Monitoring report form
(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT	
Title of the project activity	Moldova energy conservation and greenhouse gases emissions reduction
UNFCCC reference number of the project activity	0173
Version number of the monitoring report	01
Completion date of the monitoring report	14/10/2015
Monitoring period number and duration of this monitoring period	Monitoring period : 02 Duration : 01/05/2012 to 30/06/2015 (first and last days included)
Project participant(s)	• Carbon Finance Unit Moldova • Aalborg Portland A/S, Denmark • Danish Ministry of Climate, Energy and Building/Danish Energy Agency, Denmark • DONG Naturgas A/S, Denmark • Maersk Olie og Gas AS, Denmark • Nordjysk Elhandel A/S, Denmark • Kommunalkredit Public Consulting GmbH, Austria • Brussels – Capital Region, Belgium • Kingdom of Belgium - Walloon Region Ministry of the Environment, Belgium • EDP – Energias de Portugal, S.A., The Netherlands • Netherlands' Ministry of Infrastructure and the Environment (IenM), The Netherlands • FUJIFILM Corporation, Japan • Idemitsu Kosan Co., Ltd., Japan • JX Nippon Oil & Energy Corporation, Japan • The Okinawa Electric Power Co., Inc., Japan • Daiwa Securities Co. Ltd. , Japan • Endesa Generacion, S.A., Spain • Gas Natural SDG, S.A, Spain • Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness, Spain • Hidroelectrica del Cantabrico, S.A., Spain

	• Göteborg Energi AB, Sweden • Government of Italy - Ministry for the Environment, Land and Sea, Italy • Government of Luxembourg - Ministry of the Environment, Luxembourg • Ruukki Metals Oy, Finland • Schweizerische Rückversicherungsgesellschafts AG (Swiss RE), Switzerland • Statkraft Carbon Invest AS, Norway • Statoil ASA, Norway • KfW Bankengruppe, Germany • BASF SE, Germany Bilateral and Multilateral Funds: Community Development Carbon Fund (CDCF)Managing company: International Bank for Reconstruction and Development (IBRD) as Trustee of the Community Development Carbon Fund (CDCF)	
Host Party (ies)	Republic of Moldova	
Sectoral scope(s)	Sectoral scope : 1 - Energy industries (renewable - / non-renewable sources) Sectoral scope : 3 - Energy demand	
Selected methodology(ies)	AMS-II.E. Energy efficiency and fuel switching measures for buildings (version 6 dated 30/09/2005) AMS-III.B. Switching fossil fuels (version 6 dated 30/09/2005)	
Selected standardized baseline(s)	Not applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	21,257[1] tCO_2	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012 (tCO_2)	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards (tCO_2)
	1,202	8,969

[1] Refer ER calculation sheet for details

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

This project aims at greenhouse gas (GHG) emission reduction as a result of energy efficiency improvements and fuel switching measures for a number of public buildings (kindergartens, schools, vocational schools, hospitals, polyclinics, etc.) located across Moldova. This project was completely based on the heat supply and efficiency improvements component of the World Bank Moldova Energy-II Project[2], which was implemented in the Republic of Moldova.

The anthropogenic GHG emission reductions in this project were achieved as a result of:

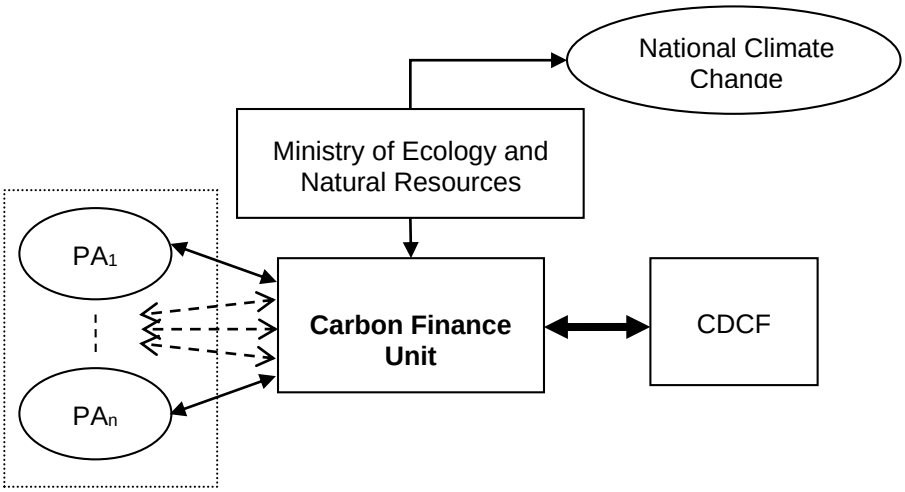
- Fuel switching from coal, electricity and mazut to natural gas
- Implementation of energy conservation measures in buildings (additional insulation of building envelopes and replacement of roofs, windows & doors)

Here, the supply side energy efficiency measures prevail over the demand side ones in terms of energy savings and emissions reduction contribution. Since the building's retrofit and energy conservation measures yield to insignificant Emission Reductions (ERs), the emission reduction effect produced by energy savings in the buildings was neglected. This is conservative.

The public buildings included in this project were previously supplied with heat from physically old, technologically outdated stoves/boilers through an extremely deteriorated heat distribution network having a high level of losses, with the overall average heating system efficiency ranging from 40 - 50%. These old stoves/boilers were replaced with efficient natural gas based modern boilers.

This project bundled 19 energy project activities (public buildings). Each out of 19 projects activities (PAs) is represented by an owner, which is either the central Ministry of Education (in case of schools and orphanages) or Ministry of Health (in case of hospitals), or the municipality/local authorities (in case of public buildings), all referred as PA-owners.

Taking into account, a need for a consolidated Emission Reduction Purchase Agreement (ERPA) due to prohibitive transaction costs (for 19 small PAs) and that there was no capacity in the country in any agency that is sustainable (for ERPA duration of 10 years), the Carbon Finance Unit (CFU) was created under the Ministry of Ecology and Natural Resources[3]. CFU has the status of an independent legal entity and is empowered to enter into ERPA. The CFU signed the subsidiary agreement with all the 19 PAs that stipulates the CFU and PA rights and responsibilities under this project. The principle of project bundling is provided in figure 1.



