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FY 2014 Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia

"Study for the development of JCM projects for comprehensive improvements in the power generation, transmission and distribution systems in Ulaanbaatar City and on the possibility of nationwide horizontal application of the same improvement model in Mongolia"

Final Report

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Overseas Environmental Cooperation Center, Japan

FY 2014 Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia

Study for the development of JCM projects for comprehensive improvements in the power generation, transmission and distribution systems in Ulaanbaatar City and on the possibility of nationwide horizontal application of the same improvement model in Mongolia

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Contents

I. SUMMARY

1. Background

Currently, power demand condition has become serious in Mongolian Central Energy Grid, supplies power to Ulaanbaatar, the capital of Mongolia. Each year Mongolia's power supply shortage grows up, which has made increasing the power supply and improving the efficiency of existing power stations urgent tasks. However, air pollution and growth of GHG are having a toll on the environment, requiring measures to be implemented soon.

Coal-fired combined heat and power plants (hereinafter "CHP") are considered to be very important facilities for implementing effective environmental measures. CHP matches the needs of Mongolia and has the potential of large-scale efficiency improvement by using Japanese technologies. Mongolian Government requires the introduction of Japanese high efficiency equipment of power transmission and distribution sectors as well. In addition, it was found that Mongolia's power generation, transmission and distribution facilities are adopted by the technologies, standards and specifications from the former Soviet Union technologies. It has been appeared that the solution can be easily distributed to the other cities inside and outside Mongolia in a similar technological situation.

Given this background, we stated a detailed study on Ulaanbaatar's power generation, transmission and distribution systems with the goal of introducing leading technologies from Japan using Joint Credit Mechanism (hereinafter "JCM"). Also, a study into project structuring was carried out with an eye on rolling out possible solutions for the power grids of other cities.

2. Scope

The following study was focused on Ulaanbaatar Thermal Power Plant No. 3 (hereinafter "CHP-3") as a project of efficiency improvement and GHG reduction. The study is also related with the reduction of air pollution materials.

(1) Efficiency improvement of Ulaanbaatar Thermal Power Plant No. 3

(2) Fundamental capacity upgrading of the of power transmission and distribution facilities in Ulaanbaatar

(3) Needs capture and project support of power generation, transmission and distribution for implementation in other cities or facilities.

3. Methodology

As a practical JCM project for reducing GHG, we visited the project counterparties on the first study, Ministry of Energy, Ministry of Environment, Green Development and Tourism, CHP-3, and Ulaanbaatar Electricity Distribution Network Company together with experts of power generation. During these meetings, the business plan for this fiscal year was explained, discussions were held on the details of the study, and requests were made for obtaining necessary detailed information for moving the study forward. On the second study, we asked the performance test in order to obtain the summer operation data for calculating reference GHG and designing the low-carbon technologies to be introduced. With the goal of technology distribution to elsewhere in the country, we visited and held meetings at a mine and combined heat and power generation facilities in Mongolia's second largest city, Erdenet, and third largest city, Darkhan, where officials were briefed on the bilateral credit program and discussions were held on future approaches to the study. Interviews were also conducted on the need for efficiency improvements. Performance testing was carried out for the third and fourth parts of the study in order to obtain operational data for the winter season. Discussions were held with officials on obtaining detailed information requested from the Mongolia side and, as well as obtaining specifications for facilities with advanced technologies. Power plants in Mongolia use a combined cycle that supplies heat (hot water). During the winter season in particular, hot water accounts for a majority of demand, so reference data was collected on the use of heat by power plants in order to define Business as Usual (BaU) emissions and reference emissions. As the final component of the study, the fifth part involved explaining the results of the study thus far to officials at CHP-3. Additionally, the implementation system and project schedule were explained for projects funded by the JCM Japan Fund set to commence next fiscal year.

A training program was held in Japan for the Mongolian side in order to foster understanding in the technologies of specific companies. This allowed officials to come into direct contact with targeted technologies, such as optimized controls, heat pump systems, battery systems and operational management of power plants, for which Japanese technologies take advantages. This experience helped to aware the knowledge about these important technologies.

4. Results

As a result of the six field studies and one training program held in Japan, we collected the data on the Optimized Control System technologies to be introduced in CHP-3. The data is BaU emissions and reference emissions. And we summarized the qualification requirements for JCM and MRV methodology. With regard to power transmission and distribution, we collected the data from the Ulaanbaatar Electricity Distribution Network Company, and summarized the qualification requirements for JCM and MRV methodology. Furthermore, we identified new potential for upgrading/ increasing the capacity of boiler, turbine and generator (BTG) and the introduction of storage cells/photovoltaic power systems. In addition to Ulaanbaatar, combined cycle facilities in Darkhan and Erdenet were visited with the aim of rolling out these same technologies, which confirmed that there is strong demand for OCS and other target technologies in other regions, building momentum for eventual implementation.

