**JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM**
**Version 01 - in effect as of: 15 June 2006**

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## SECTION A. General description of the project

### A.1. Title of the project:

Utilization of sunflower seeds husk for steam and power production at the oil extraction plant
OJSC 'Kirovogradoliya'
Sectoral number -1
Sectoral scope – « Energy industries (renewable - / non-renewable sources) »
Version 2
Date: 21 February 2008

### A.2. Description of the project:

**Purpose of the project**

The main project objective is the reconstruction of energy supply system of the Edible Oil Plant - Open Joint Stock Company "Kirovogradoliya"(hereafter OJSC 'Kirovogradoliya) – by construction of Combined Heat and Power Plant fuelled by solid biomass (sunflower seed husk). The Enterprise plans to double its production capacity, which will increase its heat and power demand. All amount of husk collected by the Enterprise after extension of its production capacity will be used for energy production. The project purpose is to satisfy own needs of the Enterprise in heat and power by husk combustion and consequently to avoid as much as possible consumption of fossil fuels and purchasing power from the grid, and also to avoid disposal of any amount of husk at the landfill.

**Project concept**

The project will be implemented at the Kirovograd Edible Oil Plant site and foresees the installation of CHP plant fuelled with the sunflower seeds husk produced as a by-product at the site. New CHP plant will consist of three steam sunflower seeds husk fired boilers (as the main fuel the sunflower husk is used, and also at one boiler gas burners will be installed to use natural gas as the reserve fuel) and steam turbine. Such approach will allow to fully utilize the sunflower seeds husk and thus to avoid the landfilling of this by product, and at the same time to cover the Kirovograd Edible Oil Plant both heat and power demands.
The project is going to be implemented in two stages:

Stage 1:
Construction of the first sunflower seeds husk fired steam boilers (2006)
Stage 1 already completed.
Stage 2:
Construction of two remained sunflower seeds husk fired boilers and the installation of steam turbine (2008).

**Expected results of the project**

- Avoiding of the sunflower seeds husk dumping at the landfill that will in turn lead to the reduction of respective expenses (see **Annex 2.1.11**);
- Substitution of outdated sunflower husk-boilers with the low efficiency by new modern and more efficient ones with expanding of installed rated thermal capacity up to 272142 MWh/a (234000 Gcal/a) ( project design 14.1/07-8-TETS);
- Generation about 12,750 MWh/yr of its own power utilizing the sunflower seeds husk, and thus reducing the fossil fuel consumption at electric power plants connected to the national power grid;
- Reduction of $CO_2$ emissions due to decreasing of the natural gas consumption;

- Considerable reduction of methane emissions due to avoiding of 69,884 tons/a of sunflower seeds husk dumping and further decay at the landfill.

**Project background information**

Core business of the enterprise is the processing of sunflower seed and production of pressed and extracted edible oil. In 1994, the elevator with the capacity of 14,000 tons of sunflower seed was put into operation. In 1994 the plant was incorporated into Open Joint-Stock Company (OJSC) «Kirovograd Edible Oil Plant» followed by the privatisation of the company. Starting from 2000 the Plant has been a part of the Holding Grain Trading Company. In 2003, Kirovograd EOP reregistered foreign direct investments in its capital.

The Plant represents an entire complex of pre-treatment, hulling and winnowing, pressing, extraction and auxiliary divisions with the developed infrastructure. Two “on the railway” elevators are available on the territory of the plant: one for sunflower seed with the capacity of 14,000 tons, and the second for 1,650 tons of regular grist and 3,000 tons of granulated grist. In addition, there is “on the railway” storage for edible oil with total capacity of 9,000 tons, designed for oil storage by types and varieties. The storage is equipped with the filling platform. Hulling and winnowing division, as well as pressing workshop, was put into operation in 1964. Hulling and winnowing division and pressing workshop of line No 2 were reconstructed during the eighties.

The Enterprise purchases electric energy from power grid of local energy utility company “Kirovogradoblenergo”.

At the moment production capacity of Kirovogradoliya is 1150-1200 t of sunflower seeds per 24 hours. The Enterprise has three old boilers for sunflower seeds husk combustion - N1, N2 and N3, nominal steam production of which is 10 t/h, 20 t/h, and 20 t/h respectively. Years of manufacture: boiler N1 DKVR-10/13-250 – 1971, boiler N2 DKVR-20/13-250 – 1962, boiler N3 DKVR-20/13-250 – 1976. Efficiency of the boilers: N1 – 84%, N2 – 90%, N3 – 82%. (Please, see **annex 2.1**, technical characteristics “Certificate on the quality of boiler manufacture” for old boilers).

The boilers were originally designed for liquid fuel combustion and later were converted for husk combustion. The boilers have been in operation for 30-41 years and exceeded their operational lifetime. The Enterprise regularly spends rather big money to keep the boilers in working condition. In 1999-2002 total sum for repairs and modernisation of the boilers amounted to 1033 thousands UAH **(annex 2.1, 2.1.6).**

As all old husk fired boilers manifestly exceeded their operational lifetime (**annex 2.1.8**), at any time their operation may be prohibited by boiler inspection body. That is why Kirovograd Edible Oil Plant developed intensive program of prospective development for 2005-2009 including reconstruction of energy supply system:

2006-2007 – reconstruction of energy supply system.

2007-2008 – construction of the shop for oil refining and deodorization (capacity 480 t/24 hr); shop for packing and storage of finished product (capacity 1500 bottles).

2008-2009 – construction of a new elevator for grist of 4,000 t capacity.

At first (in 2004) management of “Kirovogradoliya” considered the possibility of installation of new gas fired boilers instead of old husk fired boilers (**Annex 2.1, 2.1.4, Protocol 1**). After receiving information from SEC Biomass about JI projects and Austrian JI/CDM Program (in 2005), management of “Kirovogradoliya” began thinking about the possibility to implement CHP plant utilizing the husk at the Enterprise (Please see **Annex 2.1.4, Protocol 2**).Though CHP equipment is much more expensive than gas fired boilers, the Enterprise will be able to sell ERUs to the credit buyer(s) and get additional finances for the project. That is why “Kirovogradoliya” finally decided to reconstruct its energy supply system through realisation of JI project (**Annex 2.1.4, Protocol 3**).

**A.3. Project participants:**

| Party involved | Legal entity project participant (as applicable) | Please indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Ukraine (Host Party) | Open Joint-Stock Company 'Kirovogradoliya' | No |
| | Private enterprise- Holding Grain Trading Company | |
| | | |
| | Scientific Engineering Centre "Biomass" | |
| Other party | Not specified yet, under consideration | No |
| | | |

**1) Open Joint-Stock Company 'Kirovogradoliya'**

Core business of the Plant is processing of sunflower seeds and production of pressed and extracted edible oil. The enterprise is one of the leading companies in oil extraction market in Ukraine. Kirovograd EOP has production capacities of 75,000 tons of edible oil per year, which ranks it #2 in the respective industry of Ukraine. Total number of employees is 727.

**2) Holding Grain Trading Company**

Holding Grain Trading Company is a group of enterprises, operating in the Ukrainian agro-industrial sector and holds one of the leading positions in trading and processing of oilseeds and grain in local markets. "Grain Trading Company" Ltd. was established in 1996 to be at the head of the business of a group of trading companies of the Holding, which buy and sale agricultural products.

Main functions of "Holding Grain Trading Company" and its structural units are as follows:

- Procurement of sunflower seeds, barley, corn, wheat and peas in all regions of Ukraine.

- Organization of grains and sunflower seeds intake at the elevators.

- Obtaining of respective certificated for received goods.

- Complex transportation and forwarding services for transhipment through the port elevators in Odessa, Illichivsk, Mykolayiv and Kherson, as well as processing and delivery of finished products.

**3) Scientific Engineering Centre "Biomass"**

SEC Biomass is a consulting and engineering company established in January 1998 and at the moment one of the leading companies in the field of energy production from biomass (wood, straw, manure, municipal solid waste and other organic waste). Since 2004 SEC Biomass also has been rendering the consultancy service in promoting and developing the JI projects in Ukraine. At the moment the number of SEC Biomass employers accounts 22, including half of them working on JI projects in different sectors.

**A.4. Technical description of the project:**

**A.4.1. Location of the project:**

**A.4.1.1. Host Party(ies):**

Ukraine

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

Kirovograd region

**A.4.1.3. City/Town/Community etc.:**

Kirovograd City

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

Kirovograd Edible Oil Plant is located on the land plot of 8.8 hectares and owns the developed infrastructure, consisting of several power supply sources, steam boiler house, several connections to the technical and potable water supply, sewage system etc. Additionally, the Plant has an access to both the motorway and railway that ensures continuous and timely shipment of finished products and delivery of sunflower seeds. "Kirovogradoliya" is located in the centre of Ukraine that is why the cost of transportation of sunflower seeds to the plant from any part of the country is minimal. Availability of own tank storage capacities for raw material and sunflower seeds products allows to reduce cost of storage, to support the safety of storage and to accept up to 15 thousand tons a day.


Figure 1 Ukraine, showing location of Kirovograd city.

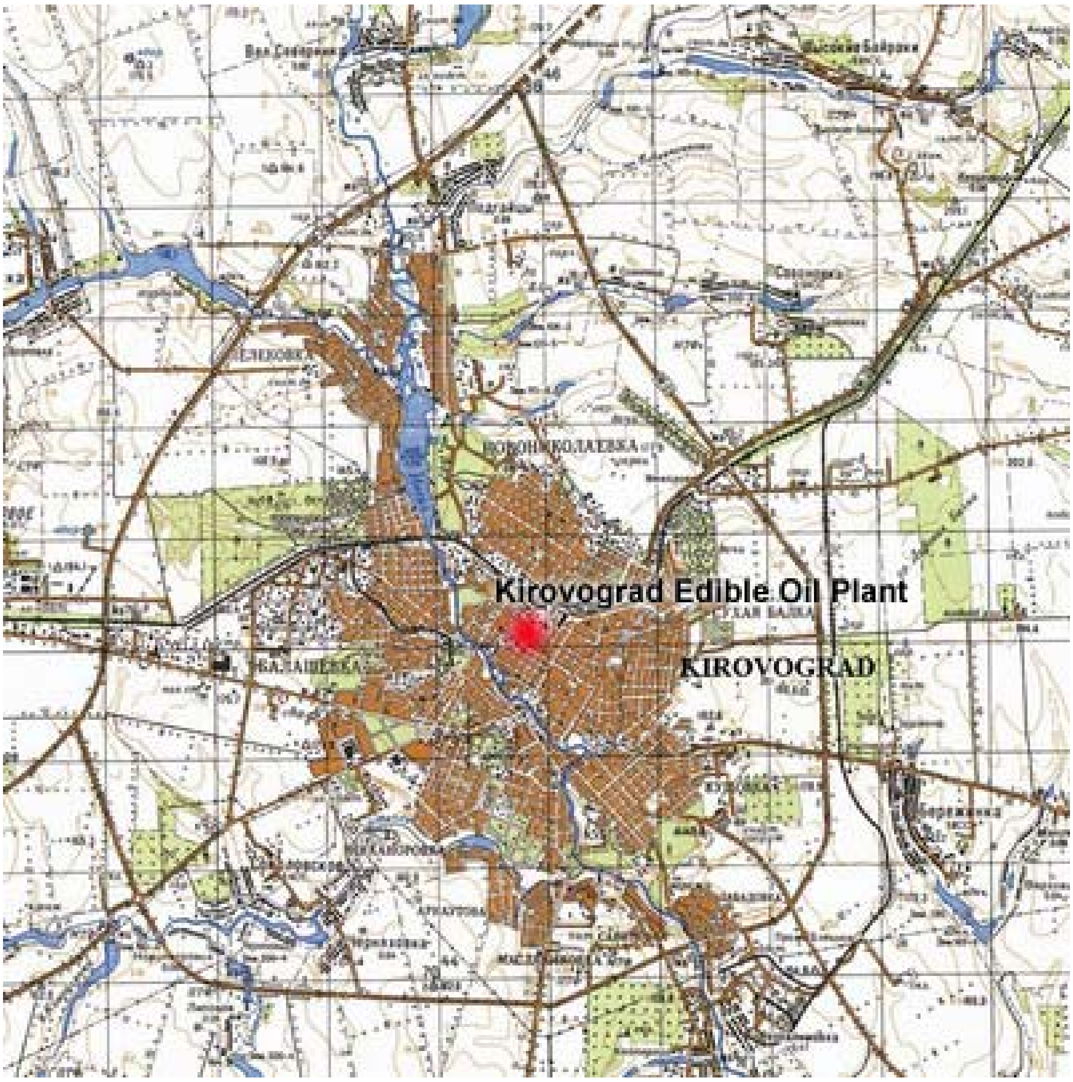


Figure 2. Kirovograd city area

**A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:**

The proposed project involves the reconstruction and modernization of heat and power supply at OJSC "Kirovogradoliya". After the reconstruction heat and power supply at OJSC "Kirovogradoliya" will be based mostly on combustion of biomass fuel – sunflower seed husk. Thus there will be very little consumption of fossil fuel (natural gas as a reserve fuel) and no purchase of electricity from power grid for own needs of CHP unit.

Presently the Enterprise has three old husk fired boilers (with consumption of mazut as additional fuel) and purchases electricity from power grid. All the boilers have exceeded their operational lifetime though they are in operating condition due to regular investments of the Enterprise into their repairs and modernisation. Presently the Enterprise is almost doubling its production capacity and its heat and power needs will increase.

Within the project boundaries three old husk fired boilers will be dismantled and sold as scrap. Three new boilers (N1, N2 and N3) for combustion of sunflower husk will be installed at the Enterprise. All boilers (N1, N2 and N3) will be operational and consume almost twice as much sunflower seed husk than it was before the extension of the Enterprise and reconstruction of its energy supply system. One of the boilers (N1) also has gas burners to use the natural gas as a reserve fuel when it is necessary. Two operational boilers (N2 and N3) are designed only for combustion of sunflower seeds husk. Natural gas in operational boiler (N1) is only reserve fuel for the case of unforeseen or unexpected situation (emergency at the Enterprise that leads to unexpected absence or lack of sunflower seed husk for the period more than 12 hours). The Enterprise has a 900 m$^3$ storage bin (6×150 m$^3$ bins) for sunflower husk that ensures uninterrupted operation of two boilers up to 12 hours.

Three operational boilers produce 48 t steam/hr. All amount of steam (direct steam) goes to the turbine for power production. After the turbine total amount of steam (waste steam) is divided into two flows. The first flow – up to 25 t/h – is the process steam which is used for technological purposes (sunflower seeds processing). The second flow goes partly for heating and hot water supply and partly to evaporator and condenser and is used for the production of distillate to recharge the boilers.

Annual amount of heat produced is **228,640 Gcal/a**. Heat supplied for technological purposes is **83,826 Gcal/a**, the rest of heat is goes to condenser and used for own need of boiler house.

CHP plant produces annually **12,750 MWh** of electricity.

Main part of produced power (**9,750 MWh/a**) is used by CHP plant for its own needs. The rest of produced power (**3,000 MWh/a**) is supplied to the Enterprise and thus reduces the electricity consumption from the grid.

Company responsible for the CHP plant construction project as a whole is the Project- Survey Institute “Kirovogradagroproject”. The Institute has to select standard equipment for CHP plant. As there are no standard husk fired boilers in Ukraine, special design organisation is also involved in the project design and implementation. Company responsible for designing of husk fired boilers is Special Project-Design and Technology Bureau “Energomashproject”, Kyiv. The Bureau has a license for such kind of work and good experience in this field. Manufacturers of the equipment are expected to be:

- husk fired boilers – OJSC “Sater” (Ukraine);
- evaporator – OJSC “The Taganrog boiler works” (Krasniy Kotelschik) (Russia);
- turbo-unit – PBS Velkobites (Czech);
- condenser – Bronsverk Heat Transfer (Czech);
- feed pumps – company “Energomash” (Ukraine).

The equipment will be installed by specialised organisation, which has a license for such kind of work and good experience in this field. It is expected that it will be OJSC “Yuzhteploenergomontazh”, Kyiv, the leading Ukrainian enterprise on the construction of thermal and nuclear plants. After the end of warranty period of manufacturers of the equipment (as usual 1-2 years), OJSC “Kirovogradoliya” itself is responsible for maintenance/repairs of the equipment. Maintenance (minor repair) is performed by specialists of the Enterprise. To perform more serious repair (for example replacement of damaged pipes) the Enterprise draws up contracts with authorised repairs organisation - CJSC “Gorizont”, Kirovograd. In case it is necessary to replace some components or parts of the equipment, it will be done by manufacturers involving Special Project-Design and Technology Bureau “Energomashproject”.

See detailed Technical Description of the Project in the Annex 2.4

**A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:**

On the whole, reduction of GHG emissions under the project will take place due:

1) Reduction of natural gas consumption comparing to baseline scenario due to using of $CO_2$ neutral fuel (sunflower seeds husk) to cover the heat demands of the Enterprise.
2) Reduction of the fossil fuels combustion at the grid-connected power plants, due to partly covering of Enterprise power demands by the operation of new CHP plant.
3) Stop of the sunflower seeds dumping at the landfill and thus the avoidance of methane emissions due to anaerobic decomposition of the husk.

As a result of the project first stage implementation (one sunflower seeds husk steam boiler) in 2006 the $CO_2$ emissions due to natural gas consumption and husk anaerobic decomposition will be reduced. After the implementation of the second project stage (rest husk steam boilers and the turbine installation) the $CO_2$ emission reduction from the above mentioned sources will be increased, and also the emission reduction due to decreasing of the grid electricity consumption will have place.

Without the project the heat (steam for the technological needs) demand of the Enterprise would be covered by the steam produced at the gas fired steam boiler(s). These boiler(s) would be installed instead of existing outdated boilers which use both the sunflower seeds husk and heavy oil (mazut) as a fuel. In such case all the husk produced at the Enterprise would be delivered to the landfill, dumped there and decomposed in anaerobic conditions causing the considerable methane emissions into the atmosphere. Without the proposed project the power for the Enterprise and for the own needs of the new gas fired boiler(s) would be provided from the outside power grid, leading to fossil fuels combustion at the grid-connected power plants. After the new CHP plant is put into operation, the Enterprise will be able to cover all its heat demand by the steam produced from the husk at the new CHP plant and partly cover its power demand. New CHP plant will also cover all its own electricity demand.

The $CO_2$ emission reduction after the proposed project implementation will mainly have place as the $CO_2$ emissions from husk burning are climatically neutral and therefore are considered to be zero. $N_2O$ emission from burning of sunflower seeds husk at the boilers is not included into account as it is negligibly small compared to $CO_2$ emissions (see also Table 3, p.21, ACM0006). At the same time the project participants decided to include the $CH_4$ emissions from the husk burning into calculations according to the ACM0006 and the fact that the methane emissions reduction due to avoidance of sunflower seeds husk decomposition is included into the project boundaries.

Without the project, the specified above reduction of GHG emissions would not be achieved, since the Enterprise would be used new gas-fired boiler(s) to cover its heat demand and continued to purchase all the required electricity from the grid. The reasons why in the absence of proposed project the gas fired boilers would have been installed to cover the heat demands of the Enterprise are as follows:

- It is hardly believable that technical conditions of the old sunflowers seeds husk boilers would allow theirs reliable operation during the next 5-10 years, as theirs operational lifetime is in the range of 30-40 years.
- When the decision about the reconstruction was being adopted (during 2005) the natural gas price was about three times lower (43 €/1,000 $nm^3$) then it is in the moment ( 150€/1,000 $nm^3$) . The gas fired steam boilers are the most developed technology for steam generation in the region and at the same time is the less costly one. Thus the investing in natural gas fired boilers installation was the less risky and most profitable option for the project owners in 2005. In other words installation of natural gas fired boiler(s) would prevent the risky and considerable investments into the new technology.

- No restriction on the GHG emissions are set up or expected for Ukrainian-based enterprises in the nearest future (at least until 2012).
- All the required permissions for husk land filling are available. It is unlikely that local authorities prohibit the organic wastes land filling (as it was done in EU) in the nearest future. So there are no any obstacles which the Enterprise may face while delivering the husk to the landfill. Without the proposed project it would have been possible to avoid the risks related to the absence of the experience in electric power generation at the Enterprise, just purchasing electricity from the grid.

### A.4.3.1. Estimated amount of emission reductions over the crediting period:

The ex ante emissions reductions are estimated to be **206,835** tonnes $CO_2$ – equivalent for commitment period 2008-2012 or approximately **41,367** tonnes $CO_2$ – equivalent annually. Note that actual emissions reductions will be based on monitored data and may differ from this estimate.

| | Years |
|---|---|
| Length of the crediting period | 5 years (2008-2012) |
| Years | Estimate of annual emission reductions in tonnes of $CO_2$ equivalent |
| 2008 | 31,777 |
| 2009 | 36,716 |
| 2010 | 41,508 |
| 2011 | 46,160 |
| 2012 | 50,674 |
| | |
| Total estimated emission reductions over the crediting period (tonnes of $CO_2$ equivalent ) | 206,835 |
| Annual average of estimated emission reductions over the crediting period | 41,367 |

### A.5. Project approval by the Parties involved:

Project is on the stage of consideration by Ukrainian DFP (designated focal point) - Ministry of Environmental Protection in order to obtain the Letter of Approval. The first version of the PDD and supplementary documents were submitted to the DFP in 2005. The new version based on this PDD will be submitted as soon as the determination report is issued by the AIE.

At the moment the Letter of no Objection (Letter of Endorsement) is available (see **Annex 2.3**).

## SECTION B. Baseline

### B.1. Description and justification of the baseline chosen:

The baseline scenario stipulates the installation of new gas-fired steam boiler(s) instead of the existing outdated boilers which use the sunflower seeds husk and the heavy oil as the fuels. In such case the heat demand of the Enterprise is covered by the combustion of natural gas at the new boiler(s), the power required for the new gas boiler(s) operation and to cover the Enterprise own technological needs is purchased from the outside national power grid, and the sunflower seeds husk is dumped at the landfill.

**Referencing of the approved baseline and monitoring methodology.** Justification of the baseline chosen is performed according to the "Consolidated methodology for grid-connected electricity generation from biomass residues" (hereinafter ACM0006, version 06, EB 33, URL: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html). This methodology is the most

suitable of the methodologies approved for Clean Development Mechanism (CDM) projects.
**Methodological tools which were used in preparing PDD.**
"Tool for demonstration and assessment of additionality, version 04, EB36.
"Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site", version 02, EB35.
"Tool to calculate project emissions from electricity consumption", version 1 EB 32.