[2] http://www.worldbank.org/projects/P040558/energy-2-project?lang=en

[3] Currently, Ministry of Environment

Figure 1: Principle of project bundling

Project activities' contribution to sustainable development

The project evidently showed the contribution to sustainable development in the following ways:

It was designed to address the rehabilitation and to upgrade the deteriorated heating systems of the public buildings. As the result of its implementation, the project provided a series of benefits that addressed the social issues.

The main benefits of the project included:

(a) reduced fuel consumption through energy efficiency measures
(b) decreased payment burden for consumed energy resources
(c) increased heating service quality
(d) reduced GHG emissions and other pollutants

Besides, the project increased the living and activity conditions within the considered public buildings such as:

- room heating temperature
- duration of heating period
- heated areas

The project also contributed to the availability and affordability of hot water in buildings like hospitals and polyclinics, schools, orphanages, etc.

The PDD was registered on 29/01/2006. As per the registered PDD, the estimated annual average emission reduction was 6,115 tCO_2e. The relevant dates of the project activity are provided in table 3 of section B.1 of the MR. Detailed description of the installed technology and plant equipment are furnished in section B.1 "Description of implemented registered project activity" of this report.

This is the 2nd monitoring period for the duration of 01/05/2012 and 30/06/2015 (first and last days included). Certified Emission Reductions (CERs) generated during this monitoring period is 10,171 tCO_2e.

A.2. Location of project activity

Host country

The PAs are implemented all over the country. Hence, the project boundary is the geographical boundaries of Republic of Moldova.

The geographical reference of Republic of Moldova is:
- Latitude : 45.4939 - 48.4830 ˚N
- Longitude : 26.5879 - 30.1365 ˚E

Region/State/Province

Rayons (First-tier Administrative Divisions) of Cantemir, Falesti, Floresti, Ialoveni, Leova, Nisporeni, Straseni, Ungheni

City/Town/Community

8 municipalities - Cantemir, Falesti, Floresti, Ialoveni , Leova, Nisporeni, Straseni, Ungheni

Figure 2: The Map of Moldova Republic: districts involved in the project

Table 1. The list of public buildings considered in the project PAs belonging to category II.E. Energy efficiency and fuel switching measures for buildings

PA No.	Beneficiary	Contact person	Complete address	Location of the boiler	District
8	Mayoralty Floreşti	Eleonora Rijcov, Director of I.M. "Retele termice Floresti"	1 Speranţei Str., Floreşti	Cultural Center + City Museum	Floreşti
9	Mayoralty Floreşti	Eleonora Rijcov, Director of I.M. "Retele termice Floresti"	3 Libertăţii Str., Floreşti	Center of Arts	Floresti
10	Mayoralty Străşeni	Cecan Larisa, Mayoralty's Accountant	37 Mihai Eminescu Str., Straseni	Musical School + School of Arts	Straseni
17	District Council Ialoveni	Mihai Cotovan; Chief Doctor	7 Alexandru cel Bun Str., Ialoveni	District Hospital	Ialoveni
26	Mayoralty Ungheni	Marcoci Iurie, Director of Municipal Company "Comgas Plus" SRL	6 Vasile Lupu Str., Ungheni	Medical College + Residential	Ungheni

	Total 5 PAs

Table 2. The list of facilities considered in the project PAs belonging to category III B. Switching fossil fuels

PA No.	Beneficiary	Contact person	Complete address	Location of boiler	District
1	Mayoralty Cantemir	Ecaterina Enciu, Director of Gymnasium	10 Trandafirilor Str., Cantemir	Gymnasium "Mihai Eminescu" (former Romanian School)	Cantemir
			16 Basarabia Str., Cantemir	Kindergarten nr.3	
2	Mayoralty Cantemir	Nadejda Coloman, Director of Gymnasium	2 Mihai Eminescu Str., Cantemir	Gymnasium ”A. Puskin”	Cantemir
			8 Gagarin Str., Cantemir	Kindergarten nr.1	
3	Mayoralty Făleşti	Lungu Aliona, Director of Gymnasium	79 Ştefan cel Mare Str., Făleşti	Lyceum "Ion Creangă" (former Gymnasium No.5)	Falesti
4	Mayoralty Făleşti	Veceaslav Dornea, Deputy Mayor	23 Moldovei Str., Făleşti	Kindergarten nr.5	Falesti
			7 Moldovei Str., Făleşti	Library	
			5 Moldovei Str., Făleşti	Center of Arts	
5	Mayoralty Făleşti	Veceaslav Dornea, Deputy Mayor	2 Bălţului Str., Făleşti	Kindergarten nr.10	Falesti
6	District Council Făleşti	Osman V., Chief Physician	7 Ştefan cel Mare Str., Făleşti	District Hospital + CFD	Falesti
11	Mayoralty Străşeni	Ciobanu Svetlana, Director of Lyceum	187 Mihai Eminescu Str., Straseni	Lyceum "Mihai Eminescu" (former School No. 1)	Straseni
12	Mayoralty Străşeni	Cecan Larisa, Mayoralty's Accountant	1 Mihai Eminescu Str., Straseni	Kindergarten nr.1	Straseni
18	District Hospital Nisporeni	Costru Tudor, Chief Doctor	5 Toma Ciorbă Str., Nisporeni	District Hospital	Nisporeni
19	Mayoralty Leova	Varban Elena, Accountant	54 Ştefan cel Mare Str., Leova	Lyceum "Lev Tolstoi"	Leova
20	Mayoralty Leova	Nicolae Avram, Chief of The Department of Construction and Road	63 Ştefan cel Mare Str., Leova	District Hospital	Leova

24	Mayoralty Ungheni	Marcoci Iurie, Director of Municipal Company "Comgas Plus" SRL	9A Bernardazzi Str., Ungheni	Kindergarten nr. 3+Residential	Ungheni
25	Mayoralty Ungheni	Marcoci Iurie, Director of Municipal Company "Comgas Plus" SRL	15A Boico Str., Ungheni	Kindergarten nr.5+Residential	Ungheni
27	Mayoralty Ungheni	Marcoci Iurie, Director of Municipal Company "Comgas Plus" SRL	161 Ştefan cel Mare Str., Ungheni	Kindergarten nr.2+ Residential	Ungheni
	Total 14 PAs				

PAs 7, 13, 14, 15, 16, 21, 22, 23 were initially included under the project for implementation. But these PAs were not implemented and subsequently removed from project during PRC (09/06/2014).