During the fifth and sixth study, the results of the review thus far were reported to officials from the Mongolian side, including those from the Ministry of Energy, the Ministry of Environment, Green Development and Tourism, CHP-3, and Ulaanbaatar Electricity Distribution Network Company. At the same time, discussions were held on actions for the subsequent fiscal year where officials were briefed on and agreed to the actions and schedule for next fiscal year

5. Review for Commercialization

We suppose the target for energy supply sector and several billions of yen in project costs at the least will be required for power generation, transmission and distribution. The financing scheme for realizing this project will be one that aims to enable leap-frog development.

On June 25, 2014, Minister of the Environment Nobuteru Ishihara held talks with Takehiko Nakao, President of the Asian Development

Bank in Tokyo during his visit to Japan, where they signed a Letter of Intent for Cooperation on Environmental Issues. They also announced the establishment of a new trust fund (JCM Japan Fund) utilizing JCM to support the adoption of advanced low-carbon technologies in its developing member countries (DMCs), with a grant of ¥1.8 billion from the Government of Japan.

This fund was established to mitigate additional costs with funds placed in a trust managed by the Asian Development Bank to ensure that advanced low-carbon technology projects are adopted, since the adoption of these types of Asian Development Bank projects have not made much progress because of the high implementation costs.

During this study, discussions with Mongolia's Ministry of Energy and the Ministry of Environment, Green Development and Tourism were moved forward, and the Government of Mongolia has agreed to cooperate with the implementation of the above project utilizing the JCM Japan Fund. Going forward, CHP-3 and the Government of Mongolia will finalize specifications of the system to be introduced and they will also carry out the necessary procedures for using the JCM Japan Fund. As a way of sharing solutions from this project in other locations, similar projects are envisioned for the introduction of OCS in the other facilities such as CHP-4, or in Erdenet and other cities, and the introduction of high efficiency transformers at distribution facilities in new town areas as part of Ulaanbaatar capital plan.

II. REPORT

1. Background

(1) Current Situation of Energy Supply within the Power Grid Centered on Ulaanbaatar

Currently, tight demand conditions for power have become a serious problem facing Mongolia's Central Energy Grid that primarily powers the capital of Ulaanbaatar. The output of each power plant on the Central Power Grid up to 2012 is as follows:

- Ulaanbaatar Thermal Power Plant No. 1 (CHP-1): Decommissioned
- Ulaanbaatar Thermal Power Plant No. 2 (CHP-2): 21.5MW
- Ulaanbaatar Thermal Power Plant No. 3 (CHP-3): 148MW
- Ulaanbaatar Thermal Power Plant No. 4 (CHP-4): 580MW
- Darkhan Cogeneration Power Plant: 48MW
- Erdenet Cogeneration Power Plant: 28.8MW
- Erdenet Mining Power Plant: 5MW
- Central Power Grid's total installed electricity generation capacity: 831.3MW

In recent years, Mongolia has enjoyed economic growth on the back of increased demand for its mineral resources (gold, copper, coal, molybdenum, and zinc, etc.), as its average GDP growth rate between 2011 and 2013 surpassed 10%. This economic growth has caused an increase in population and a concentration of its population in urban areas. Naturally, demand for power is increasing, but, up to 2012, Mongolia had yet to build a new power plant since it commenced operations at CHP-4 in the 1980s. This is because Mongolia has depended on Russian energy imports since its days as a socialist country. One reason for this is that it does not have a functional means to coordinate power generation output or it has intentionally been kept from having such a function.

To overcome this situation, Mongolia carried out the following power generation capacity increases in 2013 and 2014.

- Surhit Wind Farm: 50MW

(Mongolia's first large-scale renewable energy power plant: commenced operations in 2013)

・Ulaanbaatar Thermal Power Plant No. 3 (CHP-3): 148MW ⇒ 198MW

(added 50MW turbine: commenced operations in June 2014)

・Ulaanbaatar Thermal Power Plant No. 4 (CHP-4): 580MW ⇒ 680MW

(added 100MW turbine: schedule to commence operations in 2015)

In addition to the above, construction is moving forward on the Ulaanbaatar Thermal Power Plant No. 5 (CHP-5), but the construction site was finally decided recently and actual construction work has yet to begin. Currently, the actual situation has yet to catch up with the power supply development plan announced in 2013 and it has been pointed out that increasing energy imports from Russia would be dangerous, from the standpoint of the country's energy security.

