2. CURRENT STATUS OF CDM PROJECT DEVELOPMENT IN MONGOLIA AND CDM OPPORTUNITIES

CDM development has been concentrated in a few countries where projects are easily developed and projects resulting in large volumes of CERs can easily be identified. In particular, China and India have seen lots of CDM projects, followed by countries like Brazil, Mexico, etc. In contrast, many smaller economies have been largely ignored by the CDM community.

2.1 Status of CDM Development in Mongolia

Mongolia has been one of the countries that have seen relatively few CDM projects, because of the size of the economy and the relatively small size of the greenhouse has emission reductions projects that could be developed. In this chapter, we provide an overview of the current status of CDM project development in Mongolia and the opportunities. In turn, we focus on:

- Registered projects
- Projects submitted for validation
- Projects submitted to the Mongolian DNA
- Other opportunities

2.1.1 UNFCCC registered CDM projects in Mongolia

At the moment of writing, three Mongolian projects have been registered as CDM projects:

0295: A retrofit programme for decentralised heating stations in Mongolia.
0787: Taishir Hydropower Project in Mongolia
0786: Durgun Hydropower Project in Mongolia

Numbers are the UNFCCC reference numbers. At the moment of writing, more than 3700 projects have been registered with the UNFCCC, which demonstrates that Mongolia has had some difficulties attracting CDM projects. Two of the projects have had CERs issued; the third did not yet result in issued CERs.

2.1.2 Mongolian project under validation

At the moment of writing, the following projects are under validation:

- Salkhit Windpark
- Pellet and briquette plant in Mongolia

The last project was one for which the PDD was developed under the CBDICFP project.

2.1.3 Projects available at the Mongolian DNA

Several projects are available at the Mongolian DNA in PIN form, a form that is an example of marketing documentation as outlined in Chapter 1. See the website of the Mongolia DNA.

Table 2.1 Projects endorsed by the Mongolian DNA

Name	Annual CERs (tCO2e)
Building Energy Efficiency MON/09/301 Project	63 thousand
Project of generating energy from garbage treatment	459 thousand
Energy conservation and emission reduction from poor households	75.0 – 90.0 thousand
Community based heating supply in rural remote areas of Mongolia	17.0-23.0 thousand
Sainshand wind farm project	174.0 thousand
Biogas Plant Project in Mongolia	2.3 thousand
WGGE-waste gas to green energy	28.5 thousand

Oyu tolgoi wind power project (250MW Khanbogd high power wind farm)*	1,412 thousand
Replacement of coal and wood fired heating by renewable heating system	15.4 thousand
Reconstruction boilers in Power Plants of Darkhan and Erdenet cities	32 — 33 thousand
Energy efficiency rehabilitation for pre-cast panel buildings	100.0 —110.0 thousand

Table 2.2 Projects approved by the Mongolian DNA

Name	Annual CERs (tCO2e)
Maikhan small hydropower project (12MW)	36,377

Note that projects that have been registered or that are under validation have been excluded.

Table 2.3 Other projects available at the Mongolian DNA

Name	Annual CERs (tCO2e)
Improvement of heating systems in urban centers of Mongolia	30,000
Energy conservation with utilization of active mineral additives (pozzolans) in Cement production	30,000
Energy conservation with introduction of variable speed drive pumps for heating distribution in Ulaanbaatar	30,000
Mass replacement of gers and yurts by affordable passive housing (Geothermal heating supply in ger district)	99,600
Geothermal Project in Khangai region of Mongolia	50,000
Reduction of CO2 while introducing the Ladle Refining furnace in Darkhan metallurgical plant of Mongolia	30,000
Biogas (chicken and cow farm) project	30,000
Produce renewable energy using windpower	180,000
Biofuel (pellet plant) project	15,200

2.2 Greenhouse gas emission reduction opportunities in Mongolia

What are the main greenhouse gas emission reduction opportunities in Mongolia, and to what extent can these be developed under CDM? To answer that question, the CBDICFP project commissioned some original research that was conducted by Dorjpurev Jargal. The research consisted of a comprehensive survey in Darkhan-Uul, Orkhon and Selenge *aimag*. The main findings of the research are summarized below. In addition, we have highlighted some general comments about the potential for CDM projects (or more general, greenhouse gas emission reduction projects) in Mongolia, based on knowledge about the Mongolian economy.

2.2.1 Darkhan-Uul aimag

Key data, Darkhan-Uul aimag

- Territory - 3,280 sq. km
- Center - City of Darkhan, located 230km from Ulaanbaatar.
- Number of soums - 4 (Darkhan, Sharyn Gol, Khongor, Orkhon)
- Darkhan-Uul aimag was established in 1994

The aimag (province) has well developed infrastructure services and situated on international road in the direction of Ulaanbaatar to Altanbulag and on the junction of international railway from Ulaanbaatar to Sukhbaatar. The advantage of the province is that it has connected to the central energy system and has a cheap and regular public transportation vehicles compared to other aimags. In addition to this, the living cost of this place is relatively low. The total population is 91,093, from which 74,526 people live in Darkhan city. 64.5 % of the total population is the youth up to 35 years old. There are 24,989 households in the aimag, from which 67.5% live in public apartment buildings. Administratively, the aimag is divided into four soums of Darkhan, Orkhon, Khongor and Sharyn gol and 24 bags.

Darkhan-Uul aimag occupies 327.5 thousand of land on the north-east valley of Kharaa river, among the Khentii chain mountains on the northern part of Mongolia. From the total territory of the province 231.7 thousand hectare or 70.7 percent is the agricultural land. The province territory has resource of gold, limestone, coal and various raw materials of construction.

The maximum air temperature in July is 42.6°C, the minimum temperature in January Reaches -43.7°C. Average year precipitation is 310-320 mm, from which 284-290 mm or 85-90% is in warm season.

Darkhan-Uul province was first established with city status as an industrial base to provide the construction field of Mongolia with raw materials. There are main factories of construction materials as metallurgy plant, bricks, concrete, cement and food productions, and meat factories. The biggest factories of "Darkhan Thermal Power Plant", "Darkhan Metallurgical Plant", "Darkhan Nekhii (sheepskin)" company, "Erel Cement" company and etc. are running their activities.

From the total territory of the province 70.7 percent or 231.7 thousand hectare of field is agricultural land, from which 81.5 percent or 188.5 thousand hectare is pasture. There are 345.3 thousand heads of livestock. The agricultural production of the province is the important strategic field, which provides the population with 90 percent of meat and meat products, 100 percent of flour and 100 percent of potato and vegetables by 100 percent own domestic production.

Opportunities for greenhouse gas emission reductions in Darkhan-Uul aimag

To identify opportunities for greenhouse gas emission reductions in Darkhan-Uul, the research focused on the main energy users and producers, analyzed the production processes involved, and identified the main technical options available.

Erel cement factory

Erel Cement is a cement producer in Darkhan, Mongolia. The Darkhan Cement plant was established in 1967 and was privatized and renamed as the Erel Cement in 1998 and has 365 employees. The plant operates between 10 pm and 6 am to benefit from lower electricity tariffs, but the kiln operates 24 hours per day. The plant is closed between December and February because of the cold Mongolian winters. The company's annual production capacity is 185,000 tons.

