CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>
Energy Efficiency Improvements - Hou Ma District Heating, Shanxi Province, P.R.C.

A.2. Description of the project activity:

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The purpose of the project activity
The purpose of the project activity is to improve the energy efficiency of heat supply in the city of Hou Ma by establishing a new district heating system utilising surplus heat from power production at the Hou Ma Power Station. Further, the new system has a demonstration value as it introduces modern district heating technology based on variable flow in Hou Ma.

Because the project activity will considerably reduce the amount of fossil fuel (coal) required for heat supply, it will lead to reduction of Greenhouse Gas (GHG) emissions corresponding to 130,003 tonnes of CO_2 equivalent in year 2006 and 80,692 tonnes of CO_2 equivalent in year 2015. The emission reduction will come through increased efficiency of heat production. The project will moreover remove the heavy local pollution of dust and particles from local transportation and combustion of coal in the city area.

When established, the Hou Ma District Heating system will supply heat to 2,389,600 m^2 of residential, public and commercial buildings. The needed heat capacity to supply the buildings included in the project is 143 MW, and the heat demand in the project area of Hou Ma will be 1,071 TJ in a normal year.

Presently, many apartments in the Hou Ma project area do not have any central heat supply. Since the beginning of the nineties, 500,000 m^2 building area has been supplied with local district heating from 88 small low-efficiency coal-fired boilers. In the remaining building area of the Hou Ma project, small coal-fired stoves and furnaces are used for heat supply in each apartment. The small boilers, stoves and furnaces give a heavy local pollution from coal dust and particles.

With the construction of the new district heating system, the small coal-fired boilers, stoves and furnaces will be demolished, and the existing local district heating network will be used as secondary network in the new system. Also approx. 358,000 m^2 of new buildings, which are under construction, will be supplied from the new district heating system. Without the construction of the new district heating system, these buildings - as it the normal practice in China[1] - would be supplied from local coal-fired boiler houses.

The Hou Ma Power Station is located three kilometres from Hou Ma city centre, and one kilometre from the district heating area. The power station will be able to supply all the needed capacity for heating to the new district heating system. The power station presently cools most of the low-pressure steam in cooling towers, thereby wasting massive amounts of energy.

[1] [1] The Ministry of Construction of the PRC: Decree No. 51 - 1st July 1996

Utilising the surplus heat from the Hou Ma Power Station will contribute to significant savings of GHG. The project savings will come from:

- Savings of primary fuels (coal) in connection with the shut-down of the decentralised boiler houses (block heating) today supplying 500,000 m^2 of building area.

- Savings of primary fuel (coal) by the removal of stoves and furnaces used by residents in an area of approx. 1,531,600 m^2.

- Savings of primary fuel from increased efficiency of heat production from the 358,000 m^2 of new buildings included in the district heating area, compare to alternative traditional heat supply options.

The view of the project participants of the contribution of the project activity to sustainable development

The project is justified by its impact on the local and global environment. Also the Municipal Government of the Hou Ma will be able to use the Hou Ma District Heating Project to demonstrate the energy saving effects of a modern variable flow district heating system, thereby promoting the development of district heating in the city.

Presently, the Hou Ma Power Station cools most of its low-pressure steam in cooling towers, thereby wasting considerable amounts of energy. The construction of a district heating system in Hou Ma will provide an opportunity to use the surplus heat from the power station.

The present stoves and furnaces used have an estimated average efficiency of approx. 40%[2]. The local coal boilers are small (on average 0.39 MW) and have a very low efficiency (on average less than 50%[2]) and have no flue gas cleaning equipment and low chimneys (2 - 20 metres). By using the surplus heat from the power station, the flue gas will be cleaned (99.5% of particle content will be removed), and since the power station has a much higher chimney (129 metres), the remaining exhaust will be felt to a much lesser degree in the city area. With the new district heating system, the problem with dust from loading, unloading and transporting coal in the city is also avoided. The surplus heat (co-generated heat) is produced at a marginal fuel efficiency of 200% (to be verified during the project activity).

The immediate beneficiary of the project is Shanxi Erastone Public Utility Company, while the overall beneficiaries are the inhabitants of the Hou Ma, especially the inhabitants in the Hou Ma city area. The immediate objective of the project is to establish the Hou Ma District Heating system in stable operation, applying suitable adjusted modern western technology. The development objectives are:

- to improve the living conditions in Hou Ma by reducing the air pollution in the city and thereby improving health conditions for the inhabitants;

- to demonstrate energy savings through the introduction of modern district heating technology and by utilisation of the surplus heat from the power station.

[2] These figures are based on the experience of Shanxi Erastone Public Utility Company

A.3. Project participants:

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Shanxi Erastone Public Utility Company is responsible both for implementation and future operation and maintenance of the new district heating system. Shanxi Erastone Public Utility Company is partly municipal owned, and is presently in charge of the heat supply from the 88 local boilers to 500,000 m^2 of building area.

The Hou Ma Power Station is 90% owned by the Shanxi Provincial Government and 10% by the Hou Ma Municipal Government. The Hou Ma Power Station is an integrated part of the Shanxi Provincial Power Company, who is responsible for power production and transmission in the Shanxi province.

Project Participants:

Shanxi Erastone Public Utility Company
Partly owned by the Hou Ma Municipal Government.

Hou Ma Power Station
90% by Shanxi Provincial Power Supply Bureau.
10% by Hou Ma Municipal Government.

Danida
Ministry of Foreign Affairs, Kingdom of Denmark
(Annex 1 country participant).

ABB- Denmark
Turn-key responsible contractor for project implementation.

The contact information is further specified in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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Hou Ma, Peoples' Republic of China

A.4.1.1. Host Party(ies):

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Host Country Party: People's Republic of China

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

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Province: Shanxi Province

A.4.1.3. City/Town/Community etc:

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City: Hou Ma, approx. 330 kilometres north east of Xian

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

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The city of Hou Ma is situated in the Shanxi Province of the PRC approx. 330 kilometres northeast of Xian. Hou Ma city covers an area of 9 square kilometres and holds a population of approx. 188,000 people. The climate in Hou Ma is a continental climate with minimum winter temperatures on minus 9° Celsius. The heating season is 120 days.

The City of Hou Ma in Chinese standard is a small local city, and the present GNP per capita income is only CNY 7,013 per year (2001 figures)[3] corresponding to approx. USD 860 per year.

The city of Hou Ma is situated 111° 15' 38" east and 35° 32' 8" north.

The project area of the proposed district heating is shown on the enclosed city map.

A.4.2. Category(ies) of project activity:

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Sector: Energy
Category: Energy Efficiency in Heat Production

A.4.3. Technology to be employed by the project activity:

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District heating is used in many countries all over the world and is a very efficient heat supply option in densely populated cities with high-rise buildings. Especially if based on co-generation of heat and power in combined cycle plants or on surplus heat from extraction turbines, district heating is most likely the economic least cost solution. However, financial and institutional barriers may distort the use of surplus heat.

Western Europe district heating systems are of the variable flow type, where it is possible to adjust the heat supply to the actual demand of heat at building level. These types of district heating systems are operated with hot water at low temperatures, thereby reducing heat losses.

In China, Russia and Eastern Europe, district heating systems have traditionally been based on fixed flow systems on either steam or hot water. With fixed flow systems, it is not possible to automatically adjust the heat supply to actual demand resulting in bad energy efficiency. Further, these systems are traditionally operated at high temperatures resulting in heat losses.

The Hou Ma District Heating Project is based on modern technology with variable flow and pre-insulated pipes. Heat exchanger stations, frequency converters, speed controlled pumps and a control system are included in the project. The project includes installation of:

[3] Source: Hou Ma Municipal Government.

Extraction unit and pipes. To extract the steam from the turbines at the Hou Ma Power Station, an extraction unit and steam pipes need to be installed. Through steam pipes, the extraction units at the turbines will be connected to a main heat exchanger station also installed at the power station.

