

ANNUAL MONITORING REPORT
of JI PROJECT

“COGENERATION AND UTILIZATION OF WASTE HEAT
AT UMAN GREENHOUSE COMBIMATE”

for the period from 1st of May, 2011 until 30th of November, 2012

Version 2.1
17th of December 2012

CONTENT

- A. General information on the joint implementation project
- B. Key monitoring activities
- C. Quality assurance and quality control measures
- D. Calculation of GHGs emission reductions

“Cogeneration and Utilization of Waste Heat at Uman Greenhouse Combinate”

SECTION A**A.1 Title of the JI project**

Cogeneration and Utilization of Waste Heat at Uman Greenhouse Combinate

A.2 Registration number of the JI project

UA 1000260

A.3 Brief description of the JI project

The project is aimed at reducing greenhouse gases emissions from natural gas combustion and grid electricity consumption at Uman Greenhouse Combinate (UGC), located in Cherkasy oblast, Ukraine.

The JI project activity involves installation of

- three Caterpillar G3520C cogeneration units in Uman to produce heat, electricity and CO₂ for the plants in the greenhouses;
- two heat utilizers TUV-16 to utilize the waste heat at the Talne Gas Compressor Station (GCS) “Talne”, a part of Ukrtransgas Affiliated Company Naftogaz of Ukraine, which is located 1.5 km away from UGC’s greenhouses in Talne.

The anthropogenic emissions of GHGs are reduced by the project through offsetting the use of state grid electricity and displacing the heat produced by gas-fired water boilers.

Before project implementation heat energy was generated by water boilers with natural gas combustion to satisfy UGC’s demand in heat. Electricity demand has been covered by purchasing electricity from the national grid as there were no electricity generating capacities on site.

Substituting the carbon-intensive national grid electricity produced by traditional power plants with electricity locally generated by gas-fired cogeneration units leads to GHGs emission reductions and avoidance of electricity transportation losses during the delivery to the Enterprise. Generated heat is directed for heating the greenhouses of the company, which are offset the heat previously produced by natural gas-fired water boilers.

Approval of the project by Parties involved

National Environmental Investment Agency of Ukraine has issued Letter of Approval #463/23/7 from 2nd of March, 2011. Upon consideration of the project documents and the relevant expert opinions, it was determined that the JI Project complies with the requirements of Article 6 of the Kyoto Protocol to the UN Framework Convention on Climate Change and, therefore, is to be approved as a joint implementation project.

The Federal Republic of Germany as investor country granted its approval of the project activity “Cogeneration and Utilization of Waste Heat at Uman Greenhouse Combinate” within the framework of Joint Implementation. The approval notice concerning the project has been issued by Federal Environment Agency, German Emissions Trading Authority, on 7th of April, 2011.

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A.4 Status of project implementation

Operation phase began in November 2009, when three Caterpillar G3520C cogeneration units in Uman were put into operation. In December 2009 one heat-utilizer TUV-16 started to operate, the start of operation of the second TUV-16 has been postponed to 2013 as installation of the second heat-utilizer is technically and economically not feasible at the moment because of the insufficient amount of natural gas distributed through the GCS.

A.5 Methodology applied to the project activity (incl. version number)**A.5.1. Baseline methodology**

In line with Guidelines on criteria for baseline setting and monitoring (Version 2, adopted at JISC 18 meeting in October, 2009) a JI specific approach with combination of approved CDM methodologies was used for the proposed project baseline and monitoring setting.

Justification of the baseline chosen was performed using the alternatives to the project activity proposed by the following methodologies: Approved baseline methodology AM0014 “Natural gas-based package cogeneration” (Version 04) (for site in Uman) and Approved consolidated baseline and monitoring methodology ACM0012 “Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects” (Version 03.2) (for site in Talne).

Basic assumptions of the baseline methodology in the context of project activity were the following:

- Heat generation by the cogeneration units Caterpillar G3520C and heat-utilizers TUV-16 within the project activity refers to heat generation by natural-gas fired boilers in the baseline.
- Electricity generation by the cogeneration units in the project scenario will substitute electricity generation by the power plants of national grid in the baseline.
- Heat energy and electricity demand of the Enterprise in the baseline and project scenarios is equal.

Baseline emissions are proportional to the amount of baseline fuel consumption that is offset by heat and electricity supplied by the natural gas fired cogeneration system. Due to the similar nature of the effect resulting from the employment of heat-utilization technology, namely the substitution of the heat energy, which in the absence of the project activity would have to be produced by natural gas-fired water boilers, the similar approach for baseline emissions calculation as in the Approved baseline methodology AM0014 “Natural gas-based package cogeneration” (Version 04) for this technology was used.