$CO_2$ emission factor for grid electricity was taken from PDD version 4.0, dated 2 February 2007 "Utilization of Coal Mine Methane at the Coal Mine named after A.F. Zasydko" developed by Global Carbon B.V. (Annex 2, chapter "Standardized emission factors for Ukrainian electricity grid) http://ji.unfccc.int/JI_Projects/DB/DA22OPURGI092XUFLIK0INB5GIYEGA/PublicPDD/GT00RJXHY4VGS7ZS16MCKJ28CMMRH2/view.html

**Justification of the choice of methodology and why it is applicable to the project.** As it is mentioned in the ACM0006, it is applicable to grid-connected and biomass residue fired electricity generation project activities, including the cogeneration plants. The term *"grid-connected"* does not necessarily mean that plant must be connected to the grid and deliver electricity to the grid, but mean also that the plant generates power for the site own needs in such way reducing or avoiding electricity consumption from the grid. Among the possible project activities that may be considered under the ACM0006, there is one that exactly fits to the proposed project:

*The installation of a new biomass residue fired power generation plant at a site where currently no power generation occurs (**greenfield power projects**).*

The Table B-1 below explains the reason why the ACM0006 can be applied to the proposed project:

Table B-1 Comparison of proposed project activities with applicability of the methodology ACM0006

| ACM0006 Applicability (p.3) | Does the project activity meet the applicability requirement (Yes) or not (No) |
|---|---|
| *No other biomass types than biomass residues, as defined above, are used in the project plant and these biomass residues are the predominant fuel used in the project plant (some fossil fuels may be co-fired);* | Yes, only sunflower seeds husk will be used as the biomass residue and this husk is the predominant fuel used in the project CHP plant, although some natural gas is going to be co-fired in emergency cases and if necessary (during the start-ups of the boilers) |
| *For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice,* | Yes. The project implementation itself was caused by the planed increasing of output of the Oil-Edible Plant, but not vice versa. Output of biomass residues is increased also due to increasing of percentage content of husk in sunflower seeds |

| | |
|---|---|
| *logs, etc.) or in other substantial changes (e.g. product change) in this process;* | (please see **annex 2.1.9**). Moreover process of treatment of sunflower seeds and generation of sunflower husk are beyond the project boundaries. New boilers are installed to utilise all biomass residues from technological process. Otherwise some amount of husk will be dumped at the landfill. So it can be clearly define that project implementation will not result in an increase of the processing capacity of Oil Edible Plant. |
| *The biomass residues used by the project facility should not be stored for more than one year;* | Yes. The sunflower seeds husk produced at the Oil-Edible Plant will be combusted immediately and is not going to be stored for more then one year |
| *No significant energy quantities, except from transportation or mechanical treatment of the biomass residues, are required to prepare the biomass residues for fuel combustion, i.e. projects that process the biomass residues prior to combustion (e.g. esterification of waste oils) are not eligible under this methodology.* | Yes. No significant quantity of energy is required to prepare the biomass (sunflower seeds husk). Even no transportation neither mechanical treatment will have place. Sunflower seeds husk is produced directly at the site and do not require any prior treatment before the combustion. |

According to the ACM0006 procedure for the selection of the most plausible baseline scenario should include separate determinations of (1) how the power would be generated in the absence of the proposed project activity, (2) what would happen to the biomass residues (sunflower seeds husk) in the absence of the proposed project activity, and (3) how the heat would be generated in the absence of the proposed project activity. So it is necessary to identify most realistic and credible alternatives for power and heat generation and sunflower seeds husk treatment separately and using the steps 2 and/or 3 of the latest approved version of the "Tool for the determination and assessment of additionality" (URL: http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf_) to assess which of identified alternatives should be excluded from the further consideration.

For the power generation the project participants identified and selected the next most realistic and credible alternatives:

- (P1)[1] Proposed project activity not undertaken as JI project (installation of 1.7 $MW_{el}$ turbine generating power using the steam produced in the husk fired steam boilers).
- (P3) The generation of power in an existing (or newly constructed) plant using only fossil fuels (installation of 1.7 $MW_{el}$ turbine generating power using the steam produced in the gas-fired steam boilers).
- (P4) The generation of power in existing and/or new grid-connected power plants (in other words - the purchasing electricity from the grid - "continuation of existing situation").

For the heat generation the following realistic and credible alternatives were selected by project participants:

- (H1) The proposed project activity not undertaken as JI project (installation of three husk-fired boilers of 48 t/h of total steam output).
- (H3) The generation of heat in an existing (or newly constructed) cogeneration plant using only fossil fuels (installation of gas fired boiler(s) of 48 t/h total steam output and the turbine for power production).

[1] The "names" of the alternatives are kept as they are presented in the ACM0006

- (H4) The generation of heat in boilers using the same type of biomass residues ("continuation of existing situation", when all heat demands of the Enterprise are covered through the sunflower seeds husk combustion in the outdated boilers).
- (H6) The generation of heat in boilers using fossil fuels (installation the natural gas fired boilers to cover all heat demands of the Enterprise).
- (H7) The use of heat from external sources (purchasing heat from the local District Heating Utility "Kirovogradteplokomunenergo").

For the use of biomass residues (sunflower seeds husk) the following alternatives are considered to be the most realistic and credible:

- (B1) The sunflower seeds husk is dumped or left to decay under the mainly aerobic conditions. This applies, for example, to dumping and decay of husk on fields.
- (B2) The husk is dumped of left to decay under clearly anaerobic conditions (this applies, for example, to deep landfills with more than 5 meters).
- (B3) The husk is burnt in an uncontrolled manner without utilizing it for energy purposes.
- (B4) The husk is used for heat and/or electricity generation at the project site (continuation of existing situation, when the husk is utilized for heat production at the outdated boilers).
- (B5, B6) The husk is sold in order to be utilized for power and/or heat generation at other boilers/plants.
- (B7) The husk is used for biofuels production (e.g. pellets).

Also it should be admitted that the project is distinguished by the fact that at present, that construction and assembly works are partly completed (one of the husk boilers is in operation already). The possibility of realization of the proposed project with JI component was being considering by the project owner during 2005, thus the assessment of identified alternatives in this PDD is made taking into account the market and policy conditions of 2005. Actually the baseline scenario was chosen and justified in the PDD developed in 2005 for Austrian Energy Agency[2] and determined by the AIE (TUV SUD).

Assessing the alternatives for heat, power, and biomass use it should be mentioned that most of the separate alternatives should be combined into the "baseline scenarios"[3] and these "combined" alternatives (scenarios) should pass through the investment and barrier analysis.

**Formation of the "combined alternatives" from the separate alternatives presented above**

As the OEP first of all require the heat (steam of specified parameters) for technological needs, and at the same time taking into account that the consumption of electricity at the OEP is relatively lower comparing to heat consumption it is reasonable to start the assessing the alternatives from determination of "how the heat would be generated in the absence of proposed project activity".

(H1) - the proposed project activity not undertaken as JI stipulates the construction of 1.7 $MW_{el}$+26.$MW_{th}$[4] CHP plant using the sunflower seeds husk as a fuel. This alternative (H1) corresponds to alternative (P1) - power generation at the CHP plant using the sunflower seeds husk, and to alternative (B4) - when the husk is used for heat and electricity production at the project site. So we have the

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[2] PDD "Utilization of Sunflower Seeds Husk for Steam and Power Production at Oil-Extraction Plant OJSC "Kirovogradoliya" (June 13, 2005) may be submitted on request

[3] For instance if we consider the construction of new gas fired CHP plant as the alternative for heat generation, there is no sense to consider the construction of husk fired CHP plant for electricity production (electricity could be generated in the gas-fired CHP plant). Or for example there is little reason to consider the construction of husk fired CHP plant for as the alternative for power generation, and at the same time to consider the purchasing of heat from the district heating (heat can be produced at the CHP plant)

[4] 26.7 MW=31.2 Gcal/h=48 t/h

combined alternative (A1)=(H1)+(P1)+(B4).

(H3) - the heat generation in newly constructed gas fired CHP plant of the same as in (A1) capacity at the project site. This alternative can be combined with the (P3) and with all the alternatives for husk use except of (B4). So the combined alternative is (A2)=(H3)+(P3)+(B1…B7, except B4).

(H4) - Generation of heat in the outdated boilers from husk (continuation of existing situation). In such case the electricity would be continued to be purchased from the power grid (that corresponds to alternative P4). As for the husk use the only alternative that can be applied here is the B4. So we have the combined alternative (A3) = (H4)+(P4)+(B4).

(H6) - Generation of heat in the steam boilers using only natural gas. In such case the electricity would be continued to be purchased from the power grid (that corresponds to alternative P4). As for the husk use any alternative except the B4 can be applied here.

So we have the combined alternative is A4=(H6)+(P4)+(B1…B7, except B4).

(H7) - the purchasing required heat from the district heating system. In such case it is not feasible to install new gas-fired or husk fired installation for power production on-site or nearby. So only the alternative for power generation is the purchasing power from the grid (alternative P4). As both power and heat are purchased from the external sources, the husk use alternative could be any except B4.

So the last “combined alternative” is A5=(H7)+(P4)+ (B1…B7, except B4).

The justification of chosen baseline is presented in the sub-chapter B.2

As it mentioned above the baseline scenario is the “combined alternative” A4. So according to the ACM0006 and chosen baseline the project activity involves the installation of a new husk fired CHP plant at a site where no power was generated prior to the implementation of the project activity. The power generated by the project plant would in the absence of the proposed project be purchased from the grid. The sunflower seeds husk would in the absence of the project be dumped under clearly anaerobic conditions (see also B.2). The heat would in the absence of the proposed project be generated in newly installed natural gas fired steam boilers.

The key factors determining GHG emissions both in the baseline and in the project scenario have been singled out. These factors are as follows:

- Volume of sunflower seeds husk generated at the OEP.
- Power consumption (including for the boiler(s) own needs).
- Heat consumption by the OEP.
- Amount of fossil fuels combusted.
- Amount of sunflower seeds husk combusted.
- Amount of sunflower seeds husk dumped.

**B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:**

Due to development plan, the Enterprise increases its production capacity up to 400000 t of sunflower seeds per year.
In the baseline scenario (without JI project) the old boilers are put out of operation, dismantled and sold as scrap. One new operational gas-fired boiler of 15.5 MW is installed to meet thermal energy requirements of the technological process at the Enterprise. Required amount of electric energy for own needs of boiler house and Enterprise (5,300 MWh/yr) is purchased from power grid. All generated sunflower seeds husk is disposed of at the landfill. Natural gas is widely used in Ukraine for energy production.

Due to the methodology realistic and credible alternatives should be separately determined regarding:
• how **power** would be generated in the absence of the CDM project activity;
• what would happen to the **biomass residues** in the absence of the project activity; and
• in case of cogeneration projects: how the **heat** would be generated in the absence of the project activity.

In our case, in <u>baseline scenario</u>, if the project scenario will not occur, we would have following situation:
1. For power generation the most realistic and credible alternative is: P4- the generation of power in existing or at new grid-connected power plants.
2. For heat generation the most realistic and credible alternative is: H6 – the generation of heat in boilers using fossil fuel (in baseline scenario this is natural gas).
3. For biomass residue the most realistic alternative is B1 - the biomass residue are dumped or left to decay under clearly anaerobic conditions at the landfill (because there is no market of biomass residue in Ukraine).
Gas fired boilers are rather cheap and easy in operation and maintenance.

In <u>baseline scenario</u> there are four sources of greenhouses gases emissions:
1. Emission due to natural gas combustion by operational gas fired boiler during the period of sunflower seeds processing by the Enterprise – **21402,0** tons of $CO_2$e per year.
2. Emission due to husk decay at the landfill – on average **18583,4** tons of $CO_2$e per year.
3. Emission due to purchase of power from grid for own needs of gas boiler house during the period of sunflower seeds processing by the Enterprise – on average **11424,0** tons of $CO_2$e per year.
4. $CO_2$ emission due to purchase of power from grid during capital repairs of operational and the whole Enterprise (about 1 month per year) - on average **224** tons of $CO_2$e per year.
Annual baseline emission approximate **51633,4** tons of CO2e per year
Total baseline scenario emission for the period 2008-2012 is estimated at **258167,0** tons of $CO_2$e.

<u>In the project scenario</u> all three old husk fired boilers will be replaced by three new boilers. They will consume almost twice as much sunflower seed husks as it was before the reconstruction and extension of production capacity of the Enterprise. Also a turbine will be installed for CHP production purposes.
The biomass residue (husk) is a main fuel for all three operational boilers. The one husk boiler is equip with gas fired burners to use a natural gas as e reserve fuel in case of unforeseen situation at the Enterprise (e.g. unexpected absence or lack of sunflower seed husk for the period more than 12 hours).
The following analysis shows why the emissions in the baseline scenario would likely exceed the emissions in project scenario. First, for heat needs in baseline scenario a natural gas is used, power is delivered from the grid and in project scenario all needs in power and heat are covered by new CHP plant using biomass residue as a fuel. Also in baseline scenario the biomass residues are dumped under anaerobic conditions at landfill, what leads to $CH_4$ emissions.
**<u>Reduction of $CO_2$e by JI project in comparison with baseline scenario.</u>**

1. Total replacement of natural gas combustion by biomass (sunflower husk) combustion.
2. Total satisfaction of own needs in electricity of CHP unit by power produced by CHP unit.
3. No sunflower seed husk will be disposed of at the landfill. The capacity of three boilers is enough to ensure that the all produced sunflower seed husk will be burnt.

**<u>Project additionality</u>**

**<u>Application of additionality test to the project</u>**

The baseline methodology indicates *"The additionality of the project activity shall be demonstrated and assessed using the version 4 of the "Tool for the demonstration and assessment of additionality" agreed by the Executive Board.*

**Step 1. Identification of alternatives to the project activity consistent with current laws and regulations**

***Sub-step 1a. Define alternatives to the project activity:***

The identification of the most realistic and credible alternatives for power generation, heat generation, and sunflower husk use is presented in the section B.1 and the formation of "combined alternatives" is presented there as well. Below the short description of the alternatives is presented.

**Alternative A1**

In the Alternative A1 the old outdated husk fired steam boilers are put out of operation and dismantled. Instead of them new CHP plant using the sunflower seeds husk is constructed. The CHP plant capacity is 1.7 $MW_{el}$+26.7 $MW_{th}$. See also section A.2 as the Alternative A1 represents the proposed project activity not undertaken as JI. CHP plant covers all heat demand of the Enterprise, all own CHP plant electricity own needs, while the surplus produced electricity partly covers the Enterprise electricity demand and thus reducing the consumption of electricity from the grid. All amount of husk generated is utilized by the CHP plant.

**Alternative A2**

In the alternative A2 the old outdated husk fired boilers are substituted by the CHP plant using the natural gas as a fuel. The capacity of new CHP plant and the concept of its operation is the same as presented in the Alternative A1. All amount of husk generated at the Enterprise would be dumped at the landfill under the anaerobic conditions (See also Justification of "What would happened with the generated sunflower seeds husk if it was not combusted in the CHP plant or boiler(s)).

**Alternative A3**

Alternative A3 represents the continuation of existing situation when the heat required by the Enterprise is produced in the outdated husk fired boilers, while the required power (for husk boilers own needs and the Enterprise own needs) is purchased from the grid. The husk generated at the Enterprise is partly combusted in boilers and partly dumped at the landfill.

**Alternative A4**

In the Alternative 4 the old outdated husk fired steam boilers are put out of operation and dismantled and instead of them 1 new operational gas-fired steam boiler DE-25-1,4-225 GMO of 15.5 $MW_{th}$ capacity is installed to meet thermal energy requirements of the technological process at the Enterprise. Required amount of electricity for own needs of boiler house (5,300 MWh/yr) and the electricity for the own needs of the whole Enterprise are purchased from the power grid owned by local energy utility company "Kirovogradoblenergo". All amount of husk generated at the Enterprise would be dumped at the landfill under the anaerobic conditions (See also Justification of "What would happened with the generated sunflower seeds husk if it was not combusted in the CHP plant or boiler(s)).

**Alternative A5** stipulates that both heat energy and electricity are purchased by the Enterprise from the external sources. Electricity is to be purchased from the power grid owned by local energy utility company "Kirovogradoblenergo", while the heat is from the district heating system operated by the local utility company "Kirovogradteplokomunenergo".

But first of all it is necessary to determine what would happen with the generated sunflower seeds husk if it was not combusted at the CHP/boiler(s). According to the ACM0006 the following alternatives of waste husk use should be considered: (B1) the husk is dumped under mainly aerobic conditions; (B2) the husk is dumped under clearly anaerobic conditions; (B3) the husk is burnt in uncontrolled manner without utilizing it for energy purposes; (B4, B6) the husk is sold in order to be utilized for heat and/or electricity production at the other sites; (B7) the husk is used for pellets production.

***Consistency of husk use alternatives with mandatory laws and regulations:***

The alternatives (B1) and (B3) do not meet the Ukrainian regulation standards regarding the waste management. It is prohibited in Ukraine to burn the waste in uncontrolled manner and to leave the wastes at the open conditions (like at the fields). Thus alternative that envisages the uncontrolled burning of husk and dumping of husk under aerobic conditions are excluded from the further consideration. The other alternatives meet Ukrainian standards. The husk is allowed to be dumped at the landfills (there is no special regulations that prohibit the landfilling of organic waste, like in EU). According to information obtained from the management of Kirovograd landfill, the landfill is not going to be closed till 2012. Also the sunflower seeds husk can be sold as a fuel to other operators or used as a raw material for pellets production.

**Barrier analysis for the husk use alternatives**

There are no any barriers regarding the landfilling of the husk at the local Kirovograd landfill. OEP has the considerable experience in landfilling the surplus husk, and has all necessary licenses and permissions for this.

Selling the surplus husk faces the following barriers: (1) In Ukraine there are no any power and/or heat capacities to utilize the sunflower seeds husk, except the oil-extraction plants (two Cargill plants in Donetsk and Kherson region, Pology oil-extraction plant, Vinnitsa oil-extraction plant, etc). But these oil-extraction plants have own husk as a by-product and face the problem with the utilization of the husk. So they definitely would not purchase or transport the husk from the OEP Kirovogradoliya in order to combust it in their heat generating installations. From other hand there is a very low level of awareness among the district heating operators about the possibility to use the husk as a by-product. Taking into account that the husk is very difficult fuel to be combusted, the utility operators would not invest in husk fired boiler-houses in the nearest future (at least till 2012). The problem is deepened due to non-developed market of alternative fuels transportation. In Ukraine there is no experience of husk transportation neither even of waste wood fuel transportation. So it may be concluded that the alternative of selling husk for its further combustion for heat and/or power production should excluded from the further consideration as it would not overcome the next barriers: informative, technological (concerned the husk transportation, ash management, flue gas cleaning, problems with husk combustion, etc).

The use of husk as a raw material for pellets production directly at project site faces the next barriers: nevertheless in Ukraine there are couples of enterprises that produce the pellets from the husk; there is still considerable lack of experience in this sector. The production of pellets is the completely new sector of business for Kirovogradoliya OEP. Although the production of pellets in Ukrainian conditions is rather financially attractive, this approach requires the considerable investments and the most important the palletizing line(s) require(s) the additional land plots. So if we compare the landfilling of husk and production of pellets from the husk, the latter one requires about 1,000,000 Euro investments, about 600 $m^2$ of working areas with minimal height of 7.0 m, and 1.76 MW installed power capacity for line operating. It is obvious that such requirements for granulating line construction and operation make this alternative not feasible comparing to husk landfilling.

So it may be concluded that if generated husk was not combusted for heat and/or electricity production it would dumped at the landfill under the anaerobic conditions.

***Sub-step 1b. Consistency with mandatory laws and regulations***

**Alternative 1** is in compliance with all mandatory applicable legal regulatory requirements (at the moment all the permissions for project realization are obtained and the project is already partly completed - one husk fired boiler is installed. The only problem the project owners might have faces is the permission for husk combustion close to the residential area - but required measures to clean the flue gases were implemented into the design, and the Environmental Impact Assessment showed that the project can be realized.

**Alternative 2** is in compliance with all mandatory applicable legal regulatory requirements. It should be admitted that the alternative 2 represents rather widespread approach which number of industrial Ukrainian enterprises have already realized at their sites. The natural gas is the most widespread and easy to utilize fuel in Ukraine. The power generating installations using the natural gas emit fewer pollutants into the atmosphere than any other technologies. The procedure of getting the permission for operation of gas fired CHP is rather simple and regulated by the law of Ukraine about the Cogeneration and utilizing

the waste heat potential and by the Decrees of the National Electricity Regulatory Commission of Ukraine. As for the regulatory requirements regarding the landfilling of the generated husk the situation is following. According to information obtained from management of the Kirovograd landfill, the landfill will not be closed before 2012. As for Ukrainian legislation in the area of landfill management, the situation is the following. Presently there is a law (standard) that obliges landfills to collect methane and flare it or use for electricity generation. But this standard applies only to new landfills (which will be constructed in future) but does not properly work when applies to already constructed and managed landfills. At the moment there are no any operational methane collection system constructed at Ukrainian landfills first of all due to lack of investments and interest of the local state communal utilities that are the landfills operators. Before 2005, national standards on the operation of landfills did not envisage mandatory LFG control. In 2005, National Construction Standard DBN V.2.4-2-2005 Basics of Sites Design was introduced containing requirements on LFG collection and flaring/utilisation after the landfill closure. However, historically, the legal requirements on proper operation of landfills have not been enforced mainly due to financial barriers. Hence non-compliance with those requirements is widespread in the Host country. Due to financial state and lack of technical knowledge, this is expected to continue. Presently, common practice shows that existing landfills in Ukraine do not capture and flare or utilise their landfill gas. So the examination of current practice in wastes and landfills management though all over the country of Ukraine shows that obligations to construct the methane collection systems at the landfills are systematically not enforced (actually are not enforced at all yet) and thus the non-compliance with this requirement is widespread in the country (see step3 and step 4, PDD “Landfill methane capture and flaring at Yalta and Alushta landfills, Ukraine”
Document version number: 03, June 2007).

**Alternative 3** represents the continuation of existing situation when the sunflower seeds husk is combusted in the outdated boilers and power is purchased from the outside grid. The purchase of electricity from the grid is in compliance with all regulatory requirements. Any Enterprise can buy the grid electricity if it satisfies the number of requirements set by the local power distributing company.

Although the existing outdated husk fired boilers has already considerably exceeded their operational life-time, the situation when such outdated equipment is used is very widespread in Ukraine. Technical condition of the old boilers, in principle, allows maintaining operation at the previous level for another at least ten years. Nevertheless “Energy conservation control” authority may prohibit the exploitation of outdated equipment, at the moment the operating of this equipment is in compliance with regulatory standards of Ukraine.

**Alternative 4** is in compliance with all regulatory standards. The installation of gas-fired steam boilers and purchasing the electricity from the power grid is a common practice in Ukraine.

**Alternative 5** is in compliance with all regulatory standards. The situation when the industrial entity purchases both heat and power from the local district heating utility and power distributing company is very widespread in Ukraine.

***Step 3 Barrier analysis to eliminate alternatives to the project activity that face prohibitive barriers***

It was decided to conduct firstly the barrier analysis prior the investment analysis as it does not contradict to the Version 04 of the Tool for the demonstration and assessment of additionality” and is suggested by the Approved baseline and monitoring methodology AM0036 “Fuel switch from fossil fuels to biomass residues in boilers for heat generation” (p.8).

The next list of barriers that would prevent alternatives scenarios was established and presented below.

**Legal-administrative barriers**

- Relatively low charge for placement of sunflower seeds husk on the landfill- 5€/1,000kg (this price is taken from management of Kirovograd city landfill).
- Imperfection of state tariff policy for both heat and power.