A new main heat exchanger at the Hou Ma Power Station. The station will include two steam/hot water heat exchangers installed in parallel, each with a capacity of 93.2 $MW_{heat.}$ At the main heat exchanger station, also the main pumps for the district heating system will be installed. The pumps will be of the speed controlled type. Metering of the actual delivery of energy (hot water) from the power station to the district heating system will also take place at the heat exchanger station.

16 kilometres of primary district heating network. The pipes will be of the pre-insulated type in dimensions from DN 250 - DN 900. These pipes will distribute the hot water from the main heat exchanger station to the substations.

25 substations. The capacity will be ranging from 1.8 MW_{heat} to 11.4 MW_{heat}. Each substation will have two or three plate heat exchangers in parallel and have speed controlled pumps and frequency converters.

Secondary district heating and building installations. To supply heat from the substations to the buildings and to distribute the heat inside the buildings, new network and piping are to be installed in some of the areas and buildings supplied. In other areas and buildings, secondary district heating systems already exist and will be used by the project.

Control System. A control system operating the new district heating system will be installed at the office of the Shanxi Erastone Public Utility Company. With the control system, it will be possible to control the flow in the district heating system - thereby managing the system according to the actual demand of heat in the most critical point in the network.

The Hou Ma Power Station will supply steam to the district heating system. In China, power plants traditionally consist of a number of lines with extraction turbines, using either cooling towers or sea water as cooling media. This is also the case presently at the Hou Ma Power Station, and the power station is not presently operating in co-generation mode. However, two new production lines, "The Third Phase Extension", have been put into operation in 2002, and from these two lines, extraction of steam for the district heating system will be possible.

As district heating systems with variable flow, based on cogeneration, is not a well-known concept in China, and there is a need to provide capacity building in the field of planning and operating the system. This capacity building is part of the project activity.

There are no environmental risks involved in the project. The technology is well-proven and does not in itself pose any risks, nor does it entail any secondary risks. On the contrary, the elimination of many local coal boilers will significantly reduce any risks stemming from these, as the main heat source in future will be an already existing power station.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity,

including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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The environmental benefits in terms of greenhouse gas (GHG) emissions will come from savings of primary fuels (coal) due to the improved energy efficiency of the new heat supply system.

Without this project, the emissions would at best remain on the level of heat supply from local heat-only boilers to small district heating networks (block heating systems)

This is due to the below reasons and barriers:

1 From a regulatory point of view, the Chinese Government is responsible for the general policy on heating, while the local municipal government is responsible for implementing actual heat supply projects. The general Chinese policy states that heat supply for cities in the north of China should be based on district heating, but does not in general specify which heat source should be used to supply the systems. Choice of heat source is done by the Municipal Government - based on a regulation from the Ministry of Construction[4].

Table 1 *Size of boilers for heat supply in Chinese cities*

TYPE OF CITY	HEATING AREA IN SQUARE METERS	BOILER SIZE
-	less than 40 000	No regulation
Small	40 000 - 100 000	minimum 3 MW or 4 tons steam
Big & Medium	100 000 - 250 000	minimum 7 MW or 10 tons steam
Major	more than 250 000	minimum 12 MW or 20 tons steam

It is, however, the policy of the Chinese Government that district heating is justified because it enhances the possibilities in the long perspective of basing power production on co-generation.

No existing regulatory regime directly enhances the use of surplus heat or the construction of large district heating systems. The current regulation inclines the use of heat-only-boilers and put the responsibility of increased sustainability of heating sector development on the municipal governments. Based on the current regulation, the heat supply in Hou Ma should be based on heat-only-boilers with capacities of 12 MW.

2 The investment cost of the proposed CDM project activity is too high to be justified by normal financial viability criteria as it would be a financial least-cost solution to construct small district heating systems supplied by 12 MW heat-only boilers. This is primarily due to the facts that: a) the suggested project needs imported equipment as opposed to small heat only boilers which are locally produced and very cheap; b) the price of coal in China does not reflect the true economic cost (actual cost of labour and transport, impact on environment etc.) and does not give financial incentive to increase energy efficiency.

[4] The Ministry of Construction of the PRC: Decree No. 51 - 1st July 1996

Investing in a new large primary system with heat exchanger stations, primary network and control system is financially too expensive compared to other heat supply options, and the project is thus solely justified by its impact on the local and global environment, and will increase sustainable development of the Chinese heating sector.

3 Another barrier for implementing the project is lack of knowledge. The introduction of western technology and the import of Western European equipment had not been done in Hou Ma without the support and capacity building which is part of the present project.

The prevailing practice in Hou Ma and other cities in the Shanxi Province is that district heating is supplied by small coal-fired heat-only-boilers.

4 Also institutional barriers for utilising surplus heat from power production prevail in China. Power production, power stations and the power transmission grid are in the PRC regulated and owned by the Provincial Authorities. This means that at many power stations, they solely give priority to power production as the thinking of the power system engineers is that they must not be dependant on supplying heat as this could give disturbances in the power supply. Further, the provincial responsibility for power production and the municipal responsibility for heat supply have in several cases proven to be a barrier for utilisation of surplus heat.

Provincial ownership of power stations and municipal heat planning make it difficult to use surplus heat from power production to district heating, and many power station engineers are not positive towards being dependent on supplying heat.

The strength of the presented barriers is such that there is virtually no sole financing by municipalities of large district heating systems using western technology and equipment. Only projects like the present project activity partly financed by donor organisations from Annex 1 countries or projects in the Beijing area are - for the above reasons - presently implemented. Without the financing from the Danish Mixed Credit and the income from sales of CER's, the financial closure of the proposed CDM project activity would not have happened.

The sales of CO_2 emissions from the present project will make the project financially viable for the Hou Ma Municipal Government and release municipal funds which can be used to further improve the living conditions and efficiency of heat supply in the city.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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The crediting period has been selected to be 10 years and commence by 01 January 2006 and end by 31 December 2015.

The estimated amounts of emission reductions are listed below:

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission	130,003	117,675	105,347	93,019	80,692	80,692	80,692	80,692	80,692	80,692

reduction [ton/year]										

The CO_2 emission reduction in the period 2006 through 2015 is 930,193 ton CO_2.

A.4.5. Public funding of the project activity:

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The Hou Ma District Heating Project is financed by the Hou Ma Municipal Government, the Hou Ma Power Station and by a Danish Mixed Credit, which is a soft loan provided in accordance with the OECD Arrangement on officially Supported Export Credits

The split of financing is shown below:

Table 2 Financing of the Project Activity

FINANCING	MILLION CNY	MILLION USD
Total funding needed	**122.28**	**14.77**
Hou Ma Municipal Government	56.83*	6,86
Hou Ma Power Station	25.00	3,02
Danida Mixed Credit	40.67	4.89

* The income from sale of CER will be used to reduce the equity share of the Hou Ma Municipal Government

The financial plan for the Hou Ma project, as shown above, includes public funding from Denmark, an Annex I country. As stated in Annex 2, however, this does not result in the diversion of official development assistance and is separate and is not counted towards the financial obligations of Denmark."

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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A new baseline methodology is proposed. Reference is made to the Proposed New Baseline Methodology: Baseline (CDM-NMB)

The new baseline methodology has the title: "Energy Efficiency Improvements in District Heating Production and Distribution"

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

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The proposed new base line methodology is specifically designed for assessment of emissions caused by combustion of coal for heating and HTW in urban areas. The conditions prevailing in Hou Ma (numerous small exiting coal fired boilers, development of new buildings and ongoing replacing exiting boilers with new boilers) match the conditions for which the new base line methodology was designed.

The methodology is targeted on how to estimate the GHG emission reductions for a project activity in which improvements in the heat production efficiency (utilisation of surplus heat from a power plant) is alternative to the base line scenario. The situation is matching the situation in Hou Ma.

B.2. Description of how the methodology is applied in the context of the project activity:

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The stipulations in the proposed new base line methodology are applied for establish the base line scenario.

The CO_2 emissions in the base line and the project scenario for the Hou Ma project are calculated following the stipulations in the proposed new baseline methodology.