A.5.2. Monitoring methodology:

For monitoring of GHGs emissions a JI specific approach with elements of the approved baseline and monitoring methodology AM0014 “Natural gas-based package cogeneration” (Version 04) has been used. Monitoring plan was established in accordance with Host Party regulations, namely in accordance with Decree of Cabinet of Ministers of Ukraine #206 dated 22.02.2006 ‘On Approval of

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the Procedure of Drafting, Review, Approval and Implementation of Projects Aimed at Reduction of Anthropogenic Emissions of Greenhouse Gases’ and “Requirements for the Joint Implementation Projects preparation” approved by National Environmental Investment Agency of Ukraine (Order #33 from 25th of June, 2008).

Monitoring plan has also been established in accordance with Appendix B of the JI guidelines and taking into account Guidance on criteria for baseline setting and monitoring (Version 02) developed by JISC. The formulae applied correspond to those proposed by the approved baseline and monitoring methodology AM0014 “Natural gas-based package cogeneration” (Version 04).

Monitoring methodology AM0014 was used for the monitoring of the following sources of emissions:

- CO₂ emissions from the combustion of natural gas for heat generation in the baseline and heat and electricity generation in the project;
- CH₄ emissions from natural gas production, processing and distribution leaks.

JI project specific approach was used to estimate baseline CO₂ emissions from electricity supply to electricity grid that is offset by electricity supplied from cogeneration system. To estimate above mentioned CO₂ emissions cogeneration electricity supply to the national grid was monitored and multiplied by relevant emission factor for electricity from public supply.

Monitoring of CH₄ and N₂O emissions from natural gas combustion was excluded as they do not exceed 1% of annual average anthropogenic emissions by sources of GHGs, and therefore were considered negligible.

A.6 Deviations and/or revisions of the Monitoring Plan

No deviations and/or revisions of the Monitoring Plan since last verification have been made.

A.7 Changes since last verification
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No changes since last verification.

A.8 Person(s)/entities responsible for the preparation and submission of the monitoring report

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SECTION B**B.1 Monitoring period**

Monitoring start date: 1/05/2011

Monitoring end date: 30/11/2012

B.2 Brief description of the monitoring plan applied**B.2.1 Brief description of the approach chosen**

For monitoring of GHGs emissions a JI specific approach with elements of the approved baseline and monitoring methodology AM0014 “Natural gas-based package cogeneration” (Version 04) has been used. Monitoring plan has also been established in accordance with Appendix B of the JI guidelines and taking into account Guidance on criteria for baseline setting and monitoring developed by JISC. The formulae applied correspond to those proposed by the approved baseline and monitoring methodology AM0014 “Natural gas-based package cogeneration” (Version 04).

The approved baseline and monitoring methodology AM0014 was not used in full as it implies no excess electricity to be supplied to the power grid. Since electricity supply to the national grid is provided within project boundaries, baseline CO₂ emissions from electricity supply to electricity grid, that are offset by electricity supplied from cogeneration system, were taken into account. To estimate above mentioned CO₂ emissions, cogeneration electricity supply to the national grid was monitored and multiplied by relevant emission factor for electricity from public supply.

B.2.2 Data and parameters not monitored

Table B.2.2-1.

Data/Parameter	Data Unit	Description	Value of data/parameter applied	Source
e_b		Industrial boiler efficiency (fraction, lower heating basis)	0.95	Technical specifications of water boilers, average efficiency
GWP_{CH_4}	tCO ₂ /tCH ₄	Global warming potential of CH ₄	21	1995 IPCC Second Assessment Report, WG1, page 22, Table 4, the value for a period of 100 years
EF_{NG}	t CO ₂ /GJ	CO ₂ emission factor for natural gas combustion	0.0561	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook, Module 1: Energy, Table 1-2 Carbon emission factors (CEF) converted to CO ₂

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				emissions by multiplying on 44/12.
MLR	kg CH ₄ /GJ natural gas energy consumption	Methane Leakage Rate in natural gas production, processing, transport and distribution	0.558	1996 IPCC Guidelines for National Greenhouse Gas: Reference Manual, Chapter 1, Table 1-61 referring to Rabchuk et al (1991).

B.2.3 Data and parameters monitored

Data collected in order to estimate baseline emissions is presented in the table below.

Table B.2.3-1.1.

Data/Parameter	Data Unit	Description	Value for the period of 1.05.2011-31.12.2011	Value for the period of 1.01.2012-30.11.2012
CHO	Gkal	Cogeneration heat supplied to industrial plant	14 065	25 279
HEHO	Gkal	Heat exchangers heat supplied to industrial plant	13 534	17 537
CEP	MWh	Cogeneration electricity generation	14 525.251	26 898.618
CEO_{EG}	MWh	Cogeneration electricity supplied to electricity grid	10 431.497	25 211.024

Table B.2.3-1.2.