- Ukrainian State Inspection on Energy Conservation and Boiler Inspection Body might reinforce their activities regarding outdated equipment which had considerably exceeded theirs operational life-time.
- There are no restrictions on GHG emissions for enterprises in Ukraine, and no such restrictions are expected to be introduced in the nearest future.

**Technological barriers**

- Absence of experience of operating facilities for power generation at the enterprise.
- Absence of experience in superheated steam supplying by the local district heating utility.
- The exploitation of outdated husk-fired equipment might cause serious problems to the Enterprise.

**Financial barriers**

- High cost of sunflower fired steam boilers which require special design and operational modes.
- The project implementation requires rather risky financial investments which include both the Enterprise equity and loans.

Relatively low charges of waste placement on the landfills in Ukraine do not prevent the realization of the alternatives 2, 4, and 5. This barrier slightly influences on alternatives 1 and 3 and could influence on project owner decision in the absence of the proposed project. But this barrier cannot be considered as those that would prevent any alternative from its realization.

Imperfection of state tariff policy for both heat and power would not prevent the alternatives 1 and 2 (as in these alternatives both heat and power are expected to be generated on-site), neither the alternatives 3 and 4 (as the Enterprise already gained the experience in purchasing electricity from the grid). This barrier would prevent the realization alternative 5. The supply of steam of specific parameters is essential for the Enterprise operation. During the last time in Ukraine has been occurred great number of disputes regarding the heat supply tariffs. The reason is that heat supply tariffs are the matter of decision of the local municipalities. There were number of low-suits related to the “non-justified” tariffs set by the municipalities. Thus it may be concluded that Kirovogradoliya OEP would not rely on such unpredictable and unstable heat tariffs formation policy and would not start to purchase the heat from the local utility. So the alternative 5 should be eliminated from the further assessment.

Although existing old husk fired boilers are in rather good condition, they have exceeded their operational lifetime. There was a considerable risk that at any time their operation would might be prohibited by boiler inspection body or by the Regional (State) Inspection on Energy Conservation. Thus it was not reasonable for the project owner to base a new extension modernization investment project on old boilers even taking into account their present condition and consumption of portion of generated sunflower husk after extension of the Enterprise production capacity. This barrier was considered by the project owner(s) as the most significant and influenced on their decision to start reconstruction of energy generating facilities of the Enterprise. So it is obvious that this barrier would prevent the realization of alternative 3 and thus this alternative should be eliminated from the further assessment. At the same time this barrier would not influence or prevent the realization of the rest alternatives 1, 2, 4, and 5.

The absence of experience of operating facilities for power generation at the Enterprise would make it very difficult to properly operate the new installation. In such case the risk of unexpected stoppages and increasing of downtime is considerably raises. This may lead in turn to the additional expenses due to supplement power purchasing from the grid. So this barrier is considered significant and would prevent the realization of alternatives 1 and 2.

Absence of experience in superheated steam supplying by the local district heating utility would prevent the realization of alternative 5. Although the local district heating utility possesses the steam boilers, those boilers have not been exploited for the long time, and partly were reconstructed in order to work only in hot water mode. Moreover the heat supply pipes are out of date, so the heat leakages are significant. All above mentioned reasons prove that this barrier would definitely prevent the realization of alternative 5, and thus this alternative should be excluded from the further consideration.

The exploitation of outdated husk-fired boilers would lead to the increasing of risks of unexpected stoppages in steam production and thus would cause considerable losses to the Enterprise due to the stoppages of technological process. Moreover the exploitation of outdated husk fired boilers requires the frequent investments in order to maintain and repair it. So this barrier would prevent the realization of alternative 3.

So the barrier analysis shows that only alternative 4 does not face any listed above barriers and thus should be considered as a baseline scenario.

The barriers related to the alternative 1 (which represents the proposed project activity but not registered as JI) would either impossible or inexpedient to overcome under the normal circumstances. It only made sense to overcome the aforesaid barriers with potential possibility to participate in the Kyoto Protocol mechanism. Therefore the final decision on the project implementation was adopted taking into account a potential possibility to cover part of the costs and to offset risks through the sales the generated ERUs.

In 2005, OJSC "Kirovogradoliya started intensive cooperation with the Austrian JI/CDM program (ERUs potential buyer, which partly financed the development of the PDD and determination) and SEC Biomass (consultant, that developed the PDD and facilitated the determination). But at the moment OJSC "Kirovogradoliya" consider the different companies as the potential buyers, and as the JISC JI PDD form is already in force and some technological aspects of the project were changed, the new PDD was redrafted by the SEC Biomass.

**Step 2 Investment analysis**

Though above barrier analysis shows that only one alternative would not face the barriers, and thus should be considered as a baseline scenario, in order to prove project additionality the investment analysis was conducted and its results are presented below. For the investment analysis the alternatives 4 and 1 (which represents the proposed project activity not being registered as JI) were selected.

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

Project participants decide to apply the investment comparison analysis (Option II). This project envisages obtaining revenue from the heat and power sales in addition to ERUs sales. Therefore, simple cost analysis (Option I) cannot be applied, this means that either investment comparison analysis (Option II) or benchmark analysis (Option III) should be conducted.

***Sub-step 2b. – Option II. Apply investment comparison analysis***

The following suitable financial indicators for the proposed activity not being registered as JI and for the Alternative 4 were calculated: Net present value of the project (NPV), internal rate of return of the project (IRR), simple and discounted pay-back periods (SPB, DPB). All relevant data required for such calculations (like investment costs, operating costs, revenues, economical tariffs assumptions, etc.) and the calculations themselves are presented in the **Annex 2.2** It should be admitted that calculations were made for the case of 2005 tariffs (when the decision on undertaking the proposed project as JI was being considered) and for the case of current (2007 year) tariffs[5]. The results of the investment comparison analysis taking into account present tariffs are presented in the Table B.1 below:

[5] Since 2005 the natural gas price has raised from 300 UAH up to 1,000 UAH/1,000 nm3, while the heat supply tariff has been increased by the local district heating utility from 115 UAH/Gcal up to 228 UAH/Gcal

**Table B.1 - Investment comparison analysis for 2007 tariffs**

| Project type | Discount rate,% | NPV*, EURO | IRR, % | Simple payback period, years | Discounted payback period, years |
|---|---|---|---|---|---|
| Alternative 4 (baseline scenario with gas fired boilers) | 15% | 21,084 | 15,3% | 5,5 | 13,37 |
| Proposed project not being registered as JI | 15% | -496,075 | 14,0% | 5,8 | >15,0 |
| Proposed project with ERUs sales | 15% | 906,949 | 16,8% | 4,9 | 10,87 |

| **Current prices, tariffs, currency exchange** | | | | |
|---|---|---|---|---|
| | Euro | | | |
| Currency Exchange | 6,63 | | | |
| | UAH | | Euro | |
| Heat supply tariff | 225,0 | UAH/Gcal | 33,94 | Euro/Gcal |
| Husk fuel price | 11,0 | | 1,66 | Euro/Gcal |
| Natural gas price for heat production | 1005,0 | UAH/1000m3 | 151,58 | Euro/1000m3 |
| ERU price | 82,9 | UAH/t CO2 eq | 12,50 | Euro/t CO2 eq |
| Cost of waste disposal at the landfill | 36,5 | | 5,50 | Euro/t |
| Power tariff for industrial consumers | 350,0 | UAH/MWh | 52,79 | Euro/MWh |

- * - NPV value is calculated for the period of 2007-2021years.
- All calculations of economical indexes made in the Excel tables attached to the **Annex 2.2.**

The results of investment comparison analysis for the conditions of 2005 are presented below in the Table B.2

**Table B.2 - Investment comparison analysis for 2005 tariffs**

| Project type | Discount rate,% | NPV*, EURO | IRR, % | Simple payback period, years | Discounted payback period, years |
|---|---|---|---|---|---|
| Alternative 4 (baseline scenario with gas fired boilers) | 10% | 24,200 | 10,7% | 6.4 | >10 |
| Proposed project not being registered as JI | 10% | -497,763 | 8,1% | 7,3 | >10 |
| Proposed project with ERUs sales | 10% | 362,872 | 11,4% | 6,0 | 8,52 |

| **Prices, tariffs, currency exchange for year 2005** | | | | |
|---|---|---|---|---|
| | Euro | | | |
| Currency Exchange | 6,63 | | | |
| | UAH | | Euro | |
| Heat supply tariff | 78,5 | UAH/Gcal | 11,84 | Euro/Gcal |
| Husk fuel price | 11,0 | | 1,66 | Euro/Gcal |
| Natural gas price for heat production | 285,1 | UAH/1000m3 | 43,00 | Euro/1000m3 |
| ERU price | 46,4 | UAH/t CO2 e | 7,00 | Euro/t CO2 eq |
| Cost of waste disposal at the landfill | 33,2 | | 5,00 | Euro/t |
| Power tariff for industrial consumers | 194,3 | UAH/MWh | 29,31 | Euro/MWh |

- * - NPV value is calculated for the period of 2005-2015 years
- All calculations of economical indexes made in the Excel tables attached to the **Annex 2.2.**

As it may be concluded from the table B.1, if current tariffs are applied, then the implementation of baseline scenario in comparison with proposed project not registered as JI is slightly attractive from the point of view of investors. Both simple and discounted payback periods for baseline scenario are lower than the same indexes for the proposed project without ERUs sales. But if the revenue from the ERUs sales is included into calculations, then proposed project becomes more attractive then baseline scenario.
At the same time the Table B.2 shows that if 2005 tariffs are applied then the baseline scenario has very attractive economical indexes in contrast to the proposed project not being registered as JI. The application of JI mechanism improves the project economical indexes.
So from the conducting of comparison investment analysis it is obvious that the proposed project activity not registered as JI cannot be considered as the most financially attractive.

***Sub-step 2b – Option III. Benchmark analysis:***

Benchmark analysis was chosen for this sub-step. The most appropriate financial indicator for any investment project is internal rate of return (IRR). The IRR is a key indicator for project investor. It can be influenced by perceived technical and/or political risks and by the cost of money. The IRR must exceed at least host country's discount rate in order for the project to be suitable (appropriate) for the investments. According to National Bank of Ukraine the discount rate for Ukraine is 10.0%. Taking into account political risks and rate of inflation in Ukraine, the value of discount rate used in calculations is 15%. Interest rate in Ukrainian commercial banks is 14-15% for hryvna deposits. Proposed project Without ERUs sales project has the IRR=14. 0% that is lower than the IRR of baseline scenario IRR= 15.3%. With ERUs sales, the IRR of the proposed project reaches the value of IRR =16.8%. The value of IRR=14.0% looks not attractive for potential investors comparing with benchmark value 15%. The value of IRR=16.8% for proposed project with ERUs sales is much more financially attractive for making decision to invest into the proposed project.
Concerning NPV (period of calculation 2007-2021) for proposed project it is positive only if ERUs will be generated for sale and reaches the value 906,949 Euro. Without registering the proposed project as JI one and selling ERUs NPV is negative - 496,075 Euro.
In the baseline scenario NPV is positive 21,084 Euro, but considerably lower comparing with proposed JI project.
Resuming all calculations it can be clearly define that without registering proposed project as JI one and getting possibility of ERUs sales, the project is not financially attractive and baseline scenario (installation of gas fired boilers) would be implemented.

**Step 3.Barrier analysis**

Additionality of the proposed project can be also proven by applying barriers analysis. These barriers are quite obvious and can be summarized as follows:

**a) legal-administrative barriers**
• Absence of legislation on biomass residues utilization in Ukraine;
• Relatively low charge for placement of biomass residues on landfills;
• Absence of the system of state control over formation and utilization of biomass residues;
• Imperfection of the state tariff policy for heat and power;
•There are no restrictions on $CO_2$ emissions for enterprises in Ukraine; no such restrictions are expected to be introduced;
• There are all the required permissions for operating the equipment and the landfill, including those of the ecological nature, approved by the relevant supervisory bodies;
**b) investment barriers**
• High cost of imported equipment with delivery costs and custom duties taken into account, the total project capital expenditure make EUR 13 300 thousand;

• Absence of adequate sources of project funding available for the Enterprise;
• The project implementation required rather risky financial investments which included both the Enterprise equity and loans.
•Credit rating for Ukraine is BB-, (25.10.2006, due to information from Fitch Rating website http://www.fitchratings.ru/regional/country/ratings/list/index.wbp?order=2). Also Price WaterHouseCoopers represent the credit rating for Ukraine as BB- in its 2007 year edition "Doing business in Ukraine."? Table 1.

.**c) technological barriers**

• Absence of experience of operating facilities for power generation at the enterprise;
• Project activity is the "**first of its kind**"- for the first time in Ukraine the project activity envisages development, construction and putting into operation CHP plant on solid biomass.

These barriers would be either impossible or inexpedient to overcome under the normal circumstances. It only made sense to overcome the aforesaid barriers with potential possibility to participate in the Kyoto Protocol mechanisms.
Therefore, the decision on the project implementation was largely made with taking into account a potential possibility to cover part of the costs and to offset risks through sales of the achieved ERUs.

**Step 4. Common practice analysis**

There is no serial production of husk fired boilers in Ukraine. Each boiler is specially designed and manufactured for certain enterprise. Because of that fact the construction and production of the husk fired boilers are considerably expensive in comparison with gas fired boilers, which are produced as serial equipment. Combustion of husk for combined heat and power generation is not applied in Ukraine yet. As usual edible oil plants dispose of husk at the landfill or combust it in boilers originally designed for other kinds of fuel, mainly for saturated steam production. Examples of Ukrainian enterprises which combust sunflower seeds husk for heat production only: Zaporozhskiy Fat-and-Oil Industrial Complex, Poltavskiy Oil-Extraction Plant, Dnepropetrovskiy Oil-Extraction Plant and Chumak Oil-Extraction Plant.

**For the first time in Ukraine** the project envisages development, construction and putting into operation of high pressure boilers for superheated steam production and the turbine for electricity production. It is the first CHP plant in Ukraine on solid biomass. It will be quite unique practice in Ukraine, at least for some period of time. For technology purposes of Kirovogradoliya steam of 13 bar is required. In the project scenario new boilers will be intended for the steam production of 39 bar with the purpose of its use for power generation. For an investor such project is much more expensive and has higher risks in comparison with baseline scenario. Realization of the project as a JI project with sales of ERUs makes it more attractive for a potential investor, decreases project risks and improves apparently its financial showings.
Taking into account all facts mentioned above proposed project is additional.

**B.3. Description of how the definition of the project boundary is applied to the project:**

The proposed JI project boundary include operation of new equipment for heat and power production at the Enterprise (three husk fired boilers and turbo-generator unit - combined heat and power plant) – from fuel supply to the boilers to steam and power exit from the equipment. The only fuel for CHP plant is husk. Natural gas is used only as reserve fuel for the case of unforeseen or unexpected situation (emergency at the Enterprise that leads to unexpected absence or lack of sunflower seed husk for the period more than 12 hours). The process of treatment of sunflower seeds and generation of sunflower husk as well as process of consumption of energy by the Enterprise are beyond the project boundaries. The project envisages that power generated by CHP plant will be mainly used for own needs of CHP plant, while the surplus will partly cover the Enterprise demands. Graphically the project boundary is presented on the figure below.

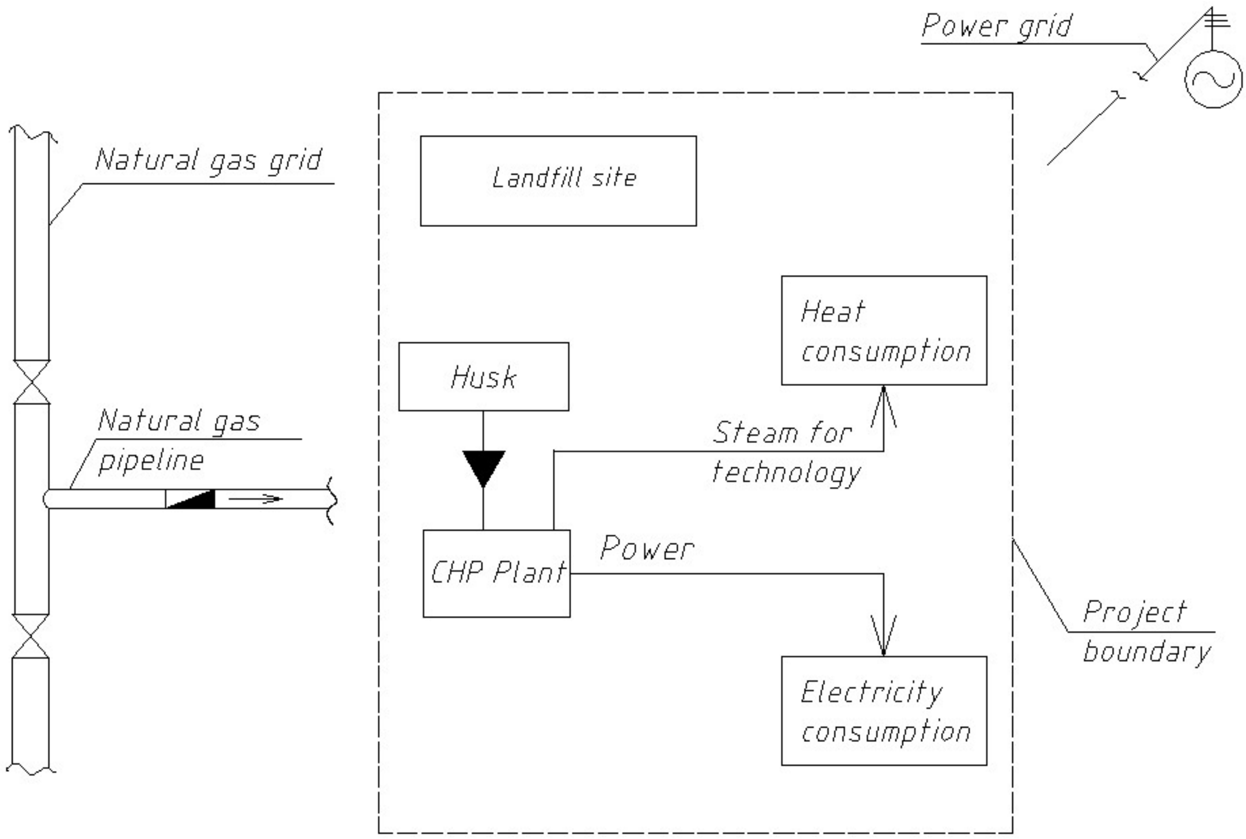



Figure 3. Graphical representation of the JI project boundary.

Detailed description of equipment to be installed within the project boundaries is presented in Annex 2.4 “Technical description of the project”.

Such elements as landfill site, power grid and connection to natural gas supply are closely connected with the project but are not included directly in its boundary. These elements allow to connect the project scenario with baseline scenario and to compare them. In baseline scenario all generated husk is disposed of at the landfill; one gas fired boiler provide steam to the Enterprise; electricity for own needs of boiler house is purchased from power grid of local energy utility company “Kirovogradoblenergo”. In the project scenario steam supply for technology purposes is based on husk combustion (three husk fired boilers); no husk is disposed of at the landfill; CHP plant totally provides itself by electricity for own needs; during 1-month period of annual capital repairs of all husk fired boilers and other equipment of the Enterprise (no generation of husk during that period) the electricity for needs of Enterprise is purchased from the grid.

Baseline scenario boundary includes operation of new boiler house at the Enterprise (one gas fired operational boiler) – from fuel supply of the boilers to steam exit from the equipment. The only fuel is natural gas. Kirovograd landfill site is also included in the boundary because all generated amount of sunflower seeds husk is disposed of at the landfill. The process of treatment of sunflower seeds and generation of sunflower husk are beyond the baseline scenario boundaries. The baseline scenario considers only power consumption for own needs of gas boiler house. Graphically the baseline scenario boundary is presented on the figure below.

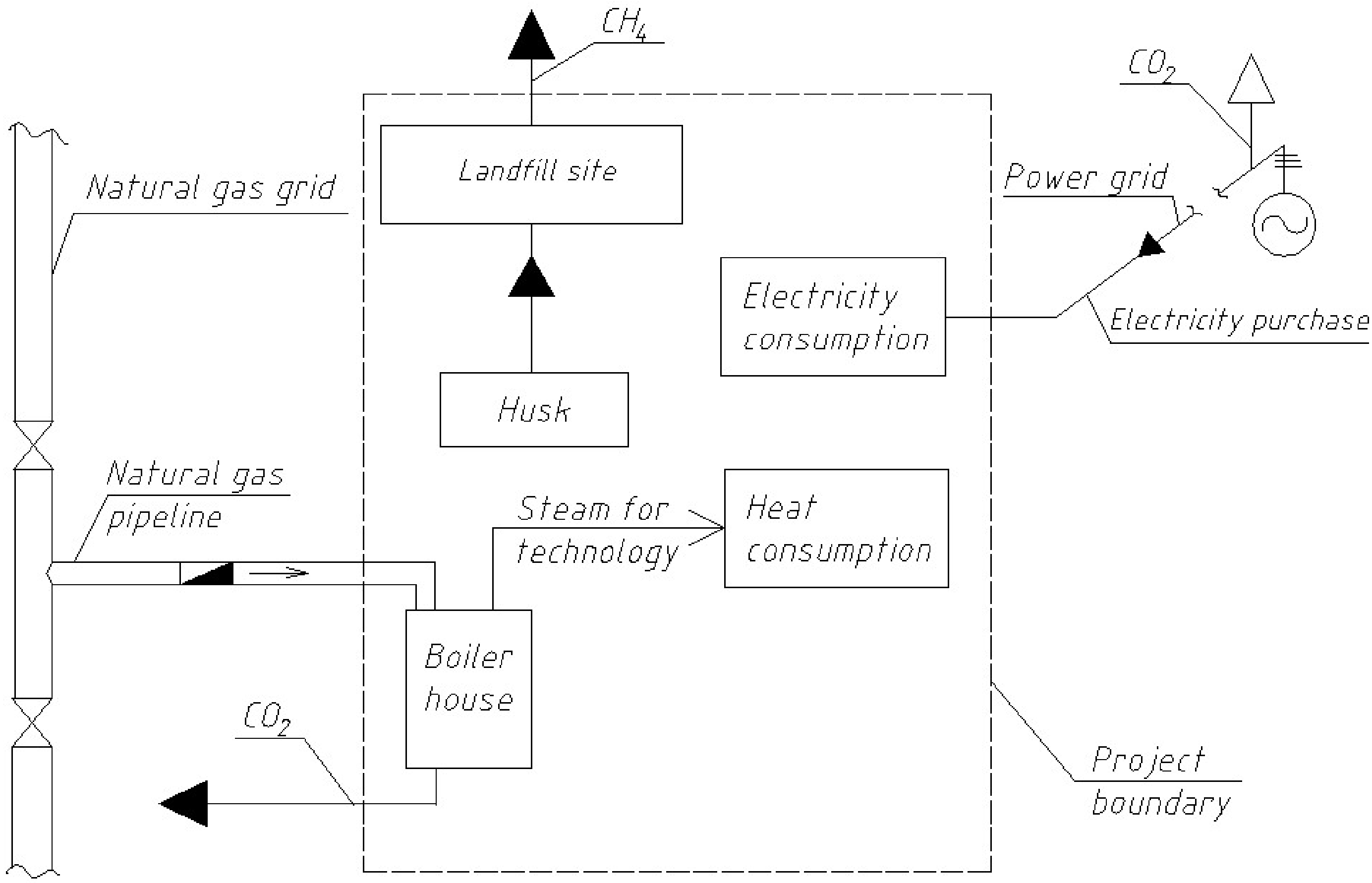



Figure 4. Graphical representation of the baseline scenario boundary.