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Moldova (host country)	Carbon Finance Unit Moldova	No
Denmark	Aalborg Portland A/S	Yes
Denmark	Danish Ministry of Climate, Energy and Building/Danish Energy Agency	Yes
Denmark	DONG Naturgas A/S	Yes
Denmark	Maersk Olie og Gas	Yes
Denmark	AS Nordjysk Elhandel A/S	Yes
Austria	Kommunalkredit Public Consulting GmbH	Yes
Belgium	Brussels – Capital Region	Yes
Belgium	Kingdom of Belgium - Walloon Region Ministry ofthe Environment	Yes
The Netherlands	Netherlands' Ministry of Infrastructure and the Environment (IenM)	Yes
The Netherlands	EDP – Energias de Portugal, S.A.	Yes
Japan	FUJIFILM Corporation	No
Japan	Idemitsu Kosan Co., Ltd.	No

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Moldova (host country)	Carbon Finance Unit Moldova	No
Japan	JX Nippon Oil & Energy Corporation	No
Japan	The Okinawa Electric Power Co., Inc.	No
Japan	Daiwa Securities Co. Ltd.	No
Spain	Endesa Generacion, S.A.	Yes
Spain	Gas Natural SDG, S.A.	Yes
Spain	Hidroelectrica del Cantabrico, S.A.	Yes
Spain	Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness	Yes
Sweden	Göteborg Energi AB	No
Luxembourg	Government of Luxembourg - Ministry of the Environment	Yes
Finland	Ruukki Metals Oy	No
Norway	Statkraft Carbon Invest AS	No
Norway	Statoil ASA	No
Switzerland	Schweizerische Rückversicherungsgesellschafts AG (Swiss RE)	No
Italy	Government of Italy - Ministry for the Environment, Land and Sea	Yes
Germany	KfW Bankengruppe	No
Germany	BASF SE	No

Bilateral and Multilateral Funds: Community Development Carbon Fund (CDCF) Managing company: International Bank for Reconstruction and Development (IBRD) as Trustee of the Community Development Carbon Fund (CDCF)

A.4. Reference of applied methodology and standardized baseline

Type of the project activity:

Type II – Energy efficiency improvement projects
Type III – Other project activities

Selected Methodologies:

- AMS-II.E "Energy efficiency and fuel switching measures for buildings" (Version 6 dated 30/09/2005)[4]

- AMS-III.B "Switching fossil fuels"(Version 6 dated 30/09/2005)[5]

A.5. Crediting period of project activity

Crediting period: 10 years and fixed

Crediting period start date as per registered PDD is 29/01/2006.

The duration of this monitoring period is between 01/05/2012 to 30/06/2015 (first and last days included).

A.6. Contact information of responsible persons/entities

Mrs. Stela Drucioc
Administrator
Carbon Finance Unit
9 Cosmonautilor Str, Office 522
Chisinau
stela.drucioc@cfu.md

The above mentioned responsible person/entity is also a project participant as listed in Appendix 1 of this MR.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

This report is prepared as a single monitoring report for the duration from 01/07/2012 and 30/06/2015 (first and last days included). Major milestones in the project implementation of the PDD are shown below:

[4] http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_7T2D2036BNUABJY0YXJYVAVSCUY7QL/SSC_II.E.pdf?t=MVZ8bjgybHRvfDAhu5jJ4OjYExNzCSNkuyO4

[5] http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_FBPOT7ZSPMU6JDHRQ5MSV9ZR69IZ5V/SSC_III.B.pdf?t=MUZ8bjgybHUwfDBPUqiTnQBfv8aVu_vbzSf8

Table 3. Timeline of the project implementation

Activity	Date
Signing of first subsidiary agreement with PA	04/08/2005
Signing of last subsidiary agreement with PA	13/09/2005
Completion of final works of first project boiler	20/01/2005
Completion of final works of last project boiler	01/12/2006
Start date of 1st monitoring period	29/01/2006
End date of 1st monitoring period	30/04/2012
Start date of 2nd monitoring period	01/05/2012
End date of 2nd monitoring period	30/06/2015

The energy efficiency measures and boiler replacements were carried out for the heating systems of public buildings such as schools, kindergartens, orphanages, community halls, health centres, etc. The new technologies employed by the PAs increased the overall efficiency of the heating systems up to 70-90%, resulting in energy savings and consequent reduction in GHG emissions.

The heating plants were operated only during the winter seasons that is from January to April and October to December, every year. All the other months (May to September), the heating system was shut down and the regular maintenance works were carried out. Other than these shutdown periods, there were no serious issues/continuous shutdown of heating systems during the monitoring period.

The schematic diagram of typical boiler system installed under the project is provided in figure 3. The boilers installed were of different models (with external or internal burner unit), as selected by the beneficiaries, as per their building heat requirements. The heating system included one or two boilers in each PA. The cumulative installed capacity of heating system per PA with natural gas boiler ranged from 60 to 4,000 kW.

In case of the PAs under methodology AMS-II.E, the energy efficiency improvements of local heating systems such as low-efficiency boiler replacements by modern ones, strengthening the insulation of external and internal heat and hot water distribution pipelines, as well as implementation of energy conservation measures in buildings (additional insulation of building envelops and replacement of roofs, windows & doors) were carried out. Since the building's retrofit and energy conservation measures yield to insignificant ERs, the emission reduction effect produced by energy savings in buildings was neglected. This is conservative.

In case of the PAs under methodology AMS-III.B, the fuel switch from coal, electricity and mazut to natural gas was carried out.

The details of fuel switching, boiler replacements and their capacities are provided in table 4 and table 5.