Data/Parameter	Data Unit	Description	Value	Source
EF_{red_elec_grid,2011}	kg CO _{2e} /MWh	Emission factor for electricity of Ukrainian grid for projects reducing electricity consumption from the grid for 2011	1227	Order #75 from 12 th of May, 2011 of National Environmental Investment Agency of Ukraine
EF_{red_elec_grid,2012}	kg CO _{2e} /MWh	Emission factor for electricity of Ukrainian grid for projects reducing electricity consumption from the grid for 2012	1227	Assumed equal to the value for 2011. Order #75 from 12 th of May, 2011 of National Environmental Investment Agency of Ukraine
EF_{prod_elec_grid,2011}	kg CO _{2e} /MWh	Emission factor for electricity of Ukrainian grid for projects producing electricity to the grid for 2011	1063	Order #75 from 12 th of May, 2011 of National Environmental Investment Agency of Ukraine
EF_{prod_elec_grid,2012}	kg CO _{2e} /MWh	Emission factor for electricity of Ukrainian grid for projects	1063	Assumed equal to the value for 2011. Order #75 from 12 th of May, 2011 of

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		producing electricity to the grid for 2012		National Investment Agency of Ukraine	Environmental Agency of Ukraine
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Data collected in order to estimate leakages is presented in the table below.

Table B.2.3-2.

Data/Parameter	Data Unit	Description	Value for the period of 1.05.2011-31.12.2011	Value for the period of 1.01.2012-30.11.2012
V_{NG}	m ³	Volume of natural gas consumed by cogeneration units (under standard conditions)	3 957 749	7 452 512
NCV_{NG}	GJ/m ³	Net calorific value for natural gas	0.03379	0.03388

Data collected in order to estimate project emissions is presented in the table below.

Table B.2.3-3.

Data/Parameter	Data Unit	Description	Value for the period of 1.05.2011-31.12.2011	Value for the period of 1.01.2012-30.11.2012
V_{NG}	m ³	Volume of natural gas consumed by cogeneration units (under standard conditions)	3 957 749	7 452 512
NCV_{NG}	GJ/m ³	Net calorific value for natural gas	0.03379	0.03388

B.3 Collecting and archiving of the monitored data

In order to ensure accurate collecting and archiving of the monitoring data the special Monitoring Procedure was introduced at the Enterprise. According to the Procedure, all the necessary data is collected by the UGC Department for Technical Modernization and will be kept for at least two years after the last transfer of ERUs for the project. Deputy Director for Technical Modernization of the UGC is responsible for the performance of monitoring data required, LLC ‘KT-Energy’ is responsible for the calculations of emission reductions based on monitoring data that is provided by the Enterprise.

Collecting and archiving of data on natural gas consumption

To measure natural gas consumption by cogeneration units gas metering equipment has been installed. Turbine gas meter Actaris TZ 100/G400 serial-№ 2782301006/C together with a corrector B25 serial-№8158 measures total natural gas consumption by all three cogeneration units. The corrector B25 brings the volume of natural gas consumption to standard conditions ($T_s=20^{\circ}\text{C}$, $P_s=101.325\text{ kPa}$). Installed corrector is capable to save daily and monthly data during two years.

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The corrector is connected with a computer of cogeneration units’ operators and automatically saves daily and monthly data on a hard disc.

Thus, input data on natural gas consumption are archived and saved in the initial memory of the corrector (during two years) and on the hard disc of the computer of cogeneration units’ operators (during at least two years of last transfer of ERUs for the project). In this way double archiving of input data is ensured.

No later than 3rd of every month boiler house manager is responsible for performing a report on total natural gas consumption during a previous month to the Deputy Director for Technical Modernization.

Cross-Checking Method for measuring and collecting of natural gas consumption: To ensure accurate measuring of natural gas consumption in cases of any malfunction of turbine gas meter Actaris TZ 100/G400 serial-№ 2782301006/C and corrector B25 serial-№8158, three additional gas meters Actaris FLUXI/TZ 80 serial-№ 2949107001/C, Actaris FLUXI/TZ 80 serial-№ 2949107002/C, Actaris FLUXI/TZ 80 serial-№ 1174907003/B for measuring of natural gas consumption by every cogeneration unit have been installed. Thus, in cases of any disruption of main metering equipment additional natural gas metering equipment would be used to measure natural gas consumption by cogeneration unit.

Collecting and archiving of data on NCV of natural gas

Data on NCV of natural gas is provided by the supplier, Gaysynske line production RPD (Regional Pipeline Division) of “Cherkasytransgas”, in the form of monthly certificates on physicochemical parameters of natural gas. The boiler-house manager is responsible for providing of the certificates to the Deputy Director for Technical Modernization along with average monthly value on NCV of natural gas as to the approved form of monthly reports according to the Monitoring Procedure.

Cross-Checking Method for estimating NCV of natural gas: In cases, when certificates on physicochemical parameters of natural gas cannot be provided by supplier, the value of $NCV_{NG}=34$ GJ/1000 m³ as per DBN V.2.5-20-2001 “Gas supply” would be used.