Such elements as power grid and connection to natural gas supply are closely connected with the baseline scenario but are not included directly in its boundary. These elements allow to connect the project scenario with baseline scenario and to compare them.

Emissions of $CO_2$e are broken into four items in the baseline scenario:

1. Emission due to natural gas combustion by operational gas fired boiler(s) during the period of sunflower seeds processing by the Enterprise.

2. Emission due to husk decay at the landfill.

3. Emission due to purchase of power from grid for own needs of gas boiler house during the period of sunflower seeds processing by the Enterprise.

4. $CO_2$ emission due to purchase of power from grid for reserve gas fired boiler during capital repairs of the whole Enterprise (about 1 month per year).

Total baseline scenario emission for the period 2008-2012 is estimated at **258167** tons of $CO_2$e.

Reduction of $CO_2$e by JI project in comparison with baseline scenario.

1. Total replacement of natural gas combustion by biomass (sunflower husk) combustion.

2. Total satisfaction of own needs in electricity of CHP unit by power produced by CHP unit.

3. No sunflower seed husk will be disposed of at the landfill. All amount of husk generated will be burned at three husk fired boilers.

4. As surplus electricity generated by new CHP plant will partly cover Enterprise power demand the $CO_2$ emissions reduction will occur.

Total reduction of $CO_2$e emission by JI project during 2008-2012 is **206835** tons of $CO_2$e.

OJSC "Kirovogradoliya" will be the owner of ERUs. Contact person for registration process at the future JI supervisory board is Mr. Vladimir Umrikhin, Chief of the board at OJSC "Kirovogradoliya" (contact information is presented in Annex 1).

Selected JI project boundary includes only emissions directly connected with CHP plant operation. Such processes as treatment of sunflower seeds and generation of sunflower husk are beyond the project boundaries. Consequently emissions connected with these processes are also beyond the project boundary. When calculating financial showings of the CHP plant, the plant is considered as a subsidiary of Kirovograd Edible Oil Plant that is as a separate object, which sales heat energy to the Enterprise. This approach is in line with selected project boundary.

**B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:**

Scientific Engineering Center "Biomass" – project developer
Contact persons: Mrs. Valeriia Leznova – Consultant ,
2A, Zhelyabov str., 03057, Kyiv, Ukraine
tel. +(38 044) 456 94 62; fax: +(38 044) 456 94 62,
leznova@biomass.kiev.ua.
Date of completing the final draft of this baseline section February, 21, 2008.

## SECTION C. Duration of the project / crediting period

### C.1. Starting date of the project:

September 2006- start of construction
September 2006 – May 2008 – construction period.

### C.2. Expected operational lifetime of the project:

20 years 0 months.

### C.3. Length of the crediting period:

5 years, 2008-2012yy.

## SECTION D. Monitoring plan

### D.1. Description of monitoring plan chosen:

The project is a grid connected biomass fired renewable electricity generation green-field power project.

The fuel used is a by-product, agricultural residue from existing agricultural activities.

The conditions are similar to approved consolidated monitoring methodology ACM0006 ("Consolidated monitoring methodology for grid-connected electricity generation from biomass residues"). ACM0006 is referred in the current Monitoring Plan.
ACM0006 "Consolidated methodology for grid-connected electricity generation from biomass residues"
URL: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html
Approved consolidated baseline methodology ACM0006 version 06, approved by CDM Executive Board 33.

### D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

**D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:**

| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 1. $FF_{project\ site,i,y}$ | Quantity of natural gas consumed by reserve gas fired burners at the operating husk fired boiler in the case of unforeseen or unexpected situation | Gas flow meter. On-site measurements | $m^3_n/a$ | m | Continuously | 100% | Electronic and paper form | Accuracy of gas flow meter is 1%; once a year gas flow meter is certified by state authorized laboratory |
| 2.$EC_{PJ,y}$ | Quantity of | Power meter | kWh | m | Continuously | 100% | Electronic and | Accuracy of |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | power consumed by husk boiler with reserve gas fired burners from power grid | On-site measurements | | | | | paper form | electricity meter is 1%; once a year electricity meter is certified by state authorized laboratory |
| 3. $EC_{PJ, HP\_needs,y}$ | On-site electricity consumption for the new sunflower seeds husk fired CHP plant own needs in the year y | Power meter<br>On-site measurements | kWh | m | Continuously | 100% | Electronic and paper form | Accuracy of electricity meter is 1%; once a year electricity meter is certified by state authorized laboratory |
| 4. T | Temperature of the consumed natural gas | Temperature gauge | $^{o}C$ | m | Continuously | 100% | Electronic and paper form | Temperature of the consumed natural gas will be measured to determine the density of consumed natural gas |
| 5. P | Pressure of the consumed natural gas | Pressure gauge | Pa | m | Continuously | 100% | Electronic and paper form | Pressure of consumed natural gas will be measured to determine the density of consumed natural gas |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6.$D_{N.G}$ | Density of natural gas | Department of head energy engineer | $t_{n,g}/m^3_n$ | c | Weekly | 100% | Electronic and paper form | Data will be used to calculate the mass flow rate of methane |
| 7 $BF_{k,v,\ wet}$ | Quantity of biomass residue type *k* combusted in the project plant during the year *y* | Weight meter | Tons of wet matter | m | Continuously, prepare annually an energy balance | 100% | Electronic and paper form | Data will be used to calculate $BF_{k,v}$ |
| 8. $BF_{k,v}$ | Quantity of biomass residue type *k* combusted in the project plant during the year *y* | Department of head energy engineer | Tons of dry matter | c | Weekly | 100% | Electronic and paper form | |
| 9. W | Moisture content of the biomass residues | Heat engineering laboratory of Kirovograd Edible Oil Plant | % Water unit | m | Weekly | 100% | Electronic and paper form | The average value is determined at the end of the year Data will be used to calculate $BF_{k,v}$ |
| 10.$EF_{CH4,BF}$ | $CH_4$ emission factor for the combustion of biomass residues in the project plant | Default values | $t_{CH4}$/GJ | - | Quarterly | 100% | Electronic and paper form | Use default value as provided in Table 4 ACM0006 |
| 11. $EG_{project\ plant,y}$ | Net quantity of electricity generated in the project plant | Department of head energy engineer | MWh/y | m | Continuously | 100% | Electronic and paper form | Power meter readings |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | during the year *y* | | | | | | | |
| 12. $Q_{project\ plant,\ y}$ | Net quantity of heat generated from firing biomass in the project plant | Department of head energy engineer | GJ | m, (c) | Continuously | 100% | Electronic and paper form | Heat meter readings. In case if any heat meter is installed then steam flow, steam temperature and pressure must be measured to calculate net quantity of heat generated. |
| 14. $NCV_{ng}$ | Net calorific value of the natural gas | Accurate and reliable local or national data | $GJ/m^3_n$ | - | Review the appropriateness of the data annually | 100% | Electronic and paper form | Default local/national net calorific values (country-specific) |
| 15. $NCV_{BR}$ | Net calorific value of biomass residue type | Heat engineering laboratory of Kirovograd Edible Oil Plant | GJ/ton | m | Quarterly | 100% | Electronic and paper form | The average value is determined at the end of the year and must be determined on the basis of dry biomass |
| 16. $EF_{grid,y}$ | $CO_2$ emission factor for grid electricity during the year *y* | PDD version 4.0, dated 2 February 2007 "Utilisation of Coal Mine Methane at the Coal Mine | $tCO_2/MWh$ | | | 100% | Electronic and paper form | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | named after A.F. Zasydko” | | | | | | |
| 17.$EF_{CO2,FF,NG}$ | $CO_2$ emission factor for natural gas, combusted in the reserve gas burners | IPCC default emission factor | $tCO_2$/GJ | - | Review the appropriateness of the data annually | 100% | Electronic and paper form | |

Project emissions rise from three emission source:

Emission source 1. Purchase of electricity from power grid for own needs during about 1-month period of annual capital repairs of all husk fired boilers and other equipment of the Enterprise (no generation of husk during that period).

Emission source 2. Emissions from on-site natural gas consumption.

Emission source 3. Methane emissions from biomass residue combustion.

**D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of $CO_2$ equivalent):**

Project emissions include $CO_2$ emissions from on-site consumption of natural gas (fossil fuel) due to the project activity ( $PEFF_y$ ), $CO_2$ emissions from consumption of electricity ( $PE_{EC,y}$ ) and $CH_4$ emissions from the combustion of biomass residues ( $PE_{Biomass,CH4,y}$ ), as this source is included in the project boundary:

$$PE_y = PEFF_y + PE_{EC,y} + GWP_{CH4} \cdot PE_{Biomass,CH4,y}$$

Where:

$PEFF_y$ =$CO_2$ emissions during the year $y$ due to natural gas consumption at the project site for operation of gas-fired reserve boiler ($tCO_2$/yr);

$PE_{EC,y}$ = $CO_2$ emissions during the year $y$ due to electricity consumption at the project site for the own needs of the new CHP plant ($tCO_2$/yr);

$GWP_{CH4}$ =Global Warming Potential for methane valid for the relevant commitment period;

$PE_{Biomass,CH4,y}$ =$CH_4$ emissions from the combustion of sunflower seeds husk at the new CHP plant during the year $y$ ($tCO_2$/yr).

**a) Carbon dioxide emissions from on-site consumption of fossil fuels ( $PEFF_y$ )**

$CO_2$ emissions caused by the on-site fossil fuel consumption ((1) when unexpected or unforeseen situations with sunflower seeds husk delivering occur or (2) due to planned using of natural gas when starting the equipment operation) in the project scenario are calculated as follows:

$$PEFF_y = FF_{project\_site,y} \cdot NCV_{NG} \cdot EF_{CO2,FF}$$

Where

| | |
|---|---|
| $FF_{project\_site,y}$ | = Quantity of natural gas combusted at the project site during the year y; |
| $NCV_{NG}$ | = Net calorific value of natural has (fossil fuel) combusted at the project site; |
| $EF_{CO2,FF}$ | = $CO_2$ emission factor for natural gas combusted at the project site, $tCO_2$/GJ. |

**b) $CO_2$ emissions from electricity consumption ( $PE_{EC,y}$ )**

$CO_2$ emissions from on-site electricity consumption ( $PE_{EC,y}$ ) are caused by purchase of electricity from the National power grid during about 1 month term each year while the new CHP plant is stopped due to maintenance and repair works. According to the equation (6a) of ACM0006 version 04, the $CO_2$ emissions from on-site electricity consumption are calculated by multiplying the electricity consumption by an appropriate grid emission factor, as follows:

$$PE_{EC,y} = EC_{PJ,y} \cdot EF_{grid,y}$$

Where:

| | |
|---|---|
| $PE_{EC,y}$ | = $CO_2$ emissions from on-site electricity consumption attributable to the project activity ($tCO_2$/yr); |
| $EC_{PJ,y}$ | = On-site electricity consumption attributable to the project activity during the year y (MWh/yr); |
| $EF_{grid,y}$ | = $CO_2$ emission factor for grid electricity during the year y ($tCO_2$/MWh). |

This formula also corresponds to the requirements set in Methodological tool “Tool to calculate project emissions from electricity consumption”, version 1 EB 32, equation (2).

**c) Methane emissions from combustion of biomass residues ( $PE_{Biomass,CH4,y}$ )**

The project participants decided to include this source in the project boundary. The $CH_4$ emissions caused by sunflower seeds husk combustion at new CHP plant according to the equation (6) of ACM0006 are calculated as follows:

$$PE_{Biomass,CH4,y} = EF_{CH4,BF} \cdot BF_y \cdot NCV_{BR}$$

Where:

$BF_y$ = Quantity of sunflower seeds husk (biomass residue) combusted in the new CHP plant during the year y (tons of dry matter);

$NCV_{BR}$ = Net calorific value of the biomass residue (sunflower seeds husk) (GJ/ton of dry matter);

$EF_{CH4,BF}$ = CH4 emission factor for the combustion of sunflower seeds husk in the new CHP plant ($tCH_4/GJ$).

The net calorific value of dry matter of sunflower seeds husk (in MJ/kg) is following:

$$NCV_{BR} = NCV_{wet,10\%} = \frac{100}{100-W}.$$

Where W = moisture content of sunflower seeds husk.

**D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:**

| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| 18. $EG_y$, ($EG_y$=EG project plant) | Net quantity of increased electricity generation as a result of the project activity (increment of baseline generation) during the year y | Electricity meter.Department of head energy engineer | MWh/y | m | Continuously | 100% | Electronic and paper form | Accuracy of electricity meter is 1%; Once a year electricity meter is certified by state authorised laboratory. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 19. $EF_{electricity,y}$ | $CO_2$ emission factor for the electricity displaced due to the project activity during the year y | PDD version 4.0, dated 2 February 2007 "Utilisation of Coal Mine Methane at the Coal Mine named after A.F. Zasydko" | $tCO_2/MWh$ | - | | 100% | Electronic and paper form | |
| 20 $BF_{k,v}$ | Amount of sunflower husk consumed by husk fired boilers during the year *y* | On-site measurements. Department of head energy engineer | Tons of dry matter | m | Continuously | 100% | Electronic and paper form | |
| 22. $\varepsilon_{boiler}$ | Energy efficiency of the boiler that would be used in the absence of the project activity | Technical manufacture's information | | - | Once at the project start | 100% | Electronic and paper form | |
| 23. $EF_{co2,BL,heat,i}$ | Emission factor of the fossil fuel (natural gas) used for heat generation in the absence of project activity | IPCC default emission factor | $tCO_2/GJ$ | - | Review the appropriateness of the data annually | 100% | Electronic and paper form | |

**D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of $CO_2$ equivalent):**

**Emission reduction due to displacement of electricity**

Emission reduction due to replacement of electricity are calculated by multiplying the net quantity of increased electricity generated with sunflower seeds husk (biomass residues) as a result of the project activity ( $EG_y$ ) with the $CO_2$ baseline emission factor for the electricity displaced due to the project ( $EF_{electricity,y}$ ), as follows:

$$ER_{electricity,y} = EG_y \cdot EF_{electricity,y}$$

Where:

$ER_{electricity,y}$ =Emission reductions due to displacement of electricity during the year y ($tCO_2/yr$);

$EG_y$ =Net quantity of increased electricity generation as a result of the project activity (increment of baseline generation) during the year y (MWh);

$EF_{electricity,y}$ =$CO_2$ emission factor for the electricity displaced due to the project activity during the year y ($tCO_2/MWh$).

According to ACM0006, if the produced electricity at the new CHP plant to be consumed on-site and substitutes the grid electricity that would have been purchased from the grid in the absence of proposed project activity, then quantity of $EG_y$ corresponds to the net quantity of electricity generation in the project plant ( $EG_y = EG_{project\_plant,y}$ ).

**Emission reduction due to displacement of heat**

In our case when the cogeneration plant is going to be put into operation, it is necessary to determine the emission reduction due to displacement of heat ( $ER_{heat,y}$ ).

As the identified baseline scenario is the generation of heat in steam boilers using the fossil fuels (natural gas), baseline emissions are calculated by multiplying the savings of fossil fuels (natural gas) with the emission factor of these fuels (natural gas).

Emissions reductions from savings of fossil fuels (natural gas) are determined by dividing the quantity of generated heat that displaces heat generation in fossil fuel (natural gas) fired boilers ( $Q_y$ ) by the efficiency of the boiler that would be used in the absence of the project activity ( $\varepsilon_{boiler}$ ), and by multiplying with the $CO_2$ emission factor of the fuel type (natural gas) that would be used in the absence of the project activity for heat generation ($EF_{CO2,BL,heat,i}$), as follows:

$$ER_{heat,y} = \frac{Q_y \cdot EF_{CO2,BL,heat,i}}{\varepsilon_{boiler}}$$

Where:
As in our case (when the baseline scenario is that all heat generated by the cogeneration project plant would in the absence of the project activity be generated in fossil fuel fired boilers) $Q_y = Q_{project\_plant,y}$ , then:

$ER_{heat,y}$ =Emission reductions due to displacement of heat during the year y ($tCO_2$/yr);

$Q_y$ =Quantity of increased heat generation in the project plant;

$Q_{project\_plant,y}$ =Net quantity of heat generated in the cogeneration project plant from firing biomass residues during the year y (GJ);

$\varepsilon_{boiler}$ =Energy efficiency of the boiler that would be used in the absence of the project activity;

$EF_{CO2,BL,heat,i}$ =$CO_2$ emission factor of the fossil fuel (natural gas) used for heat generation in the absence of project activity ($tCO_2$/GJ).

**Baseline emissions due to natural decay of sunflower seeds husk at the landfill**

As project participants decided to include this emission reduction source into the project boundaries then baseline emissions due to decay of the biomass residues ($BE_{Biomass,y}$) is determined in two steps:

Step 1: Determination of the quantity of biomass residues used as a result of the project activity.
Step 2: Estimation of methane emissions, consistent with the baseline scenario for the use of biomass residues.
Step 1. Determination of the quantity of biomass residues used as a result of the project activity ( $BF_{PJ,k,y}$ ).

According to ACM0006 and chosen scenario, the total quantity of biomass residues used in the project plant is attributable to the project activity and hence $BF_{PJ,k,y} = BF_{k,y}$

Step 2. Estimation of methane emissions, consistent with the baseline scenario for the use of biomass residues.
As the most likely baseline scenario for the use of the biomass residues is that the biomass residues would decay under clearly anaerobic conditions, the baseline emissions is calculated using the latest approved version of the *“Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site”*.

The amount of methane that would in the absence of the project activity generated from disposal of sunflower seeds husk at the solid waste disposal site is calculated with a multi-phase model. The calculation is based on the first order decay (FOD) model. The model calculates the methane generation based on the actual waste (sunflower seeds husk) streams disposed in each year x, starting with the first year after the start of the project activity until the end of the year y, for which baseline emissions are calculated.

The amount of methane produced in the year y ( $BE_{CH4,SWDC,y}$ ) due to decay of sunflower seeds husk at the landfill is calculated as follows:

$$BE_{CH4,SWDC,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} W_x \cdot DOC \cdot e^{-k_j \cdot (y-x)} \cdot \left(1-e^{-k_j}\right)$$

Where:

$BE_{CH4,SWDC,y}$ =Methane emissions avoided during the year y from preventing sunflower seeds husk at the landfill during the period from the start of the project activity to the end of the year y ($tCO_2$);

$\varphi$ =Model correction factor to account for model uncertainties;

f =Fraction of the methane captured at the landfill and flared, combusted or used in another manner;

$GWP_{CH4}$ =Global warming potential of methane, valid for the relevant commitment period;

OX =Oxidation factor (reflecting the amount of methane from landfill that is oxidized in the soil or other material covering the waste);

F =Fraction of methane in the landfill gas;

$DOC_f$ =Fraction of degradable organic carbon that can decompose;

MCF =Methane correction factor;

$W_x$ =Amount of sunflower seeds husk prevented from disposal in the landfill in the year x (tons);

$DOC$ =Sunflower seeds husk fraction of degradable organic carbon (by weight);

k =Decay rate for the sunflower seeds husk;

x =Year during the crediting period: x runs from the first year of the first crediting period (x=1) to the year y for which avoided emissions are calculated;

y =Year for which methane emissions are calculated.

**D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):**

**D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:**

| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

The section was left blank on purpose.

**D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of $CO_2$ equivalent):**

**D.1.3. Treatment of leakage in the monitoring plan:**

**D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:**

| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |

**D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of $CO_2$ equivalent):**

The main potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as the result of project activity.
In our case the use of the biomass residues did not increase fossil fuel consumption elsewhere, because prior to implementation of the project activity biomass residue have not been collected or utilized, but have been land-filled. This practice would continue in the absence of project activity, because in there is no market emerged for the biomass residues. Please see page 16 of this PDD, section" Barrier analysis for the husk use alternatives**".**

**D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of $CO_2$ equivalent):**

The project reduces $CO_2$ emissions through substitution of power purchased from the grid and heat generation with natural gas by energy generation with biomass residues (sunflower seeds husk). The emission $ER_y$ by the project activity during a given year $y$ is the difference between the emission reductions through substitution of electricity purchased from the grid ($ER_{electricity,y}$), the emission reductions through substitution of heat generation with natural gas ($ER_{heat,y}$), project emissions ($PE_y$), emissions due to leakage ($L_y$) and baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues ($BE_{biomass,y}$), as follows:

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$$

Where:

$ER_y$ =Emissions reductions of the project activity during the year $y$ ($tCO_2$/yr);

$ER_{electricity,y}$ =Emission reduction due to displacement of electricity during the year $y$ ($tCO_2$/yr);

$ER_{heat,y}$ =Emission reductions due to displacement of heat during the year $y$ ($tCO_2$/yr);

$BE_{biomass,y}$ =Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year $y$ ($tCO_2$/yr);

$PE_y$ =Project emissions during the year $y$ ($tCO_2$/yr);

$L_y$ =Leakage emissions during the year $y$ ($tCO_2$/yr).

**D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:**

Not applicable.

**D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:**

| Data *(Indicate table and ID number)* | Uncertainty level of data (high/medium/low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
|---|---|---|
| Table D 1.1.1, #1. $FF_{project\ site,i,y}$ | Low | Flow meters will be subject to a regular maintenance and periodical calibration according to the manufacturer's recommendation to ensure accuracy. |

| | | |
|---|---|---|
| Table D 1.1.1, #2. $EC_{PJ,y}$ | Low | Power meters will be periodically calibrated according to the manufacturer's recommendation to ensure accuracy. Cross-check measurements results with invoices for purchased electricity if available. |
| Table D 1.1.1, #3. $EC_{PJ, HP\ needs,y}$ | Low | Power meters will be periodically calibrated according to the manufacturer's recommendation to ensure accuracy. Cross-check measurements results with invoices for purchased electricity if available. |
| Table D 1.1.1, #4 T | Low | The temperature gauge should be subject to a regular maintenance and testing regime to ensure accuracy. |
| Table D 1.1.1, #5 P | Low | The pressure gauge should be subject to a regular maintenance and testing regime to ensure accuracy. |
| Table D 1.1.1, #7 $BF_{k,v}$ | Low | Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes. |
| Table D 1.1.1, #11 $EG_{project\ plant,y}$ | Low | Power meters will be periodically calibrated according to the manufacturer's recommendation to ensure accuracy. The consistency of metered net electricity generation should be cross-checked with the receipts from electricity sales (if available) and the quantity of fuels fired ( e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years). |
| Table D 1.1.1, #12 $Q_{project\ \_plant,\ y}$ | Low | Heat meters are regularly verified and regularly cross-checked with balance data. The consistency of metered net electricity generation should be cross-checked with the receipts from electricity sales (if available) and the quantity of fuels fired ( e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years). |
| Table D 1.1.1, #154 $NCV_{BR}$ | Low | The laboratory equipment is regularly verified. Check consistency of measurements and local/national data with default values by the IPCC. |

**D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:**

Collection of information required for calculations of reductions of GHG emissions as a result of the project is performed in accordance with the procedure common for the enterprise. Initial data will be submitted by the environmental department, by the production manager, and by the head energy engineer.
A transparent system for collection and storage of measured data in the electronic form are established. Calculations of emission reduction will be prepared by specialists of **Kirovograd Edible Oil Plant** at the end of every reporting year. The project manager of **Kirovograd Edible Oil Plant** will prepare reports, as needed for audit and verification purposes. Specialists of "**Scientific Engineering Centre "Biomass"** will check the prepared reports.