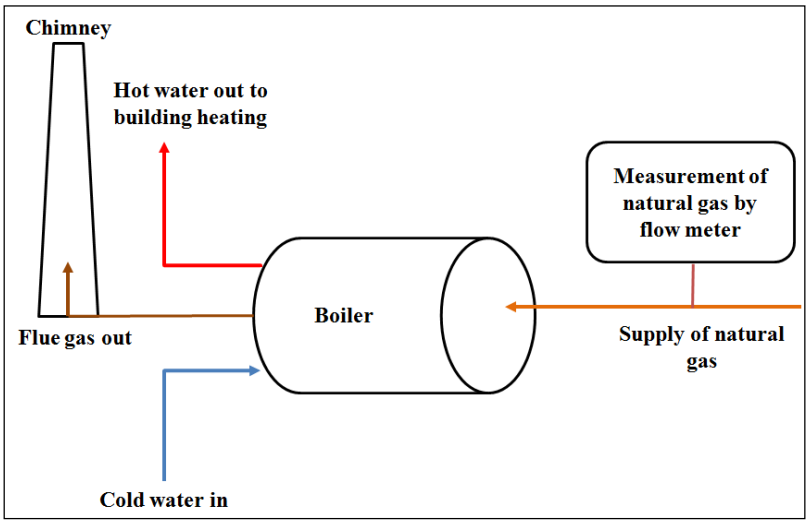


Figure 3: Typical boiler system installation

Table 4: Details of fuel switch and boiler replacements under AMS-II.E

PA No.	Category of the PAs	Fuel Switch		Boiler type	Total boiler capacity, kW
		Baseline	Project		
8	II E	Electricity	Natural gas	Ziosab-125	250
9	II E	Electricity	Natural gas	Ziosab-125	250
10	II E	Electricity	Natural gas	Ziosab-175	350
17	II E	Electricity	Natural gas	Ziosab-350; Ziosab-250;	600
26	II E	Electricity	Natural gas	KCB-1,0 "BK-22"	2,000

Table 5: Details of fuel switch and boiler replacements under AMS-III.B

PA No.	Category of the PAs	Fuel Switch		Boiler type	Total boiler capacity, kW
		Baseline	Project		
1	III B	Coal	Natural gas	Ziosab-350	700
2	III B	Coal	Natural gas	Ziosab-175	350
3	III B	Coal	Natural gas	Ziosab-125	250
4	III B	Coal	Natural gas	Ziosab-175	350
5	III B	Coal	Natural gas	Ziosab-175	350

PA No.	Category of the PAs	Fuel Switch		Boiler type	Total boiler capacity, kW
		Baseline	Project		
6	III B	Coal	Natural gas	Ziosab-750	1,500
11	III B	Coal	Natural gas	Ziosab-350	700
12	III B	Coal	Natural gas	Ziosab -30	60
18	III B	Mazut	Natural gas	Vitoplex 100	1,295
19	III B	Coal	Natural gas	Vitoplex 100	1,150
20	III B	Coal	Natural gas	Vitoplex 100	1,440
24	III B	Mazut	Natural gas	KCB-2,0 "BK-21"-M2	4,000
25	III B	Electricity	Natural gas	KCB-2,0 "BK-21"-M2	4,000
27	III B	Mazut	Natural gas	KCB-1,0 "BK-22"	2,000

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

Not applicable

B.2.2. Corrections

Not applicable

B.2.3. Changes to start date of crediting period

Not applicable

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

Not applicable

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

Not applicable

B.2.6. Changes to project design of registered project activity

There were two post registration changes (PRC) carried out after the initial project registration.

A post registration change was carried out and was accepted by UNFCCC on 16/03/2011[6] (PRC reference no: PRC-0173-001). The main changes made to the registered project during this PRC were as follows:

- Removal of proposed PAs under category AMS-I.C. Thermal energy for the user
- All references for fuel switch from coal to biomass and natural gas to biomass were removed
- In addition to coal and natural gas, mazut was added as a fuel in the baseline
- Short description of PAs under AMS II.E and AMS III.B were added
- Annual emission reduction was also revised based on the above changes

Second PRC was accepted on 09/06/2014[7]. The main changes made to the registered project were as follows:

- Revision of the monitoring plan to check and confirm the boiler heat output $Q_{boiler,PR}$ through measurement of boiler efficiency through one ex-post sampling survey
- Listing of ex-ante parameters
- Revision of PDD from VVM to VVS track

B.2.7. Types of changes specific to afforestation or reforestation project activity

Not applicable

SECTION C. Description of monitoring system

PA-owners in conformity with the signed subsidiary agreements with CFU, installed, operated and maintained the facilities and equipment (data measurement and collection systems) and employed the staff necessary for gathering all such data as required by the monitoring plan.

Procedures for monitoring, measurements and reporting

For most of the PAs activities with natural gas consumption, the monitoring frequency was in line with fuel flow meter readings. Usually, the natural gas meter readings were recorded monthly by the PA operator and the local gas supplier. The reporting documents for this meter were the monthly invoices, which consisted of the metering period, initial and final meter readings and the respective monthly consumptions.

At the beginning of every succeeding reporting year, the annual project emission report was worked out. The annual emission reduction report was printed and signed by the Project-monitor and finally, the Project-manager. The annual report included: the overall project performance, emissions reduction and comparison with baseline estimations, comments concerning monitoring plan indicators, information on monitoring plan main assumptions, calculation methods and changes in the monitoring plan.

The data flow procedure from various PAs to CFU unit is provided in figure 4.

Description of the authority and responsibility of project management

The CFU is responsible for data collection, archiving and reporting. Its specific responsibilities are to:

[6] http://cdm.unfccc.int/Projects/DB/DNV-CUK1134568842.81/history
[7] http://cdm.unfccc.int/PRCContainer/DB/prcp662541773/view

a) Contact the PA entity and collect metered data as required by the monitoring methodology (the data collection was done through e-mail, fax, phone or on site visit)
b) Verify the collected data quality and integrity, including, through regular on-site inspections, and enter the collected data in the emission calculation workbook
c) Check that calculation of emission reductions to be in line with the monitoring methodology requirements and assumptions and keep a separate emissions calculation workbook for each year of the crediting period

The PA-owner is the beneficiary of the SIF II Project. The specific responsibilities of the PA-owner are to:

- Appoint the PA-operator
- Arrange for calibration of the natural gas meter and retain the evidence of calibration
- Keep the bills for fuel consumption and/or invoices for fuel purchase
- Annually provide copies of fuel bills or invoices for fuel purchase to the project-monitor
- Monitor the project performances