Collecting and archiving of data on heat energy generation by cogeneration units

To measure heat energy generation by cogeneration units heat metering equipment has been installed. Heat energy meter SPT961.1 serial-№14693 measures total heat generation by all three cogeneration units. Installed meter is capable to save daily data during one year and monthly data during two years. Every month daily data on total heat energy generation by cogeneration units is duplicated and archived in printed version.

No later than the third of every month boiler house manager is responsible for performing a report on total heat energy generation during a previous month to the Deputy Director for Technical Modernization.

Cross-Checking Method for estimating heat energy generation: In cases of any disruption of metering equipment, heat energy generation by cogeneration units would be estimated on the basis

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of natural gas consumption and technical characteristics of cogeneration units under Description of Gas Generator Set Caterpillar G3520C.

Collecting and archiving of data on heat energy consumption from heat-exchange boiler

To measure heat energy generation by heat-exchange boiler heat metering equipment has been installed. Heat energy meter SVTU10M(M2) serial-№16298 measures total heat generation by heat-exchange boiler TUV-16. Installed heat meter is capable to save daily and monthly data during two years. Besides, daily data on heat energy consumption is daily recorded in the register “Heat energy consumption from heat-exchange boiler”. Thus, double archiving and collecting of data is ensured.

No later than 3rd of every month heat engineer of Talne Department is responsible for performing a report on heat energy consumption from heat-exchange boiler TUV-16 during a previous month to the Deputy Director for Technical Modernization.

Cross-Checking Method for estimating heat energy consumption from heat-exchange boiler: At Talne Department special electronic program is installed to measure input and output temperatures of hot water, which is supplied from heat-exchange boiler. In cases of any disruption of heat energy metering equipment, the quantity of heat energy supplied can be estimated by the formula:

$$Q = (t_1 - t_2) \cdot c \cdot \rho \cdot V \cdot T \cdot 10^{-6},$$

where

- Q – amount of consumed heat energy, GJ,
- t_1 – temperature of input hot water, K,
- t_2 – temperature of output hot water, K,
- T – period of estimation, hours,
- V – heat pump capacity, 400 m³/hour,
- ρ – water density, 1000 kg/m³,
- c – specific heat capacity of water, 4,18 kJ/kg·K.

Collecting and archiving of data on electricity export to the grid

To measure electricity export to the grid by cogeneration units power metering equipment has been installed. Electricity meters SL 7000 Smart #53118733, SL 7000 Smart #53118674, SL 7000 Smart #53118665, SL 7000 Smart #53118694 have been installed to replace CTK3-05Q2T3Mt Energija-9 serial-№50107, CTK3-05Q2T3Mt Energija-9 serial-№50101, CTK3-05Q2T3Mt Energija-9 serial-№49969 and CTK3-05Q2T3Mt Energija-9 serial-№50099 correspondingly. Meters were replaced according to the respectful legislative provisions, and their replacement does not influence the accuracy of data monitored as the main parameters (data unit, grade of accuracy) remained the same. The above mentioned meters measure electricity export to the national grid of Ukraine. Installed meters are capable to save daily and monthly data during one year. To ensure archiving of monitoring data during at least two years of last transfer of ERUs for the project, daily data on electricity export is archived on the hard disk of the computer of the Deputy Director for Technical Modernization.

Cross-Checking Method for measuring electricity export to the national grid: Uman Greenhouse Combinatе sells electricity to Cherkasyoblenergo, where also Automated electricity metering system is installed to check the quantity of electricity supplied by UGC. According to the

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agreement between Uman Greenhouse Combinate and Cherkasyoblenergo every month Cherkasyoblenergo provides hourly and daily data on electricity supply to UGC, which will be saved at least two years of last transfer of ERUs for the project, thus double archiving and cross-checking of data are ensured.

Collecting and archiving of data on electricity generation by cogeneration unit

To measure total electricity generation three frequency/voltage guards, Terberg Controls KCVF 594 serial-№15/054, KCVF 594 serial-№15/052, KCVF 594 serial-№15/051 have been incorporated in the control panel of cogeneration units (one frequency/voltage guards per one cogeneration unit). Before frequency/voltage guards’ installation they were tested by Megacon Controls Ltd.

Daily data on electricity generation is recorded by the operators of cogeneration units in the register “Electricity generation”. Control panel also saves aggregated data on electricity generation from the date of installation of cogeneration units, although daily and monthly data are not available.

No later than 3rd of every month electrical engineer is responsible for performing a report on electricity generation during a previous month to the Deputy Director for Technical Modernization.

Cross-Checking Method for estimating electricity generation: In cases of any disruption of metering equipment, electricity generation by cogeneration units would be estimated on the basis of natural gas consumption and technical characteristics of cogeneration units under Description of Gas Generator Set Caterpillar G3520C.