**D.4. Name of person(s)/entity(ies) establishing the monitoring plan:**

Monitoring plan was developed by "Scientific Engineering Centre "Biomass".
Contact person: Valeriia Leznova – Consultant.
E-mail: leznova@biomass.kiev.ua.

## SECTION E. Estimation of greenhouse gas emission reductions

### E.1. Estimated project emissions:

According to the used methodology ACM0006, generally the project emissions include $CO_2$ emissions from transportation of biomass residues to the project site ( $PET_y$ ), $CO_2$ emissions from on-site consumption of fossil fuels due to the project activity ( $PEFF_y$ ), $CO_2$ emissions from consumption of electricity ( $PE_{EC,y}$ ) and, where this emission source is included in the project boundary and relevant, $CH_4$ emissions from the combustion of biomass residues ( $PE_{Biomass,CH4,y}$ ):

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} \cdot PE_{Biomass,CH4,y}$$

Where:

$PET_y$ = $CO_2$ emissions during the year $y$ due to transport of the biomass residues to the project plant ($tCO_2$/yr);

$PEFF_y$ = $CO_2$ emissions during the year $y$ due to fossil fuels co-fired by the generation facility or other fossil fuel consumption at the project site that is attributable to the project activity ($tCO_2$/yr);

$PE_{EC,y}$ = $CO_2$ emissions during the year $y$ due to electricity consumption at the project site that is attributable to the project activity ($tCO_2$/yr);

$GWP_{CH4}$ = Global Warming Potential for methane valid for the relevant commitment period;

$PE_{Biomass,CH4,y}$ = $CH_4$ emissions from the combustion of biomass residues during the year $y$ ($tCO_2$/yr).

**Carbon dioxide emissions from the combustion of fossil fuels for transportation of biomass residues to the project plant ( $PET_y$ )**

In our case the biomass residues (sunflower seeds husk) are generated directly at the project site. Thus there is no need in vehicles exploitation for biomass fuel delivering to the site and there are no any project emissions caused by the fossil fuels combustion at vehicles.

**Carbon dioxide emissions from on-site consumption of fossil fuels ( $PEFF_y$ )**

The proper and efficient operation of new sunflower husk-fired CHP plant requires the annual maintenance and planned repair stoppages of the plant. During this time all three husk fired boilers are stopped their operation and no fossil fuels are going to be combusted. In the case of unforeseen or unexpected situation (emergency at the Enterprise that leads to unexpected absence or lack of sunflower seed husk for period more than 12 hours) project foresees the possibility to use the natural gas as a reserve fuel at one of the husk boilers. During nominal operation according to working conditions no fossil fuels are going to be co-combusted with sunflower seeds husk at new CHP plant. In such case according to equation (6) of ACM0006 version 04 and also corresponds to equation (2) in Methodological tool “Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion”, $CO_2$ emissions from combustion of natural gas as the reserve fuel are calculated as follow:

$$PEFF_y = FF_{project\_plant,i,y} NCV_{NG} \cdot EF_{CO2,FF}$$

Where:

$FF_{project\_plant,i,y}$ =Quantity of natural gas combusted as the reserve fuel in case of emergency in the biomass residue fired power plant during the year y;

$NCV_{NG}$ =Net calorific value of natural gas to be combusted as the reserve fuel;

$EF_{CO2,FF}$ =$CO_2$ emission factor for natural gas, combusted as the reserve fuel;

The value of $FF_{project\_plant,i,y}$ is taken from the project design 14.1/07-8-ТЕЦ, volume 1 developed by Technology Bureau “Energomashproject”, Kyiv.

$FF_{project\_site,y}$ =200,000 $nm^3$/yr.

The net calorific value of natural gas ( $NCV_{NG}$ ) is 33.7 MJ/nm$^3$ (the Value is taken according to statistic data of Ukraine: Statistic book "Fuel-Energy Resources of Ukraine", Kiev, 1998. Issued by State Committee of Statistics of Ukraine).

$CO_2$ emission factor $EF_{CO2,FF}$ for natural gas is 56,1 $tCO_{2e}$/TJ – the value is taken from the "*2006 IPCC Guidelines for National Greenhouse Inventories, Volume 2 - Energy, Chapter 2 – Stationary Combustion*"

Project emissions caused by natural gas combustion of each operational year y are presented in the table E.1 below:

Table E.1-Project emissions caused by natural gas combustion

| | Year | | | | |
|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | 2011 | 2012 |
| $FF_{project\_site,y}$ , Quantity of natural gas to be combusted as a reserve fuel, th. nm$^3$/yr | 200,0 | 200,0 | 200,0 | 200,0 | 200,0 |
| $NCV_{NG}$ , Net calorific value of natural gas, GJ/1,000 nm$^3$ | 33.7 | 33.7 | 33.7 | 33.7 | 33.7 |
| $EF_{CO2,FF}$ , $CO_2$ emission factor for natural gas combustion, $tCO_2$/TJ | 56.1 | 56.1 | 56.1 | 56.1 | 56.1 |
| $PEFF_y$ , $CO_2$ emissions from natural gas combustion at reserve boiler, $tCO_2$ | **378,1** | **378,1** | **378,1** | **378,1** | **378,1** |

**$CO_2$ emissions from electricity consumption ( $PE_{EC,y}$ )**

$CO_2$ emissions from on-site electricity consumption ( $PE_{EC,y}$ ) are caused by purchase of electricity from the National power grid for own needs of CHP during operation time and about 1 month period of time each year when the new CHP plant is stopped due to maintenance and repair works. According to equation (6a) of ACM0006 and equation (2) of Methodological tool "Tool to calculate project emissions from electricity consumption", the $CO_2$ emissions from on-site electricity consumption are calculated by multiplying the electricity consumption by an appropriate grid emission factor, as follows:

$$PE_{EC,y} = EC_{PJ,y} \cdot EF_{grid,y}$$

Where:

$PE_{EC,y}$ =$CO_2$ emissions from on-site electricity consumption attributable to the project activity ($tCO_2$/yr);

$EC_{PJ,y}$ =On-site electricity consumption attributable to the project activity during the year y (MWh/yr);

$EF_{grid,y}$ =$CO_2$ emission factor for grid electricity during the year y ($tCO_2$/MWh).

One site electricity consumption attributable to the project activity consists of two components:

1. $EC_{PJ,CHP\_needs,y}$ - On-site electricity consumption for new CHP own needs during the year *y*,

2. $EC_{PJ,repair,y}$ On-site electricity consumption during 1 month of capital repair during the year y.

Due to technical data from project design developer "Energomashproject"electricity consumption on site is:

$EC_{PJ,CHP\_needs,y}$ = 97500 MWh/a,

$EC_{PJ,repair,y}$ = 250MWh/a.

Thus $EC_{PJ,y}$ = 97500+250=10000MWh/a.

CO2 emission factor for grid electricity consumption is 0.896 tCO2e/MWh (the justification of this value is in PDD version 4.0, dated 2 February 2007 "Utilization of Coal Mine Methane at the Coal Mine named after A.F. Zasydko"
CO2 emissions from electricity consumption for own needs of CHP plant:
$PE_{EC,y}$ =10,000 MWh·0.896 $tCO_{2e}$/MWh = 8,960 t $CO_{2e}$/a.
Total $CO_2$ emissions from electricity consumption in the project scenario:
$PE_{EC,y}$ = 10,000 MWh·0.896 $tCO_{2e}$/MWh = 8,960 t $CO_{2e}$/a.

**Methane emissions from combustion of biomass residues ($PE_{Biomass,CH4,y}$)**

The project participants decided to include this source in the project boundary. The $CH_4$ emissions caused by sunflower seeds husk combustion at new CHP plant according to the equation (6) of ACM0006 are calculated as follows:

$$PE_{Biomass,CH4,y} = EF_{CH4,BF} \cdot BF_y \cdot NCV$$

Where:
$BF_y$ = Quantity of biomass residue (sunflower seeds husk) combusted in the new CHP plant during the year y (tons of dry matter);

$NCV$ = Net calorific value of the biomass residue (sunflower seeds husk) (GJ/ton of dry matter);
$EF_{CH4,BF}$ =$CH_4$ emission factor for the combustion of sunflower seeds husk in the new CHP plant ($tCH_4$/GJ).

The net calorific value of sunflower seeds husk to be combusted in the new CHP plant is 15.4 GJ/t, and the water content of this fuel is 10% (the data of the project owner-Heat engineering laboratory of Kirovograd Edible Oil Plant).
Thus the net calorific value of dry matter of sunflower seeds husk is following:

$$NCV = NCV_{wet,10\%} = \frac{100}{100-W} = 15.4 \cdot \frac{100}{100-10} = 17.1 \text{ MJ/t.}$$

To determine the $CH_4$ emission factor, it was decided not to conduct any measurements at the plant site, but use IPCC default values, as provided in the Table 4 of ACM0006 (p.26). The uncertainty of the $CH_4$ emission factor is in many cases relatively high. In order to reflect this and for the purpose of providing conservative estimates of emission reductions, a conservativeness factor must be applied to the $CH_4$ emission factor. The level of conservativeness factor depends on the uncertainty range of the estimate for the $CH_4$ emission factor.
According to the *Table 4. Default $CH_4$ emissions factors for combustion of biomass residues* of ACM0006, default emission factor for sunflower seeds husk (that corresponds to *other solid biomass residues*) is 30 kg $CH_4$/TJ, and assumed uncertainty is 300%. For such value of uncertainty, the conservativeness factor to be applied according to the *Table 5 Conservativeness factors* of ACM0006 is 1.37. So in such case the $CH_4$ emission factor for sunflower seeds husk combustion at new CHP plant is:

$$EF_{CH4,BF} = 1.37 \cdot 30 = 41.1 \text{ kg/TJ.}$$

The $CH_4$ emission from sunflower seeds husk combustion at new CHP plant is presented in the Table E.2 below:

Table E.2-The $CH_4$ emission from sunflower seeds husk combustion at new CHP plant

| | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Quantity of sunflower seeds husk utilized at new CHP plant (t of dry matter) | 52,417 | 69,884 | 69,884 | 69,884 | 69,884 | 69,884 |
| Net calorific value of sunflower seeds husk (GJ/t of dry matter) | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 |
| Energy of sunflower seeds husk utilized at new CHP plant, TJ/yr | 665.8 | 887.6 | 887.6 | 887.6 | 887.6 | 887.6 |
| $CH_4$ emissions factor of sunflower seeds husk, $tCH_4$/TJ | 0.0411 | 0.0411 | 0.0411 | 0.0411 | 0.0411 | 0.0411 |
| Methane emissions from sunflower seeds husk combustion at new CHP plant, $tCH_4$ | 27.36 | 36.48 | 36.48 | 36.48 | 36.48 | 36.48 |
| Methane emissions from sunflower seeds husk combustion at new CHP plant, $tCO_{2e}$ | **696,2** | **928,3** | **928,3** | **928,3** | **928,3** | **928,3** |

Total project greenhouse gases emissions in $tCO_2$ are presented in the Table E.3 below:

Table E.3-Total project greenhouse gases emissions

| | Year | | | | | |
|---|---|---|---|---|---|---|
| **Source** | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| $PET_y$, Emissions from biomass residues transportation, $tCO_2$ | 0 | 0 | 0 | 0 | 0 | 0 |
| $PEFF_y$ ,Emissions from on-site fossil fuels consumption, $tCO_2$ | 378,1 | 378,1 | 378,1 | 378,1 | 378,1 | 378,1 |
| $PE_{EC,y}$ ,Emissions from on-site electricity consumption, $tCO_2$ | 8960,0 | 8960,0 | 8960,0 | 8960,0 | 8960,0 | 8960,0 |
| $PE_{Biomass,CH4,y}$ ,Methane emissions from biomass residue combustion, $tCO_2$ | 696,2 | 928,3 | 928,3 | 928,3 | 928,3 | 928,3 |
| $PE_y$, Total project emissions, $tCO_2$ | **10034,4** | **10266,4** | **10266,4** | **10266,4** | **10266,4** | **10266,4** |

## E.2. Estimated leakage:

As indicated in the section B.**2 "Barrier analysis for the husk use alternatives"** the leakages under the project may be neglected, and therefore, were taken equal to zero.

## E.3. The sum of E.1. and E.2.:

Since leakages can be neglected: E.1+E.2 = E.1 (see section E.1).

## E.4. Estimated baseline emissions:

**Baseline emissions due to grid electricity consumption**

Emission reduction due to replacement of electricity are calculated by multiplying the net quantity of increased electricity generated with biomass residues as a result of the project activity ($EG_y$) with the $CO_2$ baseline emission factor for the electricity displaced due to the project ($EF_{electricity,y}$), as follows:

$$ER_{electricity,y} = EG_y \cdot EF_{electricity,y}$$

Where:

$ER_{electricity,y}$ =Emission reductions due to displacement of electricity during the year y ($tCO_2$/yr);

$EG_y$ =Net quantity of increased electricity generation as a result of the project activity (increment of baseline generation) during the year y (MWh);

$EF_{electricity,y}$ =$CO_2$ emission factor for the electricity displaced due to the project activity during the year y ($tCO_2$/MWh).

Step 1: Determination of the emission factor for displacement of electricity $EF_{electricity,y}$

As project activity foresees the displacement of the grid electricity which consumption would have had place in the case of the absence of proposed project activity, the emission factor for the displacement electricity should correspond to the grid emission factor ($EF_{electricity,y} = EF_{grid,y}$) and $EF_{grid,y}$ shall be determined depends on power capacity of new CHP plant.

According to ACM0006 if the power generation capacity of the project plant is less or equal to 15 MW (as it is in our case – 1.7 $MW_{el}$), the average $CO_2$ emission factor of the electricity system[6] may alternatively used by the project participants.

But as it was proved in the standardization of emission factors for the Ukrainian electricity grid[7] the average Operational Margin (OM) calculation in order to calculate the grid electricity emission factor would not present a realistic picture and distort the results, since nuclear power plants always work in the base load due to the technical limitations (and therefore cannot be displaced) and constitute up to 48% of the overall electricity generation during the past 5 years. Therefore the Simple Margin (SM) approach was used to calculate the grid emission factor in Ukraine.

According to PDD "Utilisation of Coal Mine Methane at the Coal Mine named after A.F. Zasydko[8]" the grid electricity emission factors for JI electricity reducing projects for 2006-2012 is equal to 0.896 $tCO_2$/MWh):

Step 2: Determination of $EG_y$.

According to ACM0006, if the produced electricity at the new CHP plant to be consumed on-site and substitutes the grid electricity that would have been purchased from the grid in the absence of proposed project activity, then quantity of $EG_y$ corresponds to the net quantity of electricity generation in the project plant ($EG_y = EG_{project\_plant,y}$). In such case the emission reduction due to displacement of electricity is presented in the table E.4 below:

[6] AS referred to in option (d) in step 1 of the baseline determination in ACM0002

[7] PDD version 4.0, dated 2 February 2007 "Utilisation of Coal Mine Methane at the Coal Mine named after A.F. Zasydko"

[8] PDD version 4.0, dated 2 February 2007 "Utilisation of Coal Mine Methane at the Coal Mine named after A.F. Zasydko"

Table E.4 - Emission reduction due to displacement of electricity

| | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Quantity of electricity generation in the CHP plant, $EG_{project\_plant,y}$ MWh | 13,000 | 13,000 | 13,000 | 13,000 | 13,000 | 13,000 |
| Emission factor, $EF_{electricity,y}$, $tCO_2/MWh$ | 0.896 | 0.896 | 0.896 | 0.896 | 0.896 | 0.896 |
| **Emission reduction** $ER_{electricity,y}$, **$tCO_2$/yr** | **11,648** | **11,648** | **11,648** | **11,648** | **11,648** | **11,648** |

**Baseline emissions due to natural gas combustion for heat generation.**

In our case when the cogeneration plant is going to be put into operation, it is necessary to determine the emission reduction due to displacement of heat ( $ER_{heat,y}$ ).

As the identified baseline scenario is the generation of heat in steam boilers using the fossil fuels (natural gas), baseline emissions are calculated by multiplying the savings of fossil fuel (natural gas) with the emission factor of this fuel (natural gas).

Emissions reductions from savings of fossil fuels are determined by dividing the quantity of generated heat that displaces heat generation in fossil fuel fired boilers ( $Q_y$ ) by the efficiency of the boiler that would be used in the absence of the project activity ( $\varepsilon_{boiler}$ ), and by multiplying with the $CO_2$ emission factor of the fuel type that would be used in the absence of the project activity for heat generation ( $EF_{CO2,BL,heat,i}$ ), as follows:

$$ER_{heat,y} = \frac{Q_y \cdot EF_{CO2,BL,heat,i}}{\varepsilon_{boiler}}$$

Where:

$ER_{heat,y}$ = Emission reductions due to displacement of heat during the year y ($tCO_2$/yr);

$Q_y$ = Quantity of increased heat generation in the project plant;

$\varepsilon_{boiler}$ =Energy efficiency of the boiler that would be used in the absence of the project activity.

In our case when the baseline scenario is that all heat generated by the cogeneration project plant would in the absence of the project activity be generated in fossil fuel fired boilers $Q_y = Q_{project\_plant,y}$

$Q_{project\_plant,y}$ =Net quantity of heat generated in the cogeneration project plant from firing biomass residues (sunflower seeds husk) during the year y (GJ).

$EF_{CO2,BL,heat,i}$ =$CO_2$ emission factor of the natural gas used for heat generation in the absence of project activity ($tCO_2$/GJ).

Emission reduction due to displacement of heat generation using fossil fuel by heat generated from biomass residues is presented in the table E.5 below:

Table E.5 - Emission reduction due to displacement of heat generation using fossil fuel by heat generated from biomass residues

| | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Quantity of heat generated in the CHP plant, $Q_{project\_plant,y}$ GJ/yr | 350,978 | 350,978 | 350,978 | 350,978 | 350,978 | 350,978 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Energy efficiency of existing steam gas-fired boiler | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Emission factor of natural gas, $EF_{CO2,BL,heat,i}$ , $tCO_2$/TJ | 56.1 | 56.1 | 56.1 | 56.1 | 56.1 | 56.1 |
| **Emission reduction, $ER_{heat,y}$ $tCO_2$/yr** | **21,402** | **21,402** | **21,402** | **21,402** | **21,402** | **21,402** |

**Baseline emissions due to natural decay or uncontrolled burning of anthropogenic sources of biomass residues**

As project participants decided to include this emission reduction source into the project boundaries then baseline emissions due to decay of the sunflower seeds husk ( $BE_{Biomass,y}$ ) is determined in two steps:

Step 1: Determination of the quantity of biomass residues used as a result of the project activity.

Step2: Estimation of methane emissions, consistent with the baseline scenario for the use of biomass residues

Step 1. Determination of the quantity of sunflower seeds husk used as a result of the project activity ( $BF_{PJ,k,y}$ )

According to ACM0006 and chosen scenario, the total quantity of biomass residues used in the project plant is attributable to the project activity and hence $BF_{PJ,k,y} = BF_{k,y}$

Step 2. Estimation of methane emissions, consistent with the baseline scenario for the use of biomass residues.

As the most likely baseline scenario for the use of the biomass residues is that the biomass residues would decay under clearly anaerobic conditions, the baseline emissions are calculated using the latest approved version of the *"Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site"*.

The amount of methane that would in the absence of the project activity been generated from disposal of sunflower seeds husk at the solid waste disposal site is calculated with a multi-phase model. The calculation is based on the first order decay (FOD) model. The model calculates the methane generation based on the actual waste (sunflower seeds husk) streams disposed in each year x, starting with the first year after the start of the project activity until the end of the year y, for which baseline emissions are calculated.

The amount of methane produced in the year y ( $BE_{CH4,SWDC,y}$ ) due to decay of sunflower seeds husk at the landfill is calculated as follows:

$$BE_{CH4,SWDC,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} W_x \cdot DOC \cdot e^{-k_j \cdot (y-x)} \cdot (1-e^{-k_j})$$

Where:

$BE_{CH4,SWDC,y}$ =Methane emissions avoided during the year y from preventing sunflower seeds husk at the landfill during the period from the start of the project activity to the end of the year y ($tCO_2$);

$\varphi$ =Model correction factor to account for model uncertainties;

f =Fraction of the methane captured at the landfill and flared, combusted or used in another manner;

$GWP_{CH4}$ =Global warming potential of methane, valid for the relevant commitment period;

OX =Oxidation factor (reflecting the amount of methane from landfill that is oxidized in the soil or other material covering the waste);

F =Fraction of methane in the landfill gas;

$DOC_f$ =Fraction of degradable organic carbon that can decompose;

MCF =Methane correction factor;

$W_x$ =Amount of sunflower seeds husk prevented from disposal in the landfill in the year x (tons);

$DOC$ =Sunflower seeds husk fraction of degradable organic carbon (by weight);

k =Decay rate for the sunflower seeds husk;
x =Year during the crediting period: x runs from the first year of the first crediting period (x=1) to the year y for which avoided emissions are calculated;
y =Year for which methane emissions are calculated.

Selection of proper values for calculation:

1) Model correction factor to account for the model uncertainties $\varphi$=0.9. Such value is applied in order to estimate emission reductions in a conservative manner – a discount of 10% is applied to the model results;
2) Oxidation factor OX = 0 as the waste disposal site (landfill) where the sunflower seeds husk would have been dumped in the absence of proposed project activity is not covered with any oxidizing material such as soil or compost;
3) Fraction of methane in landfill gas F=0.5, according to IPCC guidelines for National Greenhouse Gas Inventories;
4) Fraction of degradable organic carbon that can decompose $DOC_f$ =0.5, according to IPCC guidelines for National Greenhouse Gas Inventories;
5) Methane correction Factor MCF = 0.8, as the Kirovograd landfill is classified as unmanaged deep solid waste disposal sites. Its depth reaches 10-16 m that is more than 5 meters but landfill does not have cover material, neither mechanical compacting or leveling of the waste;
6) Fraction of degradable organic carbon in the sunflower seeds husk $DOC_j$ = 0.5 according to the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 5, Table 2.4). As sunflower seeds husk cannot be clearly attributed to one of the waste types in the IPCC Guidelines, the DOC for dry wood was selected by project participants to be applied in calculations, as the dry wood waste has the most similar characteristics to husk.
7) Decay rate for the sunflower seeds husk k=0.03. According to the Table 3.3 of Volume 5 of IPCC Guidelines for National Gas Inventories. The default k value for wood, wood products and straw was selected for calculation as this type of waste has the most similar characteristics to sunflower seeds husk. The climate of Kirovograd region is justified to be Boreal wet:
8) Mean annual temperature in Kirovograd region is +7.5 C.
9) MAP – mean annual precipitation = 550 mm/yr.
10) PET – potential evapotranspiration = 500 mm/yr.

