JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
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Annexes

SECTION A. General description of the project

A.1. Title of the project:

Title of the project:	Energy efficiency improvement of the district heating system in Drobeta Turnu-Severin
Version number of the document:	v.8
Date of the document:	07/11/2009

A.2. Description of the project:

ROMAG – TERMO power plant (ROMAG TPP) is a subsidiary of Regie Autonomous for Nuclear Activities RAAN, together with ROMAG – PROD Heavy Water Producer, Nuclear Research Subsidiary Pitesi – SCN, and Subsidiary for Nuclear Projects Engineering and Design.

Present Situation

The major district heating and electricity generation facility of Drobeta Turnu-Severin is the ROMAG – TERMO combined heat and power plant (CHP). The CHP has a total of 247 MW of electricity generation capacity and a total of approximately 1,702 Gcal/h of heat generation capacity. The primary fuel of the CHP is lignite, which is supplied from nearby lignite mines. However, a small amount of fuel oil is used as well. The CHP was built in 1981 to produce the necessary process steam for the nearby heavy water producer, ROMAG-PROD, as well as to supply district heating and hot portable water to the domestic and commercial consumers of Drobeta Turnu-Severin. In addition the CHP provides a majority of the cities electricity demand.

The CHP plant is equipped with 6 boiler units with a capacity of 258 Gcal/h each and 6 turbines; hereof 4 condensing turbines (3 with an electric capacity of 50 MW and 1 with an electric capacity of 25 MW) and two backpressure turbine with a specific electric capacity of 50 MW and 22 MW, respectively. The thermal and electric efficiencies of the power plant amount to approximately 27% and 21%, respectively.

The graph below illustrates the historical trend of the CHP´s district heat-, process steam-, and electricity production from year 2000 – 2005.

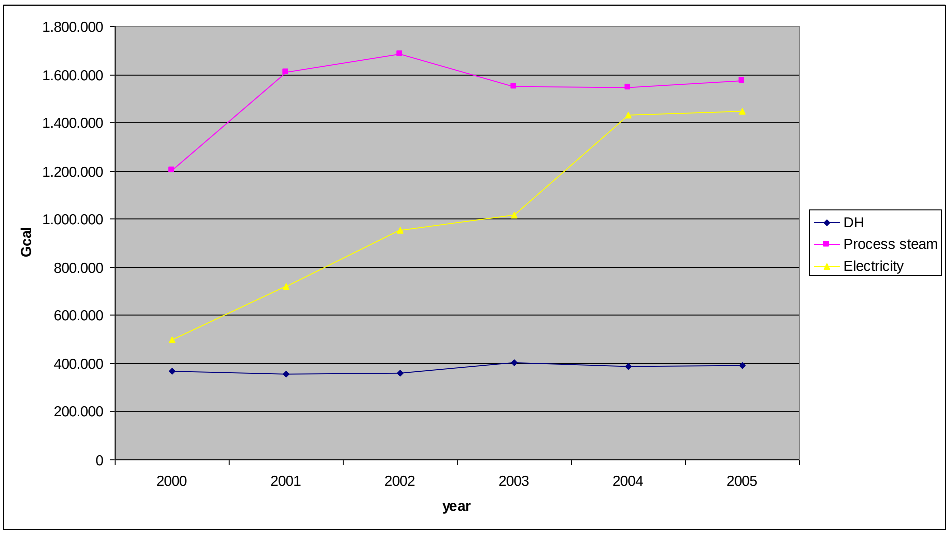


Figure 1: Historical trend of district heat, process steam, and electricity production

The graph shows that the electricity generation has increased during the last years. This is due to the fact that in year 2004 two new turbines with electric capacities of 50 MW and 25 MW, respectively, have been commissioned. On the other hand, the production of process steam as well as heat for district heating and hot portable water purposes has stayed rather constant during the last years.

The district heating system has been put into operation in various stages over a period from 1967 to 1990. Originally the entire district heating system has been administered by the municipality; however in January 2004 it has been transferred to ROMAG TPP.

Primary network:

The production of the primary heat carrier (hot water) is carried out at the CHP plant by means of three base heat exchangers. The heat for both district heating and hot portable water is transmitted via a 2-pipeline system from the power plant to the heat conversion substations through several transmission pipes, all crossing the city as a combination of aerial and underground pipelines. The total length of the primary network amounts to approximately 54 km, with a pipeline diameter ranging from DN40 – DN1100. The above ground district heating pipelines have a length of approximately 21 km, while the length of the underground pipelines amounts to 33 km. The pipes are made out of metal, insulated with mineral wool and protected by a metal plate cover sheet.

During recent years, the primary district heating network underwent various rehabilitation and maintenance work, including pipe re-insulation where insulation material was missing and the fixing of holes within the pipes, which would lead to water leakages.

Based on the heat delivered to the district heating system and the heat supplied to the heat conversions substation, both metered with existing heat meter devices, thermal primary network efficiency is about 66%[1].

Heat conversion substations:

The primary heat carrier is delivered to 54 heat conversion substations, out of which 49 are administered by ROMAG TPP. The remaining 5 heat conversion substations belong to various large and medium size industrial consumers. The heat conversion substations are on the heating side equipped with old “shell and tube” heat exchangers. Most parts of the heat exchangers are obsolete, worn out with missing or damaged thermal insulation. On the hot portable water side, new plate heat exchangers were installed during the last years, leading to an increased thermal efficiency in hot portable water conversion. Every heat conversion substation is equipped with temperature and pressure gauges as well as flow standard metering orifices for the primary heat carrier measurement. However, on the secondary side, no heat metering devices are installed.

Secondary network:

The heat and hot portable water are delivered to the consumers by means of an underground district heating, and hot portable water network. The total length of the pipes belonging to the 49 heat conversion substations operated by ROMAG TPP is approximately 175 km, of which around 120 km belong to the district heating network and 55 km to the hot portable water distribution. The district heating distribution network is designed as a 2 pipeline system with a pipe diameter between DN20 – DN250, whereas the hot potable water network consists of a forward line only. The pipe diameters range from DN20 – DN100. Due to heat and hot portable water demand changes over the last years, most parts of the secondary network are oversized. Approximately 80% of these pipes are located in within concrete ducts, while the remaining part is located within the earth.

[1] Calculated based on continuously monitored parameters such as district heat delivered to primary network, district heat delivered to heat conversion substations, and district heat delivered to new consumers connected to the primary network.

Heat and hot portable water consumers:

The end consumers of the district heating and hot portable water can be classified into three groups: residential sector, institutional sector including public and administrative sector, and commercial sector. In fact the residential sector represents the group with the largest number of consumers. A total of approximately 29,000 residential and 700 commercial consumers are connected to the district heating system. The total heated floor area corresponds to around 1.3 Mio square meters in the residential sector and approximately 17,500 square meters in the commercial sector.

The buildings connected to the district heating system are not very energy efficient. Most of them are built in a concrete panel way, badly insulated with high heat transmission losses. Due to bad insulated or missing entrance doors, heat bridges are often located just at the apartment doors.

Due to the fact that the district heating system is centrally operated at the CHP plant, and the buildings are not equipped with heat regulation devices such as consumer unit connections, radiator thermostats etc. consumers have, if at all, only very limited technical means to regulate the heat supply or even the supply temperature of the hot portable water they are receiving. It should be mentioned that historically neither heat meters nor measurement devices for hot portable water consumption were installed at the consumer buildings. Only during recent years a focus was put on the heat consumer side, followed by actions in order to install such metering equipment.

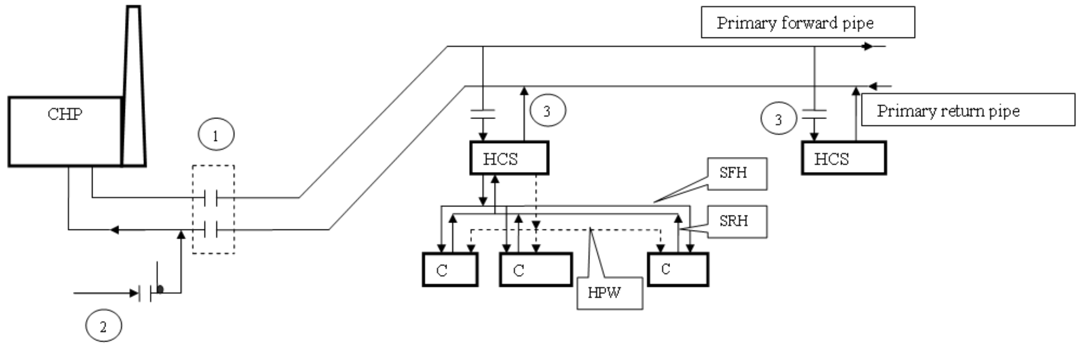
Condition of the secondary district heating network:

The existing secondary district heating network in Drobeta Turnu-Severin is in a rather poor condition. The heat exchangers on the district heating side at the heat conversion substations are worn out due to age and wear. As a consequence, the heat carrier in the form of water, circulating in the primary district heating network, is leaking over to the secondary network. Moreover most parts of the heat exchangers are without thermal insulation. In January 2005 heat measurements with portable metering device were carried out at 10 heat conversion substations and corresponding building connections. Based on the heat measurements, thermal losses over the heat exchangers were estimated at 6%. The annual primary heat carrier losses in form of water leaking from the primary network into the secondary network (through leaking heat exchangers) and further due to leakages within the pipes into the ground amount to approximately 544,000 m^3/yr. To compensate these water losses, the system is permanently replenished with additional water at the CHP plant. The thermal energy required for water replenishment accounts for approximately 30.000 Gcal/yr.

The secondary district heating network is as well in a bad condition. The concrete ducts are old and damaged and frequently filled up with water and sewage, causing a continuous degradation of the thermal insulation around the pipes. As a consequence large parts of the pipes are without insulation, leading to corrosion and leakages. In connection with the heat measurements carried out with portable metering device at 10 heat conversion substations and corresponding building connections in January 2005, thermal losses within the secondary district heating network were estimated at around 18%.

Figure 2: Heat exchanger and secondary district heating network pipes

The schematic drawing below illustrates the district heating system under the existing situation.



1 – Primary Heat Carrier Measurement Point,
2 – Replenishment Water Measurement Point,
3 – Heat Conversion Substation Measurement Point,

HCS – Heat Conversion Substation
SFH – Secondary network, forward: heat
SRH – Secondary network, return: heat
HPW – Hot portable water
C – Consumers

Figure 3: District heating system layout under existing situation

Description of the project

After ROMAG TPP took over the district heating system from the municipality, the power plant initiated a number of actions in order to improve the overall efficiency of heat and hot portable water supply. In this context a feasibility study was carried out, which concluded that the major thermal losses within the district heating system are located within the heat conversion substations as well as the secondary heat and hot portable water supply. Accordingly as a first action two third of all heat exchangers within the heat conversion substations on the hot portable water network were replaced by new plate heat exchangers followed by a replacement of pumping stations within the secondary network by modern pumps with variable drives. Moreover eight (8) selected heat conversion substations, supplying heat and hot portable water to public and municipality owned buildings such as hospitals, schools etc., underwent rehabilitation and modernisation works. This was financed with an EBRD loan and carried out during recent years.

The proposed project activity focuses on the heat conversion part of the heat conversion substations and the secondary district heating network, namely the heat and hot portable water distribution network. In this context the project includes the a redesign of the secondary district heating network and a subsequent replacement of approximately a total of 190 km of heat and hot portable water pipes by new pre-insulated district heating pipes. Moreover the project comprises the installation of 114 new heat exchangers in 38 heat conversion substations located within the secondary district heating network. In connection with the rehabilitation work, heat metering devices will be installed at the heat conversion substation outlets as well as on the heat and hot portable water consumption side.