The production process is illustrated below. Most important inputs include limestone, electricity, coal, water, and iron ore and gypsums. Most important outputs include cement, dust, waste, and emissions.

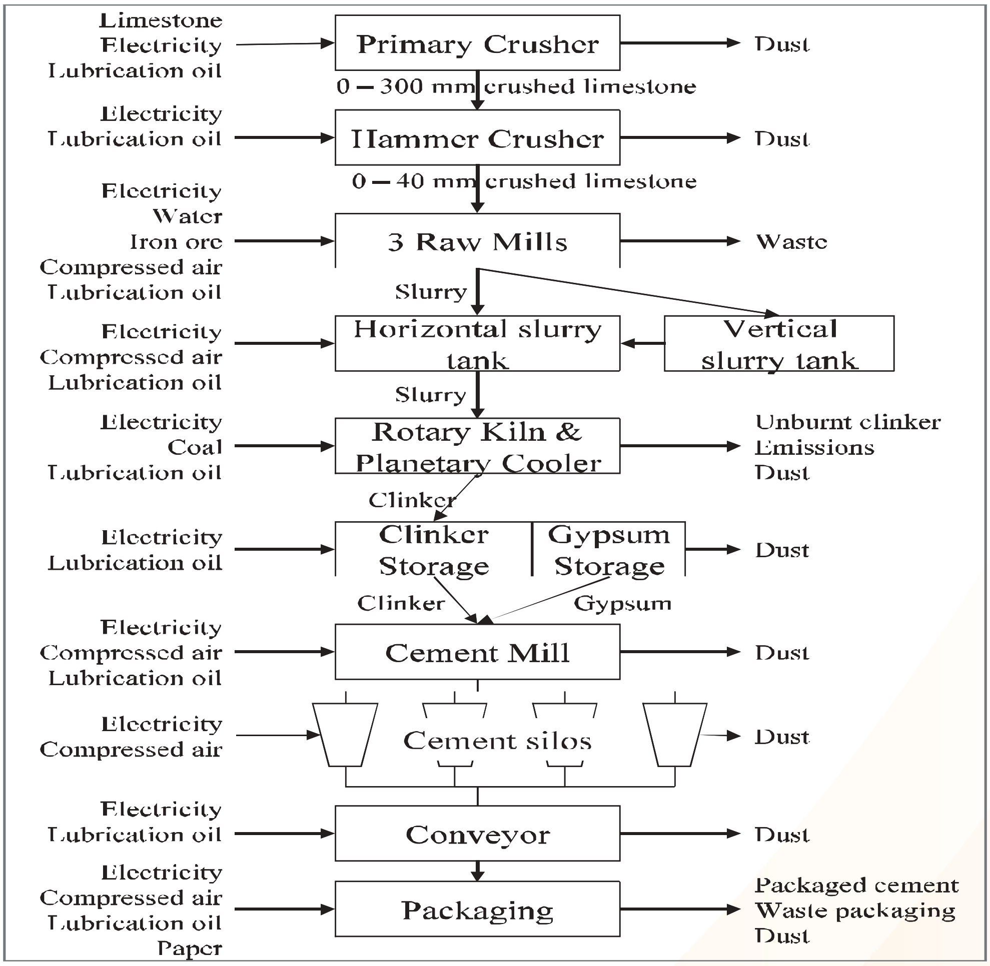

Figure 2.1 Cement production technology flow chart

During the site visit we have identified the following potential options for GHG emission reduction in the factory:

- Change kiln system from wet to dry type
- Use of waste heat from rotating kilns
- Change of fuel
- EMC cement replacement
- Improvement of sealing of dust system

1. <u>Change kiln system from wet to dry type</u>

The feasibility Study on Energy Conservation and Modernization of Darkhan Cement was carried out by New Energy and Industrial Technology Development Organization (NEDO) of Japan in 2001. The objective of this study was the reduction of Greenhouse gas emissions by introduction of Japanese energy conservation technology to cement industry in Mongolia.

According to this study, the conversion of technology from wet dry will reduce GHG emissions by 50.8%. The volume of GHG emission reductions is shown in Table 2.4. However the investment cost was prohibitively high. The Erel Cement factory still could not implement this project because of high investment cost. The management staff of thus factory said that recently they are not going to implement this project because of high investment cost and not profitability.

Table 2.4 Emission reductions from wet to dry conversion

Portion	Single year	Cumulative	
		13 years	20 years
Reduction of heat consumption	92,151	1,156,592	1,801,649
Reduction of power consumption	3,685	43,012	68,807
Total	95,836	1,199,604	1,870,456

The amount of emission reductions from conversion from wet to dry kiln technology is relatively large, close to 100,000 tCO2 per year. However, investment costs are very high, and there are no examples of CDM projects involving a switch from wet to dry technology.

2. Use of waste heat from rotating kilns

During the production of clinker discharged from kiln, lot of heat is wasted to environment air. The clinker temperature is 1100 ^{0}C and clinker is cooled by heat exchanger. Also the rotating kiln with surface temperature of 200-300 ^{0}C emits heat to air. The reuse of wasted heat from clinker production could save energy and reduce GHG emissions.

To get a handle on the amount of emission reductions from the utilization of waste heat, we can use the rule of thumb that the capacity of a waste heat to power project is approximately 2MW per 1000 t/d clinker production capacity. Given the plant size of around 500 t/d, a waste heat to power project would result in an installed capacity of 1 MW, annual power supply to the grid of about 7,000MWh, and about 8,000 tCO2 emission reductions. The applicable methodologies are AM0024, ACM0012, and ASM-III.Q.

3. Fuel switch

One of the options for GHG emission reductions is a fuel switch. In principle, it is possible to use gas or other fuels instead of coal, or alternatively, renewable fuel sources could be used, such as waste and/or biomass. There is an approved methodology that would cover this type of project in cement plants, ACM0003.

However, fuel availability is an issue. The Erel cement factory could in principle use waste gas from neighboring semi coke making factory of Sharyngol energy company. However, this would imply a diversion of the planned use of waste gas for power generation, so it would not result in net greenhouse gas emission reductions.

Additionally, the local availability of renewable fuels is limited. The population is too small to generate a large amount of municipal solid waste, although this is an issue that could be further explored and assessed.[6] The amount of crop production is too limited to provide a lot of agricultural residues that could be used as fuel. In practice, fuel switch may not be feasible because of lack of resources.

4. Introduction of Portland cement substitutes

Concrete is greenhouse gas emission intensive because it uses a large amount of Portland cement. The production of Portland cement causes a large amount of emissions, because the amount of energy required during production is large (resulting in CO2 emissions from the use of fossil fuels) and the emissions associated with the calcinations reaction in the production of clinker:

CaCO3 ➔ CaO + CO2

[6] If waste is used as a fuel, a concern is that the burning of the waste should not result in significant air pollution.