Information on the data collected is presented in the table below.

Data variable	Data unit	Source of data	Type/serial number of monitoring equipment	Measured (m), calculated (c), estimated (e)	Recording frequency	How will the data be archived? (electronic/paper)
CEP Cogeneration electricity generation	MWh	Electricity meter	KCVF 594 №15/054, KCVF 594 №15/052, KCVF 594 №15/051	m	Daily	Electronic spreadsheet

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CEO_{EG} Cogeneration electricity supplied to electricity grid	MWh	Automated electricity metered system	SL 7000 Smart #53118733 ¹ , SL 7000 Smart #53118674 ² , SL 7000 Smart #53118665 ³ SL 7000 Smart #53118694 ⁴	m	Daily	Electronic spreadsheet
CHO Cogeneration heat supplied to industrial plant	Gkal	Heat meter after cogeneration unit	SPT961.1 №14693	m	Daily	Electronic spreadsheet
HEHO Heat-exchange boiler heat supplied to industrial plant	Gkal	Heat meter after heat-exchange boiler	SVTU-10M(M2) №16298	m	Daily	Electronic spreadsheet
VNG Volume of natural gas consumed by cogeneration units	m ³	Commercial gas flow meter	Actaris TZ 100/G400 serial-№ 2782302006/C and corrector B25 serial-№8158	m	Daily	Electronic spreadsheet
NCV_{NG} Natural gas net calorific value	GJ/ m ³	Supplier	-	m	Daily	Paper

¹ Has replaced the meter CTK3-05Q2T3Mt Energiia-9 №50107 on 18.11.2011. For the details of replaced meter, please, see table B.4.

² Has replaced the meter CTK3-05Q2T3Mt Energiia-9 №50101 on 18.11.2011. For the details of replaced meter, please, see table B.4.

³ Has replaced the meter CTK3-05Q2T3Mt Energiia-9 №49969 on 18.11.2011. For the details of replaced meter, please, see table B.4.

⁴ Has replaced the meter CTK3-05Q2T3Mt Energiia-9 №50099 on 18.11.2011. For the details of replaced meter, please, see table B.4.

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B.4 Information on monitoring equipment

Data variable	Data unit	Type/serial number of monitoring equipment	Grade of accuracy	Calibrations during the monitoring period	Date of next calibration
CEP Cogeneration electricity generation	MWh	KCVF 594 №15/054, KCVF 594 №15/052, KCVF 594 №15/051	0.5%	n/a	n/a
CEO_{EG} Cogeneration electricity supplied to electricity grid (for the period from 1 st of May, 2011 until 18 th of November, 2011)	MWh	CTK3-05Q2T3Mt Energiia-9 №50107, CTK3-05Q2T3Mt Energiia-9 №50101, CTK3-05Q2T3Mt Energiia-9 № 49969 CTK3-05Q2T3Mt Energiia-9 № 50099	0.5%	05.11.2009 05.11.2009 05.11.2009 05.11.2009	05.11.2013 ⁵ 05.11.2013 ⁶ 05.11.2013 ⁷ 05.11.2013 ⁸
CEO_{EG} Cogeneration electricity supplied to electricity grid (from 18 th of November, 2011 until now)	MWh	SL 7000 Smart #53118733, SL 7000 Smart #53118674, SL 7000 Smart #53118665 SL 7000 Smart #53118694	0.5%	18.11.2011 18.11.2011 18.11.2011 18.11.2011	18.11.2017 18.11.2017 18.11.2017 18.11.2017
CHO Cogeneration heat supplied to industrial plant	Gkal	SPT961.1 №14693	0.02%	18.01.2008, 29.10.2012	28.10.2014
HEHO Heat-exchange boiler heat supplied to industrial plant	Gkal	SVTU-10M(M2) №16298	0.5%	20.01.2010	January, 2014

⁵ Was put out of operation on 18.11.2011⁶ Was put out of operation on 18.11.2011⁷ Was put out of operation on 18.11.2011⁸ Was put out of operation on 18.11.2011

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VNG Volume of natural gas consumed by cogeneration units	m ³	Actaris TZ 100/G400 serial-№ 2782301006 with corrector B25 serial-№8158	0.02%	25.02.2010, 29.10.2012	29.10.2014
NCV_{NG} Natural gas net calorific value	GJ/ m ³	n/a	n/a	n/a	n/a

B.5 Operational and management structure applied in implementing the monitoring plan

In order to ensure accurate recording of the monitoring data the special Monitoring Procedure was introduced at the Enterprise. According to the Procedure, all the necessary data is collected by the UGC Deputy Director for Technical Modernization. The management structure is on the chart below.