The additionality of the project activity is evaluated as described in the proposed new base line methodology.

Selection of justifiable and realistic Base Line Scenario

Based on an evaluation of a) the current regulations (Ref. the Ministry of Construction of the PRC: Decree No. 51 - 1st July 1996) concerning heat supply in the PRC, b) how the heat supply in Hou Ma has been done until now and c) what is currently the state of art in heat supply in China, it is most likely that without the project activity, **Alternative 1 - Replacement and Technical Enhancement, Existing Supply Concept** (ref. the proposed New Base Line Methodology) will be the Base Line Scenario.

The justification for selecting **Alternative 1 - Replacement and Technical Enhancement, Existing Supply Concept** (ref. the proposed New Base Line Methodology) is elaborated below.

- Natural gas is not available in Hou Ma, and the distance to the nearest natural gas transmission pipe line is more than 50 km, i.e. Alternative 03 - Introduction of Natural Gas, Heat Only Boilers is evaluated not to be a realistic option.

- The building areas today having no central heating and heated with stoves and furnaces would gradually be converted to central heating based on heat from local coal-fired boilers (i.e. a block heating concept);

- The building today supplied from small coal boiler stations would continue to be supplied from these;

- The new buildings under construction will have central heating based on local coal-fired boilers.

Additionality

The additionality of the project activity is evaluated by application of the stipulations in the Base Line Methodology, i.e. by application of the "Tool for demonstration and assessment of additionality"

Step 0. Preliminary screening based on the starting date of the project activity

The project participants do now request the crediting period to start prior to registration of the project activity. Accordingly, the proposed project activity passes this criterion.

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 supply of heat and hot tap water in Hou Ma could be made in the following alternative manners.

Alternative 01 - Replacement and Technical Enhancement, Existing Supply Concept:
The existing boilers will be kept in operation as long as technically possible, using the same fuel as today. At the end of the technically life span of the existing boiler, new heat only boilers with an efficiency corresponding to the efficiency of typical, new heat only boiler (fuel specific efficiency) will be installed.

For heat supply to new buildings, new heat only boilers with an efficiency corresponding to the efficiency of typical, new heat only boiler (fuel specific efficiency) will be installed.

Alternative 02 - District Heating, Heat Only Boiler Concept:
The existing boilers will be replaced by supply from a district heating pipe network. The replacement will take place in phases in compliance with construction of a distribution pipe network for heating. The heat supply to the district heating network will come from heat only boilers. The fuel used in the heat only boilers will be coal.

For heat supply to new buildings, the heat supply will be made from the district heating network.

Alternative 03 - Introduction of Natural Gas, Heat Only Boilers:
The existing boilers will be replaced by new boilers (with an efficiency corresponding to typical, natural gas fired boilers). The replacement will take place in phases in compliance with construction of a natural gas distribution pipe network.

For heat supply to new buildings, new heat only boilers (natural gas fired) with an efficiency corresponding to the efficiency of typical, new heat only boiler will be installed.

Alternative 04 - Electrical Heating
The existing boilers will be replaced by panels for electrical heating.

Alternative 05 - Solar Heating
The existing boilers will be replaced by solar panels for supply of heating.

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

From a regulatory point of view, the Chinese Government is responsible for the general policy on heating, while the local municipal government is responsible for implementing actual heat supply projects. The general Chinese policy states that heat supply for cities in the north of China should be based on district heating, but does not in general specify which heat source should be used to supply the systems. Choice of heat source is done by the Municipal Government - based on a regulation from the Ministry of Construction[5].

Table 1 *Size of boilers for heat supply in Chinese cities*

Type of city	Heating area in square meters	Boiler size
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Major	more than 250 000	minimum 12 MW or 20 tons steam

It is, however, the policy of the Chinese Government that district heating is justified because it enhances the possibilities in the long perspective of basing power production on co-generation.

No existing regulatory regime directly enhances the use of surplus heat or the construction of large district heating systems. The current regulation inclines the use of heat-only-boilers and put the responsibility of increased sustainability of heating sector development on the Municipal Governments. Based on the current regulation, the heat supply in Hou Ma should be based on heat-only-boilers with capacities of 12 MW.

According to the above:

Alternative 01 - Replacement and Technical Enhancement, Existing Supply Concept and

Alternative 02 - District Heating, Heat Only Boiler Concept

comply with the applicable legal and regulatory requirements. Other listed alternatives are eliminated from further considerations.

An alternative different from the proposed project activity has been identified, and accordingly the proposed project activity passes this criterion.

It has been chosen to demonstrate the additionality of the project activity through Step 3 Barrier analysis and not to conduct Step 2 Investment analysis.

Step 3 Barrier analysis

5 The Ministry of Construction of the PRC: Decree No. 51 - 1st July 1996

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

The investment cost of the proposed CDM project activity is too high to be justified by normal financial viability criteria as it would be a financial least-cost solution to construct small district heating systems supplied by 12 MW heat-only boilers. This is primarily due to the facts that; a) the suggested project needs imported equipment as opposed to small heat only boilers which are locally produced and very cheap; b) the price of coal in China does not reflect the true economic cost (actual cost of labour and transport, impact on environment etc.) and does not give financial incentive to increase energy efficiency.

Investing in a new large primary system with heat exchanger stations, primary network and control system is financially too expensive compared to other heat supply options, and the project is thus solely justified by its impact on the local and global environment, and will increases sustainable development of the Chinese heating sector.

Another barrier for implementing the project is lack of knowledge. The introduction of western technology and the import of Western European equipment had not been done in Hou Ma without the support and capacity building which is part of the present project.

The prevailing practice in Hou Ma and other cities in the Shanxi Province is that district heating is supplied by small coal-fired heat-only-boilers.

Also institutional barriers for utilising surplus heat from power production prevail in China. Power production, power stations and the power transmission grid are in the PRC regulated and owned by the Provincial Authorities. This means that at many power stations, they solely give priority to power production as the thinking of the power system engineers is that they must not be dependent on supplying heat as this might give disturbances in the power supply. Further, the provincial responsibility for power production and the municipal responsibility for heat supply have in several cases proven to be a barrier for utilisation of surplus heat.

Provincial ownership of power stations and municipal heat planning makes it difficult to use surplus heat from power production to district heating, and many power station engineers are not positive towards being dependant on supplying heat.

The strength of the presented barriers is such that there is virtually no sole financing by municipalities of large district heating systems using western technology and equipment. Only projects like the present project activity, partly financed by donor organisations from Annex 1 countries, or projects in the Beijing area are - for the above reasons - presently implemented. Without the financing from the Danish Mixed Credit and the income from sales of CER's, the financial closure of the proposed CDM project activity would not have happened.

The sales of CO_2 emissions from the present project will make the project financially viable for the Hou Ma Municipal Government and release municipal funds which can be used to further improve the living conditions and efficiency of heat supply in the city.

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

The two alternatives:

Alternative 01 - Replacement and Technical Enhancement, Existing Supply Concept and

Alternative 02 - District Heating, Heat Only Boiler Concept

are not affected by the above mentioned barriers for implementing the project activity.

Both alternatives are cheaper investment wise.

None of the alternatives comprise a substantial volume of imported equipment, i.e. the heat only boiler alternatives can be based on domestically manufactured equipment.

The heat only boiler technology (and district heating systems supplied by heat only boilers) is a well known technology in China and provincial cities in China and faces no barriers in respect of lack of knowledge.

The heat only boiler solution faces no institutional barriers in connection with utilisation of surplus heat from power production as the power plants and the power plant owners do not have a role in these alternatives.

It has been demonstrated that the proposed project activity faces barriers preventing the implementation of the project activity, and that the barriers do not prevent the implementation of the alternatives.

Accordingly, the proposed project activity passes this criterion.

Step 4. Common practice analyses

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

Improvements to heat supply and construction of new heating systems are occurring in numerous cities throughout China. As examples could be mentioned the South District Heating Project in Urumqi, Xinjinag Province. In this project, a new power plant is under construction for supply of co-geneated heat to the south part of Urumqi.