However, it is possible to replace Portland cement in concrete with other materials that have cementitious properties (cement-like behavior; note that cement, reacting with water, acts as glue holding the sand and small stones in the concrete together.

EMC (short for Energetically Modified Cement) is a technology to replace Portland Cement in concrete with other cementitious materials, using fly ash, volcanic ash, steel slags or quartz sand as raw materials. The main advantage is that it provides concrete with superior properties to concrete made with Portland cement only. The EMC technology has very high CO2 emission savings.

The more detail information about EMC technology is giving in the Box below. The amount of emission reductions that can be achieved are considerable: a 350,000 t/y plant would reduce greenhouse gas emissions with approximately 350,000 tCO2/y. There is a methodology available that would cover this type of project: ACM0005. However, the methodology is very complicated and requires a lot of data.

EMC Introduction

EMC stands for energetically modified cement. It is a technology, owned by EMC BV, to replace cement in concrete with other cementitious ("cement-like") materials. Cementitious materials react with water in a hydraulic reaction that creates a 'glue' that will hold the aggregates (sand, small stones) together. This technology can use many raw materials — such as quartz sand, volcanic ash, steel slag, and fly ash, and can receive very high replacement levels, with a blend mix of 30% Portland cement to 70% replacement cementitious materials with a fixed amount of total cementitious materials per m3 of concrete.

The blending percentage that can be achieved is much higher than other technologies can achieve; moreover, the EMC technology can use raw materials that others cannot use (quartz sand, volcanic ash). The latter is very important, because raw materials for cement production are becoming scarce. A final advantage of EMC is that it provides concrete with superior properties to concrete made with Portland cement only.

The technology has been proven and validated by renowned international organizations such as Sintef from Norway, and is recognized by, for example, the Department of Transport of Texas and Pennsylvania and Caltrans of California in the USA. The technology has also been identified in a report by the World Business Council for Sustainable Development as the technology for the future.

Key EMC benefits

The key benefits of this technology are:

1. Much lower investment costs than for ordinary Portland cement (1/5th for same production capacity). Putting a 350,000 t EMC plant in place would require about 15 million US$; possibly a bit more in Mongolia due to transportation costs.
2. Very substantial savings in energy use (1/10th for same production capacity)
3. Very high CO2 emission savings (per ton EMC product 0.8-1.0 tons of CO2 emission reduction, or about 10US$ per ton EMC product in additional benefits)
4. Potential to achieve over 1 billion tCO2 emission reductions per year worldwide
5. Solves the projected scarcity of limestone (a key ingredient for the production of clinker, which is a major input in the production of cement)
6. Short payback periods (less than 2 years, based on normal market conditions)
7. EBITDA margins are 2-3 times EBITDA margins for ordinary Portland cement, meaning much higher profitability than production of Portland cement.
8. Lower emissions of air pollutants.

No other cement replacement technology offers the same, comprehensive benefits as EMC cement. The EMC technology is a result of decades of research, which started in the former USSR, and was further developed in Sweden by the original USSR researchers. There are a large number of academic publications on the EMC technology that could be supplied for review. The technology is protected by a wide patent portfolio. A commercial EMC plant has been in operation in Texas, USA, since 2004.

5. *Improvement of sealing of dust system*

According to the study of regional project "Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific (GERIAP)", the improvement of sealing of dust system will give following benefits:

Environmental benefits:
- Annual coal savings: 4500 tons of coal
- Annual electricity increase: 302 MWh
- **Annual GHG emissions reduction: 11007 tons CO2 per year**

Other Benefits:
- Improved working conditions around dust conveyers and bunkers
- Reduced dust emissions
- Reduced raw material consumption (as recovered dust is recovered product

The problem is that there is no available methodology that readily fits this type of activity.

Darkhan CHP

The Darkhan combined heat and power plant (CHP) is connected to central grid and supplies about 300 million kWh/year to the grid through 35 kV and 110 kV transmission lines. The plant also supplies heat, hot water and steam. The technical data of Darkhan CHP is shown in Table 2.5.

Table 2.5 Technical data of Darkhan CHP

Boiler type	Boiler capacity	Number of boilers
BKZ 75-39 FB	75 tons/h	9
Turbine type	**Turbine capacity**	**Number of turbines**
APT 12-35-10	12 MW	4

Table 2.6 GHG emission reduction options in Darkhan CHP

Focus areas	GHG emission reduction options	Expected results/energy savings	GHG Emission reduction potential
Turbine shop	Installation of PT 30 turbine	Improvement of working regime of existing boilers	No data for estimation of GHG emission reduction
		Increase electricity production	
		Reduce share of internal use in total electricity generation	
Boiler shop	Renovation of existing boilers	Reduction of Electricity consumption (6.1 million kWh/year)	6500 tons/year
Boiler shop	Convert cooling water pumps in variable speed drivers	Reduction of electricity consumption (280,000 kWh/year)	310 tons/year
Lighting	Automatic Control of lighting system	Reduction of Electricity consumption	

It seems worthwhile to further investigate the possibilities to reduce greenhouse gas emission reductions in Darkhan CHP through the installation of PT30 turbines, as the amount of emission reductions available from this activity may be considerable (a relatively small increase in efficiency would imply emission reductions in the 30,000 – 50,000 tCO2 range). The other greenhouse gas emission reduction activities identified are relatively small, and are difficult to justify on the basis the greenhouse gas emission reduction potential.

Darkhan metallurgical factory

The technology for the production of metal products is shown in Table 2.7 and Figure 2.2.

Table 2.7 The technology for the production of metal products

Section	*Technology line*	
	Name	*Number*
Steel melting facilities	Electric Arc Furnace (25 tones)	2
	Continuous casting machine	1
	Oxygen generating facilities	1
	De-dusting and scrap preheating	1
	Continuous casting machine	11
	Crane and hoist	1
	Automatic charging system	1
Rolling facilities	Preheating furnace	1
	Roughing mill	1
	Intermediate mill	10
	Shear	3
	Bundling machine	2
	Water cooling pump	7
	Cooling bed	1
	Crane and hoist	13

1. Reduction of CO_2 while introducing the Ladle Refining furnace

The purpose of project is to improve a technology process in Darkhan metallurgical plant while installing Ladle Refining Furnace at the smelting section. According to the existing technology, an electric arc furnace is used for smelting processes of metal, resulting in high CO2 emissions during the smelting process. In order to limit CO_2, there is need to reduce a melting time in furnace. Using "Ladle Furnace", significant emission reductions can be achieved. According to the primary estimation, energy consumption will be reduced with 20 percent after implementation of the project, resulting in annual greenhouse gas emission reductions of 30,000 tCO2.

This is a complicated project type, and it is unclear whether at this moment there exists an approved methodology that can be applied to this project activity.

2. Optimization of working regime of cooling water pumps

There are 37 cooling water pumps with various electric capacities, up to 55 kW. Currently the cooling water pumps are operated manually. It is important to install an automatic controlling system of pumps, depending on water temperature. These measures will save electricity and reduce GHG emissions. The emission reductions, however, are small: the total electricity saving would be 280MWh/yr, or about 310 tCO2/year.