It should be noted that the physical project is implemented in different stages between October 2006 and December 2007. Due to the fact that the activities carried out throughout the implementation phase will lead to real and measurable heat energy savings within the district heating system it is envisaged that emission reductions are generated accordingly during the implementation phase already.

The proposed district heating network rehabilitation project will reduce heat and water losses both within the secondary district heating network and the heat conversion substations. This will simultaneously lead to reduced fuel consumption and hence a reduction of the annual greenhouse gas emissions at the ROMAG – TERMO power plant.

The proposed project activity will lead to the following energy savings:

Replacement of heat and hot portable water pipes:

The replacement of both, heat and hot portable water pipes within the secondary district heating network will lead to an expected heat energy savings. Moreover, the pipes in the secondary network have a very high external and internal roughness due to incrustations, resulting in leakages and accordingly to large amounts of water losses. To compensate for these water losses, the system is permanently replenished with additional water. In order to preheat the raw water, an extensive amount of energy is consumed. In context with the project activity energy requirements for preheating of the replenish water are expected to be reduced by the order of 90%, based on the reduction of water losses.

Replacement of heat exchangers:

The replacement of heat exchangers in the heat conversion substation of the district heating system are expected to lead to heat energy savings.

Besides greenhouse gas emission reductions, there is expected to be a decrease of local dust and particle pollution from lignite transportation and combustion in association with the proposed project activity, improving the health conditions for inhabitants of Drobeta Turnu-Severin and its surrounding. Also, the project will improve the quality of heat service delivered to the consumers in terms of a more efficient heat supply and furthermore create additional jobs during the construction period of the rehabilitation works. This should strengthen the regional development. The project will introduces modern district heating technology to the region and strongly contribute to the local technical capacity development. This will facilitate possible replications of this project.

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)*
Romania	*ROMAG TPP*	*No*
Denmark	*Danish Energy Agency*	*Yes*

For contact data see Annex 1

The **Project Proponent** is ROMAG TPP a subsidiary of Regia Autonoma pentru Activitati Nucleare – RAAN, the autonomous regime for nuclear activities. ROMAG TERMO is a state owned company registered in Romania, which owns and operates ROMAG TPP and the district heating system. Regia Autonoma pentru Activitati Nucleare – RAAN owns the heavy water producer for the nearby located nuclear power plant. ROMAG TPP holds legal title to the emission reductions generated from the project activity and holds a Letter of Endorsement for the Joint Implementation project from the Romanian Ministry of the Environment and Water Management

The **Project Emission Reduction Buyer** is the Danish Government as represented by the Danish Energy Agency (hereafter called "DEA"). DEA is responsible for the Danish Ministry of Environment's efforts to develop and finance JI and CDM projects in Central and Eastern Europe and is also the Danish Governments Designated National Authority.

A.4. Technical description of the project:

A.4.1. Location of the project:

Drobeta Turnu Severin, Mehedinti Region, Romania

A.4.1.1. Host Party(ies):

Romania

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

Mehedinti

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

Drobeta Turn-Severin

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

The city of Drobeta Turnu-Severin is located in the south-western part of Romania, on the left bank of the river Danube, right at the border to Serbia.

ROMAG TPP is located approximately 5 km north-east from Drobeta Turnu- Severin (Latitude 44°40 min 25.5 N, Longitude 22°41 min 18 E).

Figure 4: Mehedinti, Romania

Figure 5: Drobeta Turnu-Severin

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

Technology to be employed

The project activity focuses on two parts of the district heating system in Drobeta Turnu-Severin:

1) Secondary heat and hot portable water network rehabilitation and modernisation
2) Heat conversion substation rehabilitation and modernisation

<u>Secondary heat and hot portable water network rehabilitation and modernisation:</u>

Secondary network rehabilitation and modernisation includes the replacement of the existing district heating pipes with new and pre-insulated pipes re-designed based on the actual heat demand of the consumers. Moreover it includes the construction of a hot portable water return pipe.

The tables below show diameters and corresponding lengths of pre-insulated lengths of district heating pipes and hot portable water pipes which will be laid down in connection with the project activity.

Secondary district heating network											
Length of steel pre-insulated pipes (supply & return) to be laid down											
	Φ 250	Φ 200	Φ1 50	Φ 125	Φ 100	Φ 80	Φ 65	Φ 50	Φ 40	Φ 25	Φ 20
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
TOTAL	**312**	**1.791**	**8.489**	**9.559**	**13.498**	**15.131**	**13.897**	**24.260**	**8.388**	**86**	**122**

Table 1: Total length of heating pipes to be laid down

Hot portable water network								
Length of steel-zinced pre-insulated pipes (supply & return) to be laid down								
	Φ 100	Φ 80	Φ 65	Φ 50	Φ 40	Φ 32	Φ 25	Φ 20
	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
TOTAL	**904**	**3.978**	**8.028**	**16.726**	**19.979**	**21.614**	**23.300**	**690**

Table 2: Total length of hot portable water pipes to be laid down

The pictures below show both old and decayed district heating pipes and new pre-insulated pipes.


Figure 6: District heating pipes [old, new]

<u>Heat conversion substation rehabilitation and modernisation:</u>

Heat conversion substation rehabilitation and modernisation includes the replacement of existing shell and tube heat exchangers with 114 modern plate heat exchangers for the district heating part at 38 heat conversion substations within the secondary district heating network.
The pictures below show an old existing shell and tube heat exchanger and a new plate heat exchanger, which will be installed in connection with the project activity.


Figure 7: Heat exchangers [old, new]

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:

The proposed project activity aims to reduce the emissions of greenhouse gases by increasing the thermal distribution efficiency within the secondary district heating system (heat conversion substation and secondary heat and hot portable water network) and reducing the water losses within the secondary district heating network. The thermal efficiencies will increase by replacing old heat exchangers on the district heating site at the heat conversion substations and by the replacement and re-design of the old heat and hot portable water pipes in the secondary district heating network by new pre- insulated pipes. The increase of the thermal efficiency as well as the reduction of water losses results in a decrease of the overall lignite and fuel oil consumption at ROMAG – TERMO and a corresponding reduction in annual greenhouse gas emissions.

Moreover the project will reduce fuel costs by reducing the consumption of lignite and fuel oil at the CHP plant. At the same time the proposed project may help the CHP plant improve its compliance with the emission regulations, taking into account the reduction of SO_x and NO_x emissions and other particles due to reduced fuel consumption.

Without the proposed project, the annual greenhouse gas emissions would at best remain on the present level. This is due to the below reasons:

- Energy efficiency has low priority when it comes to the existing district heating system in Drobeta Turnu-Severin. This is partially due to long prevailing attitudes related to improving energy efficiency in Romania, which are historically limited due to low energy and fuel prices. More importantly the project would not be financial viable and the required investment has a higher potential for creating financial losses without Joint Implementation.
- Most district heating networks in Romania are in a rather poor condition

It should be noted that an Additionality Test is presented in section B 2.

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

The implementation of the proposed project activity will result in an estimation of greenhouse gas emission reductions conservatively calculated at approximately 503,205 tCO_2 over the first six years crediting period (2007-2012).

The table below depicts baseline emissions, project emissions and emission reductions on an annual basis.

Please indicate the length of the crediting period and provide estimates of total as well as annual emission reductions. Information shall be provided using the following tabular format.

	Years
Length of the crediting period	
Year	*Estimate of annual emission reductions in tonnes of CO_2 equivalent*
2007	*83,868*
2008	*83,868*
2009	*83,868*
2010	*83,868*

2011	*83,868*
2012	*83,868*
Total estimated emission reductions over the crediting period (tones of CO_2 equivalent)	*503,205*
Annual average of estimated emission reductions over the crediting period (tones of CO_2 equivalent)	*83,868*

A.5. Project approval by the Parties involved:

The Romanian Ministry of the Environment and the Danish Energy Agency will be responsible for the project approval in the respective countries.

SECTION B. Baseline

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

Applicability:

The baseline methodology is applicable to project activities where heat losses and water losses occur within old and decayed heat conversion substations and secondary district heating networks.

Approach:

The baseline approach for the proposed project activity is derived by using data of existing, actual or historical, greenhouse gas emissions as applicable under paragraph 48 of the CDM modalities and procedures. This choice is suitable since it is reasonable to expect that fuel consumption and greenhouse gas emissions would follow historical trends in the absence of the project activity. This approach assumes that the business-as-usual scenario (baseline) would have continued into the future without any intervention changing the historical trend.

The baseline methodology is based on the following stepwise approach:

Step 1: Calculation of baseline emissions

The baseline efficiencies for HCS and the secondary district heating network are calculated based on heat measurements carried out ex-ante before the project implementation at 10 selected heat conversion substations (HCS) and corresponding building connections in January 2005. It should be noted that these 10 selected heat conversion substations represent the sections in the district heating system, that are in a better condition than the remaining part of the system, thus the baseline efficiencies calculated based on the measurements are comparatively high for these sections. Due to the fact that the baseline efficiencies calculated based on these 10 selected heat conversion substations are utilized for the entire system thus presenting a better picture of the system, it can be considered representative and at the same time conservative.

The baseline fuel energy input and respective emissions are calculated by means of baseline efficiencies and the quantity of district heat delivered to the consumers under the project activity.

The quantity of heat delivered to new connections in the district heating system (secondary and primary network connections from the time of project start) is deducted from the overall quantity of heat delivered to consumers during the project activity.

For the reason of conservativeness possible disconnections of consumers to the primary and secondary network will not be considered throughout the crediting period of the project activity.

Step 2: Calculation of project emissions

Project emissions are calculated based on real district heat supplied to consumers by means of back calculating the corresponding fuel energy input and respective emissions.

New connections to the secondary district heating network are deducted from the quantity of heat delivered to the consumers under the project activity.

For the reason of conservativeness possible disconnections of consumers to the secondary network will not be considered throughout the crediting period of the project activity.

The following values are used for calculating the project emissions:

- District heat supply to primary network (Gcal)
- Process steam production (Gcal)
- District heat supply to consumers connected to primary network (Gcal)
- District heat supply to HCS (Gcal)
- District heat supply to secondary network (Gcal)
- District heat supply to consumers connected to secondary network (Gcal)
- Lignite and fuel oil consumption (t)
- Net calorific value of lignite and fuel oil (kcal/kg)
- Carbon factor of lignite and fuel oil (tC/TJ)
- Oxidation factor of lignite and fuel oil (%)
- Molar mass of CO2 and C (g/mol)

In order to account for new consumer connections to both the primary and secondary district heating network the following parameters are also monitored:

- District heat supply to new consumers connected to primary network (Gcal)
- District heat supply to new consumers connected to secondary network (Gcal)

Step 3: Calculation of emission reductions

The difference between baseline and project emissions represents the overall emission reductions associated with the project activity.

<u>Thermal efficiency at ROMAG – TERMO :</u>

The thermal efficiency at ROMAG – TERMO is calculated under the project activity based on fuel energy input and thermal energy output (district heat and process steam).

<u>Primary network efficiency:</u>

The primary network efficiency refers to the thermal efficiency of the primary district heating network. This efficiency is determined under the project activity based on existing heat meter equipment located at the primary heat carrier outlet at the CHP plant, the primary heat carrier inlet at the heat conversion substations, and heat consumption of existing and new consumers connected to the primary district heating network.