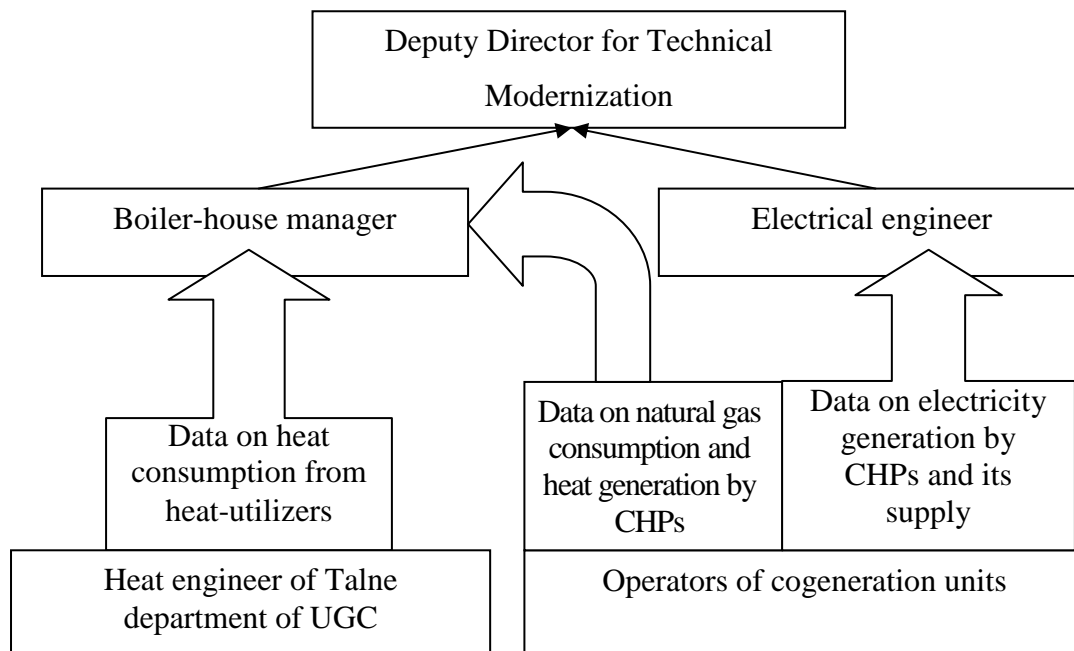


Fig. 1. Monitoring system management structure.

Monitoring data is daily recorded by the operators of cogeneration units and heat engineer of Talne department respectively. On the basis of the data recorded boiler-house manager and electrical engineer provide monthly reports to the Deputy Director for Technical Modernization, who is responsible for the performance of monitoring data to LLC ‘KT-Energy’.

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B.6 Monitoring of environmental impacts of the project

Within the project activity polluters' emissions into the atmosphere are expected. The gases emitted from the cogeneration system are monitored and reported in compliance with the requirements of the State environmental monitoring service of the Committee on natural resources in Cherkasy oblast through official quarterly statistical form 2-tp (air) *Data on protection of atmospheric air*, which contains information on amounts of trapped and neutralized atmospheric pollutants, itemized emissions of specific pollutants, number of emission sources, measures on reduction of emissions into the atmosphere, emissions from particular groups of pollution sources. The forms 2-tp (air) *Data on protection of atmospheric air* has being archived at the Enterprise for at least two years since the last transfer of the ERUs for the project.

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SECTION C**C.1 Documented procedures**

In order to ensure accurate recording of the monitoring data the special Monitoring Procedure was introduced at the Enterprise. The Procedure was approved by the Director of PRAE “Uman Greenhouse Combinatе”, Gordiy M.V. Under the Procedure the Deputy Director for Technical Modernization is responsible for the supervising and archiving of the monitoring data. According to the paragraph 6 of the Procedure, Deputy Director for Technical Modernization is responsible for keeping of the monitoring data for at least two years after the last transfer of ERUs for the current joint implementation project.

The Procedure clearly points out the distribution of powers and duties. Monitoring data are daily recorded by the operators of cogeneration units and heat engineer of Talne department respectively. On the basis of the data recorded boiler-house manager and electrical engineer are responsible for providing monthly reports to the Deputy Director for Technical Modernization. In the Monitoring Procedure monitoring parameter, its unit, recording frequency, way of archiving, calibration frequency is indicated so to ensure proper data metering, recording and archiving.

Within Monitoring Procedure cross-checking procedures are also foreseen. A particular cross-checking procedure for estimating and/or measuring of each monitoring parameter was developed in details to assure accuracy of emission reductions estimation.

Deputy Director for Technical Modernization is responsible for the performance to LLC “KT-Energy” all monitoring data that is necessary for GHGs emission reduction calculations. The specialists of LLC “KT-Energy” provide calculation of actual emission reductions according to the monitoring plan implemented.