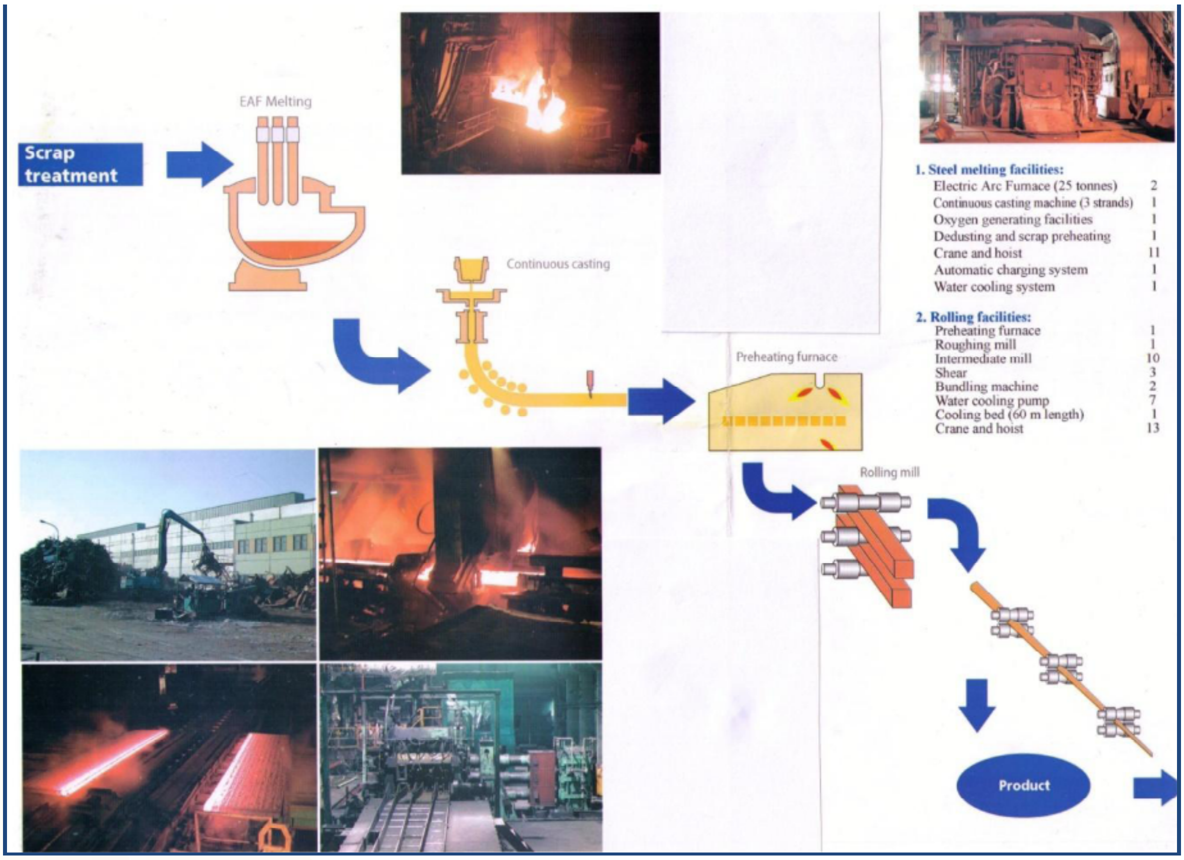

Figure 2.2 Technology scheme of Darkhan metallurgical factory

Darkhan Nekhii

The energy consumption of Darkhan Nekhii factory is not very substantial big. The electricity consumption is 1,427,800 kWh/year and steam consumption-10,000 Gcal/year. The biggest capacity of electric motors is only 17 kW. The total CO2 emissions from Darkhan Nekhii are about 5,500 tCO2/year; therefore, the potential for greenhouse gas emission reductions is small.

<u>Brick and lime factory</u>

The production capacity of the factory is:

- Lime – 22,000 tons/year
- Light brick – 50,000 m^3/year

The energy consumption of this factory is not high. The electricity consumption is 603,700 kWh/year, steam consumption is around 12,000 Gcal/year and coal consumption is around 6800 tons/year. The lime production line is old and inefficient. Therefore the factory wants to change the lime production technology with new modern technology. Implementation of the new technology will result in coal savings in 30% and GHG emission reduction will be about 2,000 tons/year.

<u>Darkhan Selenge Electricity Distribution company</u>

The company services not only Darkhan-Uul aimag also Selenge aimag and some soums of Tuv aimag (See figure 2.3.)

- Total territory of service – 74000 m^2
- Number of households – 374210 households
- Electricity distribution – 450 million kWh/year
- Electricity losses – 14.6% of electricity distribution

1. Reduction of Energy losses

The company is starting to implement a rehabilitation project focusing on the existing 0.4kV electricity distribution lines, with the technical and financial support from DANIDA (around 23 million Euro). The project will reduce technical losses and increase reliability of electricity supply to consumers. If we assume that the project could reduce electricity losses by 10%, then the electricity saving will be 20.7 million kWh/year and CO_2 emission reduction will be around 23,000 tons/year. However, as this project is already under way, it is unlikely that this project could be successfully developed as a CDM project.

Figure 2.3 Service area of Darkhan-Selenge electricity distribution company

Semi-coke production factory of Sharyn gol Energy Company

Sharyngol Energy LLC is planning to implement project named "Waste Gas to Green Energy". The project involves the utilization of waste gas from a semi-coke production facility, Sharyngol Energy LLC, for the generation of power in a 3 MW power generation facility. The power generated by the facility will be exported to the Central Energy System (CES) power grid.

By displacing power generated by power plants connected to the CES, using a waste gas resource that in the baseline scenario is flared without the use of the energy content of the waste gas, the project reduces greenhouse gas emissions. The amount of greenhouse gas emission reductions is documented elsewhere in the Project Design Document (PDD) that has been prepared with the support of the CBDICFP project. The project is expected to reduce greenhouse gas emissions with the equivalent of around 26,000 tCO2e/yr.

The following table summarizes the greenhouse gas emission reduction opportunities identified in this aimag, subject to further confirmation. Note that there may be some overlap between opportunities, and that in the case of uncertainty, the middle of an emission reduction range has been used.

Table 2.8 Greenhouse gas emission reduction opportunities, Darkhan-Uul aimag

Entity	Amount of annual emission reductions (tCO2)
Erel cement factory	464,843
Darkhan CHP	46,810
Darkhan metallurgical factory	30,310

Darkhan Nekhii	NA
Brick and lime factory	2,000
Darkhan Selenge Electricity Distribution Company	23,000
Sharyngol Energy Company	26,000
Total	**592,963**

2.2.2 Orkhon aimag

Key data, Orkhon aimag

- Territory - 840 sq. km
- Center - Erdenet, situated 410 km from Ulaanbaatar
- Number of soums - 2
- Orkhon aimag was established in 1994.