Furthermore, Ulaanbaatar and other major cities are facing air pollution problems. According to ambient outdoor air pollution data released by the World Health Organization (WHO), Ulaanbaatar's PM10 was 279μg/m^3, which is 14 times Japan and approximately double that of China. It has been pointed out that combined heat and power plants are one factor behind this pollution. Specific measures will need to be implemented to resolve this environmental issue.

(2) Mongolia's Initiatives against Climate Chang

On January 8, 2013, the world's first bilateral document for the bilateral credit program (Joint Credit Mechanism, JCM) was signed in Ulaanbaatar, ushering in the official start to this program. Meetings of the joint committee were held for the first time on April 11, 2013 and the second time of February 20, 2014. During the first meeting discussions were held on finalizing guidelines, while at the second meeting a decision was reached for registering JCM methodology for the first time in the world. This shows that the Government of Mongolia is ambitiously working on JCM implementation.

In the statement at the Ministerial Dialogues of COP19 (The nineteenth session of the Conference of the Parties), Deputy Minister for Environment and Green Development, Ms. Tulga declared his high expectations for JCM implementation and made the country's stance toward implementation quite clear.

The Government of Mongolia revised its National Climate Change Programme in 2011 as part of its plans on pushing forward further with measures to prevent global warming. Mongolia has also submitted its Nationally Appropriate Mitigation Action (NAMA) to the United Nations Framework Convention on Climate Change (UNFCCC). Mongolia's NAMA contains 11 measures. Of these, six are in the energy supply sector, including power generation, transmission and distribution. This demonstrates the strong needs for measures in Mongolia's energy sector.

At an official side event of the 38th Subsidiary Body for Implementation (SB 38) held at the Bonn Climate Change Conference in June 2013, Special Envoy on Climate Change Dagvoadorj from Mongolia's Ministry of Environment, Green Development and Tourism made a statement that the country would implement its NAMA utilizing JCM and implement mitigation measures to ensure that air pollution and energy security could be pursued simultaneously.

(3) Background

As stated above, currently, tight demand conditions for power have become a serious problem facing Mongolia's Central Energy Grid, which primarily powers the capital of Ulaanbaatar. Each year, Mongolia's power supply shortage continues to grow, which has made increasing the power supply and improving the efficiency of existing power stations urgent tasks. However, air pollution and an increase in GHG emissions are causing a toll on the environment, requiring measures to be implemented without delay.

Coal-fired Combined Heat and Power Plants (below, "CHP") are considered to be very important facilities for implementing effective environmental measures. CHP match the needs of Mongolia and carry the potential to improve efficiency on a large-scale by using Japanese technologies. Mongolia requires the introduction of Japanese equipment with leading efficiency in its power transmission and distribution sectors as well. Additionally, the study found that Mongolia's power generation, transmission and distribution technologies are mostly technologies, standards and specifications from the former Soviet Union, which indicates that implementing a solution in Mongolia can be easily shared with other cities inside and outside Mongolia in a similar technological situation.

Given this background, a detailed study on Ulaanbaatar's power generation, transmission and distribution systems would be utilizing leap-frog financing. Additionally, a study into project structuring was carried out with an eye on rolling out possible solutions for the power grids of other cities.

2. Scope

(1) Power Generation, Transmission and Distribution Measures

According to the 2nd National Communication submitted to the UNFCCC by Mongolia, about 60% of the country's GHG emissions are attributed to the energy sector. This is because nearly all of the fuel used to generate the country's energy supply is coal, winter time temperatures reach negative 30 degrees Celsius, and because large amounts of hot water are used for central heating in downtown areas and community heating needs. Of the country's heat and power supply, a prior OECC study verified that around 95% of Mongolia's power and around 70% of its steam and hot water needs depend on combined heat and power (CHP) plants. Given this situation, improvements in efficiency targeting power generation, transmission and distribution can effectively and efficiently contribute to a reduction of Mongolia's GHG emissions.

As mentioned above in 1.(1) and 1.(2), Mongolia would like to implement mitigation measures that make it possible to address air pollution and provide a stable supply of energy simultaneously and it has shown the same stance in JCM. The JCM project priority list submitted by the Ministry of Energy to the Mongolian side's secretariat contained mention of efficiency improvements for power generation, transmission and distribution. Additionally, the project priority listed submitted by the Policy and Coordination Office of the Ministry of Environment, Green Development and Tourism, which serves as the Mongolian side secretariat, to the first JCM Joint Committee meeting on April 11, 2013, also contained mention of improving efficiency of power generation, transmission, and distribution. This demonstrates that this is not only a government plan, but it also matches Mongolia's plans for JCM.

