin as well as Build Margin emission factor for the system 2014-2016 are given.

Year	POWER PLANT	Emission factor of power plants included in BM (tCO_2/MWh)	Build Margin emission factor (tCO_2/MWh)
2014	Hrazdan TPP Unit N5	0.48	0.3854
	85 small HPPs	0	
	CCGT Unit at YTPP	0.41	
2015	Hrazdan TPP Unit N5	0.46	0.3591
	94 small HPPs	0	
	CCGT Unit at YTPP	0.41	
2016	Hrazdan TPP Unit N5	0.46	0.3456
	105 small HPPs	0	
	CCGT Unit at YTPP	0.41	

Step 6: Calculate the combined margin emissions factor

For the purpose of this study the weighted average Combined Margin (CM) method (Option a) has been used as the preferred option.

As the result of the performed calculations the following CM emission factors have been received for ex post approach for 2014-2016.

Year	EX POST (tCO_2/MWh)	
2014	Simple Adjusted Operating Margin	**0.4753**
	Build Margin	**0.3854**
	CM for wind and solar	**0.4528**
	CM for all other projects	**0.4303**
2015	Simple Adjusted Operating Margin	**0.4581**
	Build Margin	**0.3456**
	CM for wind and solar	**0.4333**
	CM for all other projects	**0.4086**
2016	Simple Adjusted Operating Margin	**0.4525**
	Build Margin	**0.3456**
	CM for wind and solar	**0.4258**
	CM for all other projects	**03991**

As the result of the performed calculations the following CM emission factors have been received for ex ante approach for 2016.

Year	EX ANTE (tCO_2/MWh)	
2016	Simple Adjusted Operating Margin	**0.4620**
	Build Margin	**0.3456**
	CM for wind and solar	**0.4329**
	CM for all other projects (1st CP)	**0.4038**
	CM for all other projects (2nd and 3rd CP)	**03457**

Validity of the proposed standardized baseline

State the period of time for which the proposed standardized baseline is valid in accordance with the "Standard for determining coverage of data and validity of standardized baselines".

Three years.

Deviations from the approved methodological tool (if applicable)

Provide descriptions of and justifications for the necessity and the appropriateness of any deviations from the valid version of the approved methodological tool to develop the proposed standardized baseline. Also justify why a revision of the valid version of the approved methodological tool is not necessary.

References and any other relevant information

Supporting Documentation:

1. Excel based calculation model consisting of 4 files *(confidential):*
a. Armenia_Calculation of GEF for 2014 Ex-Post
b. Armenia_Calculation of GEF for 2015 Ex-Post
c. Armenia_Calculation of GEF for 2016 Ex-Post
d. Armenia_Calculation of GEF for 2016 Ex-Ante

2. GEF 2016 Armenia (pdf version) *(public)*

Document information

Version	*Date*	*Description*
03.0	1 September 2015	Revision to: • Reflect updated requirements in the version 04.0 of "Procedure: Development, revision, clarification and update of standardized baselines" (CDM-EB63-A28-PROC) ; • Include editorial improvement.
02.0	1 December 2013	The document title has changed from "Proposed standardized baseline form" (F-CDM-PSB) to "Proposed standardized baseline submission form" (CDM-PSB-FORM). Revision to: • Reflect updated requirements in the "Procedure: Development, revision, clarification and update of standardized baselines" • Include editorial improvement
01.0	23 March 2012	Initial publication.

Decision Class: Regulatory
Document Type: Form
Business Function: Methodology
Keywords: standardized baselines