Urumqi in which a new power plant is under construction for supply of the However, utilisation of surplus heat from power production (co-generation) is rather unique to the Hou Ma project.

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

As mentioned above, projects for heat supply based on co-generated heat are undertaken several places in China today. However, in such projects it is typical that the co-generation plant is a new power plant, i.e. constructed and designed for supply of both heat and power. In addition, the co-generation technology is

most commonly seen in the very large cities (provincial capitals) and not in a relatively small city (in Chinese terms) as Hou Ma.

The earlier mentioned barrier in respect of lack of knowledge is not seen in the very large cities. In addition, many large cities are competing and proud to be in the lead in respect of technological development, environmental improvements and implementation of advanced imported technology. The city governments in large cities typically also have much better access funds and accordingly have the ability to finance more sophisticated technological solutions than is the case for smaller cities like Hou Ma.

The proposed project activity in Hou Ma passes the criterion as it is clear that similar project activities are undertaken in other cities in China, however, barriers are not having the same impact in other cities as in a relatively small city as Hou Ma.

Step 5. Impact of CDM registration

The impact of the approval and registration of the project activity as a CDM activity will alleviate the identified barriers and thus enable the project activity to be undertaken.

The assumed income from the CDM activity contributes to decision on implementing a project activity which is not a least cost solution.

The involvement of representatives from the Danish Government, foreign consultants, experts from Beijing, etc. alleviates barriers from the utilities and Power Authorities. It becomes interesting and challenging for e.g. the Hou Ma power plant to obtain experience and know-how in modern technology, and accordingly the institutional barriers are alleviated.

Accordingly, the proposed project activity passes this criterion.

Calculation of Emissions, Baseline Scenario

Ref. above **Alternative 1 - Replacement and Technical Enhancement, Existing Supply Concept (ref. the proposed New Base Line Methodology) describes the Base Line Scenario**

Step 1: Calculation of annual heat and HTW demand

The procedure is:

Specification of design thermal loads

In Hou Ma, the capacity of the heating installations is based on the following design thermal ratings of 60 W/m^2 heated floor area (average for all buildings):

Estimation of annual heat demand
The specific annual heat demand ($GJ/m^2/year$) is estimated by multiplication of the design thermal load by the equivalent number of full load hours as indicated in equation (1).

(1) $E_{spec} = DTR * T_{eq. full, heating} * 3,600 sec/h * 10^{-9}$

where:

E_{spec} :	specific annual heat demand	[GJ/m^2/year]
DTR:	Design Thermal Rating	[W/m^2]
$T_{eq. full, heating}$:	Equivalent number of full load hours, heating	[h/year]

In Hou Ma, the average heating season is 120 days per year (120 x 24 hours/year = 2,880 hours per year). For Hou Ma, it is assessed that the equivalent number of full load hours, heating, is 2,075 h/year (i.e. the annul heat consumption can be estimated by multiplying the design thermal rating by equivalent number of full load hours, heating). The 2,075 h/year corresponds to the fact that the average heat load in the heating season is 43.22 W/m^2 heated floor area. This value is based on experience from Hou Ma municipal government.

In the Hou Ma case, the equivalent number of full load hours, heating, corresponds approximately to 2,075 / 2,880 = 72% of the length of the heating season.

The annual heat demand (heating) is calculated as indicated in equation (2), i.e. multiplying the specific annual heat demand by the heated floor area.

(2) $E_{d, heating} = E_{spec} * A$

where:

$E_{d, heating}$:	Annual Heat Demand, Heating	[GJ/year]
E_{spec}:	Specific Annual Heat Demand	[GJ/m^2/year]
A:	Heated Floor Area	[m^2]

In Hou Ma, the heated floor area and source of heating indicated in the table below. The table indicates the status as per year 2006.

	Existing Buildings Heated Floor Area [m^2]
Existing residential and commercial buildings, heated by boilers (block heating systems)	500,000
Existing residential and commercial buildings, heated by stoves and furnaces	875,200
New Buildings heated by new boilers (block heating)	1,014,400

Existing stoves and furnaces will be phased out and replaced by heat supply from new boilers (block heating systems). The pace is 218,000 m^2 heated floor area per year, i.e. by 2010 all existing stoves and furnaces have been made redundant.

In the attached spread sheet calculation of the base line scenario, the annual heat demand, heating, is calculated for each category of buildings (e.g. existing buildings heated by boilers, existing buildings heated by stoves and furnaces, etc.).

Estimation of annual energy demand for heating of HTW

Supply of HTW is not included in the project activity and accordingly is not considered in the base line scenario.

Step 2: Calculation of Fuel Demand and CO_2 emission, Baseline

For calculation of the fuel consumption and corresponding CO_2 emission - according to the proposed new baseline methodology - three parameters are required:

I: The annual average efficiency of the existing boilers, stoves and furnaces
II: The annual average efficiency of new boilers (replacing existing boilers)
III: Time schedule for replacement of existing boilers by new boilers

In Hou Ma, the following data have been applied. Reference is made to the default values indicated in the base line methodology:

I: The annual average efficiency of the existing boilers (block heating) is 50% as they are old and in poor condition
Ia: The annual average efficiency of stoves and furnaces is 40%
II: The annual average efficiency of new boilers is assumed to 85%
III: The replacement of the exiting boilers by new boilers is taking place over a time horizon of 7 years ending by 2009 (218,000 m^2 of floor area heated by stoves and furnaces are converted to heating by new block heating boilers per year). Reference is made to the attached spread sheet calculations.

The annual fuel consumption is calculated by dividing the annual heat demand plus the energy demand for HTW by the boiler efficiency.

(4): $E_{fuel,\ baseline} = (E_{d,\ heating} + E_{HTW}) / (?_{baseline}/100)$

where:

$E_{fuel,\ baseline}$:	Annual fuel demand, baseline	[GJ/year]
$E_{d,\ heating}$:	Annual Heat Demand, heating	[GJ/year]
E_{HTW}:	Annual Energy Demand for HTW	[GJ/year]
$?_{baseline}$:	Boiler, Stove and Furnace Efficiency, baseline	[%]

From the attached spread sheet calculations it can be seen that the total annual fuel consumption (coal consumption) in Hou Ma in the base line scenario has a peak of some **1,963,332** GJ/year (year 2006) and decreasing to some **1,444,269** GJ/year (2010 and onwards).

The corresponding CO_2 emission is calculated by multiplying with the emission factor of 95 kg CO_2 per GJ.

(5): CO_2 emission, baseline = $E_{fuel,baseline}$ * 95 /1,000

where:
CO_2 emission, baseline: CO_2 emission in the base line scenario [ton/year]
$E_{fuel,baseline}$: Fuel (coal) consumption (base line scenario) [GJ/year]

In the attached spread sheet calculation of the baseline scenario, the annual fuel consumption is calculated for each category of buildings (e.g. existing buildings heated by existing boilers, existing buildings heated by stoves and furnaces, etc.). In addition, the development over time in respect of conversion of existing buildings heated by stoves and furnaces to heating by new (block heating) boilers is taken into account.

The total fuel consumption is calculated as the sum of the fuel consumptions for the different categories of buildings. The CO_2 emission is calculated based on the total fuel consumption and application of equation (5).

From the attached spread sheet calculations it can be seen that the total annual CO_2 emission in Hou Ma in the base line scenario has a peak of some **186,517** ton/year (year 2006) and decreasing to some **137,206** ton/year (2010 and onwards).

Step 3: Calculation of the fuel demand and the emissions in the Project Activity Scenario

The estimation of annual **demand** for heat and HTW

The methodology and applied data to estimate the demand for heat and HTW in the project scenario are identical to the methodology and applied data in the baseline scenario, i.e. the demand for heat and HTW exactly equation (1) through (3).

The project scenario isdifferent from the baseline scenario in respect of how quick the old, existing boilers are replaced and in the project scenario supplied by district heating.

In Hou Ma, all of the heated floor area will be supplied by district heating (and co-generated heat) by year 2006, ref. the attached Excel sheet.