<u>Thermal efficiencies of heat exchangers at heat conversion substations (heating side) and secondary network:</u>

Heat metering equipment on the secondary side of the district heating system is only existent to some extend in Drobeta Turnu-Severin (heat conversion substation outlet; heat consumer level). The table below presents the results of the heat measurements carried out at 10 selected heat conversion substations (HCS) and corresponding building connections in January 2005. It should be noted that these 10 selected heat conversion substations represent the sections in the district heating system, that are in a better condition than the remaining part of the system, thus the baseline efficiencies calculated based on the measurements are comparatively high for these sections. Due to the fact that the baseline efficiencies calculated based on these 10 selected heat conversion substations are utilized for the entire system thus presenting a better picture of the system, it can be considered representative and at the same time conservative.

HCS	Heat input	Heat output	Heat consumption	$\eta_{th,HCS}$	$\eta_{th,network}$	$\eta_{th, system}$ [2]
No	**Gcal**	**Gcal**	**Gcal**	**%**	**%**	**%**
Apolodor	0.97	0.90	0.79	92	88	81
PT 1	1.63	1.53	1.27	94	83	78
PT 3	1.56	1.45	1.13	93	78	73
PT 9	1.19	1.10	0.92	93	84	78
PT 13	0.40	0.37	0.29	94	77	72
PT 20	0.68	0.64	0.54	94	84	79
PT 25	1.02	0.97	0.76	94	79	74
PT 27	1.42	1.34	1.11	94	83	78
PT 54	0.50	0.48	0.37	94	77	72
PT 58	0.40	0.38	0.31	94	83	78
			Average	**94**	**82**	**77**

Table 3:Heat metering at selected heat conversion substations

It should be mentioned that the thermal efficiencies for both, the heat conversion substations and the heat and hot portable water network seem very high compared to the general standard of Romanian district heating systems[3], main reason for this is the fact that measurements were taken in respective sections of the district heating system which were in much better conditions then the remaining part of the system. With an average thermal efficiency of 94% at the heat conversion substations and an average thermal efficiency of 82% within the hot portable water network, connected to the heat conversion substations, an average system efficiency of 77% is estimated. This encompasses both the thermal efficiency of the heat conversion substations and the heat and hot portable water network connected to the heat conversions substations.

In connection with a district heating system rehabilitation project, very similar to the one in Drobeta Turnu Severin, which is carried out in the city of Resita, Romania, the average system efficiency was estimated at approximately 68% for January 2005. This includes both heat and hot portable water network. The calculations are based on actual meter readings encompassing existing heat meters located at each heat conversion substation inlet and heat meters installed at the heat consumer level. The annual system efficiency over the secondary district heating system is estimated at 64%.

In order to get a more realistic picture of the annual thermal losses within the secondary district heating system in Turnu-Severin based on real operation data, the average annual efficiency for the secondary network was determined. This efficiency value is derived by applying the same percentage difference between the average value for January 2005 and the average system efficiency for the whole year 2005 as verified for the district heating system under the Resita Project. This proceeding is justified through the fact that during peak load heating periods (January) thermal efficiencies are highest, while the yearly

[2] The system efficiency derives from the multiplication of heat conversion substation efficiency with secondary network efficiency

[3] e.g in Resita the average system efficiency based on measured heat data is calculated at around 64 only

average is lower. It should be emphasized again that the average efficiency value measured in Turnu-Severin for January 2005 is on an unusual high level due to the fact that that measurements were taken in respective sections of the district heating system which were in much better conditions then the remaining part of the system, thus also the derived annual average can be considered rather high, which reflects a conservative approach.

In this context, based on an average system efficiency of 68% in January 2005 in Resita and respective annual average system efficiency of 64% for the whole year 2005, the average system efficiency for Turnu-Severin is determined at 72%. Baseline emissions will be calculated by applying this annual average efficiency instead of monthly averages.

The table below depicts the average secondary network system efficiency used for determination of baseline emissions under the proposed project activity:

Thermal efficiency of Heat Conversion Substations	Thermal efficiency of Secondary District Heating Network	System Efficiency
$\eta_{th, HCS}$	$\eta_{th, network}$	$\eta_{th, system}$
%	%	%
90	80	72

Table 4: Average secondary network system efficiency before project implementation

An observation and following comparison of the district heating system of Drobeta Turnu-Severin with other district heating systems in Romania (e.g. Resita) shows that the thermal efficiencies calculated based on heat measurements taken within the secondary district heating network in January 2005 do not reflect the actual situation of the district heating system and hence give a wrong picture of the performance of the district heating system, which is due to the fact that measurements were taken in respective sections of the district heating system which were in much better conditions then the remaining part of the system

Nevertheless the thermal efficiencies of heat exchangers and heat conversion substations will be based on the heat measurements taken in January 2005 and then projected on an annual basis. This seems to be justified, since it represents a very conservative approach.

Heat loss saving potentials

The objective of the project activity is to reduce thermal losses within the heat conversion substations and secondary district heat and hot portable water network and at the same time reduce the water losses in the secondary district heat network.

In connection with a feasibility study carried out during recent years by ROMAG TPP, the realisation of the following heat saving potentials can be achieved in connection with the proposed project activity.

Activity	**Saving potential**	
Heat conversion substation rehabilitation	Heat loss saving potential	5%
Secondary district heating network rehabilitation	Heat loss saving potential	10%

Table 5: Heat loss saving potential

Assuming successful realisation of the above heat loss saving potentials within the existing secondary district heating system in Drobeta Turnu-Severin the annual average thermal efficiencies are expected to be as follows:

Thermal efficiency of Heat Conversion Substations	Thermal efficiency of Secondary District Heating Network	System Efficiency
$\eta_{th, HCS}$	$\eta_{th, network}$	$\eta_{th, system}$
%	%	%
95	90	86

Table 6: Expected average secondary network system efficiency after project implementation

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:

Step 0: Preliminary screening based on the starting date (February 14th, 2006) of the project activity

The date from when emission reductions are generated on is expected to be the 1st of January 2007. In this manner a Project Idea Note was developed for the proposed Joint Implementation project and finalized in December 2005. Subsequently, a Letter of Intent for the development and trading of emissions reductions was signed by the project proponent, Regia Autonoma pentru Activitati Nucleare – RAAN, and the Danish Energy Agency (former Danish Environmental Protection Agency) in January 2006. A Letter of Endorsement for the Joint Implementation project was issued by the Romanian Council on Climate Change also in December 2005.

It should be noted that a Master Plan feasibility study for the district heating system rehabilitation was developed in September 2003 and project activity has been relatively stalled since then due to lack of financing.

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

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

The following are the identified alternatives for this project activity:

Alternative 1: Business as usual
Alternative 2: The project activity without JI participation and carbon credit trading
Alternative 3: Joint Implementation project activity

It should be noted that alternatives involving fuel switch at the ROMAG – TERMO power plant or other network efficiency improvements at Drobeta Turnu-Severin are excluded from this analysis. The basis for this exclusion is that the power plant related equipment were recently extensively rehabilitated and expanded (from 2000-2003) and are of a good quality comparable to new installations found in the EU. A very small amount of the district heating system (at municipal locations) had been rehabilitated prior to 2004-2005. All such rehabilitation and modernization has stopped due to lack of funding.

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

All of the alternatives are within applicable legal and regulatory requirements. The boiler units, turbines and associated equipment at ROMAG – TERMO power plant were extensively upgraded, and the district heating network including right-of-ways are existing from prior times. Alternatives 1, 2 and 3 are based on this currently established system and thus meet all applicable legal and regulatory requirements.

Step 2: Investment analysis

Sub-step 2a: Determine the appropriate analysis method

Investment comparison analysis will be used

Sub-step 2b: Apply investment comparison analysis

For this project activity it is best to apply an investment comparison analysis based on the Net Present Value of the project activity. In this case a discount rate of 10% is chosen, which is a reflective value based on the current Romanian economy. It is slightly over the rate of inflation 8 – 9 % (2005), and one and a half points over the National Bank of Romania's reference rate of 8.5% (June 2006), and in line with Romanian commercial bank rates (9.5-10.5%). Thus it is assumed that even a minimum investment would require a return of over 10% in order to sustain the currency value.

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

The total investment for the project is € 47,000,000 ROMAG TPP is expected to cover € 39,400,000 of the project costs, where it is anticipated that € 25,300,000 will be covered through own financial source over the project period, and € 14,100,000 will be covered via a loan. Grants of € 5,600,000 will come from the Romanian central budget allocations and € 2,000,000 will come from ARCE the Romanian Energy Conservation Agency.

The project activity could never pay for itself directly e.g. the total € 39,400,000 as covered by ROMAG TPP. Therefore, is it assumed that € 25,300,000 will be covered through own financial source of ROMAG TPP of the project period and only the loan portion (external credit) of € 14,100,000 shall be included in investment analysis.

It is clear through investment analysis that only the project activity under Joint Implementation (Alternative 3) holds enough economic viability (NPV of € 240,004). Business as Usual (Alternative 1) has no effect on the project activity, and without JI the project activity (Alternative 2) leads to a negative NPV of € -2,607,653. A summary table of this financial analysis is provided below with greater detail provided in Annex 4.

Alternatives	Estimated Investment Costs (€)	Estimated Project Costs (€)	Estimated Project Revenus and Savings (€)	NPV 10% (€)
1	0	0	0	0
2	47.000.000	21.970.633	18.724.400	-2.607.653
JI Project	47.000.000	22.075.633	21.980.138	240.004

Sub-step 2d: Sensitivity analysis

There are two parameters which can have an impact on the investment comparison analysis. They are the expected efficiency gain from the rehabilitation works and the fuel price.

The exact efficiency increase due to the rehabilitation works (the project) cannot be guaranteed and is estimated based on actual measurements of parts of the secondary network of the district heating system, and comparison with other such systems in Romania. Therefore, the level of the exact efficiency increase is not certain, fluctuations from the estimations for which this PDD are based are assumed to be less than +/- 5%.

Lignite and oil is a domestic fuel in Romania and is thus subject to regulations and state pricing but related to the market. Expected variation from this future lignite and oil price is assumed to be +/- 10% on an average annual basis.

For this sensitivity and risk analysis combined best and worst case scenarios are developed where:

Case 1: in the best case, the efficiency improvement is 5% higher (increase in energy savings) than expected, and future average annual fuel prices are 10% higher than expected;

Case 2: in the worst case, the efficiency improvement is 5% lower (decrease in energy savings) than expected, and future average annual fuel prices are 10% lower than expected;

The following outcome of this sensitivity analysis is shown below, with a summary table of this sensitivity analysis and more detail provided in Annex 4.

Alternatives	Estimated Investment Costs (€)	Estimated Project Costs (€)	Estimated Project Revenus and Savings (€)	NPV 10% (€)
+ 5% Energy Savings + 10% Fuel Price				
1	0	0	0	0
2	47.000.000	21.970.633	21.899.847	68.535
JI Project	47.000.000	22.075.633	25.070.040	2.094.120

Alternatives	Estimated Investment Costs (€)	Estimated Project Costs (€)	Estimated Project Revenus and Savings (€)	NPV 10% (€)
- 5% Energy Savings - 10% Fuel Price				
1	0	0	0	0
2	47.000.000	21.970.633	16.211.575	-3.455.761
JI Project	47.000.000	22.075.633	19.079.845	-1.629.411

Under Case 1 (+ 5% energy saving and + 10% fuel price) the sensitivity analysis indicates that both Alternative 2 and 3 (the JI project) would be financially viable and lead to a decent NPV over the project period. Under Case 2 (- 5% energy saving and - 10% fuel price) the sensitivity analysis indicates that both Alternative 2 and 3 (the JI project) would not be financially viable. Under Case 2, Alternative 2 has a major loss (NPV € -3,455,761) which clearly indicates how significantly risky the investment and project activity is without JI participation. Under Case 2, alternative 3 (the JI project) has a loss (NPV € -1,629,411) which clearly indicates the JI project risks, but to a much lower extent.