A rich deposit of copper and molybdenum was discovered by Mongolian, Russian and Czechoslovakian geologists in the territory of the aimag in 1967-1970. In 1974, the "Erdenet" Soviet-Mongolian copper ore dressing enterprise was established. Now the enterprise is considered as one of the ten biggest plants in the world. Construction of the enterprise became the first step in building a new city of Erdenet, the center of Orkhon aimag.

According to the Bulletin of Statistics of Orkhon aimag, the total population of Orkhon aimag in 2009 was 90266, from which 96.5% live in Erdenet (Bayan-Undur soum. In the autonomous municipality of Orkhon, and Erdenet is Mongolia's third-largest city. The reason for Erdenet's existence is the copper mine, which employs about 8000 people and is the lifeblood of the city.

The copper was first seriously prospected during the 1960s, and by 1977 a train line to Ulaanbaatar was installed for hauling the ore. In 1981 an ore-processing plant was commissioned and Erdenet began exporting copper concentrate (30% copper), mostly to the former Soviet Union.

The regional GDP is very much dominated by the Erdenet company. Agriculture and services account for only small percentages of the regional GDP.

Opportunities for greenhouse gas emission reductions in Orkhon aimag

To identify opportunities for greenhouse gas emission reductions in Orkhon, the research focused on the main energy users and producers, analyzed the production processes involved, and identified the main technical options available.

<u>Erdenet Mining Corporation</u>

Erdenet Mining Corporation is one of the biggest Ore mining and Ore processing factories in Asia. The main mineral deposit, extracted by the Corporation is the Erdenetiin-Ovoo area which locates 400 kilometers northwest from Ulaanbaatar, 180 kilometers east from Darkhan city. The Corporation's operation includes prospecting, mining, mineral processing and sales. Erdenet Mining Corporation is a Mongolian-Russian joint venture, 51% of shares are owned by the state property committee of Mongolian government and 49% of shares are owned by the Russian government.

At present it is a fairly large complex processing 25 million tons of ore per year and producing over 530.0 thousand tons of copper concentrate and 3.0 thousand tons of molybdenum concentrates annually. Energy use is significant:

- Annual electricity consumption: 780-805 million kWh/year (25% of distributed electricity from Central energy system)

- Maximum load: 105 MW (17% of maximum load of Central energy system)
- Annual heat consumption: 380,000 Gcal.

This means that the total CO2 emissions from the Erdenet Mining Corporation are well in excess of 1 million tCO2 per year, indicating a potentially large potential for greenhouse gas emission reductions.

Erdenet Mining Corporation has own thermal station for heating of buildings and technology steam supply. The thermal station has 6 boilers type BKZ-75-39 FB with capacity 75 tons/hour (53.4 Gcal/hour) each. Annual coal consumption is 180,000 tons/year.

The GHG emission reduction potentials are shown in Table 2.9.

Table 2.9 GHG emission reduction potential

Focus areas	GHG mitigation options	Expected results/ Energy savings	GHG Emission reduction potential
District heating steam supply pipelines	Convert from dependent system to independent system	Reduction of electricity consumption for additional water (2,300,000 kWh/year)	2,500 tons/year
		Increase of reliability	
		Reduction of coal consumption (3,000 tons/year)	3,900 tons/year
	Insulation Improvement of district heating and steam supply pipelines	Reduction of heat losses in district heating system	No data for estimation of GHG emission reduction
		Fuel savings (1,850 tons/year)	2,400 tons/year
	Reduce diameter of steam supply pipelines	Fuel savings (8,000 tons/year)	10,400 tons/year
Heat consumers	Change existing old ventilation system by new modern one	Reduction of electricity consumption	No data for estimation of GHG emission reduction
Heating Station	Convert heating station into a small capacity CHP	Fuel and electricity savings	No data for estimation of GHG emission reduction
Technological Water	Construction of a 1.5MW Hydro power plant.	Electricity savings by generating electricity from own Hydropower plant	10,000 tCO2/y

The following energy saving technology can be implemented in Erdenet Copper ore mining:

- Soft star motor equipment on the main motors of Copper ore Enrich Factory
- Variable Speed Drivers on the pump stations
- Energy efficient pumps and motors
- Power factor improvement measures
- Control and regulation of heating

<u>Erdenet Combined heat and power plant</u>

The Erdenet combined heat and power plant (CHP) is connected to central grid and supplies about 113 million kWh/year to the grid. The plant also supplies heat, hot water and steam. The technical data of Erdenet CHP are shown in Table 2.10.

Table 2.10 Technical data of Erdenet CHP

Boiler type	Boiler capacity	Number of boilers
BKZ 75-39 FB	75 tons/h	7
Turbine type	Turbine capacity	Number of turbines
PT 12-35/10M	12 MW	1
P12-2/3	12 MW	2

Table 2.11 GHG emission reduction potential in Erdenet CHP

Focus areas	*GHG mitigation options*	*Expected results/energy savings*	*GHG Emission reduction potential*
Turbine shop	Installation of PT 30 turbine	Improvement of working regime of existing boilers	No data for estimation of GHG emission reduction
		Increase electricity production	
		Reduce share of internal use in total electricity generation	
Boiler shop	Renovation of existing boilers (Shuud uleelgend shiljuuleh)	Reduction of Electricity consumption (6.1 million kWh/ year)	6500 tons/year
	Installation of Control automatization system		
District heating	Convert district heating pumps in variable speed drivers	Reduction of electricity consumption (2,450,000 kWh/year)	2800 tons/year

It seems worthwhile to further investigate the possibilities to reduce greenhouse gas emission reductions in Erdenet CHP through the installation of PT30 turbines, as the amount of emission reductions available from this activity may be considerable (a relatively small increase in efficiency would imply emission reductions in the 15,000 – 20,000 tCO2 range). The other greenhouse gas emission reduction activities identified are relatively small, and are difficult to justify on the basis the greenhouse gas emission reduction potential.

Erdenet-Bulgan electricity distribution company

The key data of the Erdenet-Bulgan electricity distribution company are provided below:

Total electricity sales	- 930 million kWh/year
From which:	
Electricity sales to Erdenet Copper Mining	- 750 million kWh/year
Electricity sales to other consumers	- 180 million kWh/year
Technical losses	- 12.3% (22.14 million kWh)

The following table provides an estimate of the emission reductions from the reduction of power transmission losses in the Erdenet-Bulgan electricity distribution company.

Table 2.12 GHG emission reduction potential in Erdenet-Bulgan electricity distribution company

Focus areas	GHG mitigation options	Expected results/ energy savings/	GHG Emission reduction potential
Electricity grid 0.4 kV	Change grid by cable line	Reduction of technical losses up to 4% (14.9 million kWh)	16,000 tons/year

Erdenet Carpet Company

The "Erdenet Carpet" is one of the largest carpet manufacturing companies in Mongolia producing and providing wide variety of choices with its 6 types of carpet and rugs with over 720 patterns and differing in design, color and size.