Calculation of Fuel Consumption and CO_2 emission, Project Scenario

In the Hou Ma project, the capacity of the co-generation installations will be 2 x 93.2 $MW_{heat\ =}$ 186.4 $MW_{heat.}$ This means that the capacity of the co-generation facility exceeds the maximum heat (and HTW) demand of the connected buildings (including thermal losses from the distribution pipe system). The peak demand of the connected buildings is estimated not to exceed 143 MW.

In the Hou Ma project, all heat will be supplied as co-generated heat and no heat will be produced by heat only boilers. Accordingly, stipulations as indicated under b) shall be applied.

b) Heat supplied as co-generated heat

In case the proposed project activity involves heat supply from a co-generation plant (or plants) operated in combination with heat only boilers, the project developer shall through preparation of duration curves (or similar) illustrate the proportion of energy to be supplied to the district heating network which will be useful, co-generated heat supplied to the district heating network. As mentioned above, the design thermal rating of the co-generation facility exceeds that maximum heat demand of the district heating system and all heat supplied to the district heating system will be supplied as co-generated heat.

The heat supplied from the co-generation facility to the district heating network is calculated as:

(20 b) $Q_{Heat\ co\text{-}gen} = (E_{d,\ heating} + E_{HTW}) / (?_{DH,\ network}/100) * F_{co\text{-}gen} /100$

where:

$Q_{Heat\ co\text{-}gen}$: Annual heat supplied to the DH network from co-generation, project scenario [GJ/year]

$E_{d,\ heating}$: Annual Heat Demand, heating [GJ/year]

E_{HTW}: Annual Energy Demand for HTW [GJ/year]

$?_{DH,\ network}$: Annual Average Efficiency, DH network [%]

$F_{co\text{-}gen}$: Factor, project and time specific [%]

In the Ho Ma project, the default value of 90% is applied for the average annual efficiency of the district heating network.

In the Hou Ma project, the $F_{co\text{-}gen}$ factor is 100% as all heat is supplied as co-generated heat (the thermal capacity of the co-generation plant exceeds the maximum thermal demand of the connected buildings.

In Hou Ma, the heat production is based on steam extraction from the (existing) steam turbines.

The marginal fuel consumption is calculated as follows:

(25) $Q_{Fuel,\ marginal} = Q_{Heat\ co\text{-}gen} / \eta_{h,m}$

where:

$Q_{Fuel,\ marginal}$: the marginal fuel consumption at the power plant [GJ/year]

$Q_{Heat,\ co\text{-}gen}$: Annual heat supplied to the DH network from co-generation, project scenario [GJ/year]

$\eta_{h,m}$: the marginal fuel efficiency for heat production [-]

For the Hou Ma project, the default value for the marginal fuel efficiency of 200% is applied.

Application of equations (25) shows a fuel consumption of **594.884** GJ/year in the project scenario.

At the Hou Ma power plant, the fuel is coal.

The CO_2 emission from the heat co-generated heat in the project scenario shall be calculated matching the fuel allocated in the project scenario.

(27): CO_2 emission co-gen, project scenario, coal = $E_{coal\ mar.,\ co\text{-}gen,\ project\ sc.}$ * 95 /1,000
where:

CO_2 emission co-gen, project scenario, coal: CO_2 emission in the project scenario from coal fired co-generation, [ton/year]

$E_{coal\ \ mar.\ co\text{-}gen,\ project\ sc.}$ Marginal energy consumption by coal fired co-generation, project scenario [GJ/year]

As heat is only produced as co-generated heat and only coal is applied as fuel, equation (27) also indicates the total CO_2 emission in the project scenario, i.e. in the Hou Ma project scenario equations (29) and (30) will give identical numbers as equation (27).

Application of equations (27) shows a CO_2 emission of 56,514 GJ/year in the project scenario.

Step 4: Calculation of Emission Reductions

By application of equation (31), the emission reductions are calculated. The calculated emission reductions are listed in the table below:

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission reduction [ton/year]	130,003	117,675	105,347	93,019	80,692	80,692	80,692	80,692	80,692	80,692

The CO_2 emission reduction in the period 2006 through 2015 is 930,193 ton CO_2.

Step 5: Calculation of Emission Reduction Factor

According to the stipulations in the Base Line Methodology, the emission reduction factors are calculated. Stipulations listed under b) and c) Projects involving supply of heat by co-generation are followed, i.e. application of equation (32 b).

The calculated emission reduction factors are listed in the table below

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission red. factor, supply DH network [ton CO_2 per GJ]	0.109	0.099	0.089	0.078	0.068	0.068	0.068	0.068	0.068	0.068
Energy Supply to the District	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768

Heating Network (forecast) [GJ/year]										
CO_2 emission reduction [ton/year]	130,003	117,675	105,347	93,019	80,692	80,692	80,692	80,692	80,692	80,692

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

>>

1) Description of base line scenario

In the base line scenario, the old, existing, coal fired heat only boilers, stoves and furnaces will continue to be in operation for a substantial number of years. Existing stoves and furnaces will be replaced by new coal fired heat only boilers with a higher efficiency than the existing stoves and furnaces.

2) Description of the project scenario

In the project scenario, the old, existing coal fired heat only boilers are demolished, and heat supply will come from a (new) district heating system. The heat supply to the district heating system is based on utilisation of surplus heat from electric power production. The annual average efficiency of the co-generated heat is considerably higher than even the new heat only boilers. The annual average efficiency of the heat supply accordingly becomes higher than the efficiency in the base line scenario.

3) Analyses of emission in the baseline and the project scenario

The reduction in the emission of GHG (CO_2) is caused by the difference in efficiency in the heat production, i.e. the heat (and HTW) demand is identical in both the base line and the project scenario.

The key factor in the project is that the improved heat production efficiency will reduce the fuel (coal consumption), and subsequently the emission of CO_2 will be reduced.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>

The project boundary is strictly the district heating project, from the heat extraction unit at the Hou Ma Power Station to the end-user demand for heat. The project boundary includes only emission reduction obtained from the energy efficiency improvements in supplying heat to the 2,368,600 m^2 project area in Hou Ma.

This means that the emission reduction from the project is only based on the difference in coal consumption per GJ of heat supplied to the project area before and after the implementation of the project activity.

The **base line coal consumption** for heat production is calculated based on efficiencies of the existing and new local boilers, stoves and furnaces as explained above.

The **coal consumption from the project activity** is calculated as the extra coal consumption to extract heat at the power station - at a constant power production level.

This definition of the project boundary makes sense due to the fact that:

- Changes in heat demand are equally adopted into both the baseline and the project activity scenarios;
- Changes in power production at the Hou Ma Power Station supplying surplus heat to the district heating system are not relevant as only the extra coal used for heat extraction - at constant power production levels - is included in the analyses (as described in the Base Line Methodology);
- No efficiency improvements due to better supply of the heat according to actual demand have been included in the methodology, i.e. a conservative estimate;
- The base line methodology includes losses from the district heating pipe network (assumed to be constructed in the project scenario).

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>>

The base line study has been completed by January 2005 by:

Ms. Birgitte Brinch Madsen, COWI, Consulting Engineers and Planners,
Parallelvej 2, DK-2800 Kongens Lyngby, Denmark

and

Mr. Andrew T. Christensen, COWI, Consulting Engineers and Planners,
Parallelvej 2, DK-2800 Kongens Lyngby, Denmark

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

A contract for supply of part of the equipment has been signed, and the manufacturing/installation of equipment is in progress.

C.1.2. Expected operational lifetime of the project activity:

>>

20y-0m

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

Not applied.

C.2.1.2. Length of the first crediting period:

>>

Not applied.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

Starting date: 01/01/2006

C.2.2.2. Length:

>>

Length: 10 years, 0 months

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

A new monitoring methodology is proposed. Reference is made to the "Proposed New Methodology: Monitoring (CDM-NMM)". The new monitoring methodology is named: "Monitoring of Energy Efficiency Improvements in District Heating Production and Distribution

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

The application of the monitoring methodology for estimation of the CO_2 emission reduction is considered a feasible, easy and transparent manner to monitor and calculate the emission reductions.