The determination of potential project losses and gains is a major part in a decision making structure, especially when taking into account the various demands for investment. This risk of losses relates directly to ROMAG TPPs ability to payback credit loans which are taken out for implementing the project. In this case a tool for determining the comparative impact of potential project gains and losses relating to the different alternatives is used. The Gain to Loss Ratio compares the magnitude of potential gains as opposed to the magnitude of potential losses. Thus an alternative would not be chosen if its potential for losses significantly outweighs its potential for gains. The Gain to Loss Ratio is determined for Alternative 2 and 3 (the JI project), a ratio is not determined for the Alternative 1 (Business as usual) as it has no financial impact. The Gain to Loss Ratio is indicated below:

Gain to Loss Ratio (X) = ABS (Potential Gain / Potential Loss)

[X < 1, the potential for losses exceed the potential for gains]

[X > 1, the potential for gains exceed the potential for losses]

Alternatives	Gain to Loss Ratio
1	NA
2	0,02
JI Project	1,29

As it can be seen the Gain to Loss Ratio for Alternative 2 is 0.02, which indicates that the potential for losses of the project activity without JI participation is quite high (50%). The Gain to Loss Ratio for the project activity with JI participation (Alternative 3) is 1.29 which clearly indicated a greater potential for gains than losses.

Based on the investment analysis comparison in Sub-step 2c and the sensitivity analysis in Sub-step 2d, it is clear that the project activity would not occur without participation in Joint Implementation due to 1) the indicated expected negative NPV of Alternative 2 under assumed conditions, and 2) the much higher potential for project losses as opposed to project gains of Alternative 2. This leads to the conclusion that the project activity would not occur without participating in Joint Implementation (Alternative 3) where the expected NPV is encouragingly positive and the potential for gains is much greater than the potential for losses. Thus, without participation in Joint Implementation only Alternative 1 business as usual would occur due to the fact that it presents no net financial change for ROMAG TPP, and of course requires no action.

Step 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of type of the proposed project activity:

<u>**Investment Barriers**</u>

ROMAG TPP has limited ability to gain the required investment capital for the rehabilitation of the district heating network due to the large renovation works which are required. The feasibility study for the rehabilitation of the district heating system was finalised in September 2003, since that time only very minor works have been performed on the secondary district heating system (mostly relating to the replacement of heat exchangers for hot potable water), no comprehensive effort has been taken. The root cause of this is the lack of investment to do so. This lack of investment is caused by a number of problems which are typical in the Romanian district heating sector including:

1) Large available capital being spent on the power plant (which has stretched the available credit line of the company);
2) Consumer heat and electricity prices which are below the actual production prices (thus operation is subsidised via municipal payments, and the heat/power companies would not be financially viable without this);
3) Regulation of consumer heat and electricity prices which significantly limits increases;
4) Lack of creditors willing to loan or invest capital due to point 2 and better investment opportunities;
5) A lack of financial support funds from the National Government, the EU (ISPA and PHARE), and development banks, which also require matching funds.

The total investment need for the project is around € 47,000,000. At this point in time it is expected that ROMAG TPP (RAAN) will be able to gain grants of € 5,600,000 from the Romanian central budget allocations and € 2,000,000 will come from ARCE the Romanian Energy Conservation Agency. These grants are designed to cover only a portion of an energy efficiency projects investment needs, and only cover 16% of this projects investment need. The remaining 84% (€ 39,400,000) will come from ROMAG TPP, where a loan of € 14,100,000 is expected. The JI component of this project is expected to lead to revenues of € 3,275,00 which will help cover 15% of the loan principle ROMAG TPP will have to rely on other efforts to cover the remaining investment. Future investments such as this project by ROMAG TPP will be based on a priority and risk basis, as for example loans need to be paid back.

As indicated in the Investment Analysis (Step 2) the financial risks associated with the project activity are perceived to be high which has limited ROMAG TPP willingness to make the investment. It can be seen in the sensitivity and risk analysis (Sub-Step 2d) that the potential losses on the investment are greater than the potential gains without Joint Implementation involvement. This financial risk level is considered to be significantly higher than the business as usual scenario. It is also a major question as to how ROMAG TPP will cover its investment capital input to the project activity without its participation in Joint Implementation.

Barriers due to Prevailing Practice

The general condition of the district heating sector in Romania is poor, where rehabilitation of such networks is typically performed only at a very small scale, which usually focus on municipal building such as schools and hospitals. This is predominately due to the general lack of financing for such efforts and a general attitude of prioritizing other national and municipal investments.

The prevailing practice in Romania in relation to the district energy and heating sector is not to focus on energy efficiency but on production capacity improvements. In relation to this the order of priority is 1) the rehabilitation of the heating, power and CHP plants as the first step, 2) the primary district heating network as a second step, and 3) the secondary network and substations last. In general this means that nearly all investment capital and credit lines, especially from development banks, are used up for the first priority and nothing is left for the third priority. As for the lack of energy efficiency in this sector, it is partially caused by a lack of implementation of legislation targeting energy efficiency and lack of related financing and investment capital. This leads to a situation where "the fact that energy efficiency and renewable potential is very high remains largely ignored".[4]

Evidence of this can be found in nearly all major and small cities in Romania, where Drobeta Turnu-Severin is a very good and typical example. The district heating systems were established in the 1960s through 1980s with low efficiency technologies (often due to poor insulation). These district heating systems have only undergone general operation and maintenance, and still have the same installations as when they were first installed and are now in poor shape, and highly inefficient. Since the 1990s comparatively very little has been done to the secondary district heating networks or on the demand side to improve energy efficiency. It should be noted that few exceptions do of course exist in a small number of Romanian cities.

Through the establishment of this project activity under Joint Implementation a portion of the investment demand will become available and the project will become more financially viable for long term operation. Projects such as this one will highlight to the energy sector in Romania that secondary network rehabilitation can be viable to increase energy efficiency and lead to reduced operational costs from energy savings.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

As indicated in Step 2 and Sub-Step 3a the project activity without Joint Implementation (Alternative 2) will not occur without the inclusion of Joint Implementation. Therefore, the only other alternative which is likely to happen is Alternative 1 – Business as usual. Business as usual will be the same general operation of secondary district heating network which has occurred since 1967, where the efficiency has decreased over time increasing GHG emissions.

Step 4: Common practice analysis

[4] "ARRESTED DEVELOPMENT ENERGY EFFICIENCY AND RENEWABLE ENERGY IN THE BALKANS" – Romania, Pages 51-63 - May 2005

Sub-step 4a: Analyze other activities similar to the proposed project activity:

As indicated previously the large scale rehabilitation of the secondary heat network and heat conversion substations is not common in Romania, and such large scale efforts are new to Romania. The only other known similar large scale district heating rehabilitation project know to be near implementation at this time is one in Iasi, where the EBRD is financing approximately 60% of the € 31 million project, and the Swiss Government is also assisting the project.

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

The large scale rehabilitation of the secondary heat network and heat conversion substations is not common place in Romania, mainly due to the large investment demand as indicated with the EBRD project in Iasi in sub-step 4a.

Step 5: Impact of Joint Implementation

Based on the investment analysis comparison in Sub-step 2c and the sensitivity analysis in Sub-step 2d, it is clear that the project activity would not occur without participation in Joint Implementation due to 1) the indicated expected negative NPV of Alternative 2 (€ -2,607,653), and 2) the much higher potential for project losses as opposed to project gains of Alternative 2. This leads to the conclusion that the project activity would not occur without participating in Joint Implementation (Alternative 3) where the expected NPV is positive and the potential for gains are greater than the potential for losses. Thus, without participation in Joint Implementation only Alternative 1 - Business as usual would occur due to the fact that it presents no net financial change or investment for ROMAG TPP.

There is a clear investment barrier to implementing the project activity without Joint Implementation (Alternative 2). This is due to the fact that there is a general lack of investment is caused by a number of problems which are typical in the Romanian district heating sector as described in Sub-step 3a, and include general financial risk for losses and loan payback. In addition the prevailing practice in the Romania energy and district heating sector severely limits investment for energy efficiency in the district heating networks.

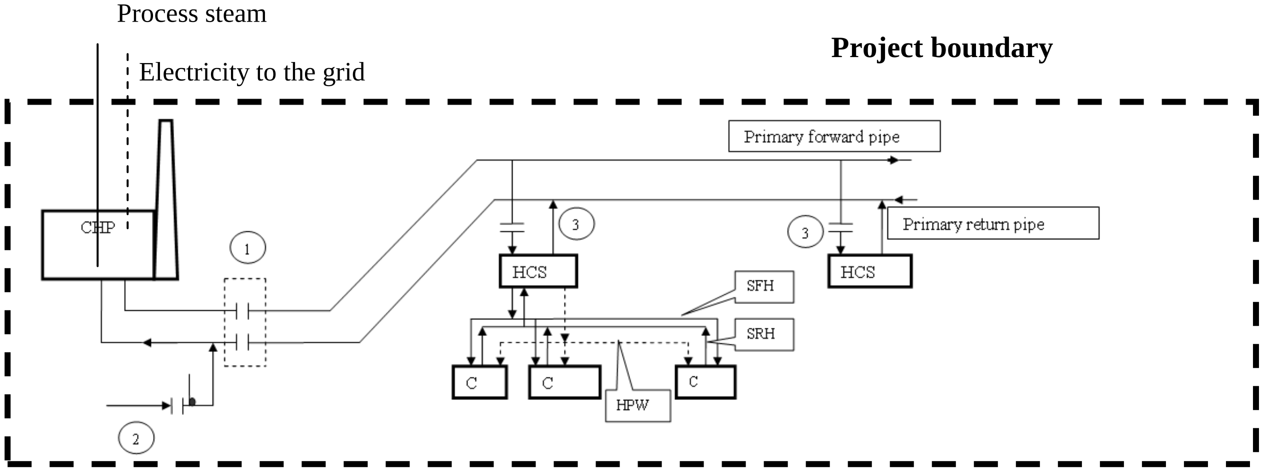
The benefits of the project activity are increased energy efficiency within the district heating network which will reduce fuel consumption and the related emission of GHGs. This is expected to lead to a reduction of lignite demand of approximately 109,251 tons per year, a reduction of fuel oil demand of around 1,352 tons per year, the reduction of replenishing water of around 490,000 cubic meters per year, and a reduction of approximately 85,248 tons of CO2 emissions per year. In addition the fuel savings will reduce other pollutant emissions related to combustion and transport.

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

The project boundary shall encompass all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonably attributable to the JI project activity.

The system boundary of the proposed project "Energy efficiency improvement of the district heating system in Drobeta Turnu-Severin" encompasses the combined heat and power plant ROMAG – TERMO and the entire district heating network of Drobeta Turnu-Severin as illustrated in the graph below.

The greenhouse gas which is accounted for is carbon dioxide (CO_2) from lignite and fuel oil combustion in the boilers located at the CHP plant.



1 – Primary Heat Carrier Measurement Point,
2 – Replenishment Water Measurement Point,
3 – Heat Conversion Substation Measurement Point,

HCS – Heat Conversion Substation
SFH – Secondary network, forward: heat
SRH – Secondary network, return: heat
HPW – Hot portable water
C – Consumers

Leakage:

According to UNFCCC leakage is defined as “the net change in anthropogenic emissions by source of greenhouse gas emissions, which occurs outside the project boundary, and which is measurable and attributable to the project activity”. Leakage effects do not disqualify a project’s validity, unless expected leakage emissions compensate a large percentage of the project emission reductions. However, it might be extremely difficult to identify leakage effects reliable. They can occur in two directions: positive leakage refers to emission reductions, while negative leakage refers to emission enhancement, induced outside the project boundary.