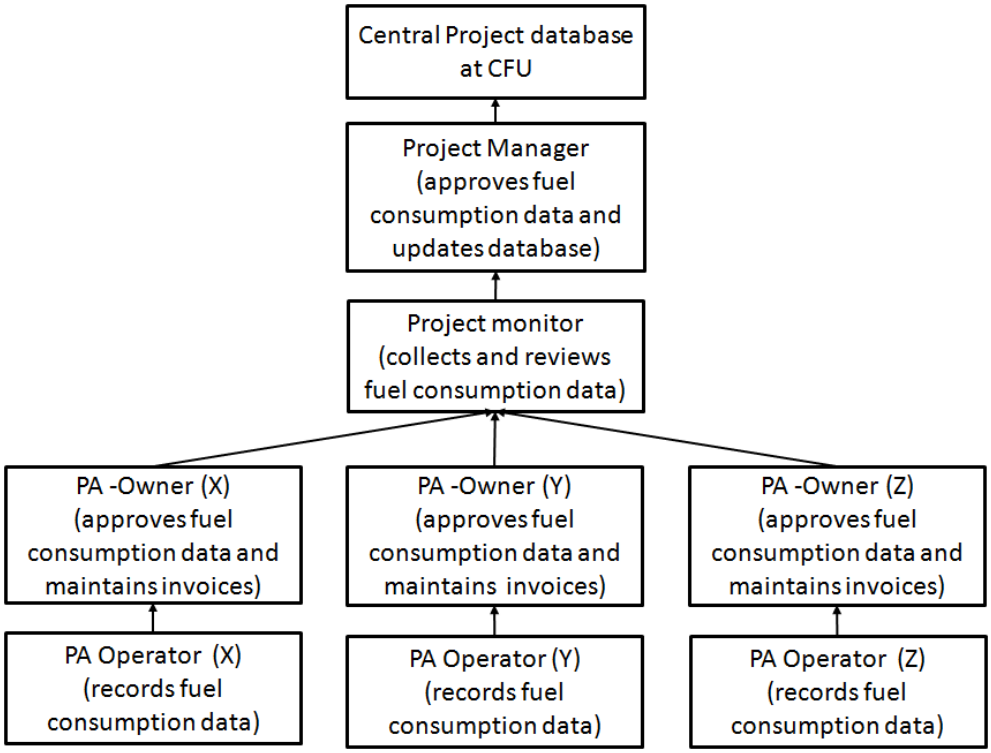


Figure 4: Project data flow diagram

The PA-operator is the person, legally designated by the PA-owner, responsible for PA local heating system operation and maintenance. The specific responsibilities of the PA-operator are to maintain records of the monthly fuel consumption, calibration of meters, etc. and submit the documents and/or invoices to PA-owner.

The Project manager is the head of the CFU. The specific responsibilities of project manager are to:

- Represent the PA-owners for the CDM purposes of this project
- Appoint the project-monitor
- Ensure that the project monitor is duly trained
- Submit monitoring report to the DOE
- Take decisions on the distribution of CERs to the PAs

The Project-monitor is the person, designated by the Carbon Finance Unit, responsible for collecting the data from the PAs, archiving and reporting. The specific responsibilities of the project-monitor are to:

- Contact the PA-owners monthly and collect the metered fuel consumption and other documented data as required by the monitoring methodology (the data collection would be through e-mail, fax, phone or on site visit)
- Verify the collected data quality and integrity and enter the collected data in the emissions calculation workbook
- Check if the calculation of emission reductions are in line with the monitoring methodology requirements and assumptions
- Assure that the data are stored and relevant measures are taken to avoid loss of information
- Inform the PA-owners about their emission reduction performances
- Prepare and submit the annual monitoring report to the Project-manager
- Keep the collected data and elaborated reports make them available for the external audit and verification purposes
- Keep a separate emissions calculation workbook for each year of the crediting period
- Store the saved files with annual emissions workbooks and annual reports on a local computer and CD
- Keep e-mails and faxes concerning the monitored data on printed paper
- Keep good records of all the mentioned files, reports and the original reporting information

Calibration of the monitoring equipment

The fuel flow meter to measure the natural gas consumption is the only meter involved in the project. The volume of natural gas consumption was registered by the fuel flow meter installed in all the PAs. This monitoring equipment was periodically verified and tested according to the Moldovan regulations. After the verification and testing, for each meter, the authorized laboratory submitted a certificate of: (a) acceptance for operation, or (b) refusal for operation. In case of any failure in the meter operation, the meter was repaired and a certificate of reparation and calibration was issued by an authorized entity. If the meter could not be repaired, a new meter was purchased; the receipt and technical passport for that meter was submitted. The frequency of calibration of meters varies from 2 to 5 years based on type of meters installed in the respective PAs[8].

Also, in the Law nr.123-XVIII from 23/12/2009 on natural gases, article 51, line 1, it is stipulated that the gas provider and distributor entity is responsible for meters calibrations. Without the regular calibration of gas meters, gas cannot be delivered.

The details of natural gas meter model, serial number and accuracy for each PA using natural gas as fuel is given in table 6.

Table 6: Details of natural gas meters

PA No	Gas meter model	Gas meter serial number(s)	Accuracy (%)
1	DKZ G25	0019591	1.00
2	DKZ G16	0019650	1.00
3	DKZ G16	0019652	1.00

[8] State register of measurement meters for utilisation in Moldova, dated 04/07/2012

4	DKZ G16	0019653	1.00
5	DKZ G16	0019649	1.00
6	DKZ G65	0020533	1.00
8	DKZ G16	0019654	1.00
9	DKZ G16	0019588/2004	1.00
10	DKZ G16	0019646	1.00
11	DKZ G25	0019658	1.00
12	BK G6T	24087473	1.50
17	DKZ G25	062702	1.00
18	CGR-01 G100	210488	1.00
19	CGR-01 G65	150803	1.00
20	CGR-01 G65	150747	1.00
24	DKZ G100	0015583	1.00
25	DKZ G100	0024318	1.00
26	DKZ G65	0015564	1.00
27	DKZ G65	0015565	1.00

Procedures for possible monitoring data adjustments and uncertainties

The key parameter laid down to the project emission calculation was the metered/documented fuel consumption. In practise, sufficient proof for fuel consumption such as meter readings or invoices was available and there were no data adjustments or uncertainties in ER calculation.

Though PAs carried out the calibration of meters regularly, difficulty was faced in collecting calibration certificate records for the total period from 2012 - 2015. However, it was ensured that one latest calibration certificate was made available for each PA to prove that their meter accuracy was within the limit. For the periods where a calibration certificate was not available, the maximum permissible error values of the instrument were applied to the measured consumption values in calculation of CERs.

Emergency preparedness

All reasonable measures towards emergency preparedness were foreseen under the responsibilities of the project-monitor and the project-manager.