The monitoring methodology implies that data on heat supplied to the district heating system shall be monitored for each of the sources supplying heat to the district heating system. For the Hou Ma district heating system, this means that energy supply to the district heating system shall be monitored at the:

Hou Ma Power Station (monitoring of co-generated heat supplied to the district heating network)

The selected monitoring methodology exactly match the conditions prevailing in Hou Ma, i.e. supply of co-generated heat through a district heating system, replacing heat supply from heat only boilers, stoves and furnaces.

Base on the above consideration, the proposed new monitoring methodology is found both adequate, practical and justified for monitoring of the CO_2 emissions reduction.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

This option is not applied.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	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.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

This option is not applied

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	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

E 1	*Heat supplied to the district heating system*	*Energy Meter*	*GJ/year*	*m*	*Continuously*	*100%*	*Electronic (accumulated values shall be archived minimum on daily basis)*	*Heat supplied as co-generated heat. Data as listed in the proposed monitoring methodology shall be monitored and archived (e.g. metered energy consumption (GJ) (accumulated value) shall be supplemented with metered data on actual flow (m^3/h), accumulated water flow water flow (m^3), supply temperature (°C), return temperature (°C), differential temperature (°C) and actual load MW. All above data shall be furnished with a time stamp.* *The energy meter shall be able to store data and data must not be lost in case of power failure. The energy meter shall record number of operation hours.*
F 1	*Coal delivered to the Hou Ma Power Plant*	*Weight of coal delivered to coal yard (scales applied at coal supplier or at the coal yard) ref. records*	*ton/year*	*m*	*Continuously*	*100%*	*Electronic / paper*	*The weight of the coal delivered to the Hou Ma Power plant shall be calculated in compliance with the stipulations in the contract between the coal supplier and the purchaser*

Cal 1	*Calorific value of coal*	*Lab test of coal samples*	*MJ/kg*	*m*	*Samples*	*Samples in compliance with contract between coal supplier and purchaser*	*Electronic / paper*	*The calorific value(and other properties) of the coal delivered to the Hou Ma Power plant shall be measured in compliance with the stipulations in the contract between the coal supplier and the purchaser*
P 1	*Electric Power supplied to the grid*	*Electrical high voltage meter at power plant*	*MWh/year*	*m*	*Continuously*	*100%*	*Electronic / paper*	*The supply of electric power to the grid shall be measured by the high voltage electrical meters installed at the power plant.*

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

The monitoring methodology implies that emissions from the project scenario are not calculated, the methodology applies direct calculation of emission reductions based on the monitored supply of co-generated heat from the Hou Ma power plant and multiplication with the agreed emission reduction factors.

Reference is made to Section D.2.4 below.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Leakage is not included in the baseline methodology and in the monitoring methodology.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

The CO_2 emission in the base line and the project scenario is calculated by applications of equations (1) through (30), and the CO_2 emission reduction is calculated by application of equation (31). Reference is made to the Proposed New Methodology: Base line (CDM-NMB) "Energy Efficiency improvements in district heating production and distribution".

The CO_2 emission reduction per supplied energy unit to the district heating system is calculated as:

(32 b) CO_2 emission red. factor, supply DH network = CO_2 emission, reduction / $Q_{Heat\ co\text{-}gen}$

where:

CO_2 emission red. factor, supply DH network: The agreed CO_2 emission reduction factor based on supplied energy to the DH network [ton CO_2/GJ]

CO_2 emission, reduction: CO_2 emission reduction, ref. equation (31) [ton/year]

$Q_{Heat\ co\text{-}gen}$: Annual Energy Demand, District Heating Network, ref. equation (20 b) [GJ/year]

The above listed factor: CO_2 emission red. factor, supply DH network for the Hou Ma district heating project listed in the table below:

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission red. factor, supply DH network [ton CO_2 per GJ]	0.109	0.099	0.089	0.078	0.068	0.068	0.068	0.068	0.068	0.068

The calculation of the emission reductions actually obtained shall be calculated based on the equation below:

(33) CO_2 emission red., actual = CO_2 emission red. factor, supply DH network * $E_{monitored,\ DH\ network}$

where:

CO_2 emission red., actual: The actual obtained CO_2 emission reduction [ton CO_2/year]

CO_2 emission red. factor, supply DH network: The agreed CO_2 emission reduction factor based on supplied energy to the DH network (ref. table above) [ton CO_2/GJ]

$E_{monitored,\ DH\ network}$ The monitored energy supply to the district heating network (one year) [GJ/year]

In the Hou Ma district heating project, only heat supplied as co-generated heat from the source (the Hou Ma power plant) shall be monitored.

The emission reduction factors shall be subject to adjustment according to actual obtained marginal fuel efficacy at the Hou Ma Power Plant.

The calculation of the actually obtained marginal fuel efficiency at the Hou Ma Power Plant shall follow the stipulations in the proposed new base line methodology, i.e.

Step 6:
Updating of emission reduction factors based on monitored data

The emission reduction factors shall be adjusted according to the monitored data. The principle is that the emissions calculated for the baseline scenario are not changed.

The emissions in the project scenario are re-calculated based on actual efficiencies. Step 4 and Step 5 are repeated, and a set of emission reduction factors valid for the specific year are obtained. The actual emission shall be calculated reflecting the actual fuel used (i.e. fuel consumption in terms of coal shall be monitored).

The actual marginal heat production efficiency is calculated by application of equations (26 a) through (26 d) ref. below.

Based on historical data (3 years data prior to the start of the project activity, i.e. in Hou Ma for the years 2003, 2004 and 2005) on electric power production (electric power supplied to the grid) and fuel consumption, the fuel consumption per unit of electric power supplied shall be calculated as:

26 a) $\text{Spec. Fuel con. per MWh}_{(historic)} = \text{Fuel consumption}_{(historic)} / \text{Elec. power to grid}_{(historic)}$

where:
$\text{Spec. Fuel per MWh}_{(historic)}$: Specific Fuel consumption for electric power production [GJ/MWh] (historic data)
$\text{Elec. power to grid}_{(historic)}$ Electric power Supplied to grid [MWh/year] (historic data)
$\text{Fuel consumption}_{(historic)}$ Fuel consumption at power plant [GJ/year] (historical data)

The average value of the 3 years shall be applied.

During the project activity, data on electric power production (electric power supplied to the grid), thermal energy extracted from the turbine and fuel consumption shall be monitored. For each year during the project activity, the fuel consumption per unit of electric power supplied (during the project activity) shall be calculated as:

26 b) Spec. Fuel con. per MWh $_{(project)}$ = Fuel consumption $_{(project)}$ / Elec. power to grid $_{(project)}$

where:

Spec. Fuel per MWh $_{(project)}$:	Specific Fuel consumption for electric power production [GJ/MWh] (project data)
Elec. power to grid $_{(project)}$	Electric power Supplied to grid [MWh/year] (project data)
Fuel consumption $_{(project)}$	Fuel consumption at power plant [GJ/year] (project data)

The additional fuel consumption is calculated as:

26 c) $Q_{Fuel,\ marginal}$ = Elec. power to grid $_{(project)}$* (Spec. Fuel per MWh $_{(project)}$ - Spec. Fuel per MWh $_{(historic)}$)

where:

$Q_{Fuel,\ marginal}$:	the marginal fuel consumption at the power plant [GJ/year]
Elec. power to grid $_{(project)}$	Electric power Supplied to grid [MWh/year] (project data)
Spec. Fuel per MWh $_{(project)}$:	Specific Fuel consumption for electric power production [GJ/MWh] (project data)
Spec. Fuel per MWh $_{(historic)}$:	Specific Fuel consumption for electric power production [GJ/MWh] (historic data)

The actual marginal fuel efficiency for co-generation is calculated as:

26 d) $\eta_{h,m\ (actual)} = Q_{Heat,\ co\text{-}gen\ (act)} / Q_{Fuel,\ marginal} * 100\%$

where:

$\eta_{h,m\ (actual)}$ marginal fuel efficiency (actual)

$Q_{Heat, co\text{-}gen (act)}$: Annual heat supplied to the DH network from co-generation, actual [GJ/year]
$Q_{Fuel, marginal}$: the marginal fuel consumption at the power plant [GJ/year]

The default value for the marginal fuel efficiency (200%) is replaced by the actual marginal fuel efficiency calculated for a specific year, and the actual emission reduction factor is calculated.