(2) Advanced Nature of Japanese Technologies in Power Generation, Transmission and Distribution and the Feasibility of Sharing These at Other Locations

This project aims to introduce Japanese technologies. As a specific example, an optimized system for the supply of heat and power is being proposed to power plants (Optimized Control System [below, OCS] comprising an optimizer + DCS [distributed control system] + matrix converter [with advanced inverter technology] + heat pump). With the overseas expansion of maintenance management considered to be an excellent Japanese technology being called for, the implementation of this OCS not only optimizes the steam as well as power plant turbine and boiler operations based on demand, but it combines optimized maintenance management services with a Japanese provider, which cannot be offered by other countries, making it a progressive initiative.

Additionally, Mongolia's coal-fired combined heat and power plants are based on the former Soviet Union's technologies, standards and equipment, making solutions easy to roll out at other power plants in Mongolia. Specifically, the same type of combined heat and power plants can be found not only in Ulaanbaatar, but also in the country's second largest city Erdenet and third largest city Darkhan as well, making it feasible to implement similar solutions there. Furthermore, there are a large number of former Soviet Union era power plants in Vietnam as well and many coal-fired thermal power plants are operating in Indonesia. Therefore, this project in Mongolia could potentially serve as a good practice that can be expanded to a broad range of other countries in Asia.

3. Study Item

This study comprised the following:

①Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3;

②Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar; and

③Identifying needs of power generation, transmission and distribution for implementation in other cities or facilities and support for project structuring.

Details of the study were examined together with the relevant experts and project partners who will be introduced below. Reporting sessions were also organized with officials from government ministries and agencies to confirm progress of the project and share/spread information.

With regards to ①and ②above, the project cost required will be several billions of yen at the very least. The financing scheme for realizing this project will be one that aims to enable leap-frog development.

On June 25, 2014, Minister of the Environment Nobuteru Ishihara held talks with Takehiko Nakao, President of the Asian Development Bank in Tokyo during his visit to Japan, where they signed a Letter of Intent for Cooperation on Environmental Issues. They also announced the establishment of a new trust fund (JCM Japan Fund) utilizing JCM to support the adoption of advanced low-carbon technologies in its developing member countries (DMCs), with a grant of ¥1.8 billion from the Government of Japan.

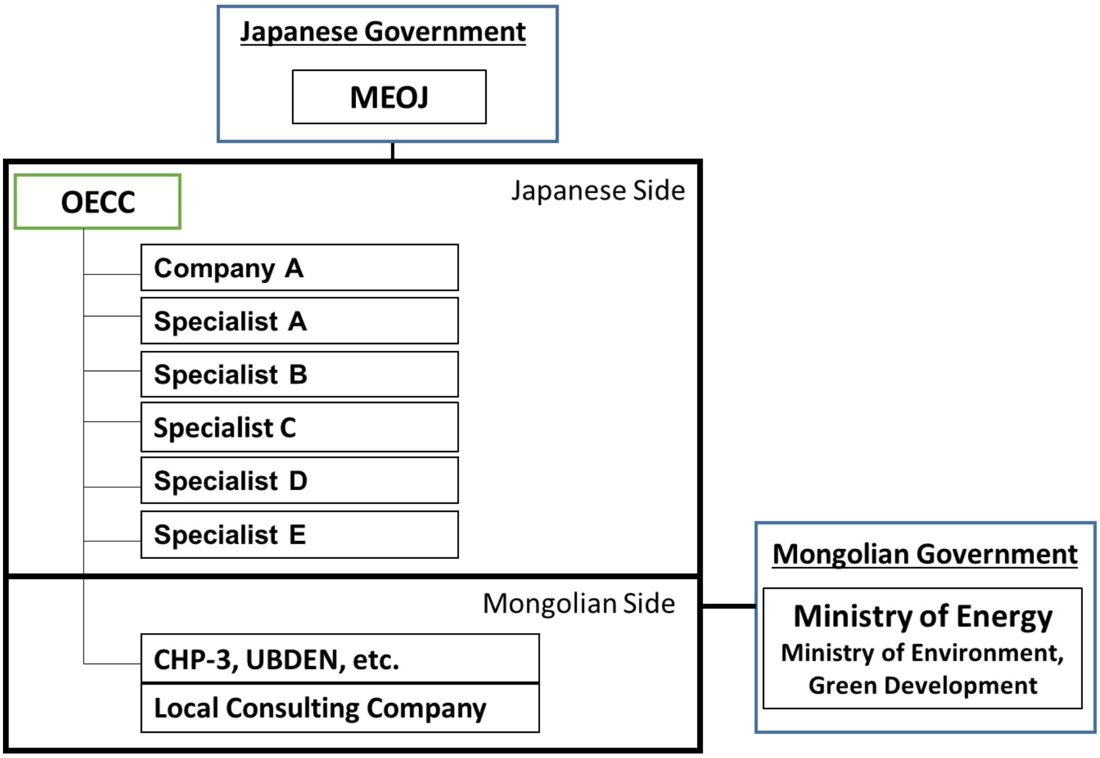
This fund was established to ensure that advanced low-carbon technology projects are adopted, since the adoption of such projects have not made much progress because of the high implementation costs. Therefore, a detailed study was conducted to ascertain details about technologies currently being implemented, and those set to be implemented in the future which are expected to be used for the project, in order to verify that they are indeed advanced low-carbon technologies. Additional technologies were researched that are eligible for these funds which aim to enable leap-frog development.