In case of measurement equipment break down, the further natural gas supply can be done through the bypass pipe, with the permission of the gas supplier. The seal on the bypass pipe is removed by the gas supplier in the presence of the PA owner or their staff, and a bilateral act in 2 copies for the each party is also signed. Responsibility for the seals installed by the gas supplier lies with the PA owner. The natural gas volume supplied through the bypass pipeline is determined based on the nominal capacity of the equipment and the registered operational time.

During the period of time when the measurement equipment is dismounted for the periodic metrological verification (calibration) or other technical checking, the volume of the natural gas

consumed is determined using the average daily consumption registered during a similar, previous period of time.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

(Copy this table for each piece of data and parameter)

Data/parameter:	LHV_{PR}
Unit	MJ/Nm^3
Description	Natural gas net calorific value
Source of data	National Statistics Bureau; Energy Balance Annual Report, Form 1-BE, approved by order nr. 123, 24.10.2007,Chisinau, MOLDOVA, http://www.statistica.md/public/files/Formulare_statistice_2008/Industria_si_energia_electrica/1_BE_anual.pdf
Value(s) applied)	33.5
Choice of data or measurement methods and procedures	Official source
Purpose of data	Calculation of project emissions
Additional comments	Not applicable

Data/parameter:	EF_{PR}
Unit	tCO_2/TJ
Description	Natural gas emission factor
Source of data	Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied)	56.1
Choice of data or measurement methods and procedures	IPCC
Purpose of data	Calculation of project emissions
Additional comments	Not applicable

Data/parameter:	$EF_{BSL, coal}$
Unit	tCO_2/TJ
Description	Coal emission factor
Source of data	Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied)	94.6
Choice of data or measurement methods and procedures	The coal emission factor is taken from IPCC default values since analysis or data are not available from the coal suppliers.
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$EF_{BSL, mazut}$
Unit	tCO_2/TJ
Description	Mazut emission factor
Source of data	Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied)	77.3
Choice of data or measurement methods and procedures	IPCC
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$\eta_{boiler,BSL,coal}$
Unit	%
Description	Efficiency of existing coal boiler

Source of data	Expert judgement (Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova)
Value(s) applied)	60
Choice of data or measurement methods and procedures	Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$\eta_{boiler,BSL,mazut}$
Unit	%
Description	Efficiency of existing mazut boiler
Source of data	Expert judgement (Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova)
Value(s) applied)	76
Choice of data or measurement methods and procedures	Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$\eta_{net,BSL}$
Unit	%
Description	Efficiency of existing external heat network
Source of data	Expert judgement (Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova)
Value(s) applied)	90
Choice of data or measurement methods and procedures	Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova

Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$\eta_{stove,BSL,coal}$
Unit	%
Description	Efficiency of existing coal stove
Source of data	Expert judgement (Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova)
Value(s) applied)	40
Choice of data or measurement methods and procedures	Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$\eta_{PP,BSL}$
Unit	%
Description	Weighted average efficiency of the local power plants
Source of data	State Enterprise Moldelectrica - the National Electricity Transmission Operator
Value(s) applied)	33
Choice of data or measurement methods and procedures	Official source
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$\eta_{net,BSL}$
Unit	%
Description	Overall efficiency of the local electrical distribution and transmission networks
Source of data	National Agency for Energy Regulation and UNDP Moldova
Value(s) applied)	80
Choice of data or measurement methods and procedures	80% = 100% - 15.5% - 4.5% The normative level of electricity losses in Moldova represents 4.5% for the transportation network (Technology needs and Development Priorities Report, UNDP Moldova, Chisinau 2002. Table 1.9, page. 37) and 15.5% for distribution network, according to National Agency for Energy Regulation (www.anre.md, Methodologies)
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	$\eta_{net,PR}$
Unit	%
Description	Efficiency of project external heat network
Source of data	Expert judgement (Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova)
Value(s) applied)	98
Choice of data or measurement methods and procedures	Value as determined by Prof. Dr. Valentin Arion, Technical University of Moldova
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter:	p_f
Unit	-

Description	Proportion of annual heat embedded in the f-type of fuel burnt to meet the heat demand of the PA
Source of data	PA records
Value(s) applied)	

PA	p_{coal}	p_{mazut}	$p_{natural-gas}$	p_{wood}
PA1	0.54	0	0	0.46
PA2	0.76	0	0	0.24
PA3	0.96	0	0	0.04
PA4	0.69	0	0	0.31
PA5	0.72	0	0	0.28
PA6	1	0	0	0
PA8	0	0	1	0
PA9	0	0	1	0
PA10	0	0	1	0
PA11	0.32	0	0.66	0.02
PA12	0.93	0	0	0.07
PA17	0	0	1	0
PA18	0	1	0	0
PA19	1	0	0	0
PA20	1	0	0	0
PA24	0	1	0	0
PA25	0	0	1	0
PA26	0	0	1	0
PA27	0	1	0	0

Choice of data or measurement methods and procedures	Proportions are based on three years historical data, or all available historical data where less than three years were recorded, of fuel consumption at each PA. For PAs where the baseline was electric heating, natural gas is considered as the fuel type, as explained in section B.6.1 of PDD.
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter)

Data/parameter:	$V_{fuel,PR}$
Unit	Nm^3
Description	Natural gas consumption
Measured/calculated/default	Recorded from fuel flow meters

Source of data	Measured (fuel consumption records and invoices)
Value(s) of monitored parameter	As shown in the ER calculation sheet
Monitoring equipment	Fuel flow meter
Measuring/reading/recording frequency:	Monthly
Calculation method (if applicable):	In practise, sufficient proof for fuel consumption such as meter readings or invoices was available. Though PAs carry out the calibration of meters regularly, difficulty was faced in collecting calibration certificate records for the total period from 2014 - 2015. However, it was ensured that one latest calibration certificate was made available for each PA to prove that their meter accuracy is within the limit. For the periods where a calibration certificate was not available, the maximum permissible error values of the instrument were applied to the measured values in calculation of CERs.
QA/QC procedures:	Fuel meters were calibrated in line with the national regulation. The meter readings were checked against fuel purchasing invoices, wherever possible
Purpose of data:	Calculation of project emissions
Additional comments:	Not applicable