Table 2.13 Main information of Erdenet Carpet factory

Purpose	To manufacture 1.3 million sq. meters of carpets and to produce 2000 tons of washed wool, and 2444 tons of spun thread annually
Origin of equipment	From Germany, UK, France, Poland, Japan, China and Russia.
Technology	Incorporate Cut-pile 3-1 shoot, double base
Material	92-100% sheep wool
Number of employees	Over 900 employees
Brand names	Hunny, Chinggis, Erdenet
Products	Carpet, Carpeting, Hand tufting, Felt and Felt products, Blankets, Souvenirs, Washed wool, Spun thread
Exports	To Russia, China, Australia, Italy, Hungary, Sweden, Japan, USA, England, Spain, Jordan, Kazakhstan, Kyrgyzstan and Tajikistan
Electricity consumption	3,800,000 kWh/year
Steam consumption	6,320 Gcal/year
CO2 emissions	8,000 tCO2/year

The information on the electricity and steam consumption can be used to calculate the gross CO2 emissions for which the company is directly or indirectly responsible. The total amount of CO2 emissions, 8,000 tCO2, clearly indicates that the potential to reduce greenhouse gas emisisons is quite limited.

The following table provides an overview of the identified greenhouse gas emission reduction options.

Table 2.14 GHG emission reduction potential in Erdenet Carpet factory

Focus areas	GHG mitigation options	Expected results	GHG Emission reduction potential
Waste water cleaning	Adjustment of motor capacity of air blowers	Reduction of electricity consumption (460,800 kWh)	500 tons/year
Lighting	Installation of LED lighting	Reduction of electricity consumption (190,000 kWh)	200 tons/year

The following table summarizes the greenhouse gas emission reduction opportunities identified in this aimag. Note that there may be some overlap between opportunities, and that in the case of uncertainty, the middle of an emission reduction range has been used.

Table 2.15 Greenhouse gas emission reduction opportunities, Orkhon aimag

Entity	Amount of annual emission reductions (tCO2)
Erdenet Mining Corporation	29,200
Erdenet CHP	26,800
Erdenet-Bulgan electricity distribution company	16,000
Erdenet Carpet Company	700
Total	**72,700**

2.2.3 Selenge aimag

Key data, Selenge aimag

- Territory - 43,000 sq. km
- Center - Sukhbaatar town, located 335 km from Ulaanbaatar.
- Number of soums — 17

Selenge province is located in the North part of Mongolia in a basin formed by the Orkhon -Selenge, Kharaa and Yeruu rivers in the forest steppe zone. It borders on North with Russia, on west with Bulgan and Orkhon province, on South with Tuv province, on East with Khentii province and encloses Darkhan Uul province completely.

Selenge province has relatively well-developed infrastructure and is connected to Ulaanbaatar and other central provinces with railway and highway road. Selenge province has the territory of 43 thousand square kilometer and 42 percent of the territory is covered with broad-leaved and coniferous forest, 47 percent of the territory is pasture, 7 percent is hay field. It covers 2.7percent of the national territory and 20 percent of the forest resource of the country. 55 percent of the running water flows through Selenge province.

Administratively, Selenge aimag is divided into 17 soums, 5 villages and 49 bags. It contains 3 local towns named Sukhbaatar, Zuunkharaa and Hutul. Total population of the aimag is estimated as 94.5 thousand and there are 24.5 thousand families.

Agriculture and industry are the leading sectors of Selenge aimag. 2084.6 thousand ha area which is 50.6% of the total territory of the aimag is agricultural land in use. Every year approximately 150 thousand ha enters cultivation. The aimag produces 65% of Mongolia's total crop production, 15% of Mongolia's potato production, and more than 20% of Mongolia's vegetable production. Thus it has the leading position in the production of crops and the second place in the production of potato and vegetable. Animal husbandry is one of the main sectors of agricultural industry; the aimag has 1.5 million livestock.

The aimag is also industrially well-developed. It produces 90% of spirit, 90% of lime, 80% of cement, 35% of flour, and 40% of gold of Mongolia and it has many factories such as spirit plant in Zuunkharaa, cement and lime factory in Hutul, "Boroo gold" gold deposit mining in Bayangol -Mandal soum, "Yeruu - Boldtumur" iron ore mining and "Altan taria" wheat milling factory. There are many useful minerals in Selenge aimag such as coal, iron ore, gold, silver, and mercury, lead, marble and lime stone. Coal, gold, and lime stone have been used in the manufacture.

Opportunities for greenhouse gas emission reductions in Selenge aimag

To identify opportunities for greenhouse gas emission reductions in Selenge, the research focused on the main energy users and producers, analyzed the production processes involved, and identified the main technical options available.

Hutul cement and Lime factory

The Hutul cement and lime factory was constructed from 1981 with financial and technical assistance from the USSR and started operation in 1986 with 2 wet kilns (production capacity: 500,000 tons/year). Before the breakup of the USSR and the communist system, the two production lines produced at almost full capacity under planned economy system and achieved maximum production of 510,000 t in 1989. But the financial and technical assistance stopped after 1991. The Mongolian Economy became sluggish so that cement production decreased sharply and remains weak. Hutul Cement factory is still state-owned share holding company but cannot respond to significant changes and cement production decreased to about 40-50% of the installed capacity.

1. Energy Conservation with utilisation of active mineral additives in Cement production.

Use of active mineral additive could improve the quality of cement, and also could reduce greenhouse gas emissions by reducing amount of fuel for producing clinker. In developed countries, factory waste and artificial materials such as slag from metallurgy, aluminum waste Calcium silicates, which are a set of four compounds obtained by reacting calcium oxide and silica in various ratios from aluminum factory, are used as an active mineral additive. But in Mongolia, on the other hand, there is no waste from heavy industry. So we have to find active mineral additives from waste materials from nature and small and middle industry. The Hutul cement factory submitted the Project Idea Note (PIN) on "Energy Conservation with utilisation of active mineral additives in Cement production". The PIN can be finding in website of CDM DNA Mongolia. According to the PIN, the annual CO_2 emission reduction is 30000 tons/year. The required investment cost is 0.6-0.8 million US$.

An alternative is to use EMC cement, which is described in the section on Erel (Darkhan-Uul aimag). This would require a more substantial investment, but would lead to much larger greenhouse gas emission reductions (around 350,000 tCO2 for a typical plant).

2. Change to dry method technology of producing clinker

Hutul Cement and lime factory studied to implement dry technology for cement production. The study was executed by Japanese project experts. On the bases of this study the factory prepared pre-feasibility study to convert one of two kilns to dry technology. According to this study, in order to implement this technology, 38 million US dollars is required for reduce length rotary kiln, building dry storage of mixing raw material, pre-homogenization of dry raw materials, building heat exchanger on the surface of kiln and other changes. However, these changes will have number of advantages such as improvement of cement quality and increase of annual production, reduction of specific coal consumption for clinker production. The description of the technology changes are shown in below.