Next, another study was conducted simultaneously on target technologies and existing technologies in order to set the qualification requirements for JCM. Furthermore, data was collected on BaU emissions, reference emissions, and project emissions in order to formulate the MRV methodology for JCM (draft) and PDD (draft). As specific examples, data was collected on fixed loads and intermediate load testing for the power generation project and data pertaining to the differences in combined heat and power plant operations in Mongolia due to the large temperature differences, as winter time temperatures can reach more than negative 30 degrees Celsius.

With regards to 3), a study was carried out to flush out the early stage potential for rolling out efficiency improvement measures targeted in 1) and 2) at mainly combined heat and power plants in other major cities in Mongolia in order to verify the viability of JCM implementation, including the potential for introducing new technologies. Data was prepared on energy efficiency improvement diagnostics and other potential technologies. Based on these, Japanese technologies and products that contribute to improving energy efficiency were summarized into a proposal.

(1) Implementation Structure

The project was carried out using the following implementation structure:



(2) Details of Study

As the first part of the study on a project for reducing GHG emissions with JCM, visits were made locally, together with experts in power generation, distribution and conversion, to the projected counterparties in the scheme, including the Ministry of Energy, the Ministry of Environment, Green Development and Tourism, CHP-3, and Ulaanbaatar Electricity Distribution Network Company. During these meetings, the business plan for this fiscal year was explained, discussions were held on the details of the study, and requests were made for obtaining necessary detailed information for moving the study forward. The second part of the study included performance testing in order to obtain necessary operational data from the summer time for calculating reference GHG and designing the low-carbon technologies to be introduced later. With the goal of rolling out technologies elsewhere in the country, meetings were held at a mine and combined heat and power generation facilities in Mongolia's second largest city of Erdenet and third largest city of Darkhan, where officials were briefed on the bilateral credit program and discussions were held on future approaches to the study. Interviews were also conducted on the need for efficiency improvements. Performance testing was carried out for the third and fourth parts of the study in order to obtain operational data for autumn, in addition to summer. Discussions were held with officials on obtaining detailed information requested from the Mongolia side and specifications for facilities with advanced technologies. Power plants in Mongolia use a combined cycle that supplies heat (hot water) and power, and in the winter and autumn in particular hot water accounts for a majority of demand, so reference data was collected on the use of heat by power plants in order to define Business as Usual (BaU) emissions and reference emissions. In addition, a study was performed simultaneously on target technologies and existing technologies in order to set qualification requirements for JCM.

A training program was held in Japan for the Mongolian side in order to foster understanding in the technologies of specific companies. This allowed officials to come into direct contact with targeted technologies, such as integrated controls as well as storage cell systems and operational management of power plants, for which Japanese technologies are said to be among the leading in the world. This experience helped to raise awareness about these important technologies.

During the fifth and sixth parts of the study, the results of the review thus far were reported to officials from the Mongolian side, including those from the Ministry of Energy, the Ministry of Environment, Green Development and Tourism, CHP-3, and Ulaanbaatar Electricity Distribution Network Company. At the same time, concrete discussions were held on actions for the subsequent fiscal year.

4. Study Results

(1) Performance and Results

As described in 3. (2), six field studies in Mongolia were held, as well as one Japan-held training program. Details about performance and results are discussed in (2) below.