Comment:
Please observe that only the actual marginal fuel efficiency shall be subject to adjustment for calculation of the actual emission reduction factors. The heat supplied shall be **identical** in both the **base line scenario** and in the **project scenario** for correct calculation of the emission reduction factor. The **actual emission reduction** is calculated by multiplying the **actual emission reduction factor** by the **actual volume of heat supplied.**

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
E 1	*Low*	*The energy meters shall be recalibrated according to procedures and at a frequency in compliance with national regulations (Chinese regulations) for meter equipment used for billing.* *Check and recalibration of a meter can be requested if a party is questioning the accuracy of the metered data. In case the accuracy is proven to be within the accuracy stipulated in the relevant norms, the party requesting the recalibration will bear the cost for the check. In case the accuracy is found to exceed the accuracy stipulated within the relevant norms, the owner of the meter will bear the cost for the check and recalibration.* *The agreement on how to monitor the energy supplied will also include procedures on how to estimate the energy supplied in case of (temporary) failure of a meter.* *The system operator shall keep accurate records of actual fuel consumption (e.g. ton of coal used), calorific value of combusted coal, replenishment water consumption and internal energy consumption at the boiler houses. The above mentioned data shall be available so that the monitored energy supply to the district heating network can be compared and evaluated in respect of actual fuel consumption.*
F 1	*Medium*	*The weight of the fuel supplied to the coal yard is measured with a methodology and accuracy as stipulated in the contract between the coal supplier and the coal purchaser. The procedures for quality assurance and quality check of the supplied weight of coal shall follow the stipulations in the contract between the coal supplier and the coal purchaser.*
Cal 1	*Low*	*The calorific value of the fuel supplied to the coal yard is measured with a methodology, sampling procedure and accuracy as stipulated in the contract between the coal supplier and the coal purchaser. The procedures for quality assurance and quality check of the calorific value of the coal shall follow the stipulations in the contract between the coal supplier and the coal purchaser.*
P 1	*Low*	*The electric power supplied to the grid is measured by the power plant by use of the high voltage electrical meters installed at the power plant. The accuracy of the data is high and recalibration of meters follows the procedures and frequency as for other high voltage metres operated by the utility.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

The staff at Hou Ma power plant who is in charge of operating the district heating system (main pumps, heat extraction etc.) will be in charge of the monitoring.

Already today, Hou Ma Power Plant has well established routines in monitoring of the system operation and archiving data for e.g. system analyses, system optimisation, accounting and billing.

The monitoring of heat supplied to the network, fuel consumption and supply of electric power to the grid from the power plant will physically be undertaken by operation staff at the power plant.

The district heating system (including the district heating facilities at the power plant) will be furnished with a SCADA system (System Control and Data Acquisition) system. The SCADA system will comprise a number of RTUs (Remote Terminal Units) and also central control room data from the actual control and coordination of the of the system operation.

The data on heat supplied to the district heating system will be extracted from the above mentioned SCADA system. The system is designed in a manner that the actual monitored data will be stored at the RTU (Remote Terminal Units), typically a huge number of data monitored at e.g. a frequency of say once every 10 seconds. The RTUs will be furnished with facilities to extract a more comprehendible report from the huge number of monitored data. A report will typically comprise hourly mean values and also maximum and minimum values.

At regular intervals, the compiled reports are transmitted to the facilities at the central control room where they are stored (ele ctronically archived).

The electronic archive at the central control room will be the data source for retrieving the heat supplied to the district heating network from each of the boiler houses.

D.5 Name of person/entity determining the monitoring methodology:

>>

COWI, Consulting Engineers and Planners, Parallelvej 2, DK-2800 Kgs. Lyngby, Denmark

COWI is consultant to the Government of Denmark

COWI is not a project participant

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

In the project scenario the CO_2 emissions are:

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission [ton/year]	56,514	56,514	56,514	56,514	56,514	56,514	56,514	56,514	56,514	56,514

The CO_2 emission in the period 2006 through 2015 is 565,140 ton CO_2.

E.2. Estimated leakage:

>>

Emission reductions related to leakage are not included.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

The sum of E.1 and E.1 are identical to the values indicted in E.1 as E.2 equals zero.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission [ton/year]	56,514	56,514	56,514	56,514	56,514	56,514	56,514	56,514	56,514	56,514

The CO_2 emission in the period 2006 through 2015 is 565,140 ton CO_2.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

In the base line scenario, the emission of CO_2 is estimated to be as indicated in the table below:

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission reduction [ton/year]	186,517	174,189	161,861	149,533	137,206	137,206	137,206	137,206	137,206	137,20

The CO_2 emission reduction in the period 2006 through 2015 is 1,495,333 ton CO_2.

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

>>

The directly estimated emission reductions due to the project activity are listed in the table below. The estimates are based on application of equation (33).

The stipulated values "Monitored Energy Supply to the District Heating Network (forecast) [GJ/year] are values identical to the values estimated in the project scenario.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CO_2 emission red. factor, supply DH network [ton CO_2 per GJ]	0.109	0.099	0.089	0.078	0.068	0.068	0.068	0.068	0.068	0.109
Monitored Energy Supply to the District Heating Network (forecast) [GJ/year]	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768	1,189,768
CO_2 emission reduction [ton/year]	130,003	117,675	105,347	93,019	80,692	80,692	80,692	80,692	80,692	80,692

The CO_2 emission reduction in the period 2006 through 2015 is 930,193 ton CO_2.

The above CO_2 emission is identical to the values calculated by subtracting the base line scenario values from the project scenario values. As mentioned above, the actual emission reduction factors shall be subject to adjustment calculated based on actually obtained marginal fuel efficiency.

Actual values for monitored energy supplied to the district heating network shall be applied.

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

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Emission reduction from project activity (supply of 11,897,680 GJ over a 10-year period)

	Year	Baseline [ton CO_2]	Project Activity [ton CO_2]	Emission Reduction [ton CO_2	Energy supplied to DH system [GJ]	Emission Reduction per supplied energy unit [ton CO_2/GJ]
Year 1	2006	173,345	56,514	130,003	1,189,768	0.109
Year 2	2007	162,996	56,514	117,675	1,189,768	0.099
Year 3	2008	152,646	56,514	105,347	1,189,768	0.089
Year 4	2009	142,297	56,514	93,019	1,189,768	0.078
Year 5	2010	131,948	56,514	80,692	1,189,768	0.068
Year 6	2011	131,948	56,514	80,692	1,189,768	0.068
Year 7	2012	131,948	56,514	80,692	1,189,768	0.068
Year 8	2013	131,948	56,514	80,692	1,189,768	0.068
Year 9	2014	131,948	56,514	80,692	1,189,768	0.068

Year 10	2015	131,948	56,514	80,692	1,189,768	0.068
Total		1,422,972	565,140	930,193	11,897,680	

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

The environmental impact for the suggested project activity is mainly positive. Reduction in coal consumption will considerably reduce the local pollutions of dust and particles and the emission of CO_2.

However, according to Chinese regulation, an environmental impact assessment of a municipal investment project is necessary prior to its execution.

A feasibility study including an assessment of environmental project impacts has been made by the Tai Yuan Municipal Engineering Design and Research Institute as an integrated part of the planning of the project activity.

Also from the point of view of Danida, the assessment of environmental impacts is essential.

None of the above assessments have found any negative impacts of the project activity.

No negative changes to the environmental situation have been reported.