Table 2.16 Comparison of production capacity of kilns after changes of one kiln to dry technology

		Measuring unit	Kiln 1	Kiln 2	Total
Capacity	Recent	tons/hour	25	21	46
	After project implementation	tons/hour	25	83	108
Production amount after project implementation					
Number of working months per year		Month	12	12	12
Annual production	Clinker	tons/year	200000	600000	800000
	Cement	tons/year	250000	750000	1000000

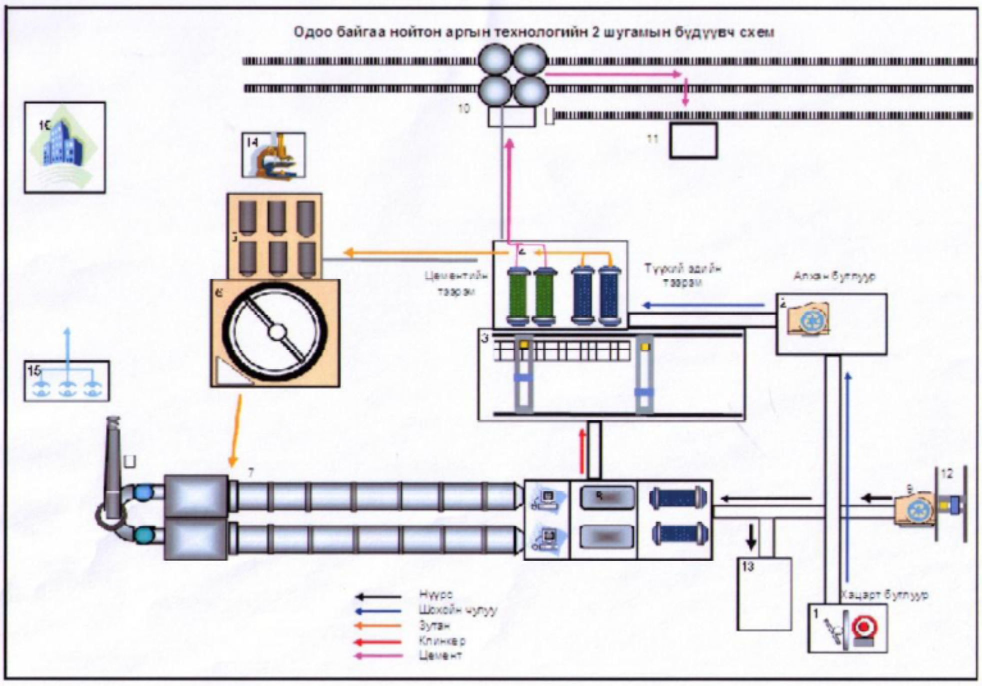

Figure 2.4 The existing wet technology of cement production

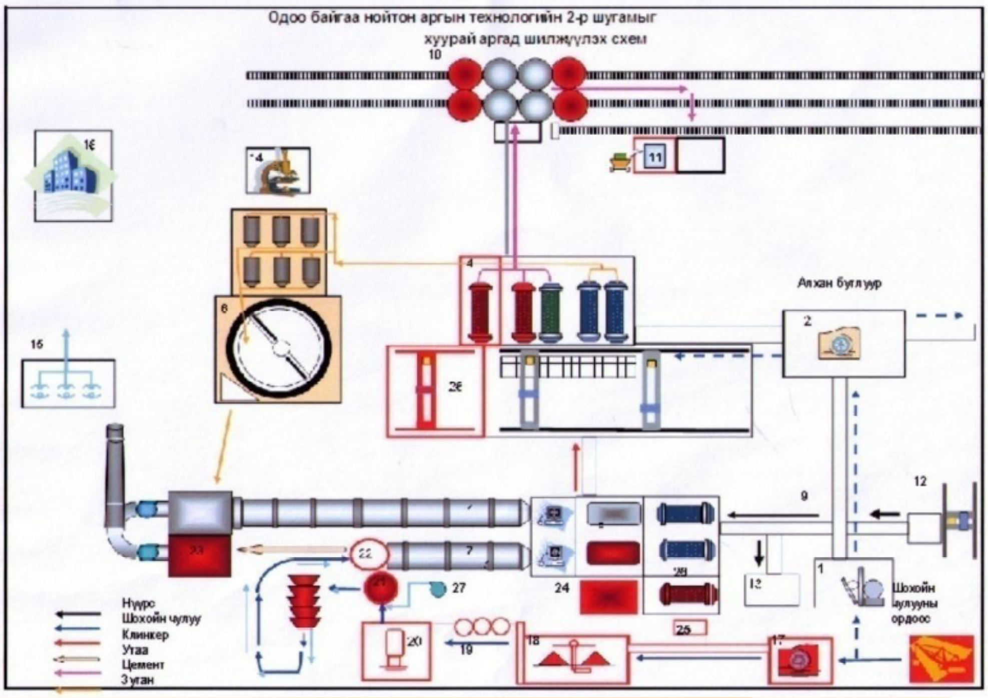

Figure 2.5 The scheme to convert one kiln to dry technology of cement production

According to the pre-feasibility study, the production of 1 ton clinker by old technology needs 0.29 tons of coal with heat content 5500 kcal/kg. After implementation of dry technology the coal per unit (1 ton) of clinker production will be 0.15 tons. Coal saving for production 600,000 tons of clinker by dry technology will be 86,200 tons/year and Greenhouse gas emission reductions will be 112,000 tons/year.

Table 2.17 GHG emission redaction potential in Hutul cement and lime factory.

Focus areas	GHG mitigation options	Expected results/ energy savings/	Investment cost	GHG Emission reduction potential
Rotating kiln	Energy Conservation with utilisation of active mineral additives in Cement production	Improvement of quality of cement, Reduction of fuel amount for producing clinker	0.6-0.8 million US$/year	30,000 tons/ year
Rotating kiln	Change to dry method technology of producing clinker:	Increase of annual production, reduction of specific coal consumption for clinker production	38 million US$/ year	112000 tons/ year
Cement replacement	EMC cement to partly replace Portland cement	Improved quality of the concrete, reduced greenhouse gas emissions, reduced water and lime use	15 million US$/ year	350,000 tons/ year

“Selenge-Energy” heating station

In the heating station, there are commissioned 4 steam boilers of KE-25-14 type capable to produce 25 tons of steam each hour and a main district heating line in 1989. There is also space available to install one additional boiler. In 2003, 2004 and 2005 boilers 1, 2 and 4 were respectively transferred to become HOBs, leaving the boiler No. 3 as a steam processing unit. The available capacity of the TP is 20 Gcal/h. During winter peak hours 2 HOBs operate and 1 stands in reserve and generate 16-20 Gcal/h heat.

Heating season starts on October 1 and ends on May 1.