The names of the personnel involved for this monitoring period are following:

1. Deputy Director for Technical Modernization, Zozulya Kostyantyn
2. Chief heat engineer, Kolomiets Mykola
3. Boiler-house manager, Petyk Vasyl
4. Electrical engineer, Koroban Volodymyr
5. Heat engineer of Talne department, Gorbachenko Yuriy

To ensure proper operating and maintenance of the cogeneration units in Uman and heat-utilizers in Talne initial trainings of the personnel were conducted. The trainings have been provided by technical consultant of Power Units Department of Zeppelin Ukraine LLC on December 18th, 2009. According to the Act on Conducting the Trainings boiler-house manager, electrical engineers, cogeneration units’ operators have successfully passed the training course on general principles of functioning and the rules of operation of the installed equipment as well as were acquainted with the specific characteristics of the CHPs and safety regulation. As it was mentioned before, the special Monitoring Procedure was introduced at the Enterprise. According to the Act on Conducting the Trainings for Monitoring Parameters for Calculation of Emission Reduction from 20th of October, 2009, the stuff involved in the monitoring of parameters was also acquainted with the Procedure.

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C.2 Control measures

Deputy Director for Technical Modernization is responsible for the accuracy of data provided according to the Monitoring Procedure. In order to control accurate recording of data monitored chief heat engineer every day checks values of such parameters as heat energy generation, natural gas consumption, total electricity generation in the registers and panels of metering equipment. Every month chief heat engineer rechecks total heat energy generation by heat utilizer TUV-16 according to the register and data of heat meter. Deputy Director for Technical Modernization every month rechecks data on electricity export.

To control proper operation of metering equipment its calibration will be provided regularly according to the national requirements.

C.3 Troubleshooting procedures

Under the Monitoring Procedure the boiler-house manager and the electrical engineer are responsible for the reporting to the Deputy Director for Technical Modernization about the cases of any malfunctioning within one day. In case of any disruption in functioning of metering equipment it would be replaced with a working one or cross-checking procedure would be used for the calculations of that period.

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SECTION D**D.1 Baseline emissions calculations**

Table D.1-1. Baseline emission estimation

Data variable	Description	Method of calculation
BE_y	Total baseline GHGs emissions, tonnes CO _{2e} /year	$BE_y = BE_{th} + BE_{th\ equiv\ fug} + BE_{elec\ grid} + BE_{elec\ own}$
BE_{th}	Baseline CO ₂ emissions from combustion of baseline fuel for heat supply, tonnes CO ₂ /year	$BE_{th} = ABEC_{BF} \times EF_{BF}$
$BE_{th\ equiv\ fug}$	Baseline methane emissions from natural gas production and leakage in transport and distribution, corresponding to heat supply, tonnes CO _{2e} /year	$BE_{th\ equiv\ fug} = ABEC_{BF} \times MLR \times GWP(CH_4) \times 10^{-3}$
$BE_{elec\ grid}$	Baseline emissions of CO ₂ from electricity supply to electricity grid that is offset by electricity supplied from cogeneration system, tonnes CO _{2e} /year	$BE_{elec\ grid} = CEO_{EG} \times EF_{prod_elec\ grid} \times 10^{-3}$
$BE_{elec\ own}$	Baseline emissions of CO ₂ from electricity supply to industrial plant that is offset by electricity supplied from cogeneration system, tonnes CO _{2e} /year	$BE_{elec\ own} = CEO_{IP} \times EF_{red_elec\ grid} \times 10^{-3}$
$ABEC_{BF}$	Annual energy consumption for heat supply at baseline plant, GJ/year	$ABEC_{BF} = (CHO/e_b + HEHO/e_b) \times 4.1868$
EF_{BF}	CO ₂ emission factor of the fuel used to generate heat, tonnes CO ₂ /GJ	See table B.2.2-1.1
CHO	Cogeneration heat supplied to industrial plant, Gkal/year	See table B.2.3-1.1
$HEHO$	Heat-exchanger heat supplied to industrial plant, Gkal/year	See table B.2.3-1.1
MLR	Methane Leakage Rate in natural gas production, transport and distribution leakage, including leaks at the industrial site (lower heating value basis), kg CH ₄ /GJ natural gas energy consumption	See table B.2.2-1.
$GWP(CH_4)$	Global warming potential of methane	See table B.2.2-1.
CEO_{EG}	Cogeneration electricity supplied to electricity grid, MWh/year	See table B.2.3-1.1
$EF_{prod_elec\ grid}$	Emission factor for electricity of Ukrainian grid for projects producing electricity to the grid, kg CO ₂ /MWh	See table B.2.3-1.2
CEO_{IP}	Cogeneration electricity supplied to	$CEO_{IP} = CEP - CEO_{EG}$

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	industrial plant, MWh/year	
$EF_{red_elec\ grid}$	Emission factor for electricity of Ukrainian grid for projects reducing electricity consumption from the grid, kg CO ₂ /MWh	See table B.2.3-1.2