Positive leakage

With the proposed project activity the following positive leakage effects might occur:

- The flow of the heat carrier through the pipeline system leads to energy losses due to friction at the inner pipeline surface appearing at the pumping stations within the network. The replacement of the corroded existing heat and hot portable water pipes within the secondary district heating network will lead to reduced pressure losses and thus to reduced electricity consumption at the pumping station

- Less transportation of lignite and fuel oil to ROMAG TPP plant is required due to a reduced consumption at the plant

Negative leakage

With the proposed project activity no significant negative leakage effects can be identified.

In the proposed project activity, the positive leakage effects will be neglected to sustain a conservative approach.

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

Detailed baseline information is provided in Annex 2 to this PDD.

The baseline approach carried out by Grue & Hornstrup Consulting Engineers A/S in June 2006 was revised in January 2009 in accordance with the operational changes of ROMAG TPP.

Date of baseline setting: January /2009

The baseline developer is not project proponent.

The baseline study was prepared by:

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SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The starting date for the project is February 14th, 2006 the date when the contract was signed with the contractor.

C.2. Expected operational lifetime of the project:

The expected operational lifetime of the project is 20 years

C.3. Length of the crediting period:

The length of the period within which emission reduction units are to be earned ends in 2012. However, the project lifetime exceeds the first commitment period of the Kyoto Protocol, and additional emission reductions could be claimed once a post Kyoto period has been decided upon.

Under recent circumstance the length of the period within emission reduction units are to be earned is as follows:

- January 1st 2007 to December 31st 2007: AAUs (Assigned Amount Units)
- January 1st 2008 to December 31st 2012: ERUs (Emission Reduction Units)

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The proposed project aims to reduce the emissions of greenhouse gases by reducing thermal losses within the secondary district heating network and heat conversion. The losses will be reduced by replacing heat exchangers on the heating side at the heat conversion substations and by replacing the old corroded heat and hot portable water pipes within the secondary district heating network.

The estimation of emission reductions associated with the project activity is based on actual operation data. Fuel consumption and corresponding emissions will be related to the district heat supply to the primary district heating network.

The following parameters are monitored and will be used for calculating the emission reductions associated with the proposed project activity:

- Lignite and fuel oil consumption (t)
- Net calorific value of lignite and fuel
- District heat supply to primary network (Gcal)
- Process steam production (Gcal)
- District heat supply to consumers connected to primary network (Gcal)
- District heat supply to new consumers connected to primary network (Gcal)
- District heat supply to heat conversion substations (Gcal)
- District heat supply to secondary network (Gcal)
- District heat supply to consumers connected to secondary network (Gcal)
- District heat supply to new consumers connected to secondary network (Gcal)

The following parameters are fixed and will be used for calculating the emission reductions associated with the proposed project activity:

- Carbon factor of lignite and fuel oil (tC/TJ)
- Oxidation factor of lignite and fuel oil (%)
- Molar mass of CO2 and C (g/mol)

Both lignite and fuel oil consumption are measured and recorded using recognized procedures.

Through the SCADA system all power plant output data is monitored and recorded continuously, including the amount of electricity, district heat and process steam produced and the amount of district heat delivered to heat conversion substations.

It is important that possible changes in the demand structure (e.g. consumer connections, disconnections) to secondary and primary network is monitored by both ROMAG TPP and the EPA, as a change in the demand structure will lead to a false recording of emission reductions.

In this context all consumers connected to the district heating network (both primary and secondary network) shall be monitored during the entire crediting period.

Where new connections occur, the annual heat delivered to these consumers will be removed from the heat quantity delivered and subsequent emissions.

For conservative reasons possible disconnections of consumers to the primary and secondary network are not considered throughout the crediting period of the project activity and will be neglected.

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
$V_{P,lignite}$	Quantity of lignite consumed	-	T	c	per month	100%	electronic and paper	Data calculated in accordance with specific procedures and logged on a monthly basis
$V_{P,oil}$	Quantity of oil consumed	-	T	c	per month	100%	electronic and paper	Data calculated in accordance with specific procedures and logged on a monthly basis
$cv_{P,lignite}$	Net calorific value of lignite	-	kcal/kg	m	per month	100%	electronic and paper	Based on onsite analysis and billing records
$cv_{P,oil}$	Net calorific value of oil	-	kcal/kg	m	per month	100%	electronic and paper	Based on onsite analysis and billing records
$Q_{P,DH,primary}$	District heat supplied to primary network	Heat meter	Gcal	m	per month	100%	electronic and paper	Data collected manually every 8 hours and logged for the day.
$Q_{P,ps}$	Process steam produced for heavy water producers	Dedicated Computer	Gcal	m	per month	100%	electronic and paper	Data collected manually and automatically every hour and logged for the day
$Q_{P,DH,HCS}$	District heat supplied to heat conversion substations	SCADA	Gcal	m	per month	100%	electronic and paper	Data collected manually and automatically every hour and logged for the day
$Q_{P,DH,pr.con}$	District heat supplied to consumers connected to the primary network	Individual Heat Meter	Gcal	m	per month	100%	electronic and paper	Data collected manually on a monthly basis

$Q_{P,DH,secondary}$	District heat supplied to secondary network	SCADA	Gcal	m	per month	100%	electronic and paper	Data collected manually and automatically every hour and logged for the day
$Q_{P,DH,consumers}$	District heat supplied to consumers connected to the secondary network	SCADA (after completing the connections of local Heat Meters to the new installed M Bus cable) **At Present:** Heat Meters	Gcal	m	per month	100%	electronic and paper	Data collected manually and automatically every hour and logged for the day **At Present:** Data collected manually on a monthly basis
$Q_{P,DH,pr.new\_con}$	District heat supplied to new consumers connected to the primary network	Individual Heat Meter	Gcal	m	per month	100%	electronic and paper	Data collected manually on a monthly basis
$Q_{P,DH,sec.new\_con}$	District heat supplied to new consumers connected to the secondary network	Individual Heat Meter	Gcal	m	per month	100%	electronic and paper	Data collected manually on a monthly basis

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 are calculated as follows:

$$PE = PE_{P,DH,consumers} - PE_{P,DH,sec.new\_con}$$

where:

PE	project emissions	[t CO_2]
$PE_{P,DH,consumers}$	project emissions associated with district heat supplied to consumers connected to the secondary network	[t CO_2]
$PE_{P,DH,\sec.new\_con}$	project emissions associated with district heat supplied to new consumers connected to the secondary network	[t CO_2]

Project emissions associated with the district heat supplied to consumers are calculated as follows:

$$PE_{P,DH,consumers} = \frac{Q_{P,DH,consumers} \times factor_1 \times (fraction_{lignite} \times EF_{lignite} + fraction_{oil} \times EF_{oil})}{\eta_{P,power\ plant} \times \eta_{P,primary} \times \eta_{P,HCS} \times \eta_{P,\sec ondary}}$$

where:

$PE_{P,DH,consumers}$	project emissions associated with district heat supplied to consumers connected to the secondary network	[t CO_2]
$Q_{P,DH,consumers}$	district heat supplied to consumers connected to the secondary network	[Gcal]
$\eta_{P,power\ plant}$	thermal efficiency of the power plant	[%]
$\eta_{P,primary}$	thermal efficiency of the primary network	[%]
$\eta_{P,HCS}$	thermal efficiency of the heat conversion substations	[%]
$\eta_{P,\sec ondary}$	thermal efficiency of the secondary network	[%]
$factor_1$	conversion factor from TJ to Gcal	[0.004 TJ/Gcal]
$fraction_{lignite}$	fraction of lignite consumed in power plant	[%]
$fraction_{oil}$	fraction of oil consumed in power plant	[%]
$EF_{lignite}$	CO2 emission factor for lignite	[tCO2/TJ]
EF_{oil}	CO2 emission factor for oil	[tCO2/TJ]

The thermal efficiency of the power plant is calculated as follows:

$$\eta_{P,power\ plant} = \frac{(Q_{P,DH,primary} + Q_{P,ps})}{factor_2 \times (V_{P,lignite} \times cv_{P,lignite} + V_{P,oil} \times cv_{P,oil})}$$

where:

$Q_{P,DH,primary}$	district heat supplied to the primary network	[Gcal]
$Q_{P,ps}$	process steam produced for heavy water producers	[Gcal]
$factor_2$	conversion factor 1/1,000	[-]
$V_{P,lignite}$	quantity of lignite consumed	[t]
$cv_{P,lignite}$	net calorific value for lignite	[kcal/kg]
$V_{P,oil}$	quantity of oil consumed	[t]
$cv_{P,oil}$	net calorific value for oil	[kcal/kg]

The thermal efficiency of the primary network is calculated as follows:

$$\eta_{P,primary} = \frac{(Q_{P,DH,HCS} + Q_{P,DH,pr.con} + Q_{P,DH,pr.new\_con})}{Q_{P,DH,primary}}$$

where:

$\eta_{P,primary}$	thermal efficiency of the primary network	[%]
$Q_{P,DH,HCS}$	district heat supplied to heat conversion substations	[Gcal]
$Q_{P,DH,pr.con}$	district heat supplied to consumers connected to the primary network	[Gcal]
$Q_{P,DH,pr.new\_con}$	District heat supplied to new consumers connected to the primary network	[Gcal]
$Q_{P,DH,primary}$	District heat supplied to the primary network	[Gcal]

The thermal efficiency of the heat conversion substations is calculated as follows:

$$\eta_{P,HCS} = \frac{Q_{P,DH,secondary}}{Q_{P,DH,HCS}}$$

where:

$\eta_{P,HCS}$	thermal efficiency of the primary network	[%]

$Q_{P,DH,\sec ondary}$	district heat supplied to secondary network	[Gcal]
$Q_{P,DH,HCS}$	district heat supplied to heat conversion substations	[Gcal]

The thermal efficiency of the secondary network is calculated as follows:

$$\eta_{P,HCS} = \frac{Q_{P,DH,consumers} + Q_{P,DH,\sec.new\_con}}{Q_{P,DH,\sec ondary}}$$

where:

$\eta_{P,\sec ondary}$	thermal efficiency of the primary network	[%]
$Q_{P,DH,\sec ondary}$	district heat supplied to secondary network	[Gcal]
$Q_{P,DH,consumers}$	district heat supplied to consumers connected to the secondary network	[Gcal]
$Q_{P,DH,\sec.new\_con}$	district heat supplied to new consumers connected to the secondary network	[Gcal]

The fraction of lignite consumed is calculated as follows:

$$fraction_{lignite} = \frac{V_{P,lignite} \times cv_{P,lignite}}{V_{P,lignite} \times cv_{P,lignite} + V_{P,oil} \times cv_{P,oil}}$$

where:

$V_{P,lignite}$	quantity of lignite consumed	[t]
$cv_{P,lignite}$	net calorific value for lignite	[kcal/kg]
$V_{P,oil}$	quantity of oil consumed	[t]
$cv_{P,oil}$	net calorific value for oil	[kcal/kg]

The fraction of oil consumed is calculated as follows:

$$fraction_{oil} = \frac{V_{P,oil} \times cv_{P,oil}}{V_{P,oil} \times cv_{P,oil} + V_{P,lignite} \times cv_{P,lignite}}$$

where:

$V_{P,oil}$	quantity of oil consumed	[t]
$cv_{P,oil}$	net calorific value for oil	[kcal/kg]
$V_{P,lignite}$	quantity of lignite consumed	[t]
$cv_{P,lignite}$	net calorific value for lignite	[kcal/kg]

The CO2 emission factor for lignite is calculated as follows:

$$EF_{lignite} = C_{lignite} \times oxid_{lignite} \times \frac{M_{CO2}}{M_C}$$

where:

$C_{lignite}$	carbon factor for lignite	(27.6 tC/TJ)
$oxid_{lignite}$	oxidation factor of lignite	(97%)
M_{CO2}	molar mass of CO2	(44.01g/mol)
M_C	molar mass of C	(12.01g/mol)

The CO2 emission factor for oil is calculated as follows:

$$EF_{oil} = C_{oil} \times oxid_{oil} \times \frac{M_{CO2}}{M_C}$$

where:

C_{oil}	carbon factor for oil	(21.1tC/TJ)
$oxid_{oil}$	oxidation factor of oil	(99.5%)
M_{CO2}	Molar mass of CO2	(44.01g/mol)
M_C	molar mass of C	(12.01g/mol)

The emission factors for the specific fuels used are calculated in accordance with the “Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual”

Project emissions associated with new consumers connected to secondary network are calculated as follows:

$$PE_{P,DH,\sec.new\_con} = \frac{Q_{P,DH,\sec.new\_con} \times factor_1 \times (fraction_{lignite} \times EF_{lignite} + fraction_{oil} \times EF_{oil}}{\eta_{P,power\ plant} \times \eta_{P,primary} \times \eta_{P,HCS} \times \eta_{P,\sec ondary})}$$

where:

$PE_{P,DH,\sec.new\_con}$	project emissions associated with district heat supplied to new consumers connected to the secondary network	[t CO_2]
$Q_{P,DH,\sec.new\_con}$	district heat supplied to new consumers connected to the secondary network	[Gcal]
$\eta_{P,power\ plant}$	thermal efficiency of the power plant	[%]
$\eta_{P,primary}$	thermal efficiency of the primary network	[%]
$\eta_{P,HCS}$	thermal efficiency of the heat conversion substations	[%]
$\eta_{P,\sec ondary}$	thermal efficiency of the secondary network	[%]
$factor_1$	conversion factor from TJ to Gcal	[0.004 TJ/Gcal]
$fraction_{lignite}$	fraction of lignite consumed in power plant	[%]
$fraction_{oil}$	fraction of oil consumed in power plant	[%]
$EF_{lignite}$	CO2 emission factor for lignite	[tCO2/TJ]
EF_{oil}	CO2 emission factor for oil	[tCO2/TJ]

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
$Q_{B,DH,HCS}$	District heat supplied to heat conversion substation	Heat meter	Gcal	m	per day	100%	electronic and paper	1 month measurement campaign carried out in Jan 2005 on

								selected substations
$Q_{P,DH,\text{secondary}}$	District heat supplied to secondary network	Heat meter	Gcal	m	per day	100%	electronic and paper	1 month measurement campaign carried out in Jan 2005 on selected substations.
$Q_{P,DH,consumers}$	District heat supplied to consumers connected to secondary network	Heat meter	Gcal	m	per day	100%	electronic and paper	1 month measurement campaign carried out in Jan 2005 on consumers connected to selected substations.

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

The calculation of baseline emissions follows the same approach as described under D.1.1.2. "*Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent)"*. However efficiencies for heat conversion substations and secondary network are based on a 1 month measurement campaign carried out in Jan 2005 on selected heat conversion substations and associated district heat consumers.

Based on the thermal efficiencies of the heat conversion substations (94%) and in the secondary network (82%), the thermal efficiency over the secondary network including heat conversion substations amounts to 82% x 94% = 77%.

The average system efficiency is based on peak load heat operation in January 2005 and is adjusted to a yearly operation basis by deriving respective figures from the district heating system operation in Resita, Romania, which provides heat metering equipment installed at each heat conversion substation inlet and all building connections while showing similar conditions as the original Turnu-Severin network.

In Resita the average system efficiency in January 2005 amounts to 68%, while the system efficiency based on an annual operation duration amounts to 64%. When applying this efficiency difference to the secondary district heating system in Drobeta Turnu-Severin, the average system efficiency amounts to: 64%/68% x 76.4% = 71.9%. The specific monthly efficiencies for heat conversion substation and secondary district heating network will be adjusted using the annual average system efficiency of 72% instead.

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

Not applicable, Option 1 is chosen.

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

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:

No leakage effects with a negative impact on the overall emission reductions associated with the project activity can be identified.

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):

No leakage effects with a negative impact on the overall emission reductions associated with the project activity can be identified.

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 following formula will be used in order to estimate the annual emission reductions associated with the project activity:

$$ER = BE - PE$$

where:

ER	emission reductions	[t CO_2]
BE	baseline emissions	[t CO_2]
PE	project emissions	[t CO_2]

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.
$V_{P,lignite}$	Low	Registration of these data is an integrated element in the procedures performed bydedicated TPP Technical Department
$V_{P,oil}$	Low	Registration of these data is an integrated element in the procedures performed by dedicated TPP Technical Department
$cv_{P,lignite}$	Low	Registration of these data is an integrated element in the procedures performed by dedicated TPP Technical Department
$cv_{P,oil}$	Low	Registration of these data is an integrated element in the procedures performed by dedicated TPP Technical Department
$Q_{P,DH,primary}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff
$Q_{P,ps}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff
$Q_{P,DH,HCS}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff
$Q_{P,DH,pr.con}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff
$Q_{P,DH,secondary}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff
$Q_{P,DH,consumers}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff
$Q_{P,DH,pr.new\_con}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff

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$Q_{P,DH,\text{sec.}new\_con}$	Low	Registration of these data is an integrated element in the procedures performed by the control room staff

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

The operational and management structure including direct QA measures are detailed in the monitoring plan under Annex 3.

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

The monitoring plan was prepared by:

Mr. Thomas Bosse Borges

Grue & Hornstrup A/S
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Guidance and review provided by:

Mr. Lars Grue and Mr Douglas A. Marett

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Year	Project Emissions (tCO2/yr)
2007	510,693
2008	510,693
2009	510,693
2010	510,693
2011	510,693
2012	510,693
TOTAL	**3,064,160**

E.2. Estimated leakage:

No leakage effects with a negative impact on the overall emission reductions associated with the project activity can be identified.

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

Since no leakage effects will be considered in the project activity, the sum of E.1. and E.2. equals the project emissions:

Year	Project Emissions (tCO2/yr)
2007	510,693
2008	510,693
2009	510,693
2010	510,693
2011	510,693
2012	510,693
TOTAL	**3,064,160**

E.4. Estimated baseline emissions:

Year	Baseline emissions (tCO2/yr)
2007	594,561
2008	594,561
2009	594,561
2010	594,561
2011	594,561
2012	594,561
TOTAL	**3,567,366**

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

Year	Emission reductions (tCO2/yr)
2007	83,868
2008	83,868
2009	83,868
2010	83,868
2011	83,868
2012	83,868
TOTAL	**503,205**

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

The results of the application of the formulae above shall be indicated using the following tabular format.

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tones of CO_2 equivalent)	Estimated emission reductions (tones of CO_2 equivalent)
2007	510,693	-	594,561	83,868
2008	510,693	-	594,561	83,868
2009	510,693	-	594,561	83,868
2010	510,693	-	594,561	83,868
2011	510,693	-	594,561	83,868
2012	510,693	-	594,561	83,868
Total (tonnes of CO_2 equivalent)	**3,064,160**	**-**	**3,567,366**	**503,205**

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:

To date it is assessed that no Environmental Impact Assessment is required by the host Party due to the fact that the district heating system is existing, and all works will be done within the existing system, right-of-ways etc.. In this manner the project activity has a positive environmental impact since it will reduce the overall emissions from the facilities at ROMAG-TERMO, due to less fuel use. This means that the net regulated emissions based on production from ROMAG-TERMO based on production of CO_2, NOx, Sulphur compounds, particles etc. should be reduced by the project activity.

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:

Not applicable.

SECTION G. Stakeholders' comments

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

None received as of the date of issuing this document

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2
BASELINE INFORMATION

General information

Emission factors

CO2 emission factors			
Lignite	98.10	t CO2/TJ	
Fuel oil	76.93	t CO2/TJ	
Carbon factors			
Lignite	27.60	t C/TJ	IPCC 2006
Fuel oil	21.10	t C/TJ	IPCC 2006
Oxidation factors			
Lignite	97.00%		ICEMENERG (Licensed Laboratory)
Fuel oil	99.50%		ICEMENERG (Licensed Laboratory)
Molar masses			
C	12.01	gC/mol	
CO2	44.01	gCO2/mol	

Conversion factor

Conversion factor Gcal --> TJ	0.0041868	Gcal/TJ

Project emissions [2007]

Fuel consumption

	A	B	C	D	E=A*B/A*B+C*D	F=C*D/A*B+C*D
	$V_{P,lignite}$	$cv_{P,lignite}$	$V_{P,oil}$	$cv_{P,oil}$	$fraction_{lignite}$	$fraction_{oil}$
	t/month	kcal/kg	t/month	kcal/kg	%	%
Month	Quantity of lignite consumed	Net calorific value of lignite	Quantity of fuel oil consumed	Net calorific value of fuel oil	Share of lignite consumption	Share of oil consumption
January	335,950	1,850	5,245	9,725	92%	8%
February	354,400	1,845	3,595	9,725	95%	5%
March	377,450	1,883	3,612	9,740	95%	5%
April	292,350	1,899	3,256	9,755	95%	5%
May	295,000	1,818	3,496	9,755	94%	6%
June	309,900	1,868	3,025	9,760	95%	5%
July	293,500	1,859	4,125	9,760	93%	7%
August	320,000	1,805	3,473	9,750	94%	6%
September	328,900	1,768	4,234	9,750	93%	7%
October	333,600	1,805	6,087	9,743	91%	9%
November	382,000	1,752	5,114	9,746	93%	7%
December	414,500	1,800	4,620	9,740	94%	6%
Total	**4,037,550**		**49,882**			
Average		**1,829**		**9,746**	**94%**	**6%**

Energy production

	A	B	C	D	E	D
	$Q_{P,ps}$	$Q_{P,DH,primary}$	$Q_{P,DH,HCS}$	$Q_{P,DH,secondary}$	$Q_{P,DH,consumers}$	$Q_{P,DH,pr.con}$
	Gcal/month	Gcal/month	Gcal/month	Gcal/month	Gcal/month	Gcal/month
Month	Process steam production	District heat supplied to primary network	District heat supplied to heat conversion substations	District heat supplied to secondary network	District heat supplied to consumers	District heat supplied to consumers connected to the primary network
January	139,044	57,307	51,807	49,116	43,377	2,380
February	124,145	50,866	46,344	43,913	38,762	2,140
March	131,261	45,632	41,119	38,132	33,363	1,890
April	124,373	16,556	7,451	6,568	5,699	340
May	121,366	10,113	5,261	4,440	3,875	300
June	113,402	8,834	3,301	2,863	2,456	200
July	115,731	6,480	2,495	2,289	1,924	100
August	116,571	2,138	700	650	600	55
September	115,489	9,225	3,587	3,263	2,747	250
October	126,603	23,378	9,420	8,391	7,436	600
November	129,013	52,187	40,939	39,142	34,859	2,330
December	140,874	65,071	48,414	48,103	44,963	2,250
Total	**1,497,872**	**347,787**	**260,838**	**246,870**	**220,061**	**12,835**

New connections to primary and secondary network

	Primary network	**Secondary network**
	Additional Connections	Additional Connections
Month	Gcal/month	**Gcal/month**
January	158	103
February	243	147
March	328	190
April	380	237
May	405	248
June	430	259
July	455	269
August	400	250
September	484	311
October	492	338
November	544	414
December	584	475
Total	**4,902**	**3,241**

Emissions associated with new connections to secondary network

	Secondary network
	Additional Connections
Month	**Gcal/month**
January	103
February	147
March	190
April	237
May	248
June	259
July	269
August	250
September	311
October	338
November	414
December	475
Total	**3.241**