The project brings environmental benefits in the form of:

- improved air quality in the local areas
- reduced emission of GHG
- reduced coal transport related traffic
- reduced noise in the local areas
- reduced land needed for heat generation.

A significant improvement in air quality in the local areas is expected as the existing small boilers are not equipped with any form of flue gas cleaning equipment and the chimneys are of a height of only 2 to 20 meters.

By replacing the existing boilers by heat supply from the district heating system, noise emission from the existing boilers will be eliminated. Many of the existing boilers are installed in the basement of the buildings, and no noise reduction equipment has been installed.

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

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No negative environmental impacts have been assessed or mentioned by any of the parties.

SECTION G. Stakeholders' comments

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G.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

G.2. Summary of the comments received:

>>

G.3. Report on how due account was taken of any comments received:

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Shanxi Erastone Public Utility Company
Street/P.O.Box:	
Building:	
City:	Hou Ma
State/Region:	Shanxi
Postfix/ZIP:	
Country:	People's Republic of China
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last Name:	
Middle Name:	
First Name:	
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 1-B

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Hou Ma Power Station
Street/P.O.Box:	
Building:	
City:	Hou Ma
State/Region:	Shanxi
Postfix/ZIP:	
Country:	People's Republic of China
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
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Annex 1-C

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	Marc Normann / Mr. Jes B. Christensen
Title:	
Salutation:	Mr.
Last Name:	Normann
Middle Name:	
First Name:	Marc
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 1-D

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	ABB Energy and Industry
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FAX:	
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Direct FAX:	+(45) 44 50 47 10
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The Hou Ma District Heating Project is financed by the Hou Ma Municipal Government, the Hou Ma Power Station and by a Danish Mixed Credit, which is a soft loan provided in accordance with the OECD Arrangement on officially Supported Export Credits

The split of financing is shown below:

FINANCING	MILLION CNY	MILLION USD
Total funding needed	**122.28**	**14.77**
Hou Ma Municipal Government	56.83*	6,86
Hou Ma Power Station	25.00	3,02
Danida Mixed Credit	40.67	4.89

* The income from sale of CER will be used to reduce the equity share of the Hou Ma Municipal Government

The financial plan for the Hou Ma project, as shown above, includes public funding from Denmark, an annex I country. As stated in the below letter from Danida, this does not result in the diversion of official development assistance and is separate and is not counted towards the financial obligations of Denmark."

Annex 3

BASELINE INFORMATION

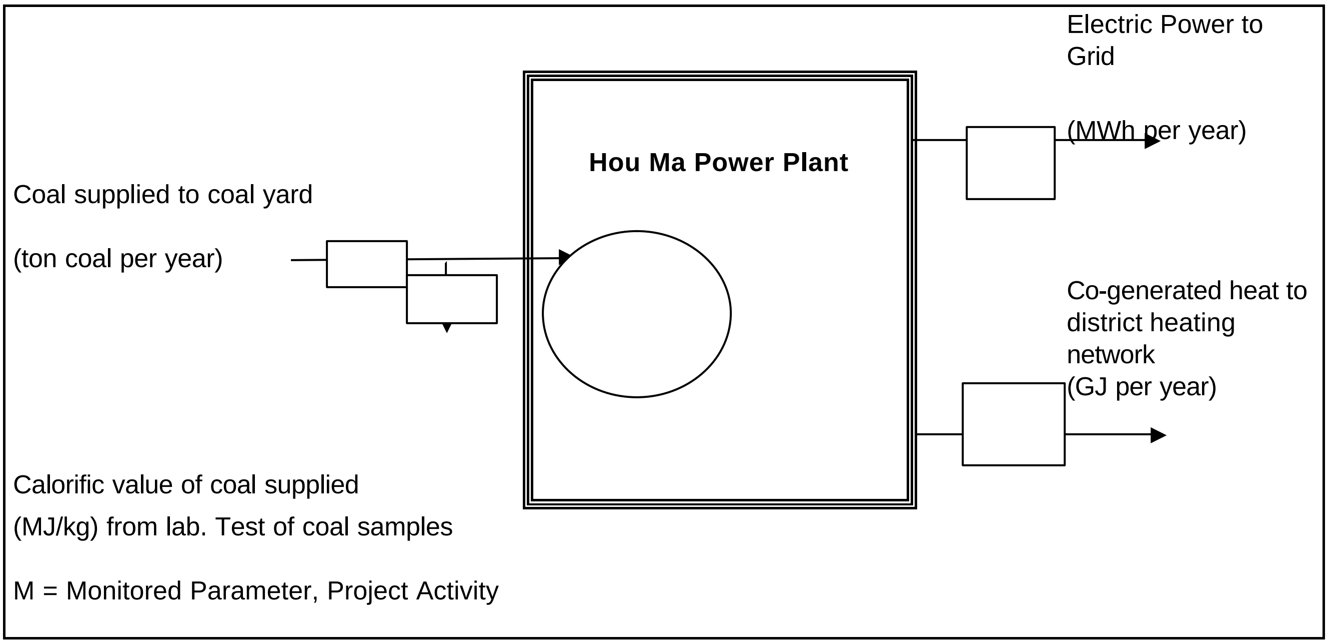
Parameters (Baseline Scenario)	**Source**	**Reference**	**Justification**
E_{spec} : specific annual heat demand	Calculated		
DTR : Design Thermal Rating		Shanxi Erastone Public Utility Company	Value applied for design of heating installations
$T_{eq.full, heating}$: Equivalent number of full load hours, heating	Calculated		Calculated based on length of heating season
$E_{d, heating}$: Annual Heat Demand, Heating	Calculated		
A : Heated Floor Area	Measured	Shanxi Erastone Public Utility Company	Value applied for design of heating installations
$E_{fuel, baseline}$: Annual fuel demand, baseline	Calculated		
$?_{baseline}$: Boiler, Stove and Furnace	Default value in	Poland - Coal to Gas	

Efficiency, baseline	NMB	Conversion Project, GEF Project Document, Report No: 13054, 1994/10/31	
$CEF_{baseline:}$ CO_2 emission factor for the baseline fuel	IPCC standard value		Specific values for Hou Ma are not available

Annex 4

MONITORING PLAN

The parameters to be monitored (continuous metering of parameters) and subsequent compiling annual values are illustrated below.



M1:

$E_{monitored, DH network}$ The monitored energy supply to the district heating network (one year). The value shall be applied in equation (33).

$Q_{Heat co-gen}$: Annual heat supplied to the district heating network (co-generated heat) supplied from the Hou Ma Power plant. The value shall be applied in equation (32 b).

$Q_{Heat co-gen (act)}$ Annual heat supplied to the district heating network (co-generated heat) supplied from the Hou Ma Power plant. The value shall be applied in equation (26 d).

In the Hou Ma situation $E_{monitored, DH network}$, $Q_{Heat co-gen}$ and $Q_{Heat co-gen(act)}$ are identical as all heat supplied will be co-generated heat, i.e. the energy meter for monitoring $Q_{Heat co-gen}$ and $Q_{Heat co-gen (act)}$ will also be applied for monitoring of $E_{monitored, DH network}$

The heat supplied shall be monitored by an energy meter installed at the Hou Ma Power Plant. The meter will be installed either at the installations for steam extraction (water side of the heat exchanger) or in the district heating main header (main header for supply to the district heating network).

M2:

Elec.power to grid (project) Electric power supplied to the grid during the project activity (annual values). The electric power supplied to the grid shall be monitored as the high voltage power supplied from the Hou Ma Power plant to the grid by the electrical meters installed at the switch gears / voltage transformers.

The value shall be applied in equation (26 b) and (26 c).

M3 and M4:

Fuel consumption (project) Fuel consumption at the Hou Ma Power Plant. The fuel consumption shall be monitored as the weight of the fuel supplied to the coal yard at the Hou Ma Power Plant (reference shall be made to records on coal supplied on an annual basis). The energy content in the fuel supplied shall be calculated by multiplication with the calorific value for the coal supplied (calorific value is obtained by lab testing of coal samples).

The value shall be applied in equation (26 b).

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