Thus MAP/PET>1,

11) As at the moment no methane is captured at existing Kirovograd landfill, and there are no any initiatives to construct any landfill gas collection and utilization system at Kirovograd landfill, we may apply the Fraction of methane captured at the landfill and flared, combusted and used in another manner f=0.
12) Global Warming Potential of methane $GWP_{CH4}$=21. This value is valid for the first commitment period due to the Decision under UNFCCC and the Kyoto Protocol.
13) Amount of sunflower seeds husk prevented from disposal at the landfill is 52,413 t/a for the 2007 (when only the first line of proposed project to be completed) and 69,884 t/yr during the each year after 2007. These figures are the wet matter amount of waste sunflower seeds husk, the moisture content is 10%.

Baseline methane emissions $BE_{CH4,SWDC,y}$ in $tCO_{2e}$ due to natural decay of sunflower seeds husk at the landfill during the commitment period (2008-2012) are presented in the table E.6 below:

Table E.6 - Baseline methane emissions $BE_{CH4,SWDC,y}$ in $tCO_{2e}$

| Sunflower seeds husk dumped, t/yr | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Total (2008-2012) |
|---|---|---|---|---|---|---|---|
| | 3903,6 | 8993,0 | 13932,0 | 18725,1 | 23376,5 | 27890,4 | 92,917.0 |

Total baseline $CO_2$ emissions are presented in the table E.7 below:

Table E.7 - Total baseline $CO_2$ emissions

| Source | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Electricity purchasing from the grid | 11,648 | 11,648 | 11,648 | 11,648 | 11,648 | 11,648 |
| Natural gas combustion for heat generation | 21,402 | 21,402 | 21,402 | 21,402 | 21,402 | 21,402 |
| Sunflower seeds husk decay at the landfill | 3903,6 | 8993,0 | 13932,0 | 18725,1 | 23376,5 | 27890,4 |
| Total | 36 953,6 | **42 043,0** | **46 982,0** | **51 775,1** | **56 426,5** | **60 940,4** |

**E.5. Difference between E.4. and E.3. representing the emission reductions of the project:**

The difference between baseline emissions (E.4) and project emissions (E.1) are presented in the table E.8 below:
Table E.8 - Total emission reduction

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Project emissions | 10034,3 | 10266,4 | 10266,4 | 10266,4 | 10266,4 | 10266,4 |
| Baseline emissions | 36953,6 | 42043,1 | 46982,1 | 51775,1 | 56426,5 | 60940,4 |
| Emission reduction | 26919,3 | 31776,7 | 36715,7 | 41508,7 | 46160,1 | 50674,0 |
| Total emission reduction during commitment period ( 2008-2012) | | | | | | **206, 835** |

**E.6. Table providing values obtained when applying formulae above:**

| Year | Estimated project emissions (tonnes of $CO_2$ equivalent) | Estimated leakage (tonnes of $CO_2$ equivalent) | Estimated baseline emissions (tonnes of $CO_2$ equivalent) | Estimated emissions reductions (tonnes of $CO_2$ equivalent) |
|---|---|---|---|---|
| 2008 | 10266,4 | 0 | 42043,1 | 31776,7 |
| 2009 | 10266,4 | 0 | 46982,1 | 36715,7 |
| 2010 | 10266,4 | 0 | 51775,1 | 41508,7 |
| 2011 | 10266,4 | 0 | 56426,5 | 46160,1 |
| 2012 | 10266,4 | 0 | 60940,4 | 50674,0 |
| Total (tonnes of $CO_2$ equivalent) | | 0 | | **206, 835** |

## SECTION F. Environmental impacts

**F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:**

Before the start of the project implementation, OJSC "Kirovogradoliya" has received all the required conclusions of the state ecology examinations.
Project implementation increases biomass residues (husk) consumption as fuel while decreasing consumption of fuel oil (natural gas).
This results in the reduction of GHG emissions into the atmosphere.

**F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:**

Some environmental effects will occur during the project lifetime.

Effects on the medium air

Comparing to natural gas combustion (baseline scenario), the combustion of sunflower seeds husk is "dirtier" and requires installation of corresponding cleaning system. Concentration of pollutants in flue gas of husk fired boiler E-16-3,9-360 D is dust - 0.39 $g/Nm^3$, $NO_x$ – 0.3 $g/Nm^3$, CO – 2.00 $g/Nm^3$. To avoid ingress of contamination into the atmosphere project foresees some mitigation measures.

Mitigation measures

Flue gas cleaning system for husk fired boilers consists of three two-field horizontal electrostatic cleaner type EGU 15-12-6W-2 .The efficiency of electrostatic filter is 99% (data is taking from working design project according to manufacture′s technical characteristic). Dissemination of flue gas after CHP work is anticipated by the way of individual 75 m height chimney construction.

## SECTION G. Stakeholders' comments

**G.1. Information on stakeholders' comments on the project, as appropriate:**

No comments yet.

Annex 1

**CONTACT INFORMATION ON PROJECT PARTICIPANTS**

*Project Participant 1*

| | |
|---|---|
| Organisation: | Open Joint-Stock Company ‘Kirovogradoliya’ |
| Street/P.O.Box: | 30 Urozhaina str., 25013, , Ukraine |
| Building: | 30 |
| City: | Kirovograd |
| State/Region: | Kirovograd region |
| Postal code: | 25013 |
| Country: | Ukraine |
| Phone: | +38 0522 390 112 |
| Fax: | +38 0522 565 896 |
| E-mail: | post@vatko.kr.ua |
| URL: | |
| Represented by: | Vladimir Umrikhin |
| Title: | Chief of the board at the OJSC ‘Kirovogradoliya’ |
| Salutation: | Mr. |
| Last name: | Umrikhin |
| Middle name: | Konstantinovich |
| First name: | Vladimir |
| Department: | |
| Phone (direct): | +38 0522 390 122 |
| Fax (direct): | +38 0522 565 896 |
| Mobile: | +38 050-341-25-90 |
| Personal e-mail: | |

*Project Participant 2*

| | |
|---|---|
| Organisation: | Holding Grain Company |
| Street/P.O.Box: | Verkhniy Val str., Ukraine |
| Building: | 72 |
| City: | Kyiv |
| State/Region: | Ukraine |
| Postal code: | 04070 |
| Country: | Ukraine |
| Phone: | +(38 044) 238 65 65 |
| Fax: | +(38 044) 238 65 64 |
| E-mail: | M.m@grain-tc.com |
| URL: | www.grain-tc.com |
| Represented by: | Mr. Maxim Matveev |
| Title: | Director of Financial Economic Department |
| Salutation: | Mr. |
| Last name: | Matveev |
| Middle name: | |
| First name: | Maxim |
| Department: | Economic Department |
| Phone (direct): | +(38 044) 238 65 65 |
| Fax (direct): | +(38 044) 238 65 64 |
| Mobile: | mobile 203-10-85 |
| Personal e-mail: | M.m@grain-tc.com |

*Project Participant 3*

| | |
|---|---|
| Organisation: | Scientific Engineering Centre “Biomass” |
| Street/P.O.Box: | Zhelyabov str., Ukraine |
| Building: | 2A, |
| City: | Kyiv |
| State/Region: | Kyivskiy region |
| Postal code: | 03057 |
| Country: | Ukraine |
| Phone: | +38 044 456 94 62 |
| Fax: | +38 044 453 2856 |
| E-mail: | info@biomass.kiev.ua |
| URL: | www.biomass.kiev.ua |
| Represented by: | Georgiy Geletukha |
| Title: | Chef of SEC ”Biomass” |
| Salutation: | Mr. |
| Last name: | Geletukha |
| Middle name: | Georgievich |
| First name: | Georgiy |
| Department: | Bioenergy department |
| Phone (direct): | +38 044 456 94 62 |
| Fax (direct): | +38 044 453 2856 |
| Mobile: | |
| Personal e-mail: | Geletukha@biomass.kiev.ua |

Annex 2

## BASELINE INFORMATION

## Annex 2.1

### 2.1.1 Technical characteristics

### 1.1 Old boilers

(Translation)

**Boiler N1**

**Certificate**
on the quality of boiler manufacture

Boiler, serial No 1079, was manufactured in **March 1971**.

Manufacturer: the Biysk boiler works, Biysk, P. Merlina street, 63.
Type, system: DKVR 10-13-250º, two-drums water-tube with furnace for combustion of gas and mazut

Design pressure of steam:
a) in the drum 14 kilogram-force/cm$^3$
b) at the outlet of steam super-heater 13 kilogram-force/cm$^3$

Design temperature of superheated steam 250 ºC
Steam production 10 t/h

Heating surface:
a) boiler itself (convective) 207.5 m$^2$
b) dasher (radiation) 47.9 m$^2$
c) steam super-heater 17 m$^2$
Total 272.4 m$^2$

Volume of the boiler:
water 9.04 m$^3$
steam 2.56 m$^3$
feeding 1.36 m$^3$

(Translation)

**Boiler N2**

**Certificate**
on the quality of boiler manufacture

Boiler, serial No 4, was manufactured in **June 1962**.

Manufacturer: the Biysk boiler works, Biysk, P. Merlina street, 63.
Type, system: DKVR 20-13-250º, two-drums water-tube

Design pressure of steam:
a) in the drum 14 kilogram-force/cm$^3$
b) at the outlet of steam super-heater 13 kilogram-force/cm$^3$

Design temperature of superheated steam 250 ºC
Steam production 20 t/h

Heating surface:
a) boiler itself 270 m$^2$
b) dasher (radiation) 73.5 m$^2$
c) dasher (building) -
d) steam super-heater 34 m$^2$
e) Water economizer -
Total 377.5 m$^2$

Volume of the boiler:
water 10.6 m$^3$
steam 1.8 m$^3$
feeding 0.88 m$^3$

(Translation)

**Boiler N3**

**Certificate**
on the quality of boiler manufacture

Boiler, serial No 3442, was manufactured in **December 1976**.

Manufacturer: the Biysk boiler works, Biysk, P. Merlina street, 63.
Type, system: DKVR 20-13-250 (E-20-14-250), two-drums water-tube with furnace for combustion of gas and mazut

Design pressure of steam:
a) in the drum 14 kilogram-force/$cm^3$
b) at the outlet of steam super-heater 13 kilogram-force/$cm^3$

Design temperature of superheated steam 250 ºC
Steam production 20 t/h

Heating surface:
a) boiler itself (convective) 285 $m^2$
b) dasher (radiation) 73.5 $m^2$
c) steam super-heater 34 $m^2$
d) -
e) -

Volume of the boiler:
water 10.5 $m^3$
steam 1.8 $m^3$
feeding 0.88 $m^3$

**1.2 Technical characteristics for gas boiler proposed for installation in the baseline scenario**

In the baseline scenario 1 the old boilers are put out of operation and dismantled and 1 new operational gas-fired boiler DE-25-1,4-225 GMO of 15.5 MW is installed to meet thermal energy requirements of the technological process at the Enterprise.

Table 2.1. Technical characteristics of gas fired boiler DE-25-1,4-225 GMO

| Parameter | Numerical value |
|---|---|
| Manufacturer | OJSC "TEKOM" (Ukraine) |
| Design temperature superheated steam, ºC | 225 |
| Design pressure of superheated steam (absolute), MPa<br>- after steam super-heater<br>- in boiler drum | <br>1.25<br>1.4 |
| Steam production, t/h | 25 |
| Feed water temperature, ºC | 104 |
| Temperature of flue gases, ºC | 170 |
| Efficiency, % | up to 92 |
| Type of fuel combustion | flare |
| Emission of NOx, mg/m3 | meets the standards |
| Emission of flying ash, g/m3 | meets the standards |
| Emission of SOx, mg/m3 | meets the standards |
| | |

**2.1.2.Economical indexes**

For calculations of economical indexes of project and baseline scenario t
he following values were used:
Income tax rate -– 25%:
Amortisation rate for buildings –3,0 %.
Amortization rate for equipment – 6,0 %.
Discount rate for 2005 year – 10 %.
Discount rate for 2007 year -15 %, because the inflation has increased.

**2.1.3. Investments costs for 2007 year prices**

| PROJECT SCENARIO | |
|---|---|
| **Investment costs** | **EURO** |
| Design and certification works in Ukraine | 72 000 |
| Land | 18 000 |
| Boiler house construction | 560 000 |
| Construction works | 1 825 000 |
| Equipment (three husk fired boilers and CHP equipment) | 6 865 000 |
| Assembly and start-up | 3 360 000 |
| Contingencies | 527 000 |
| **Total** | **13 227 000** |

| BASELINE SCENARIO | |
|---|---|
| **Investment costs** | **EURO** |
| Ukrainian design and certification works | 57 000 |
| Use of land | 8 000 |
| Boiler house building reconstruction | 40 000 |
| Construction works | 320 000 |
| Equipment (one gas fired boiler: 1 - operational) | 650 000 |
| Assembly and start-up | 520 000 |
| Contingencie | 50 000 |
| Total | **1 645 000** |

**2.1.4. Investments costs for 2005 year prices**

| Project scenario | |
|---|---|
| **Investment costs** | **EURO** |
| Design and certification works in Ukraine | 1730 |
| Land | 7652 |
| Boiler house construction | 187627 |
| Construction works | 1022855 |
| Equipment (three husk fired boilers and CHP equipment) | 4227462 |
| Equipment (stand-by gas boiler) | 286006 |
| Assembly and start-up | 255714 |
| Contingencies | 59890 |
| **Total** | **6 048 936** |

| Baseline scenario | |
|---|---|
| **Investment costs** | **EURO** |
| Ukrainian design and certification works | 1000 |
| Use of land | 7652 |
| Boiler house building reconstruction | 44000 |
| Construction works | 42000 |
| Equipment (two gas fired boilers: 1 - operational, 2 - stand-by) | 572000 |
| Assembly and start-up | 22000 |
| Contingencies | 68865,2 |
| **Total** | **757 517** |

**2.1.5. Protocols of technical meetings.**

**Protocol 1**

(Translation)

**"Agreed"**
Chief Engineer
OJSC "Kirovogradoliya"
V.K. Umrikhin

**Protocol N 26.09.04**
of technical meeting

26.09.2004 Kirovograd

**Present**
OJSC "Kirovogradoliya"

| | |
|---|---|
| Chief Engineer | Umrikhin V.K. |
| Deputy Chief Engineer | Chernysh N.L. |
| Chief Power Engineer | Demidenko N.T. |
| Head of boiler house | Sopov V.V. |
| Combustion engineer | Kosolapov V.V. |

**Subject of discussion:**

1. Technical and economic possibility to replace old steam boilers which exceeded their operational lifetime by new gas boilers.

a) Chief Power Engineer Demidenko N.T. gave a report about necessity to replace old steam boilers because they had exceeded their period of exploitation. His resolution: it is necessary to replace old boilers by new gas boilers.

b) Head of boiler house Sopov V.V. gave a report.
Point of the report: the equipment of boiler house became out of date (morally and physically). To continue its exploitation it is necessary all the time to apply to State labour protection body in order to conduct technical diagnosing of the boilers. It means that the boilers need permanent control that leads to additional expenditures. Under present conditions, there exists a real threat of the boilers and auxiliary equipment breakdown that will result in laying-off of the whole enterprise.

**Resolution:**
To investigate technical and economic possibility to replace the old boilers by new gas boilers.

**Signed:**

| | |
|---|---|
| Deputy Chief Engineer | N.L. Chernysh |
| Chief Power Engineer | N.T. Demidenko |
| Head of boiler house | V.V. Sopov |
| Combustion engineer | V.V. Kosolapov |

**Protocol 2**

(Translation)

**"Agreed"**
Chief Engineer
OJSC "Kirovogradoliya"
V.K. Umrikhin

**Protocol N 21.02.05**
of technical meeting

21.02.2005 Kirovograd

**Present**
OJSC "Kirovogradoliya"

| | |
|---|---|
| Chief Engineer | Umrikhin V.K. |
| Deputy Chief Engineer | Chernysh N.L. |
| Chief Power Engineer | Demidenko N.T. |
| Head of boiler house | Sopov V.V. |

**Subject of discussion:**

1. Participation of OJSC "Kirovogradoliya" in Austrian Program JI/CDM
2. Technical and economic possibility to construct CHP plant with new husk fired boilers.
3. To request SEC "Biomass" to prepare grounding documents.

**Resolution:**
As the enterprise plans to increase the volume of sunflower seeds processing to 1200 t/day, the volume of husk will increase to 170 t/day. Existing boiler house is not able to consume this amount of husk.

According to information obtained from SEC "Biomass", OJSC "Kirovogradoliya" can realize the project within the framework of Austrian Program JI/CDM and get additional finances from selling ERUs. Taking into account the fact, it is necessary to consider construction of CHP plant and purchase of new husk fired boilers which will be able to consume mentioned above amount of husk.

It is necessary to request SEC "Biomass" to prepare grounding documents.

**Signed:**

| | |
|---|---|
| Deputy Chief Engineer | N.L. Chernysh |
| Chief Power Engineer | N.T. Demidenko |
| Head of boiler house | V.V. Sopov |

(Translation)

**"Agreed"** **Protocol 3**

Chief of the Board
OJSC «Kirovogradoliya»
_________S.I.Tarshyn

**Protocol № 20.08.05**
of technical meeting

20.08.2005 Kirovograd

**Present**
OJSC "Kirovogradoliya"

| | |
|---|---|
| Chief Engineer | Umrikhin V.K. |
| Deputy Chief Engineer | Chernysh N.L. |
| Chief Power Engineer | Demidenko N.T. |
| Head of boiler house | Sopov V.V. |
| Heat and power engineer | Kosolapov V.V |

**Subject of discussion:**

1. Participation of OJSC "Kirovogradoliya" in Austrian Program JI/CDM.
2. Main findings of JI project determination.
3. Technical and economic possibility to construct CHP plant with new husk fired boilers taking into account possibility to get an additional financing if the project will be implemented as JI project and will generate additional income from selling ERUs.
4. Technical and economic possibility to replace old steam boilers by new gas boilers.

**Resolution:**

Taking into account the possibility to implement JI project together with Austrian Programm JI/CDM and those decreasing the financial risks related to CHP construction due to possibility of ERUs sales, management of OJSC "Kirovogardoliya decides to revise the original decision about gas-fired boiler installation and decide to construct the first in Ukraine combined heat and power plant fuelled with solid biomass (sunflower seeds husk) and implement this project as JI project.

**Signed:**

| | |
|---|---|
| Chief Engineer | Umrikhin V.K. |
| Deputy Chief Engineer | Chernysh N.L. |
| Chief Power Engineer | Demidenko N.T. |
| Head of boiler house | Sopov V.V. |
| Heat and power engineer | Kosolapov V.V |

**2.1.6. Costs for repairs of old boilers**

(Translation)

REFERENCE

Cost of repairs and modernization of boilers DKVR 20/13 (2 boilers) and DKVR 10/13 by repair and engineering division of OJSC “Kirovogradoliya” in 1999, 2000, 2001, 2002 amounted to 1033 thousand UAH

Chief accountant
T.A. Pavlova

**2.1.7 Husk content in sunflower seeds**

(Translation)

OJSC "Kirovogradoliya"

30.01.08

REFERENCE
About husk content in sunflower seeds, which are supplied for treatment
to OJSC "Kirovogradoliya" during 2003-2007 years

| Year | Husk content in sunflower seeds % |
|---|---|
| 2003 | 25,19 |
| 2004 | 25,72 |
| 2005 | 26,13 |
| 2006 | 26,53 |
| 2007 | 27,75 |

Head of the laboratory Tasenko V.A

**2.1.8 Document about operational lifetime of old steam boilers**

(Translation)
OJSC "Kirovogradoliya"

ACCEPTED BY

Chief Engineer
__________ Bratunyak O.F.
"_16_"____01_____2008

ACT

We, undersigned, the Chief power engineer - Mr. Demydenko N.T. and the Head of the boiler house Mr. Sopov V.V., draw up this document, which certifies that boilers of the boiler house were put into operation and work through the following period of time:

| Boiler | Reg. № | Year of manufacture | Putting into operation | Total operational time, years |
|---|---|---|---|---|
| DKVR-10/13 № 1 | 361 | March 1971 | 1973 | 34 |
| DKVR-20/13 № 2 | 196 | June 1962 | 1966 | 41 |
| DKVR-20/13 № 3 | 802 | December 1976 | 1977 | 30 |

The lifetime of the DKVR type boilers is 20 years. Thus, the boilers DKVR-10/13 № 1, DKVR-20/13 № 2 and DKVR-20/13 № 3, has exceeded their operational life time and must be replaced.

The copies of manufacture boilers certificates are attached.

The Chief power engineer Mr. Demydenko N.T

The Head of boiler house Mr. Sopov V.V.

## 2.1.9 Reference about volume of sunflower seeds treated and husk generated at the OJSC "Kirovogradoliya" during 2003-2007 years.