Data/parameter:	$Q_{boiler,PR}$
Unit	MWh
Description	Boiler heat output
Measured/calculated/default	Calculated
Source of data	Calculation sheet
Value(s) of monitored parameter	As shown in the ER calculation sheet
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Monthly
Calculation method (if applicable):	Calculated from $V_{fuel,PR}$, LHV_{PR} and $\eta_{boiler,PR}$ as follows: $Q_{boiler,PR} = (V_{fuel,PR} \times LHV_{PR} \times \eta_{boiler,PR}) / 1000$
QA/QC procedures:	Not applicable
Purpose of data:	Calculation of baseline emissions
Additional comments:	Not applicable

Data/parameter:	$\eta_{boiler,PR}$
Unit	%
Description	Boiler efficiency
Measured/calculated/default	Measured
Source of data	Monitoring sample survey results
Value(s) of monitored parameter	90
Monitoring equipment	Flue gas analyzer
Measuring/reading/recording frequency:	Once ex-post

Calculation method (if applicable):	One ex-post sampling campaign of efficiency measurements was done to define the boiler efficiency. The heat losses was deducted from the boiler campaign results, and therefore, gained a mean value of 91.32%, for which the precision at the 90% confidence level is 0.96%, less than 10%. Hence it is considered reasonable and conservative to apply the efficiency value at the lower limit of the 90% confidence interval of the mean value determined by sampling, 90.41%, which is 90% when applied as a rounded number.
QA/QC procedures:	Results must conform to a 90 / 10 accuracy / precision standard
Purpose of data:	Calculation of baseline emissions
Additional comments:	Not applicable

D.3. Implementation of sampling plan

Procedures for one-time ex-post measurement campaign of boiler efficiency [Sampling Plan]

The project boiler efficiency was measured and fixed, ex-post based on one measurement campaign in a sample of project boilers. The measurement campaign took place once ex-post during April 2012 and November 2012 – January 2013.

Objectives and Reliability

The objective of the sampling effort was to calculate the average project boiler efficiency for boilers of each fuel type used by the project, parameter $\eta_{boiler,PR}$. In the present project case, the relevant fuel type is natural gas. The measurement campaign took place once ex-post and was finished within the space of two heating seasons. The boiler efficiency sampling survey aimed to meet the reliability requirements of 90/10 confidence/precision.

Target population

The target population was the project boilers, grouped by the fuel type. Each group of project boilers utilizing the same fuel represented a target population. In this project, the total number of natural gas boilers involved in this project activity was 38.

Sampling method

Simple random sampling method was used to identify the sample boilers. The sampling tool referred was “Best practice examples focusing on sample size and reliability calculations” version 01, EB 67[9].

Sample size

The sample size was calculated to meet the 90% confidence level with 10% error margin. The determination of the sample size (n) was based on the following formula:

$$n \geq \frac{1.645^2 \; x \; N \; x \; V}{(\mathrm{N}-1) \; x \; 0.1^2 + \; 1.645^2 V}$$

Where,

n = Sample size

V = Variance

[9] http://cdm.unfccc.int/filestorage/N/G/P/NGPMF4O672J3CBDVAYRTS8IXQZ5WKL/eb67_repan06.pdf?t=SWR8bjgycjV1fDBdyTlT5kbjQVxyMtVwhKN_

N = Target population (38)

1.645 = Represents the 90% confidence required

0.1 = Represents the 10% precision

Variance is given by

V = $(SD/mean)^2$

Where,

mean = Expected mean value of boiler efficiency (92%)

SD = Expected standard deviation of boiler efficiency (10%)

Substituting values in the equation,

V = $(0.1/0.92)^2 = 0.0118$

$$n \geq \frac{1.645^2 \, x 38 \, x \, 0.0118}{(38-1) \, x \, 0.1^2 + \, 1.645^2 \, x \, 0.0118}$$

n = 3.02

According to the Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (Version 03.0), "If the sample size calculation returns a value of less than 30 samples, a minimum sample size of 30 must be chosen." Hence a sample size of at least 30 was selected.

Field measurements

Boiler efficiency was measured using a flue gas composition test at full load as per the local standard. As required by the local regulation, the testing was conducted using a measurement device (flue gas analyzer) and method certified and approved by the relevant national authority.

Quality Assurance/Quality Control

The measurements were undertaken using the duly calibrated and certified flue gas analyzer(s) by qualified technical personnel. The measurements of boiler efficiency were done according to a methodology recommended and approved by the supplier of the equipment following relevant national standards. Identification of outliers followed the three-sigma rule. Identified outliers were excluded from the calculation of the mean boiler efficiency.

Analysis

The collected measurements were used to calculate an average (mean) boiler efficiency to check the *ex-ante* value to be applied in the emission reduction calculations. The average was calculated at full load and/or at other representative load regimes.

Implementation

The sampling plan was implemented after registration of the project activity and after the project activity boilers have begun operation. Local technical experts were engaged to undertake the boiler efficiency measurements.

Assumptions and justifications

There were two important assumptions inherent in this sampling approach.

1. The efficiency of the boilers selected for sampling was similar to that of the population of boilers.
2. The efficiency measured in a single campaign provided a reasonable and conservative result for the efficiency during the whole crediting period.

Assumption 1 was justified because the boiler population was quite homogenous. The boilers were all installed during more or less the start of the project activity and hence, were of almost similar age. They were divided into two groups- namely, natural gas and coal and the efficiency was determined separately for each group/fuel type. They are all of similar sizes, possessing installed capacities less than or equal to 2,000 kW with an average of 568 kW.

With respect to assumption 2, the sampling campaign is carried out in year 7 (2012) of the 10 year crediting period, when the boilers had undergone years of efficiency loss due to aging. Hence the efficiency measured by the campaign was lower than what would have been measured during the first 6 years of the crediting period, providing an overall conservative result.

In case of the natural gas boilers, the upper limit of boiler efficiency calculated was 92.16% and the lower limit was 90.41%. The lower limit of 90.41 % is selected and rounded down to 90% for CER calculations. The precision achieved was 0.42%, which is higher than the 10% as required by CDM.

The details of data collected and samples analysed are provided in the sampling survey data excel sheet.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

The procedure for the overall emission calculation during the project and the baseline activity is shown in figure 5.