First field study:	June 2014
Second field study:	August 2014
Third field study:	September 2014
Fourth field study:	October 2014
Training program in Japan:	November 2014
Fifth field study:	December 2014
Sixth field study:	January 2015

As a result of the six field studies and one Japan-held training program, data was collected on the OCS technologies, which CHP-3 is considering introducing, BaU emissions, and reference emissions, among other items, the qualification requirements for JCM (draft) were formulated, and MRV methodology (draft) was prepared. With regards to power transmission and distribution, data was also collected from the Ulaanbaatar Electricity Distribution Network Company, qualification requirements for JCM (draft) prepared, and MRV methodology (draft) formulated. Furthermore, further technologies were researched that are suited to power generation, transmission and distribution projects. New potential was identified for upgrading/increasing the capacity of BTG and the introduction of storage cells/photovoltaic power systems. Those technologies that can be implemented during 2015 will be included as targets of the project. In addition to Ulaanbaatar, combined cycle facilities in Darkhan and Erdenet were visited with the aim of rolling out these same technologies, which confirmed that there is strong demand for OCS and other target technologies in other regions, building momentum for eventual implementation.

During the sixth field study in January 2015, the results of the review thus far were reported to officials from the Mongolian side, including those from the Ministry of Energy, the Ministry of Environment, Green Development and Tourism, CHP-3, and Ulaanbaatar Electricity Distribution Network Company.

At the same time, discussions were held on actions for the subsequent fiscal year, where officials were briefed on and agreed to the actions and schedule planned for the next fiscal year

(2) Reduction of GHG Emissions

As for the results of GHG emission reductions, calculations were performed separately for (1) Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3 and (2) Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar. Detailed calculation formulas are provided in section 5, MRV Methodology and Monitoring System.

① Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3

Reference emissions: 1,143,500 tCO_2/y

Project emissions: 1,028,500 tCO_2/y

Emissions reduction: 115,000tCO_2/y

Assumptions: If the following OCS is installed on CHP-3 high-pressure unit

Optimizer (software) ＋ DCS = 1 package

Price of coal (Baganuur coal): 24,500Tg (Tugrik) (1Tg = 0.058 yen)

Central Power Grid emissions coefficient $= 0.5\times1.1542 + 0.5\times1.0566 = 1.1054 tCO_2/MWh$

② Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar

Reference emissions: 12,300 tCO_2/y

Project emissions: 3,700 tCO_2/y

Emissions reduction: 8,600 tCO_2/y

Assumptions: If the Ulaanbaatar Electricity Distribution Network Company upgrades its 1,899 10kV transformers in Ulaanbaatar to amorphous high efficiency transformers and changes its new 1,284 10kV transformers into amorphous transformers.

(3) Total Project Cost

Total project cost was calculated separately for the following:

①Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3

②Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar

① Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3

Project cost: million yen

Assumptions: If the following OCS is installed on CHP-3's high-pressure unit

・Optimizer ＋ DCS

② Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar

Project cost: million yen

Assumptions: If the Ulaanbaatar Electricity Distribution Network Company changes 1,899 units of existing and installs 1,284 units of new 10kV transformers in Ulaanbaatar to amorphous high efficiency transformers and introduces a management system

(4) Co-benefit effects

As stated above tight demand conditions for power have currently become a serious problem facing Mongolia's Central Energy Grid, which primarily powers the capital of Ulaanbaatar. Each year, Mongolia's power supply shortage continues to grow, and this has made increasing the power supply and improving the efficiency of existing power stations urgent tasks. However, air pollution and an increase in GHG emissions are causing a toll on the environment, requiring measures to be urgently implemented. The technologies covered in this study have not only been confirmed to reduce GHG emissions, but they have also proven effective against these environmental issues, and thus, the Mongolian side has appraised these technologies highly.

① Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3

- Stabilize the supply of power by achieving a supply-demand balance through matching
- Lower NOx, SOx, and soot and dust associated with reducing coal consumption
- Reduce number of shutdowns by accidents by improving the accuracy of power conditioning

- Improve operating capabilities of power plant operators (mitigate operational burdens)

② Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar

- Increase surplus supply at power plants (amount from reduced loss)
- Increase transient stability of the power grid
- Lower NOx and SOx emissions attributed to the reduction of coal consumption
- Achieve greater grid stability by improving specifications of power transmission and distribution facilities (reduce the number of blackouts, etc.)