(Translation)

OJSC "Kirovogradoliya"

"1-st" February 2008 Kirovograd city

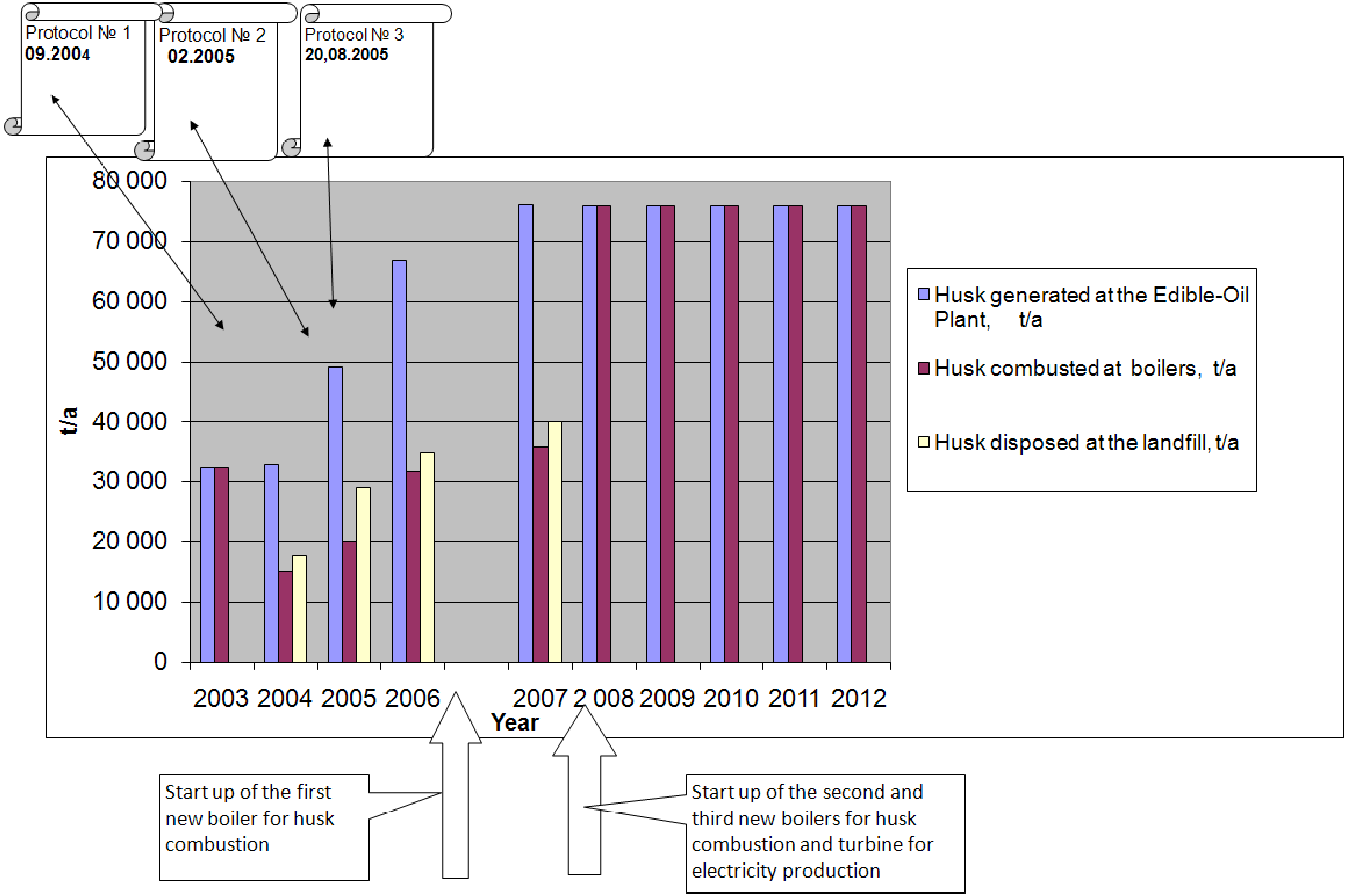
REFERENCE

About the processing amounts
of sunflower seeds at the OJSC "Kirovogradoliya"
and the output of waste products (husk)
in seeds processing in period 2003-2007

| Year | The amount of processing sunflower seeds, ths. t/year | The amount of processing sunflower seeds, t/24hours | The output of sunflower seeds husk (annual), % | The amount of sunflower seeds husk from treatment, ths. t/year | The amount of sunflower seeds husk from treatment, t/24hours | The amount of sunflower seeds husk, which combusted in boilers, ths. t/year | The amount of sunflower seeds husk, which dumped to the landfill, ths. t/year |
|---|---|---|---|---|---|---|---|
| 2003 | 203003 | 615 | 15,94 | 32 359 | 98 | 32 355 | 4 |
| 2004 | 201891 | 612 | 16,37 | 33 050 | 100 | 15 302 | 17 748 |
| 2005 | 292068 | 885 | 16,86 | 49 243 | 149 | 20 102 | 29 141 |
| 2006 | 382621 | 1 159 | 17,46 | 66 806 | 202 | 31 870 | 34 936 |
| 2007 | 402954 | 1 221 | 18,88 | 76 078 | 231 | 35 916 | 40 162 |

Manufacturing manager ________________________ R.M. Polishchuyk
Tel. 39-01-34

**2.1.10 Graphical representation of all facts and arguments proving the baseline scenario**



### 2.1.11 Costs of husk disposal at the landfill

(Translation)

Open Join Stock Company
**"Kirovogradoliya"**

**ISO 9001:2000**

Urozhaina street 30, Kirovograd city, 25013
s/a 260031845 in OJSC "Raiffeisen Bank Aval"
Tel.: 39-01-22, 24-59-78, Fax: 22-78-35
e-mail: post@vatko.kr.ua

**REFERENCE**

Costs related to dumping of the sunflower seeds husk at the city landfill in the period 2003-2007 are 686.2 ths. hryvnas, including annually:

| Year | Landfill services | Transportation services | Total (ths. hryvnas) |
|---|---|---|---|
| 2003 | 10,6 | 9,0 | 19,6 |
| 2004 | 24,2 | 17,0 | 41,2 |
| 2005 | 49,0 | 52,0 | 101,0 |
| 2006 | 104,9 | 160,0 | 264,9 |
| 2007 | 83,7 | 175,8 | 259,5 |
| Total | 272,4 | 413,8 | 686,2 |

Chief accountant Pavlova T.A.

# Annex 2.2

## 1. Economical indexes for 2007 year prices and tariffs

**Baseline scenario for 2007 prices and tariffs**

**BASELINE SCENARIO**

| Item | Year of operation | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Investment costs | 1 645 000 | | | | | | | | | | | | | | |
| Operating costs | 0 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 | 2 484 784 |
| Loan interests | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Amortization assesments | | 142 513 | 111 267 | 86 872 | 67 825 | 52 954 | 41 344 | 32 279 | 25 202 | 19 676 | 15 362 | 11 994 | 9 364 | 7 311 | 5 708 |
| Amortizaton assessment for | | 41 295 | 36 558 | 32 364 | 28 652 | 25 365 | 22 456 | 19 880 | 17 600 | 15 581 | 13 794 | 12 211 | 10 811 | 9 571 | 8 473 |
| Amortizaton assessment | | 183 808 | 147 825 | 119 236 | 96 477 | 78 320 | 63 800 | 52 159 | 42 802 | 35 257 | 29 156 | 24 205 | 20 175 | 16 882 | 14 181 |
| Total revenue | 0 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 | 2 842 357 |
| Balance sheet profit | 0 | 173 765 | 209 748 | 238 336 | 261 095 | 279 253 | 293 773 | 305 413 | 314 771 | 322 315 | 328 416 | 333 367 | 337 397 | 340 691 | 343 391 |
| Income tax | 0 | 43 441 | 52 437 | 59 584 | 65 274 | 69 813 | 73 443 | 76 353 | 78 693 | 80 579 | 82 104 | 83 342 | 84 349 | 85 173 | 85 848 |
| Net profit | 0 | 130 323 | 157 311 | 178 752 | 195 822 | 209 440 | 220 329 | 229 060 | 236 078 | 241 736 | 246 312 | 250 025 | 253 048 | 255 518 | 257 544 |
| Cash flow | -1 645 000 | 314 131 | 305 135 | 297 988 | 292 298 | 287 759 | 284 129 | 281 219 | 278 880 | 276 994 | 275 468 | 274 231 | 273 223 | 272 400 | 271 725 |
| Money on the account | **-1 645 000** | **-1 330 869** | **-1 025 733** | **-727 745** | **-435 447** | **-147 687** | **136 442** | **417 661** | **696 540** | **973 534** | **1 249 002** | **1 523 233** | **1 796 456** | **2 068 856** | **2 340 580** |
| Simple payback period | | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **5,52** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** |
| Simple payback period | | | | | | | **5,52** | | | | | | | | |
| Discount factor | 1 | 0,870 | 0,756 | 0,658 | 0,572 | 0,497 | 0,432 | 0,376 | 0,327 | 0,284 | 0,247 | 0,215 | 0,187 | 0,163 | 0,141 |
| Discounted Cash flow | | 273158 | 230726 | 195932 | 167123 | 143067 | 122837 | 105721 | 91166 | 78739 | 68092 | 58944 | 51067 | 44273 | 38402 |
| Discounted money on the account | **-1 645 000** | **-1371842** | **-1141116** | **-945184** | **-778061** | **-634994** | **-512157** | **-406437** | **-315271** | **-236532** | **-168440** | **-109496** | **-58429** | **-14156** | **24246** |
| Discounted payback period | | | | | | | | | | | | | | | **13,37** |

***Economic indexes***

| | | |
|---|---|---|
| **Net Pesent Value** | **21 084** | **Euro** |
| **Internal Return Rate** | **15,3%** | |
| **Simple Payback Period** | **5,5** | **years** |
| **Discounted payback period** | **13,37** | **years** |

**PROJECT SCENARIO without JI mechanism**

*ALTERNATIVE 1- REVENUES FROM HEAT AND ELECTRICUTY SALE TO ENTERPRISE without ERUs sales*

| *Item* | *Year of operation* | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** |
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| Investment costs | 13 227 000 | | | | | | | | | | | | | | |
| Operating costs | | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 |
| Loan interests | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Amortization assesments for | | 1 505 158 | 1 175 151 | 917 498 | 716 335 | 559 278 | 436 656 | 340 919 | 266 172 | 207 813 | 162 250 | 126 677 | 98 903 | 77 218 | 60 288 |
| Amortizaton assessment for | | 273 577 | 242 195 | 214 414 | 189 819 | 168 045 | 148 769 | 131 705 | 116 597 | 103 223 | 91 382 | 80 900 | 71 620 | 63 405 | 56 132 |
| Amortizaton assessment | | 1 778 735 | 1 417 346 | 1 131 912 | 906 155 | 727 324 | 585 425 | 472 623 | 382 769 | 311 036 | 253 632 | 207 577 | 170 523 | 140 623 | 116 420 |
| Total revenue | 0 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 |
| Balance sheet profit | 0 | 874 250 | 1 235 639 | 1 521 074 | 1 746 831 | 1 925 662 | 2 067 560 | 2 180 362 | 2 270 216 | 2 341 949 | 2 399 353 | 2 445 409 | 2 482 463 | 2 512 362 | 2 536 566 |
| Income tax | 0 | 218 563 | 308 910 | 380 268 | 436 708 | 481 415 | 516 890 | 545 091 | 567 554 | 585 487 | 599 838 | 611 352 | 620 616 | 628 091 | 634 141 |
| Net profit | 0 | 655 688 | 926 729 | 1 140 805 | 1 310 123 | 1 444 246 | 1 550 670 | 1 635 272 | 1 702 662 | 1 756 462 | 1 799 515 | 1 834 057 | 1 861 847 | 1 884 272 | 1 902 424 |
| Cash flow | -13 227 000 | 2 434 423 | 2 344 076 | 2 272 717 | 2 216 278 | 2 171 570 | 2 136 095 | 2 107 895 | 2 085 431 | 2 067 498 | 2 053 147 | 2 041 633 | 2 032 370 | 2 024 895 | 2 018 844 |
| Money on the account | **-13 227 000** | **-10 792 577** | **-8 448 502** | **-6 175 785** | **-3 959 507** | **-1 787 937** | **348 158** | **2 456 053** | **4 541 484** | **6 608 982** | **8 662 129** | **10 703 762** | **12 736 132** | **14 761 027** | **16 779 871** |
| Simple payback period | | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **5,84** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** |
| Simple payback period | | | | | | | **5,84** | | | | | | | | |
| Discount factor | 1 | 0,870 | 0,756 | 0,658 | 0,572 | 0,497 | 0,432 | 0,376 | 0,327 | 0,284 | 0,247 | 0,215 | 0,187 | 0,163 | 0,141 |
| Discounted Cash flow | | 2116889 | 1772458 | 1494348 | 1267164 | 1079654 | 923493 | 792436 | 681731 | 587712 | 507507 | 438835 | 379864 | 329102 | 285321 |
| Discounted money on the | **-13 227 000** | **-11110111** | **-9337653** | **-7843304** | **-6576141** | **-5496486** | **-4572994** | **-3780558** | **-3098827** | **-2511115** | **-2003608** | **-1564773** | **-1184908** | **-855806** | **-570486** |
| | | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** |
| Discounted payback period | | | | | | | | | | | | | | | |

***Economic indexes***

| | | |
|---|---|---|
| **Net Pesent Value** | **-496 075** | **Euro** |
| **Internal Return Rate** | **14,0%** | |
| **Simple Payback Period** | **5,8** | **years** |
| **Discounted payback period** | **>15** | **years** |

## Project scenario with ERUs sales

| *ALTERNATIVE 2- REVENUES FROM HEAT AND ELECTRICUTY SALE TO ENTERPRISE with ERUs sales* | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Item*** | ***Year of operation*** | | | | | | | | | | | | | | |
| | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** |
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| Investment costs | 13 227 000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Operating costs | 0 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 | 350 171 |
| Loan interests | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Amortization assesments for | | 1 505 158 | 1 175 151 | 917 498 | 716 335 | 559 278 | 436 656 | 340 919 | 266 172 | 207 813 | 162 250 | 126 677 | 98 903 | 77 218 | 60 288 |
| Amortizaton assessment for | | 273 577 | 242 195 | 214 414 | 189 819 | 168 045 | 148 769 | 131 705 | 116 597 | 103 223 | 91 382 | 80 900 | 71 620 | 63 405 | 56 132 |
| Amortizaton assessment | 0 | 1 778 735 | 1 417 346 | 1 131 912 | 906 155 | 727 324 | 585 425 | 472 623 | 382 769 | 311 036 | 253 632 | 207 577 | 170 523 | 140 623 | 116 420 |
| Total revenue | 0 | 3 520 245 | 3 520 245 | 3 520 245 | 3 520 245 | 3 520 245 | 3 520 245 | 3 520 245 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 | 3 003 157 |
| Balance sheet profit | 0 | 1 391 338 | 1 752 727 | 2 038 162 | 2 263 919 | 2 442 750 | 2 584 648 | 2 697 450 | 2 270 216 | 2 341 949 | 2 399 353 | 2 445 409 | 2 482 463 | 2 512 362 | 2 536 566 |
| Income tax | 0 | 347 835 | 438 182 | 509 540 | 565 980 | 610 687 | 646 162 | 674 363 | 567 554 | 585 487 | 599 838 | 611 352 | 620 616 | 628 091 | 634 141 |
| Net profit | 0 | 1 043 504 | 1 314 545 | 1 528 621 | 1 697 939 | 1 832 062 | 1 938 486 | 2 023 088 | 1 702 662 | 1 756 462 | 1 799 515 | 1 834 057 | 1 861 847 | 1 884 272 | 1 902 424 |
| Cash flow | -13 227 000 | 2 822 239 | 2 731 892 | 2 660 533 | 2 604 094 | 2 559 386 | 2 523 911 | 2 495 711 | 2 085 431 | 2 067 498 | 2 053 147 | 2 041 633 | 2 032 370 | 2 024 895 | 2 018 844 |
| Money on the account | **-13 227 000** | **-10 404 761** | **-7 672 869** | **-5 012 336** | **-2 408 243** | **151 143** | **2 675 055** | **5 170 766** | **7 256 197** | **9 323 695** | ########## | **13 418 475** | **15 450 845** | **17 475 740** | **19 494 584** |
| Simple payback period | | **0,00** | **0,00** | **0,00** | **0,00** | **4,94** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** |
| Simple payback period | | | | | | **4,94** | | | | | | | | | |
| Discount factor | 1 | 0,870 | 0,756 | 0,658 | 0,572 | 0,497 | 0,432 | 0,376 | 0,327 | 0,284 | 0,247 | 0,215 | 0,187 | 0,163 | 0,141 |
| Discounted Cash flow | | 2454121 | 2065703 | 1749344 | 1488899 | 1272467 | 1091157 | 938230 | 681731 | 587712 | 507507 | 438835 | 379864 | 329102 | 285321 |
| Discounted money on the | **-13 227 000** | **-10772879** | **-8707177** | **-6957833** | **-5468934** | **-4196467** | **-3105310** | **-2167080** | **-1485349** | **-897637** | **-390130** | **48705** | **428569** | **757671** | **1042992** |
| | | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **0,00** | **10,87** | **0,00** | **0,00** | **0,00** |
| Discounted payback period | | | | | | | | | | | | **10,87** | | | |

***Economic indexes***

| | | |
|---|---|---|
| **Net Pesent Value** | **906 949** | **Euro** |
| **Internal Return Rate** | **16,8%** | |
| **Simple Payback Period** | **4,9** | **years** |
| **Discounted payback period** | **10,87** | **years** |

**2. Economical indexes for 2005 year prices and tariffs**

| Economic calculations for 2005 year prices, Euro | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Project scenario with ERUs sales, Indicative ERUs price 6,5 Euro/t CO2e*** | *Year of operation* | | | | | | | | | | | *Scrap value* |
| | *0* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | |
| Investment costs | 6 048 936 | | | | | | | | | | | |
| Operational costs | | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | |
| Loan interests | 0 | 367 049 | 293 640 | 220 230 | 146 820 | 73 410 | 0 | 0 | 0 | 0 | 0 | |
| Depreciation charges | | 857 566 | 735 988 | 631 646 | 542 097 | 465 243 | 399 285 | 342 677 | 294 096 | 252 401 | 216 618 | 1 311 319 |
| Total revenue/Общий доход | | 1 333 560 | 1 652 368 | 1 652 368 | 1 652 368 | 1 652 368 | 1 652 368 | 1 652 368 | 1 333 560 | 1 333 560 | 1 333 560 | |
| Balance sheet profit | | -154 816 | 358 981 | 536 733 | 699 692 | 849 956 | 989 324 | 1 045 931 | 775 705 | 817 399 | 853 182 | |
| Income tax | | 0 | 89 745 | 134 183 | 174 923 | 212 489 | 247 331 | 261 483 | 193 926 | 204 350 | 213 296 | |
| Net profit | | -154 816 | 269 236 | 402 549 | 524 769 | 637 467 | 741 993 | 784 448 | 581 779 | 613 049 | 639 887 | |
| Cash flow | -6 048 936 | 702 751 | 1 005 223 | 1 034 195 | 1 066 865 | 1 102 709 | 1 141 277 | 1 127 126 | 875 874 | 865 451 | 856 505 | 1 311 319 |
| Money on the account | **-6 048 936** | **-5 346 185** | **-4 340 961** | **-3 306 766** | **-2 239 900** | **-1 137 191** | **4 086** | **1 131 212** | **2 007 086** | **2 872 537** | **3 729 041** | |
| Simple payback period | | | | | | | **6,00** | | | | | |
| Discount factor | | 1,000 | 0,909 | 0,826 | 0,751 | 0,683 | 0,621 | 0,564 | 0,513 | 0,467 | 0,424 | 0,386 |
| Discounted Cash flow | | 702751 | 913840 | 854707 | 801552 | 753165 | 708643 | 636233 | 449462 | 403739 | 363242 | |
| Discounted money on the account | **-6 048 936** | **-5346185** | **-4432345** | **-3577638** | **-2776086** | **-2022921** | **-1314278** | **-678045** | **-228583** | **175156** | **538398** | |
| Discounted payback period | | | | | | | | | | **8,52** | | |
| ***Economic indexes*** | | | | | | | | | | | | |
| **Net Pesent Value (NPV)** | **362 872** | **Euro** | | | | | | | | | | |
| **Internal Return Rate (IRR)** | **11,4%** | | | | | | | | | | | |
| **Simple Payback Period** | **6,0** | **year** | | | | | | | | | | |
| **Discounted payback period** | **8,52** | **year/лет** | | | | | | | | | | |

| *Economic calculations, Euro* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Project scenario without ERUs sales*** | *Year of operation* | | | | | | | | | | | *Scrap value* |
| | *0* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | |
| Investment costs | 6 048 936 | | | | | | | | | | | |
| Operational costs | | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | 263 760 | |
| Loan interests | 0 | 367 049 | 293 640 | 220 230 | 146 820 | 73 410 | 0 | 0 | 0 | 0 | 0 | |
| Depreciation charges | | 857 566 | 735 988 | 631 646 | 542 097 | 465 243 | 399 285 | 342 677 | 294 096 | 252 401 | 216 618 | 1 311 319 |
| Total revenue | | 1 333 560 | 1 333 560 | 1 333 560 | 1 333 560 | 1 333 560 | 1 333 560 | 1 333 560 | 1 333 560 | 1 333 560 | 1 333 560 | |
| Balance sheet profit | | -154 816 | 40 173 | 217 925 | 380 884 | 531 148 | 670 516 | 727 123 | 775 705 | 817 399 | 853 182 | |
| Income tax/Налог на прибыль | | 0 | 10 043 | 54 481 | 95 221 | 132 787 | 167 629 | 181 781 | 193 926 | 204 350 | 213 296 | |
| Net profit | | -154 816 | 30 130 | 163 444 | 285 663 | 398 361 | 502 887 | 545 342 | 581 779 | 613 049 | 639 887 | |
| Cash flow | -6 048 936 | 702 751 | 766 118 | 795 089 | 827 760 | 863 604 | 902 171 | 888 020 | 875 874 | 865 451 | 856 505 | 1 311 319 |
| Money on the account | **-6 048 936** | **-5 346 185** | **-4 580 067** | **-3 784 978** | **-2 957 218** | **-2 093 615** | **-1 191 443** | **-303 424** | **572 451** | **1 437 901** | **2 294 406** | |
| Simple payback period | | | | | | | | | **7,35** | | | |
| Discount factor | | 1,000 | 0,909 | 0,826 | 0,751 | 0,683 | 0,621 | 0,564 | 0,513 | 0,467 | 0,424 | 0,386 |
| Discounted Cash flow/ | | 702751 | 696471 | 657099 | 621908 | 589853 | 560177 | 501264 | 449462 | 403739 | 363242 | |
| Discounted money on the account | **-6 048 936** | **-5346185** | **-4649714** | **-3992615** | **-3370707** | **-2780855** | **-2220677** | **-1719413** | **-1269951** | **-866212** | **-502971** | |
| Discounted payback period | | | | | | | | | | | | |
| ***Economic indexes*** | | | | | | | | | | | | |
| **Net Pesent Value (NPV)** | -497 763 | **Euro** | | | | | | | | | | |
| **Internal Return Rate (IRR)** | **8,1%** | | | | | | | | | | | |
| **Simple Payback Period** | **7,3** | **year** | | | | | | | | | | |
| **Discounted payback period** | **>10** | **year** | | | | | | | | | | |

### *Baseline scenario*

| Economic calculations for 2005 year prices, Euro | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Baseline scenario** | *Year of operation* | | | | | | | | | | | *Scrap value* |
| | *0* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | |
| Investment costs | 757 517 | | | | | | | | | | | |
| Operational costs | | 1 067 328 | 1 067 328 | 1 067 328 | 1 067 328 | 1 067 328 | 1 067 328 | 1 067 328 | 1 067 328 | 1 067 328 | 1 067 328 | |
| Loan interests | 0 | 47 648 | 38 118 | 28 589 | 19 059 | 9 530 | 0 | 0 | 0 | 0 | 0 | |
| Depreciation charges | | 107 394 | 92 169 | 79 102 | 67 888 | 58 263 | 50 003 | 42 914 | 36 830 | 31 609 | 27 127 | 164 218 |
| Total revenue | | 1 221 695 | 1 221 695 | 1 221 695 | 1 221 695 | 1 221 695 | 1 221 695 | 1 221 695 | 1 221 695 | 1 221 695 | 1 221 695 | |
| Balance sheet profit | | -675 | 24 080 | 46 677 | 67 421 | 86 575 | 104 364 | 111 453 | 117 537 | 122 759 | 127 240 | |
| Income tax | | 0 | 6 020 | 11 669 | 16 855 | 21 644 | 26 091 | 27 863 | 29 384 | 30 690 | 31 810 | |
| Net profit/Чистая прибыль | | -675 | 18 060 | 35 007 | 50 565 | 64 931 | 78 273 | 83 590 | 88 153 | 92 069 | 95 430 | |
| Cash flow | -757 517 | 106 719 | 110 229 | 114 109 | 118 453 | 123 194 | 128 276 | 126 504 | 124 983 | 123 678 | 122 557 | 164 218 |
| Money on the account | **-757 517** | **-650 798** | **-540 569** | **-426 459** | **-308 006** | **-184 812** | **-56 536** | **69 968** | **194 951** | **318 629** | **441 186** | |
| Simple payback period | | | | | | | | **6,45** | | | | |
| Discount factor | | 1,000 | 0,909 | 0,826 | 0,751 | 0,683 | 0,621 | 0,564 | 0,513 | 0,467 | 0,424 | 0,386 |
| Discounted Cash flow | | 106719 | 100208 | 94305 | 88995 | 84143 | 79649 | 71408 | 64136 | 57697 | 51976 | |
| Discounted money on the account | **-757 517** | **-650798** | **-550590** | **-456284** | **-367289** | **-283146** | **-203496** | **-132088** | **-67952** | **-10255** | **41721** | |

| *Economic indexes* | | |
|---|---|---|
| **Net Pesent Value** | **24 200** | **Euro** |
| **Internal Return Rate** | **10,7%** | |
| **Simple Payback Period** | **6,4** | **year** |
| **Discounted payback period** | **>10** | **year** |

**Annex 2.3**

МІНІСТЕРСТВО
ОХОРОНИ НАВКОЛИШНЬОГО
ПРИРОДНОГО СЕРЕДОВИЩА
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Our ref: 10060/20/1-7
05 October 2004

Kommunalkredit Public Consulting GmbH
Austrian JI/CDM Programme

Tuerkenstrasse 9
A-1092 Vienna
Austria

## Letter of No Objection for JI Project

Ministry of Environmental Protection of Ukraine as a legal and authorised representative of Ukraine referring to JI project "Utilization of sunflower husks for steam and power production at the oil extraction plant OJSC 'Kirovogradoliya'," proposed by oil extraction plant OJSC "Kirovogradoliya", hereafter to be referred to as "Applicant".