The annual emissions for each PA included in this project, can be determined by applying the formula:

$$Em_{BSL} = Q_{fuel,BSL} \times EF_{BSL}$$

Where,

Em_{BSL} = annual baseline emissions, in tCO_{2e}

$Q_{fuel,BSL}$ = fuel embedded heat of the fuel used in baseline scenario

EF_{BSL} = emission factor corresponding to the fuel burned in baseline scenario, in tCO_{2e}/TJ

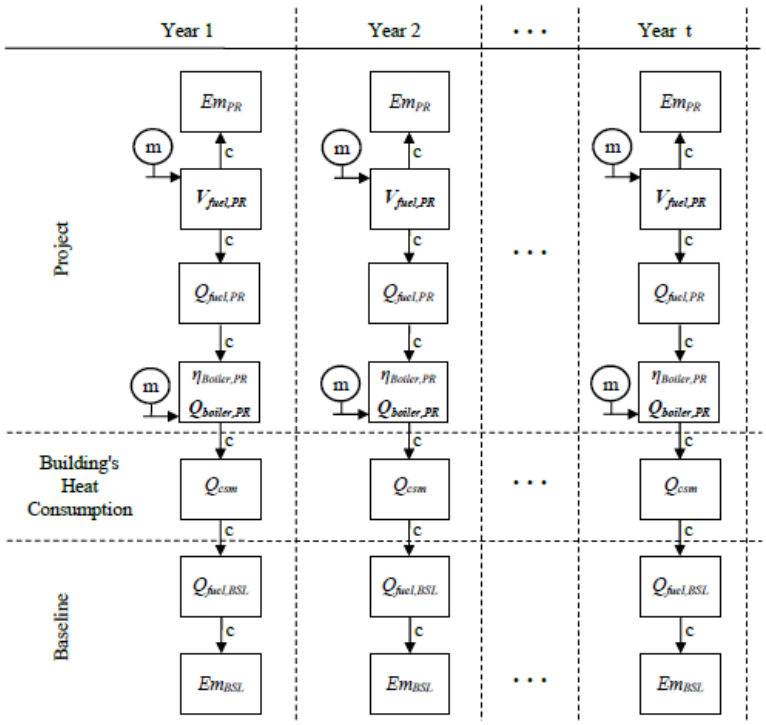


Figure 5: Procedure of calculation of project and baseline emissions

For PA 1, the annual emissions is given as,

Em_{BSL}	=	$Q_{fuel,BSL}$	x	EF_{BSL}
(tCO_{2e})		(TJ)		(tCO_{2e} /TJ)
	=	23.47	x	51.08
	=	1198.87	tCO_{2e}	

$Q_{fuel,BSL} = Q_{csm} / \eta_{boiler,BSL} \times \eta_{net,BSL}$

Where,

Q_{csm}	=	building heat consumption, in TJ
$\eta_{boiler,BSL}$	=	efficiency of existing boiler (%)
$\eta_{net,BSL}$	=	efficiency of existing external network, including the building's energy losses, caused by its deterioration

For PA 1, the fuel embedded heat of the fuel used in baseline scenario is given by,

$Q_{fuel,BSL}$	=	Q_{csm}	/	[$\eta_{boiler,BSL}$	x	$\eta_{net,BSL}$]
(TJ)		(TJ)		(%)		(%)
	=	9.39	/	[0.4	x	1]
	=	23.47	TJ			

$Q_{csm} = V_{fuel,PR} \times LHV_{PR} \times \eta_{boiler,PR} \times \eta_{net,PR} / 1000$

Where,

$V_{fuel,PR}$ = annual fuel volume burned at a given project activity site, in 1000 Nm^3

LHV_{PR} = low heat value of the fuel burned at a given project activity site, in MJ per Nm^3

$\eta_{boiler,PR}$ = efficiency of project boiler (%)

$\eta_{net,PR}$ = efficiency of project external network, including the building's energy losses, caused by its deterioration (%)

For PA 1, the building heat consumption is given by,

Q_{csm} (TJ)	=	$V_{fuel,PR}$ (1000 Nm^3)	x	LHV_{PR} (MJ per 1000Nm^3)	x	$\eta_{boiler,PR}$ (%)	x	$\eta_{net,PR}$ (%)	/ 1000
	=	317.71	x	33.5	x	0.9	x	.98	/ 1000
	=	9.39	TJ						

Similarly, the calculated baseline emission reductions from all the 19 project activities as per the above equation are provided in the ER calculation sheet. The total baseline emissions calculated is:

Em_{BSL} = 17,003 tCO_{2e}

E.2. Calculation of project emissions or actual net GHG removals by sinks

Since only one type of fuel at each heating source is used, the annual project CO_2 emissions for each considered PA, at the monitoring stage, is easily determined by applying the following formula:

$Em_{PR} = V_{fuel,PR} \times LHV_{PR} \times EF_{PR} / 1000$

Where,

Em_{PR} = annual project emissions, in tCO_{2e}

$V_{fuel,PR}$ = annual fuel volume burned at a given project activity site, in 1000 Nm^3

LHV_{PR} = low heat value of the fuel burned at a given project activity site, in MJ per Nm^3

EF_{PR} = emission factor corresponding to the fuel burned in project scenario, in tCO_{2e}/TJ

For PA 1, the annual project emissions is given by,

Em_{PR} (tCO_{2e})	=	$V_{fuel,PR}$ (1000 Nm^3)	x	LHV_{PR} (MJ per 1000 Nm^3)	x	EF_{PR} (tCO_{2e}/TJ)	/	1000
	=	317.71	x	33.5	x	56.1	/	1000
	=	597.09	tCO_{2e}					

Similarly, the calculated project emission reductions from all the 19 project activities as per the above equation are provided in the ER calculation sheet. The total project emissions calculated is:

$Em_{PR,}$ = 6,832 tCO_{2e}

E.3. Calculation of leakage

There are no leakage effects foreseen under this project.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks ($t CO_2e$)	Project emissions or actual net GHG removals by sinks ($t CO_2e$)	Leakage ($t CO_2e$)	GHG emission reductions or net GHG removals by sinks ($t CO_2e$) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	17,003	6,832	0	1,202	8,969	10,171

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks ($t CO_2e$)	21,257	10,171

E.6. Remarks on difference from estimated value in registered PDD

The CER generated during the monitoring period was 52.15 % smaller than the estimated value.

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Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for completing the CDM-MR-FORM
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First name	Marisa
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Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
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