Table D.1-2. Baseline emissions

Data variable	Period	Baseline emissions
BE_{2011}	1.05.2011-31.12.2011	25 723
BE_{2012}	1.01.2012-30.11.2012	43 730

D.2 Project emissions calculations

Table D.2-1. Project emission estimation

Data variable	Description	Method of calculation
PE_y	Total project GHGs emissions during year y, tonnes CO _{2e} /year	$PE_y = PE_{cs}$
PE_{cs}	Project carbon dioxide emissions from natural gas combustion in the cogeneration system, tonnes CO ₂ /year	$PE_{cs} = AEC_{NG} \times EF_{NG}$
AEC_{NG}	Annual energy consumption of natural gas in cogeneration system, GJ/year	$AEC_{NG} = V_{NG} \times NCV$
V_{NG}	Volume of natural gas consumed by cogeneration units (under standard conditions), m ³ /year	See table B.2.3-3.
NCV_{NG}	Natural gas net calorific value, GJ/ m ³	See table B.2.3-3.
EF_{NG}	CO ₂ emission factor of natural gas (lower heating value basis), tonnes CO ₂ /GJ.	See table B.2.2-1.

Table D.2-2. Project emissions

Data variable	Period	Project emissions
PE_{2011}	1.05.2011-31.12.2011	7 491
PE_{2012}	1.01.2012-30.11.2012	14 126

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D.3 Leakage emissions calculations

Table D 3-1. Leakages emission estimation

Data variable	Description	Method of calculation
$LE_{equiv\ fug,y}$	Leakage methane emissions from natural gas production and leakage in transport and distribution, corresponding to consumption of natural gas in cogeneration system in the year y, tonnes CO _{2e} /year	$LE_{equiv\ fug,y} = AEC_{NG} \times MLR \times GWP(CH_4) \times 10^{-3}$,
AEC_{NG}	Annual energy consumption of natural gas in cogeneration system, GJ/year	$AEC_{NG} = V_{NG} \times NCV_{NG}$
V_{NG}	Volume of natural gas consumed by cogeneration units (under standard conditions), m ³ /year	See table B.2.3-2.
NCV_{NG}	Natural gas net calorific value, GJ/m ³	See table B.2.3-2.
MLR	Methane Leakage Rate in natural gas production, transport and distribution leakage, including leaks at the industrial site (lower heating value basis), kg CH ₄ /GJ natural gas energy consumption	See table B.2.2-1.
$GWP(CH_4)$	Global warming potential of methane	See table B.2.2-1.

Table D.3-2. Leakage emissions

Data variable	Period	Leakage
$LE_{equiv\ fug,2011}$	1.05.2011-31.12.2011	1 568
$LE_{equiv\ fug,2012}$	1.01.2012-30.11.2012	2 956

D.4 Emission reductions calculations

Calculation of emission reductions is based on conservative assumptions.

Emission reductions were calculated according to the following formulae:

$$ER_{2011} = (BE_{2011} - PE_{2011}) - LE_{equiv\ fug,2011}$$

$$ER_{2012} = (BE_{2012} - PE_{2012}) - LE_{equiv\ fug,2012}$$

Table D.4-1. Emission reductions

Period	Emission reductions
1.05.2011-31.12.2011	16 664
1.01.2012-30.11.2012	26 648

The amount of total emission reductions during the period from 1st of May, 2011 till 30th of November, 2012 is 43 312 tonnes of CO_{2e}.

According to the PDD under the JI project “Cogeneration and Utilization of Waste Heat at Uman Greenhouse Combinate” the amount of ERUs for the period from 1st of May, 2011 till 30th of

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November, 2012 constitutes 121 466 tonnes of CO_{2e}. However, the actual amount of emission reductions for the indicated period is 43 312 tonnes of CO_{2e}. Inconsistency in the above mentioned values is caused by a number of technical and economical reasons.

The start of operation of the second TUV-16 has been postponed to 2013 as installation of the second heat-utilizer is technically and economically not feasible at the moment because of the insufficient amount of natural gas distributed through the Gas Compressor Station (GCS). Reduced consumption of natural gas in Ukraine resulted in the decrease of natural gas distribution through GCS and, thus, reduced amount of waste heat that can be utilized by TUV-16. Taking into account that installation of the exhaust boiler requires significant investments, it was decided by the senior management of UGC to postpone this part of the project until stabilization of natural gas distribution.

As it is clearly indicated in the PDD, generated within the project heat energy is consumed by UGC on its own needs. As the main activity of the Enterprise is to grow plants, the amount of generated and consequently consumed heat energy is highly dependent on the weather conditions. Favorable weather conditions resulted in the lower need of heat and/or electricity for growing plants that led to the decrease of total ERUs under the project.

To sum up, the difference between the values of emission reductions provided in the PDD and in the MR (for the same period) is caused by a number of sound economic and technical reasons.