(5) Identifying Needs of Power Generation, Transmission and Distribution for Implementation at Other Cities or Facilities and Support for Project Structuring

① Energy Efficiency Improvement Diagnostics

Energy efficiency improvement diagnostics were performed on the Erdenet Mining Company, which operates a combined heat and power facility outside of Ulaanbaatar, in order to identify low-carbon technology projects for Japan. The items specified in the energy efficiency improvement diagnostics for thermal power plants are shown in Table 1.

Table 1 Diagnostic Items for Energy Efficiency Improvements

Target item	Current problems	Requests
Power generation facilities (Boiler and STG)	Plan on introducing new STG to operate facilities based on benchmark for heat supply needs in the winter time	Achieve consistently efficient operational method throughout the year
Coal mill	Rotating type mill that consumes a large amount of energy (50% of power used) and soaring electricity rates have impacted management	Reduce power consumption through more efficient operations
Water intake and supply system	The pump head range is set for water intake/supply resulting in a large amount of power consumption	Reduce power consumption through more efficient pump operations

Details of the items reviewed are as follows.

(i) Improve operations of power generation facilities (Boiler and STG)

The power generation facilities began operating in 1978. There are six 75t/h boilers and two 2.5MW turbine generators. During the summer season, one boiler is more than sufficient. In the winter season however, two are required. Going forward, the company is looking to operate four boilers, with one a back-up and performing inspections on another, so it plans on issuing a bid for four 12MW turbine generators.

(ii) Energy saving of the mill

Erdenet Mining Company uses a large amount of power and it has a factory located in the city. Erdenet Mining Company buys electricity at the highest rates.

About 70% of power is consumed by the mill, etc. in the factory, with 20% attributed to water supply and 10% other sources. The breakdown of the factory's consumption is 70% for the mill and 30% for the crusher. Nearly half of the total power is consumed by the mill.

To make operations more energy efficient, the company will use two Canadian motors to operate the single Chinese mill. The extent of reductions will be studied after operations begin in April 2015.

(iii) Make the water supply pump more efficient

The water supply facility captures water from the Selenga River and supplies 1,600t/h to Erdenet Mine and Erdenet City. It has a total of five pumps (including one reserve) at three locations. The pump head range of these pumps is set to between 25 and 30 meters and a large amount of power is consumed to maintain this range.

② Low-carbon technologies for the target efficiency improvement items

With regard to the above items requested for review, Table 2 contains the potential of possible technologies and application methods mainly for the implementation of technologies currently being examined for introduction in Ulaanbaatar at other cities.

Table 2 Potential of Possible Technologies

Target item	Technology potential	Application method
Power generation facilities (boiler and STG)	Operations controlled by an OCS	Introduce OCS and achieve controls using an equipment inverter
Coal mill	Operations controlled by an OCS	Introduce OCS and achieve controls using an equipment inverter
Water intake and supply facilities	Pump operations controlled by an OCS	Introduce OCS

Details of this potential are discussed below.

(i) Improve operations of power generation facilities (boiler and STG)

As with Ulaanbaatar's CHP, the company will examine introducing an OCS and changing pump fans over to inverters. The OCS will be used for the mill fan, induced draft fan (IDF), and boiler feed water pump (BFP), which have large inputs.

(ii) Make the mill more energy efficient

As with (i) above, the company will examine improving energy efficiency by introducing an OCS. There was advice provided explaining that work would progress smoothly if an agreement could be reached with the automated departments of the factory.

(iii) Make the water supply pump more efficient

The water supply pump comprises five individual facilities and all four pumps, with the exception of the reserve pump (Russian made) have been changed over to Japanese made equipment. The pump produces between 1,360 and 1,560kW, but the pump head range has been set at 30 meters to prevent any back flows. By reducing the pump head range to zero after introducing an OCS, power consumption can be reduced and energy efficiency promoted. Compared to the power generation facilities, the pump's operational pattern is simple, making it easy to introduce an OCS, which will prove to be highly effective at reducing CO2 emissions.

A specific proposal will be drafted in the near future, but the Erdenet Mining Company is a joint venture between Russian and Mongolian companies, meaning that approval is necessary at a meeting that will include the Russian side as well. Therefore, the details of the proposal must be made known to gain the understanding of the mining company side.

Erdenet Mining Company uses a large amount of power and operates a factory located in the city. Erdenet Mining Company purchases electricity at the highest rates. Electricity rates have been increased around 15% annually over the past several years. Rates tripled from 50Tg/kWh (about 3 yen) to 150T/kWh (about 9 yen) in 2007. The company consumes about 750 million kWh annually. The copper market was robust until recently, so there was no problem on that front. The cost of copper mining has risen annually. More and more copper is being dug up underground with each passing year, so the rising cost of copper per ton now necessitates the implementation of energy conservation measures.