Some key data of the heating station:

- Number of employees – 120;
- Annual coal consumption – 25000-30000 tons/year;
- Annual electricity consumption – 2.2- 2.7 million kWh/year;
- Annual water consumption – 140000 m^3;
- Heat production – 54.6 thousand Gcal/year;
- Heat consumers – 250 state organizations and enterprises; 1500 households

Table 2.18 Energy production and consumption data

	Measuring unit	October 2010	From the begging year
Heat production	GJ	26000	193746
Heat distribution	GJ	25000	188702
Coal consumption	Tons	4474.3	20657.8
Coal consumption	TCE	2000	9300
Specific coal consumption	Kg/GJ	80.00	49.28
Electricity consumption	kWh	273504	1713456
Specific electricity consumption	kWh/GJ	10.94	9.08
Water consumption	m^3	18876	97148
Added water (water losses)	m^3	16070	80335
Added water	%	8513	82.69

The peak total heat demand is currently 28.3 Gcal/h. Therefore the generation capacity needs to be increased. The district heating system has 2 pumps of Д-630-90 type capable to increase pressure of 630 ton water by 9 atm in an hour and also other 2 pumps of TsN-630-105 type capable to increase pressure of 400 ton water up to 10.5 atm within an hour. There are 2 de-aerators of DSA-100 in the district heating system. There are 3 filters for primary chemical treatment and 2 for secondary chemical treatment. Because of high water hardness the water treatment requires a lot of salt. Of the 3 K-35/45 pumps designed for additional water one is working permanently and adds 20-35 t/h water. Of the 6 heat substations, in total, 3 installed in apartments have domestic hot water heaters. At the same time 1 in hospital and 7 in school have their own domestic hot water heaters installed. Old apartments designed for one or two households have no domestic hot water heaters. Railway HSs have small HOBs to heat domestic hot water.

The total length of district heating line and branch double lines is 25.5 km.

The working regime was calculated for 120/70^{0}C and produce 28.3 Gcal/h heat by 470 ton/h became unable to heat network water above 90/55^{o}C or volume of district heating water used to be higher than required due to insufficient boiler capacity, non-automated system, corroded and rusted heating facilities and adjustment inaccuracy. Heat loss of apartment buildings constructed by pre-fabricated blocks does not meet standard requirements or is extremely high. The TP and heat transmission and distribution networks are under the ownership of the local government.

There are several options available to reduce greenhouse gas emissions, including

1. Convert existing heating system to an independent system:

The utilization rate of the consumers heating facilities is very low. The technical condition of branch pipelines, manholes and chambers is poor. Consumers who have no domestic hot water system take hot water from district heating system illegally. Domestic hot water heat exchangers are worn out and deteriorated and temperature control device are missing. Because of insufficient head at the end users it is recommended to convert to an independent system. The water losses with temperature 60^{0}C are 20 tons/hour. In order to heat 20 tons of water from 5^{0}C to 60^{0}C, it is requires 300-500 kg coal. The coal consumption for heating of 20 tons/h during the heating season will be 2880 tons/year.

2. Installation of modern energy efficient water heating boilers and improvement of coal quality

Generation capacity of thermal station can be improved by converting boiler to fluidized bed combustion technology or install new efficient boilers. The existing boilers consume 60 tons coal/day. If we assume that the coal consumption can be reduced by 20%, then annual coal savings will be 6000 tons.

Table 2.19 GHG emission reduction potential

Focus areas	GHG mitigation options	Expected results/ Energy savings	GHG Emission reduction potential
District heating system	Convert existing heating system to an independent system	Reduction of water losses (20 tons/hour)	
		Increase of heat supply reliability	
		Reduction of coal consumption for water heating (2,880 tons/year)	3,700 tons/year
Heating station	Installation of modern energy efficient water heating boilers and improvement of coal quality	Increase of heat supply reliability	
		Reduction of coal consumption for water heating (6,000 tons/year)	7,800 tons/year

The following table summarizes the greenhouse gas emission reduction opportunities identified in this aimag. Note that there may be some overlap between opportunities, and that in the case of uncertainty, the middle of an emission reduction range has been used.

Table 2.20 Greenhouse gas emission reduction opportunities, Selenge aimag

Entity	Amount of annual emission reductions (tCO2)
Hutul Cement and lime factory	492,000
"Selenge-Energy" heating station	11,500
Total	**503,500**

2.2.4 Greenhouse gas emission reduction potential in Mongolia, general comment

The preceding sections show that finding good (i.e., sizable) greenhouse gas emission reduction projects in Mongolia is not easy in the industrial and energy supply sectors. The reason is the small size of the Mongolian economy, and the wide dispersion of the people — which means that most industrial companies are relative small, and that the energy supply stations also tend to be relatively small. Both mean that the possibilities for greenhouse gas emission reduction projects are small.

An additional issue is that in Mongolia, energy supply to a relatively large extent is related to the provision of heat[7] rather than power, whereas most CDM methodologies that target the energy sector focus on the power sector. More methodologies focus on the supply of power than on the supply of heat, and also the methodologies that focus on power are simpler to apply than those that focus on heat supply.

Greenhouse gas emission reduction through renewable power projects

Does Mongolia have a potential for power projects that has not been mentioned? It does. Mongolia covers a large surface area, has a large solar influx, and has also good wind locations. This offers opportunities:

- Off-grid renewable power for communities: This is a sector that has potential and also covers a social need, the provision of power to areas of Mongolia that are not covered by the power grid. Typically, such projects would replace diesel-fired power with windpower and solar power. The small size of these projects, however, remains a problem.
- Off-grid renewable power for companies: This may be more significant, a source of power supply to mining companies in Mongolia. A question is what factors could compel mining companies to use renewable power: often there will be coal resources available that would provide a cheaper off-grid power supply source.
- On-grid renewable power, Mongolia: Renewable power supplied to the power grid of Mongolia. This is the most straightforward option. However, it should be recognized that the amount of renewable power that can be absorbed by the Mongolian grid is limited, unless there is also a possibility to store power to make it dispatchable. Other studies indicate that at this moment, the Mongolian grid could absorb about 100MW of non-dispatchable power.
- On-grid renewable power, exported: In principle, renewable power projects could also export power to other countries. This would also result in greenhouse gas emission reductions and at least in theory, the amount of greenhouse gas emission reductions could be sizable. One question is whether such projects are realistic (conditions for the export of power), and another question is whether the grid tariff offered would be attractive enough. If such projects are developed as CDM projects, both the host country and the power importing country should provide a letter of approval for the project. If the power is exported to a country that is not member of the Kyoto Protocol, or one that has a greenhouse gas emission reduction target, the situation becomes more complicated to analyze.

[7] Mongolia's capital has the lowest average temperature of all countries. Of course, CDM projects can only be hosted by countries that are not in the Annex I, and most of these countries have much warmer climates (located closer to the equator).

LULUCF

Another sector that may produce significant greenhouse gas emission reductions is the so-called LULUCF (Land Use, Land Use Change and Forestry) sector. The sheer size of Mongolia means that this sector can be a quite significant source of greenhouse gas emission reductions (despite the slow forest growth rate caused by the cold climate and long winters), typically through afforestation and reforestation projects (A/R CDM) and through avoided deforestation (REDD).

The issue with these type of projects is that the commercial demand is limited, because emission reductions from A/R CDM and/or REDD cannot be used in the main compliance greenhouse gas emission reduction markets (the EU ETS). That means that most of the demand for the emission reductions from projects in this sector come from the voluntary market.