Efficiencies

	A	B	C	D
	$\eta_{P,power\ plant}$	$\eta_{P,primary}$	$\eta_{P,HCS}$	$\eta_{P,seconday}$
	%	%	%	%
Month	Thermal efficiency of the power plant	Thermal efficiency of the primary district heating network	Thermal efficiency of the Heat Conversion Substations	Thermal efficiency of the secondary district heating network
January	29%	95%	95%	88%
February	25%	96%	95%	88%
March	24%	95%	93%	87%
April	24%	49%	88%	87%
May	23%	59%	84%	87%
June	20%	44%	87%	86%
July	21%	47%	92%	84%
August	19%	54%	93%	92%
September	20%	47%	91%	84%
October	23%	45%	89%	89%
November	25%	84%	96%	89%
December	26%	79%	99%	93%
Average	**23%**	**66%**	**92%**	**88%**

Project emissions

B
PE
tCO2/month
Project emissions
75.417
77.062
73.806
24.462
14.683
13.428
8.845
1.580
13.731
35.522
77.369
94.789
510.693

Baseline emissions

Measurements taken in January 2005 at selected heat conversion substations

HCS		APOLODOR	PT 1	PT 3	PT 9	PT 13	PT 20	PT 25	PT 27	PT 54	PT 58
Heat input	kWh	1.132,00	1.894,00	1.809,79	1.380,70	461,79	790,69	1.191,58	1.655,01	586,49	465,51
Heat output	kWh	624,86	1.165,04	1.265,09	873,15	305,15	535,14	820,27	965,56	392,25	297,83
HTW output	kWh	416,58	617,00	421,69	410,90	130,78	208,11	303,39	591,80	160,22	140,16
Heat Exchanger Energy Losses		90,56	111,96	123,01	96,65	25,86	47,44	67,92	97,65	34,02	27,52
Heat Exchanger Energy Losses		8,00%	5,91%	6,80%	7,00%	5,60%	6,00%	5,70%	5,90%	5,80%	5,91%
Average Heat Exchanger Energy Losses		6,26%									
Efficiency		94%									
Secondary network											
Secondary Network (heat) Energy Losses	kWh	88,43	230,66	342,81	184,75	87,23	98,31	219,90	232,76	111,90	63,31
Secondary Network (HTW) Energy Losses	kWh	34,96	71,69	29,09	26,68	14,41	18,79	21,51	37,23	14,93	
Total losses in secondary network	kWh	123,39	302,35	371,90	211,43	101,64	117,10	241,41	269,99	126,83	63,31
Total losses in secondary network		11,85%	16,97%	22,05%	16,47%	23,32%	15,76%	21,48%	17,34%	22,96%	16,56%
Average losses in secondary network		18,47%									
Efficiency		82%									

Building Connections	APOLODOR Heat [kWh]	APOLODOR HTW [kWh]	PT 1 Heat [kWh]	PT 1 HTW [kWh]	PT 3 Heat [kWh]	PT 3 HTW [kWh]	PT 9 Heat [kWh]	PT 9 HTW [kWh]	PT 13 Heat [kWh]	PT 13 HTW [kWh]	PT 20 Heat [kWh]	PT 20 HTW [kWh]	PT 25 Heat [kWh]	PT 25 HTW [kWh]	PT 27 Heat [kWh]	PT 27 HTW [kWh]	PT 54 Heat [kWh]	PT 54 HTW [kWh]	PT 58 Heat [kWh]	PT 58 HTW [kWh]
1	16,58	11,88	26,52	11,7	35,95	11,63	12,22	6,76	39,35	27,46	13,7	4,05	90,98	46,29	107,02	117,48	12,32	6,56	72,56	41,46
2	17,33	9,07	25,42	12,1	34,74	12,76	11,16	6,32	35,22	25,27	7,6	2,94	10,2	7,17	9,1	12,04	11,59	5,81	17,85	9,94
3	15,73	12,52	24,32	10,8	31,3	11,86	11,74	5,66	9,68	5,3	11,34	3,68	11,88	6,52	54,6	32,51	9,91	6,85	18,9	8,8
4	11,45	13,82	26,52	12,5	33,37	9,35	10,86	6,32	10,2	8,11	15,09	8,1	9,5	6,85	10,56	5,5	17,19	8,94	19,42	10,51
5	19,15	13,39	25,12	12,1	37,15	11,86	10,96	3,92	20,29	12,48	15,73	7,73	9,6	6,36	10,35	7,05	17,64	9,1	19,53	8,24
6	16,58	13,82	15,17	9,95	12,73	10,72	10,38	5,67	20,91	8,11	17,44	9,2	14,95	6,52	10,14	6,19	50,06	26,82	19,54	8,8
7	14,23	13,82	13,77	9,55	18,75	10,48	8,92	6,32	82,27	29,64	16,48	8,46	8,91	4,56	9,93	5,85	11,76	4,32	44,73	31,81
8	8,88	12,74	32,72	21,06	15,14	10,26	11,16	8,5			11,56	4,23	10,3	5,22	18,04	19,09	47,43	29,65	2,11	1,14
9	5,67	10,8	11,2	5,07	19,78	10,03	8,34	4,14			16,48	8,1	11,78	5,71	7,33	7,74	7,22	2,09	1,56	0,85
10	9,31	12,1	12,6	5,7	13,76	9,12	10,09	5,23			12,41	7,91	8,12	4,4	10,82	7,91	26,21	11,47	2,23	1,7
11	16,05	14,04	11,8	5,1	13,59	10,49	8,44	3,71			16,59	7,9	8,71	4,73	9,62	8,26	20,66	14,6	1,73	1,42
12	33,81	43,42	10,66	5	17,2	9,8	9,99	7,85			12,41	7,18	10,09	5,87	9,36	8,6	8,68	4,47	1,93	0,85
13	20,11	11,66	11,52	4,46	27,52	11,17	10,16	6,54			15,73	7,36	10,29	4,89	9,41	8,59	10,53	6,56	1,55	0,57
14	20,65	11,02	13,12	7,36	27,53	11,18	9,8	4,14			15,41	7,54	10,79	7,01	60,64	39,38	29,15	8,05	2,36	0,85
15	23,11	21,81	14,35	9,4	27,51	11,16	11,74	5,89			17,33	8,28	8,11	6,68	57,72	41,11			2,99	1,14
16	25,25	20,3	13,12	10,1	21,84	7,3	10,38	4,14			14,12	7,36	9,11	7,17	30,52	20,98			2,49	1,15
17	15,52	10,37	15,42	8,32	21,16	8,66	11,35	5,67			15,09	6,81	10,79	6,52	27,66	20,64			3,04	1,7
18	11,24	7,99	13,18	9,5	21,14	8,65	9,12	5,01			15,94	6,44	9,8	3,59	27,98	20,47				
19	11,77	8,2	15,26	7,8	39,56	17,78	11,35	4,8			16,69	7,18	8,91	6,36	24,5	19,61				
20	12,73	7,78	31,49	19,5	17,03	5,02	8,63	3,05			13,8	5,52	10,3	5,37	30	23,39				
21	9,95	7,78	28,37	21,06	19,95	7,98	10,77	6,54			13,7	5,51	6,53	3,75	58,4	44,03				
22	11,45	7,34	12,82	5,46	18,92	11,17	9,12	2,62			15,51	6,62	6,04	3,74	87,2	63,47				
23	10,06	6,91	10,95	5,99	18,4	9,35	12,22	5,23			11,98	5,52	7,82	3,73	51,9	14,68				
24	11,23	6,48	13,82	5,1	36,64	10,49	10,38	4,8			13,48	5,89	8,22	3,76						

Measurements taken in January 2005 at selected heat conversion substations

HCS		APOLODOR		PT 1		PT 3		PT 9		PT 13		PT 20		PT 25		PT 27		PT 54		PT 58	
Heat input	kWh	1.132,00		1.894,00		1.809,79		1.380,70		461,79		790,69		1.191,58		1.655,01		586,49		465,51	
Heat output	kWh	624,86		1.165,04		1.265,09		873,15		305,15		535,14		820,27		965,56		392,25		297,83	
HTW output	kWh	416,58		617,00		421,69		410,90		130,78		208,11		303,39		591,80		160,22		140,16	
Heat Exchanger Energy Losses		90,56		111,96		123,01		96,65		25,86		47,44		67,92		97,65		34,02		27,52	
Heat Exchanger Energy Losses		8,00%		5,91%		6,80%		7,00%		5,60%		6,00%		5,70%		5,90%		5,80%		5,91%	
Average Heat Exchanger Energy Losses		**6,26%**																			
Efficiency		**94%**																			
Secondary network																					
Secondary Network (heat) Energy Losses	kWh	88,43		230,66		342,81		184,75		87,23		98,31		219,90		232,76		111,90		63,31	
Secondary Network (HTW) Energy Losses	kWh		34,96		71,69		29,09		26,68		14,41		18,79		21,51		37,23		14,93		
Total losses in secondary network	kWh	123,39		302,35		371,90		211,43		101,64		117,10		241,41		269,99		126,83		63,31	
Total losses in secondary network		11,85%		16,97%		22,05%		16,47%		23,32%		15,76%		21,48%		17,34%		22,96%		16,56%	
Average losses in secondary network		**18,47%**																			
Efficiency		**82%**																			
	25	11,88	6,26	12,36	5,8	18,23	11,4	11,93	7,41			19,05	7,18	15,05	7,5						
	26	11,57	6,7	14,2	5,2	18,75	11,86	10,28	7,19			12,52	5,52	27,81	8,15						
	27	19,69	5,83	10,82	7,36	22,88	7,75	17,85	21,15			12,63	5,34	25,44	8,31						
	28	14,98	9,07	12,2	9,9	22,87	12,08	20,95	11,12			13,41	5,33	33,06	7,09						
	29	13,48	8,42	13,6	9,45	11,52	5,93	16,78	10,46			33,61	6,44	14,65	3,26						
	30	12,73	8,85	13,8	8,6	28,21	13,91	21,05	11,55					18,41	3,75						
	31	14,23	14,04	13,9	10,4	26,83	12,77	18,62	10,46					13,07	4,4						
	32	13,7	13,39	14,87	7,9	28,9	11,4	29	17					14,16	3,59						
	33	56,33	0	14,95	9,75	23,74	8,89	15,23	10,03					9,01	4,06						
	34			14,91	8,88	23,73	11,4	16,78	10,9					53,06	24,61						
	35			14,78	9,94	17,03	6,16	18,33	10,8					57,52	32,76						
	36			15,3	8,5	25,97	10,03	17,55	10,46					7,4	1,63						
	37			13,1	7,2	43	16,19	18,04	11,34												
	38			11,99	10,14	29,96	4,56	21,92	15,7												
	39			11,1	11,3			16	8,5												
	40			16,3	12,1			31,72	15,26												
	41			14,7	11,1			20,27	8,07												
	42			15,2	4,76			11,45	4,58												
	43			13,8	11,9			12,03	5,45												
	44			12,33	9,31			12,9	8,07												
	45			11,48	9,2			11,35	4,58												
	46			15,7	9,95			11,64	6,32												
	47			15,2	9,8			9,41	9,37												
	48			14,9	8,14			9,73	8,72												
	49			13,5	7,55			38,31	10,9												
	50			12,44	9,75																
	51			12,97	6,75																
	52			15,09	9,36																
	53			13,8	9,7																
	54			12,78	9,5																
	55			16,3	18,42																
	56			15,81	12,52																
	57			60,96	10,5																
Total		**536,43**	**381,62**	**934,38**	**545,31**	**922,28**	**392,6**	**688,4**	**384,22**	**217,92**	**116,37**	**436,83**	**189,32**	**600,37**	**281,88**	**732,8**	**554,57**	**280,35**	**145,29**	**234,52**	**130,93**