1. Wishes to refer to the request by the Applicant that Emission Reductions generated by the aforementioned project be considered to be purchased by the Austrian JI/CDM Programme.

2. Appreciates that the objective of the Austrian JI/CDM Programme is to purchase Emission Reduction Units (ERUs) generated by Joint Implementation (JI) and Clean Development Mechanism (CDM) projects that in due are expected to be eligible for the purposes of Article 6/12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) in accordance with the Kyoto Protocol and the relevant rules, guidelines and modalities adopted thereunder.

3. Declares that:

a. Ukraine Party has ratified the Kyoto Protocol.

b. In order to participate in activities mentioned in Article 6 of the Kyoto Protocol Ministry of Environmental Protection of Ukraine is aware that Ukraine

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should comply with the eligibility requirements as stated in the Marrakech Declaration no later than 1 September 2006.

c. Ministry of Environmental Protection of Ukraine has taken notice of the JI project and is aware that the Applicant intends to sell ensuing Emission Reductions to the Republic of Austria.

d. Ministry of Environmental Protection of Ukraine will assess the JI project to the Ukraine´s criteria for JI projects;

e. Ministry of Environmental Protection of Ukraine will start discussions with the Applicant on the distribution of ensuing ERUs.

f. Endorses further development of the JI project in accordance with the Article 6 of the Kyoto Protocol and is committing itself to render such assistance as may be necessary in the future validation, verification, issuance and transfer of the ERUs.

In case the results from the assessment and discussion as mentioned above are positive, Ministry of Environmental Protection of Ukraine will consider to grant formal approval of the JI project with the intention to enable the transfer of ERUs to the account of Austria.

Ministry of Environmental Protection of Ukraine acknowledges the fact that the JI project will already be operational prior to 01. January 2008 and will reduce GHG emissions in that period. Ministry of Environmental Protection of Ukraine will consider transferring to Austria Assigned Amount Units (AAUs) to the amount equal to the number of verified emission reductions realized by the JI Project prior to 2008 according to the signed agreement.

Ukraine,
Kyiv

**Sv'iatoslav Kurulenko,**
**Deputy Minister**

## Annex 2.4
## Technical description of the project

**PROJECT SCENARIO**

**Technical inputs**
**PROPOSED SYSTEM:**

| | Value | Unit | Comments | |
|---|---|---|---|---|
| Technology: | | | | |
| Net thermal capacity | 33,60 | MWth (out) | *Three boilers of 11,2 MW each* | |
| Net electrical capacity | 1,7 | MWe (out) | | |
| Nominal operating hours | 7 920 | h/a | | |
| Total nominal loading rate of boilers | 100% | | | |
| Nominal loading rate of turbine | 95% | | | |
| Boiler efficiency | 86% | | *Value from boiler design developers* | |
| Thermal input (by fuel) | 1 113 957 | GJ/a | 265 861 | Gcal/a |

| Biomass inputs: | t/a | Moist (%wb) | LHV (GJ/t) | Density (t/m3) | Volume (sm3/a) |
|---|---|---|---|---|---|
| Sunflower husk | **69 884** | 10% | 15,9 | 0,17 | 411 085 |

**New Process Outputs:**

| | Value: | Unit | Comments | |
|---|---|---|---|---|
| Electricity produced | 12 750 | MWhe/a | | |
| Electric capacity required for own needs of CHP unit | 1,23 | MWe/a | *Electricity produced by CHP totally covers own needs in power* | |
| Electricity consumed for own needs | 9 750 | MWhe/a | *This value is taken according to data of manufacturers of CHP equipment. Data is taken from project design document developed by "Energomashproekt".* | |
| Heat produced (gross) | 957 317 | GJ/a | 228 640 | Gcal/a |
| Heat losses | 0 | % | *As received from project desing documentation* | |
| Heat produced (net) | 957 317 | GJ/a | 228 640 | Gcal/a |
| Heat supplied to consumers (technological purposes) | **350 978** | GJ/a | *Up to **25 t** steam/hr (process steam) is supplied to consumers (technological purposes - processing of sunflower seeds)* | |
| | | | **83 826** | Gcal/a |
| Substitution of natural gas in heat supplied to consumers (technological purposes) | 11 320 | 1000 m3/a | | |
| Total( potential)substitution of natural gas (if all produced heat will be used) | 25 585 | 1000 m3/a | | |

| | | | |
|---|---|---|---|
| Natural Gas Substitution | 1000 m3/a | LHV (GJ/1000 m3) QHp | Density (t/m3) |
| | 11 320 | 33,70 | 0,000735 |

**BASELINE SCENARIO**

**Technical inputs**
**PROPOSED SYSTEM:**

| | Value | Unit | | |
|---|---|---|---|---|
| Technology:/ Технология: | | | | |
| Net thermal capacity | 15,50 | MWth | | |
| Net electrical capacity: | 0,0 | Mwe | | |
| Nominal operating hours | 7 920 | h/a | | |
| Nominal loading rate | 82% | | | |
| Overall efficiency | 92% | | | |
| Thermal input (by fuel) | 394 140 | GJ/a | 94 067 | Gcal/a |

| Fuel input: | 1000nm3/yr | Moist (%wb) | LHV (GJ/nm3) | Density (t/m3) | Volume (m3/a) |
|---|---|---|---|---|---|
| Natural gas | 11 696 | - | 33,70 | 0,000735 | 11 696 |

**Heat production:**

| | Value | Unit | | |
|---|---|---|---|---|
| Electricity produced | 0 | MWhe/a | | |
| Heat produced (gross) | 362 608 | GJ/a | 86 541 | Gcal/a |
| Heat losses/ Тепловые потери | 3 | % | | |
| Heat produced (net)* | **350 932** | GJ/a | **83 755** | Gcal/a |

** All produced heat (up to 25 t/hr of process steam) is supplied to consumers (technological purposes - processing of sunflower seeds)*

**Electricity purshase from the grid**

| | Value | Unit |
|---|---|---|
| For technological purposes | 5050 | MWh/a |
| During the overhaul period | 250 | MWh/a |
| Annual electricity consumption | 5300 | MWh/a |

# Annex 2.5

### *Baseline emissions*

**_Emission reduction due to avoiding of electricity purchasing from the grid, tCO2e_**

| Symbol | Unit | Year 2007,0 | 2008,0 | 2009,0 | 2010,0 | 2011,0 | 2012,0 |
|---|---|---|---|---|---|---|---|
| $EG_y$ | MW/yr | 13000,0 | 13000,0 | 13000,0 | 13000,0 | 13000,0 | 13000,0 |
| $EF_{electricit\ y,y}$ | tCO2/MWh | 0,896 | 0,896 | 0,896 | 0,896 | 0,896 | 0,896 |
| $ER_{electricity,y}$ | tCO2/yr | 11648,0 | 11648,0 | 11648,0 | 11648,0 | 11648,0 | 11648,0 |
| **Total during commitment period** | | | | | | | **58 240** |

**_Emission reduction due to replacement of fossil fuel by biomass residue fuel, tCO2e_**

| Symbol | Unit | Year 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| $Q_y$ | GJ/yr | 350978 | 350978 | 350978 | 350978 | 350978 | 350978 |
| $\varepsilon_{boiler}$ | % | 92 | 92 | 92 | 92 | 92 | 92 |
| $EF_{CO2,BL,heat,i}$ | tCO2/GJ | 56,1 | 56,1 | 56,1 | 56,1 | 56,1 | 56,1 |
| $ER_{heat,y}$ | tCO2/yr | 21 402 | 21 402 | 21 402 | 21 402 | 21 402 | 21 402 |
| **Total during commitment period** | | | | | | | **107 010** |

**Baseline emissions due to natural dacay or uncontrolled burning of anthropogenic sources of biomass residues**

The amount of methane produced due to natural decay of biomass residues (sunflower seeds husk) at the landfill is calculated as follows:

$$BE_{CH4,SWDC,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} W_x \cdot DOC \cdot e^{-k_j \cdot (y-x)} \cdot \left(1-e^{-k_j}\right)$$

**Where:**

| **Symbol** | **Value** | **Unit** | **Comment** |
|---|---|---|---|
| $BE_{CH4,SWDC,y}$ | See table below | tCO2e/yr | Methane emissions avoided during the year y from preventing sunflower seeds husk decay at landfill during the period from the start of the project activity to the end of the year y |
| $\varphi$ | 0,9 | - | Model correstion factor |
| f | 0 | - | Fraction of methane captured at the landfill and flared, combusted or used in another manner |
| $GWP_{CH4}$ | 21 | tCO2e/tCH | Global Warming Potential of methane, valid for the relevant commitment period |
| OX | 0 | - | Oxidation factor (reflecting the amount of methane from landfill that is oxidized in the soil or other material covering the waste |
| F | 0,5 | - | Fraction of methane in the landfill gas |
| $DOC_f$ | 0,5 | - | Fraction of degradable organic carbon that can decompose |
| MCF | 0,8 | - | Methane correction factor |
| Wx | See table below | t/yr | Amount of sunflower seeds husk prevented from disposal in the landfil in the year x |
| $DOC$ | 0,5 | - | |
| k | 0,03 | - | Decay rate of for the sunflower seeds husk |
| x | variable | - | Year during the crediting period x runs from the first year of the first crediting period (x=1) to the year y for which avoided emissions are calculated |
| y | variable | - | Year for which methane emissions are calculated |

***Methane baseline emissions due to sunflower seeds husk natural decay at the landfill in tCO2***

| Year | Waste dumped, t/yr/ year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| 2007 | 52413 | 3903,6 | 3788,2 | 3676,3 | 3567,6 | 3462,2 | 3359,9 |
| 2008 | 69 884 | 0,0 | 5204,8 | 5051,0 | 4901,7 | 4756,8 | 4616,2 |
| 2009 | 69 884 | 0,0 | 0,0 | 5204,8 | 5051,0 | 4901,7 | 4756,8 |
| 2010 | 69 884 | 0,0 | 0,0 | 0,0 | 5204,8 | 5051,0 | 4901,7 |
| 2011 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 5204,8 | 5051,0 |
| 2012 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 5204,8 |
| 2013 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2014 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2015 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2016 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2017 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2018 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2019 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2020 | 69 884 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| **Total** | | **3903,6** | **8993,0** | **13932,0** | **18725,1** | **23376,5** | **27890,4** |
| **Total during commitment period** | | | | | | | **92 917,0** |

***Total baseline emissions in tCO2***

| Source | Symbol | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Electricity purchasing from the grid | $ER_{electricity,y}$ | 11648,0 | 11648,0 | 11648,0 | 11648,0 | 11648,0 | 11648,0 |
| Fossil fuels consumption | $ER_{heat,y}$ | 21402,0 | 21402,0 | 21402,0 | 21402,0 | 21402,0 | 21402,0 |
| Sunflower husk disposal at the landfill | $BE_{CH4,SWDS,y}$ | 3903,6 | 8993,0 | 13932,0 | 18725,1 | 23376,5 | 27890,4 |
| **Total baseline emissions** | | **36 953,6** | **42 043,1** | **46 982,1** | **51 775,1** | **56 426,5** | **60 940,4** |
| **Baseline emissions during 2008-2012** | | | | | | | **258 167,2** |

## Annex 2.6
## Project emissions

***CO2 emisions from combustion of additional fossil fuels, tCO2e***

| Symbol | Unit | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| $FF_{project\_plant,y}$ | th. nm3/a | 200 | 200 | 200 | 200 | 200 | 200 |
| | th. nm3/a | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| $NCV$ | GJ/nm3 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 |
| $EF_{CO2,FF}$ | tCO2/TJ | 56,1 | 56,1 | 56,1 | 56,1 | 56,1 | 56,1 |
| $PEFF_y$ | tCO2 | **378,1** | **378,1** | **378,1** | **378,1** | **378,1** | **378,1** |
| Total during the commitment period 2008-2012 | | | | | | | **1 890,6** |

***CO2 emissions from on-site electricity consumption, tCO2e***

| Symbol | Unit | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| $EC_{PJ,y}$ | MWh | 10000,0 | 10000,0 | 10000,0 | 10000,0 | 10000,0 | 10000,0 |
| $EF_{grid,y}$ | tCO2/MWh | 0,896 | 0,896 | 0,896 | 0,896 | 0,896 | 0,896 |
| $PE_{EC,y}$ | tCO2 | **8960,0** | **8960,0** | **8960,0** | **8960,0** | **8960,0** | **8960,0** |
| Total during the commitment period 2008-2012 | | | | | | | **44 800,0** |

***Methane emissions from biomass residues combustion at new CHP Plant, tCO2e***

| Symbol | Unit | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| $BF_y$ | t of dry matter/a | 47172 | 62896 | 62896 | 62896 | 62896 | 62896 |
| $BF_{wet,y}$ | t of wet matter/a | 52413 | 69884 | 69884 | 69884 | 69884 | 69884 |
| W | % | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 | 10,0 |
| $NCV$ | GJ/t of dry matter | 17,1 | 17,1 | 17,1 | 17,1 | 17,1 | 17,1 |
| $EF_{CH4,BF}$ | kgCH4/TJ | 41,1 | 41,1 | 41,1 | 41,1 | 41,1 | 41,1 |
| $PE_{Biomass,CH4,y}$ | tCH4/a | 33,15 | 44,20 | 44,20 | 44,20 | 44,20 | 44,20 |
| $GWP_{CH4}$ | - | 21 | 21 | 21 | 21 | 21 | 21 |
| $PE_{Biomass,CH4,y}$ | tCO2e/a | **696,2** | **928,3** | **928,3** | **928,3** | **928,3** | **928,3** |
| Total during the commitment period 2008-2012 | | | | | | | **4 641,4** |

***Total project emissions, tCO2e***

| Source | Symbol | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Emissions from biomass residues transportation | $PET_y$ | 0 | 0 | 0 | 0 | 0 | 0 |
| Emissions from on-site fossil fuels consumption | $PEFF_y$ | 378,1 | 378,1 | 378,1 | 378,1 | 378,1 | 378,1 |
| Emissions from on-site electricity consumption | $PE_{EC,y}$ | 8960,0 | 8960,0 | 8960,0 | 8960,0 | 8960,0 | 8960,0 |
| Methane emissions from biomass residue combustion | $PE_{Biomass,CH4,y}$ | 696,2 | 928,3 | 928,3 | 928,3 | 928,3 | 928,3 |
| Total project emissions | $PE_y$ | **10034,3** | **10266,4** | **10266,4** | **10266,4** | **10266,4** | **10266,4** |
| Total project emisions during commitment period 2008-2012 | | | | | | | **51 332,0** |

**Annex 2.7**
**Estimated GHG emission reductions**

***Emissions reduction, tCO2e***

| | **Year** | | | | | |
|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| Project emissions $PE_y$ | 10034,3 | 10266,4 | 10266,4 | 10266,4 | 10266,4 | 10266,4 |
| Baseline emissions | 36953,6 | 42043,1 | 46982,1 | 51775,1 | 56426,5 | 60940,4 |
| Emission reduction | 26919,3 | 31776,7 | 36715,7 | 41508,7 | 46160,1 | 50674,0 |
| Emisission reduction during commitment period (2008-2012) | | | | | | **206 835,3** |

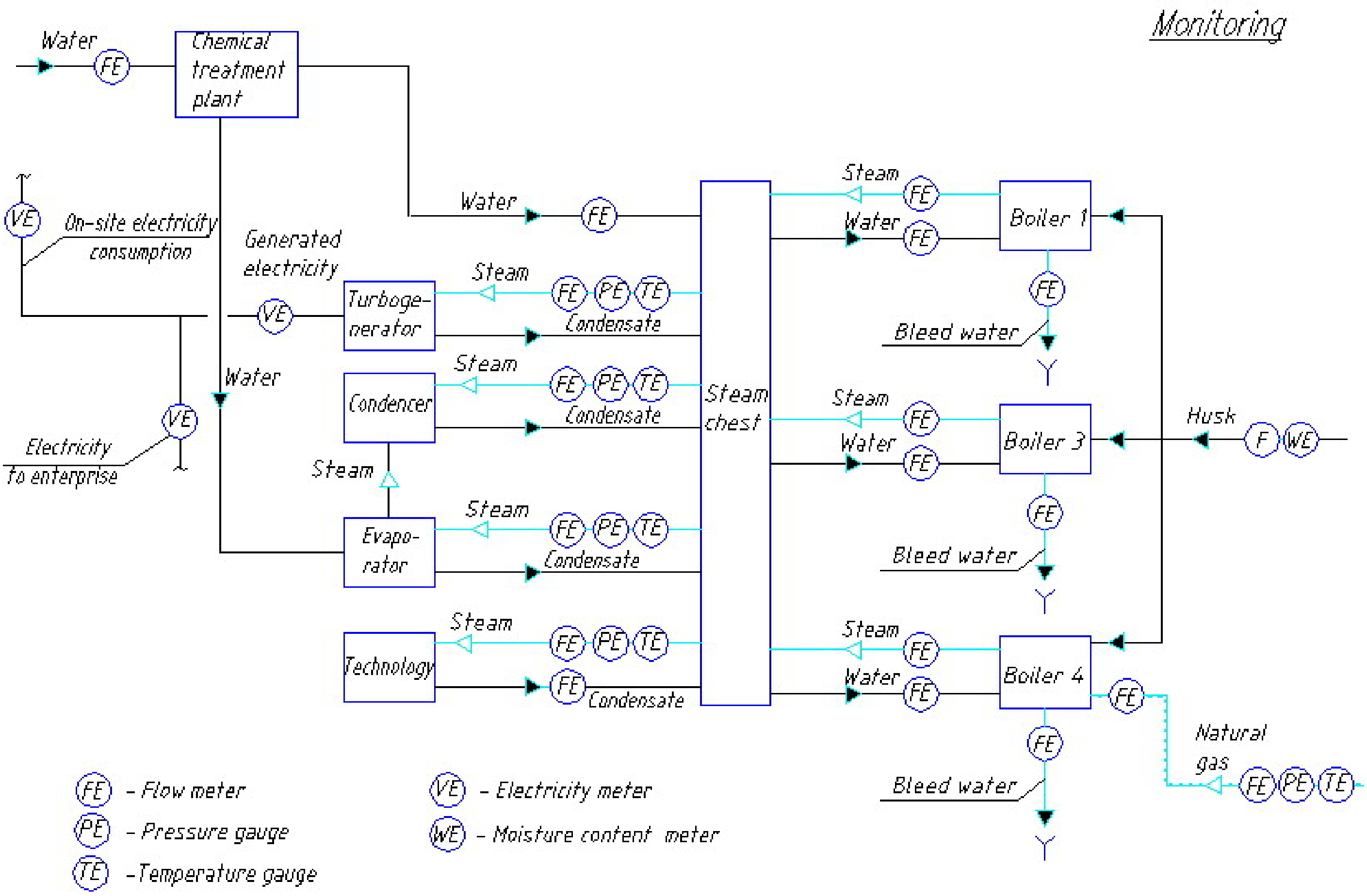
Annex 3

## MONITORING PLAN

The implementation of the monitoring plan is to ensure that real, measurable, long-term Greenhouse Gas Emission Reduction can be monitored, recorded and reported. It is a crucial procedure to identity the final ERUs of the proposed project. This monitoring plan for the proposed project activity will be implemented by the project owner, OJSC "Kirovogradoliya".

### 1. What data will be monitored?

As is shown in Section D, there are two series of data that need to be monitored: Project related emissions and Baseline related emission. The detailed meters installation is illustrated in the following figure;



**2. How will the data be monitored, recorded and managed?**

All meters installed in the proposed project should be accorded with national standard. All the equipment used will be serviced, calibrated and maintained in accordance with the original manufactures instructions and complete recorded preservation. Data storage and filing system is to be established.

Recording preservation is the most important process in the monitoring plan. Without accurate and efficient record keeping, project emission reductions cannot be verified. As stand in Section D4, the responsible personal for monitoring JI related information would be appointed by the proposal project owner and supervised by the JI developer.

The data are analyzed on a daily basis by the operator. In case of a drift of one parameter the operator can react quickly and fix any potential problems. All data required for the emission calculations will be kept in the onsite-monitoring database. On a regular basis, all monitoring information is analyzed following the formulas in Section B.

**3. Calibration of Meter and Metering**

Flow meters will be subject to a regular maintenance and periodical calibration according to the manufacturer's recommendation to ensure accuracy.
Power meters will be periodically calibrated according to the manufacturer's recommendation to ensure accuracy.
The temperature gauge should be subject to a regular maintenance and testing regime to ensure accuracy
The pressure gauge should be subject to a regular maintenance and testing regime to ensure accuracy.
At least once a year all meters must be certified by state authorised laboratory.

**4. Verification Procedure**

The main objective of the verification is to independently verify whether the emission reductions reported in the PDD has been achieved by the proposed project. It is expected that the verification could be done annually.
Main verification activities for the project included:

1) The project owner, OJSC "Kirovogradoliya" will sign a verification service agreement with specific AIE in accordance with relevant JISC regulations:
2) The project owner will provide the completed data records.
3) The project owner will cooperate with AIE to implement the verification process, i.e. the personnel in charge of monitoring and data handling should be available for interview and answer questions honestly;

To be summarized, the project owner OJSC "Kirovogradoliya" will implement a proper monitoring plan to make sure that the emission reduction for the proposed project would be measured accurately.