Resita system efficiency over HCS and secondary networks before rehabilitation	
Januar	68%
Annual	64%

Turnu Severin system efficiency over HCS and secondary networks before rehabilitation	
January	76%
Annual (calculated)	72%

Baseline emissions

A
tCO2/month
Baseline emissions
87.793
89.613
83.259
26.013
15.036
13.890
9.483
1.883
14.620
38.986
91.593
122.393
594.561

Emission reductions

	A	B	C
		PE	*ER*
	tCO2/month	tCO2/month	tCO2/month
Month	Baseline emissions	Project emissions	Emission reductions
January	87.793	75.417	12.375
February	89.613	77.062	12.551
March	83.259	73.806	9.453
April	26.013	24.462	1.551
May	15.036	14.683	353
June	13.890	13.428	462
July	9.483	8.845	638
August	1.883	1.580	303
September	14.620	13.731	889
October	38.986	35.522	3.463
November	91.593	77.369	14.224
December	122.393	94.789	27.605
Total	**594.561**	**510.693**	**83.868**

Annex 3

MONITORING PLAN

The Monitoring Plan is indicated in Section D and in a separate document
Monitoring Plan Guidelines and Procedures

Annex 4

Appendixes

Investment Comparison Analysis

Alternatives

Alternative 1: Business as usual
Alternative 2: The project activity without JI participation and carbon credit trading
Alternative 3: Joint Implementation project activity

Financial analysis assumptions

This investment analysis takes into account the following assumptions based on the different alternatives:

- Total investment of the project activity is to be € 47,000,000
- ROMAG TPP will cover € 39,400,000 of the project costs, where € 25,300,000 will be covered through own financial source over the project period, and €14,100,000 will be covered via a loan.
- Grants of € 5,600,000 will come from the Romanian central budget allocations and € 2,000,000 will come from ARCE the Romanian Energy Conservation Agency
- A 10-year Romanian commercial loan taken out by ROMAG TPP with Romanian commercial interest rates of 9%.
- An annual operation and maintenance cost is neglected as it should reflect the same costs as the existing situation.
- Average annual cost of Joint Implementation (e.g. verification) € 15,000
- At full implementation an annual CO_2 savings of 91,548 tons/yr at a price of 6.00 €/ton CO_2
- A Net Present Value (NPV) discount rate of 10%, which is a reflective value based on the current Romanian economy. It is slightly over the rate of inflation 8 – 9 % (2005), and one and a half points over the National Bank of Romania's reference rate of 8.5% (June 2006), and in line with Romanian commercial bank rates (9.5-10.5%).

Implementation schedule			
Activity	2006	2007	Total
Costs Network (€)	16,450,000	30,550,000	47,000,000

Price for lignite	8,20	€/Gcal
Price for fuel oil	346,00	€/t
Price for water	0,28	€/m3
Price of ER	6,00	EUR/tonne of CO2
Discount rate	10%	
Bank interest rate for loan	9,0%	

Financial Analysis with JI	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Emission Reductions (tCO2)	503.205		83.868	83.868	83.868	83.868	83.868	83.868			
Lignite savings (t)	983.262		109.251	109.251	109.251	109.251	109.251	109.251	109.251	109.251	109.251
Fuel oil savings (t)	12.172		1.352	1.352	1.352	1.352	1.352	1.352	1.352	1.352	1.352
Water savings (m3)	4.406.400		489.600	489.600	489.600	489.600	489.600	489.600	489.600	489.600	489.600
Investment Analysis	**TOTALS**										
Total investment Cost	**47.000.000**	**16.450.000**	**30.550.000**								
Own Financing source	25.300.000										
Central budget	5.600.000										
ARCE Romanian Energy Conservation Agency	2.000.000										
Total Principle for loan	14.100.000										
Debits	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Loan Payment [€]	21.970.633	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063
Revenue and Savings	**TOTALS**										
ERs [€]	3.019.232	0	503.205	503.205	503.205	503.205	503.205	503.205			
Lignite savings [€]	14.749.455	0	1.638.828	1.638.828	1.638.828	1.638.828	1.638.828	1.638.828	1.638.828	1.638.828	1.638.828
Fuel oil savings [€]	4.211.452	0	467.939	467.939	467.939	467.939	467.939	467.939	467.939	467.939	467.939
Water savings (€)	1.233.792	0	137.088	137.088	137.088	137.088	137.088	137.088	137.088	137.088	137.088
Cash Flow	1.243.298	-2.197.063	549.997	549.997	549.997	549.997	549.997	549.997	46.792	46.792	46.792
NPV (10%)	**240.004**										

Financial Analysis without JI	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Lignite savings (t)	983.262	0	109.251	109.251	109.251	109.251	109.251	109.251	109.251	109.251	109.251
Fuel oil savings (t)	12.172	0	1.352	1.352	1.352	1.352	1.352	1.352	1.352	1.352	1.352
Water savings (m3)	4.406.400	0	489.600	489.600	489.600	489.600	489.600	489.600	489.600	489.600	489.600
Investment Analysis	**TOTALS**										
Total investment Cost	**47.000.000**	**16.450.000**	**30.550.000**								
Own Financing source	25.300.000										
Central budget	5.600.000										
ARCE Romanian Energy Conservation Agency	2.000.000										
Total Principle for loan	14.100.000										
Debits	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Loan Payment [€]	21.970.633	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063
Revenue and Savings	**TOTALS**										
Lignite savings [€]	14.512.947	0	1.612.550	1.612.550	1.612.550	1.612.550	1.612.550	1.612.550	1.612.550	1.612.550	1.612.550
Fuel oil savings [€]	4.211.452	0	467.939	467.939	467.939	467.939	467.939	467.939	467.939	467.939	467.939
Water savings (€)	1.233.792	0	137.088	137.088	137.088	137.088	137.088	137.088	137.088	137.088	137.088
Cash Flow	-3.246.233	-2.197.063	-116.574	-116.574	-116.574	-116.574	-116.574	-116.574	-116.574	-116.574	-116.574
NPV (10%)	**-2.607.653**										

Underlying Assumptions Sensativity Analysis

Average annual JI costs	15.000	€/yr
Price for lignite	8,20	€/Gcal
Price for fuel oil	346,00	€/t
Price for water	0,28	€/m3
Price of ER	6,00	EUR/tonne of CO2
Discount rate	10%	
Bank interest rate for loan	9%	

Sensativity Analysis with JI	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Emission Reductions (tCO2)	503.205		83.868	83.868	83.868	83.868	83.868	83.868			
Lignite saved (t)	983.262		109.251	109.251	109.251	109.251	109.251	109.251	109.251	109.251	109.251
Fuel oil saved (t)	12.172		1.352	1.352	1.352	1.352	1.352	1.352	1.352	1.352	1.352
Water savings (m3)	4.406.400		489.600	489.600	489.600	489.600	489.600	489.600	489.600	489.600	489.600
Total investment Cost	**47.000.000**	**16.450.000**	**30.550.000**								
Own Financing source	25.300.000										
Central budget	5.600.000										
ARCE Romanian Energy Conservation Agency	2.000.000										
Total Principle for loan	14.100.000										

Sensativity Analysis with JI

Increase in Fuel costs (+ 10%) and increase in energy savings (+ 5%)

Debits	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Loan Payment [€]	21.970.633	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063
Average annual JI costs	105.000		15.000	15.000	15.000	15.000	15.000	15.000	15.000		
Revenue and Savings	**TOTALS**										
ERs [€]	3.170.193		528.366	528.366	528.366	528.366	528.366	528.366			
Lignite savings [€]	17.035.620		1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847
Fuel oil savings [€]	4.864.227		540.470	540.470	540.470	540.470	540.470	540.470	540.470	540.470	540.470
Water savings (€)	1.425.030		158.337	158.337	158.337	158.337	158.337	158.337	158.337	158.337	158.337
Cash Flow	**4.419.438**	-2.197.063	907.955	907.955	907.955	907.955	907.955	907.955	379.590	394.590	394.590
NPV (10%)	**2.094.120**										

Decrease in Fuel costs (- 10%) and decrease in energy savings (- 5%)

Debits	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Loan Payment [€]	21.970.633	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063
Average annual JI costs	105.000		15.000	15.000	15.000	15.000	15.000	15.000	15.000	0	0
Revenue and Savings	**TOTALS**										
ERs [€]	2.868.270		478.045	478.045	478.045	478.045	478.045	478.045			
Lignite savings [€]	12.610.784		1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198
Fuel oil savings [€]	3.600.792		400.088	400.088	400.088	400.088	400.088	400.088	400.088	400.088	400.088
Water savings (€)	1.054.892		117.210	117.210	117.210	117.210	117.210	117.210	117.210	117.210	117.210
Cash Flow	**-1.940.895**	-2.197.063	184.478	184.478	184.478	184.478	184.478	184.478	-293.567	-278.567	-278.567
NPV (10%)	**-1.629.411**										

Sensativity Analysis without JI

Increase in Fuel costs (+ 10%) and increase in energy savings (+ 5%)											
Debits	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Loan Payment [€]	21.970.633	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063
Revenue and Savings	**TOTALS**										
Lignite savings [€]	17.035.620		1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847	1.892.847
Fuel oil savings [€]	4.864.227		540.470	540.470	540.470	540.470	540.470	540.470	540.470	540.470	540.470
Water savings (€)	1.425.030		158.337	158.337	158.337	158.337	158.337	158.337	158.337	158.337	158.337
Cash Flow	**1.354.244**	-2.197.063	394.590	394.590	394.590	394.590	394.590	394.590	394.590	394.590	394.590
NPV (10%)	**68.535**										

Decrease in Fuel costs (- 10%) and decrease in energy savings (- 5%)											
Debits	**TOTALS**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Loan Payment [€]	21.970.633	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063	2.197.063
Revenue and Savings	**TOTALS**										
Lignite savings [€]	12.610.784		1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198	1.401.198
Fuel oil savings [€]	3.600.792		400.088	400.088	400.088	400.088	400.088	400.088	400.088	400.088	400.088
Water savings (€)	1.054.892		117.210	117.210	117.210	117.210	117.210	117.210	117.210	117.210	117.210
Cash Flow	**-4.704.165**	-2.197.063	-278.567	-278.567	-278.567	-278.567	-278.567	-278.567	-278.567	-278.567	-278.567
NPV (10%)	**-3.455.761**										

Alternatives	Estimated Investment Costs (€)	Estimated Project Costs (€)	Estimated Project Revenus and Savings (€)	NPV 10% (€)
1	0	0	0	0
2	47.000.000	21.970.633	18.724.400	-2.607.653
JI Project	47.000.000	22.075.633	21.980.138	240.004

Alternatives	Estimated Investment Costs (€)	Estimated Project Costs (€)	Estimated Project Revenus and Savings (€)	NPV 10% (€)
+ 5% Energy Savings + 10% Fuel Price				
1	0	0	0	0
2	47.000.000	21.970.633	21.899.847	68.535
JI Project	47.000.000	22.075.633	25.070.040	2.094.120

Alternatives	Estimated Investment Costs (€)	Estimated Project Costs (€)	Estimated Project Revenus and Savings (€)	NPV 10% (€)
- 5% Energy Savings - 10% Fuel Price				
1	0	0	0	0
2	47.000.000	21.970.633	16.211.575	-3.455.761
JI Project	47.000.000	22.075.633	19.079.845	-1.629.411

Alternatives	Gain to Loss Ratio
1	NA
2	0,02
JI Project	1,29