In addition to Erdenet Mining Company, a study was carried out on the Erdenet Combined Heat and Power Plant that is owned by the City of Erdenet and on the combined heat and power plant located in Darkhan, the country's third largest city. Discussions on the introduction of OCS will be held for these facilities, as they were for the power generation facilities of the mining company.

5. Review for Commercialization

(1) Commercialization/JCM Scenarios

This project targets the energy supply sector and several billions of yen in project costs at the least will be required for power generation, transmission and distribution. The financing scheme for realizing this project will be one that aims to enable leap-frog development.

On June 25, 2014, Minister of the Environment Nobuteru Ishihara held talks with Takehiko Nakao, President of the Asian Development Bank in Tokyo during his visit to Japan, where they signed a Letter of Intent for Cooperation on Environmental Issues. They also announced the establishment of a new trust fund (JCM Japan Fund) utilizing JCM to support the adoption of advanced low-carbon technologies in its developing member countries (DMCs), with a grant of ¥1.8 billion from the Government of Japan. The flow of JCM Japan Fund is shown in Figure 1.

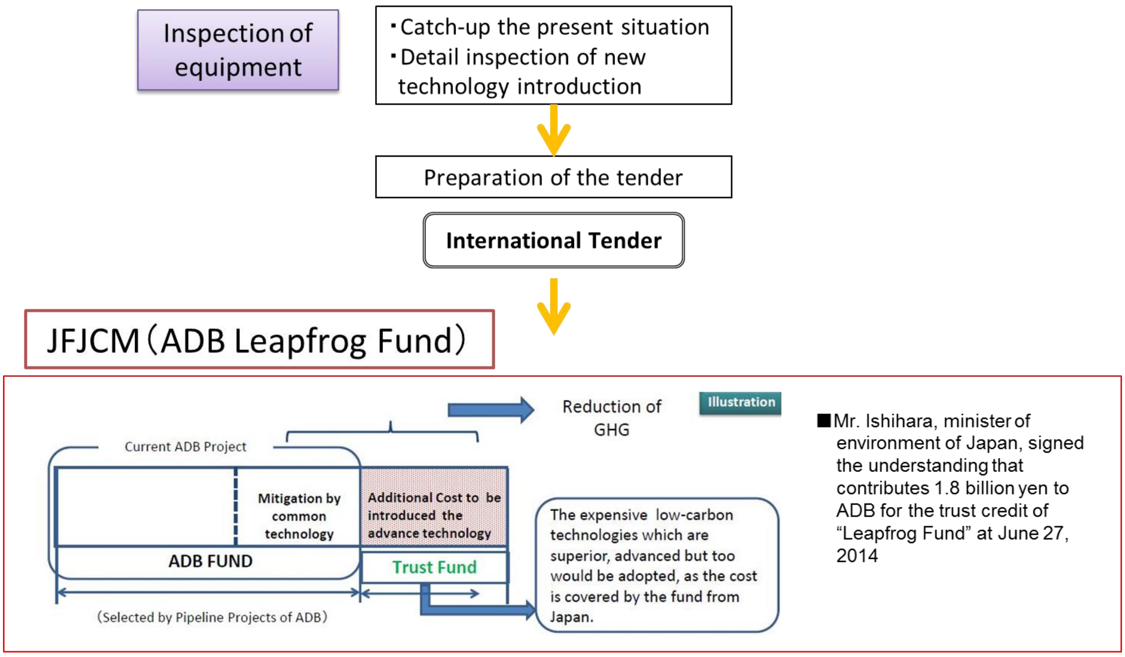


Figure 1　JCM Japan Fund flow

This fund was established to mitigate additional costs with funds placed in a trust managed by the Asian Development Bank to ensure the adoption of advanced low-carbon technology projects, since the adoption of these types of

Asian Development Bank projects have not made much progress because of the high implementation costs.

During this study, discussions with Mongolia's Ministry of Energy and the Ministry of Environment, Green Development and Tourism were moved forward, and the Government of Mongolia has agreed to cooperate with the implementation of the above project utilizing the JCM Japan Fund.

Project proceeding scheme is shown in Figure 2. The Government of Mongolia is currently in talks with the Asian Development Bank and a framework memorandum of understanding has already been concluded between the Ministry of Economic Development and the Asian Development Bank for commencing a project on power generation, transmission and distribution.

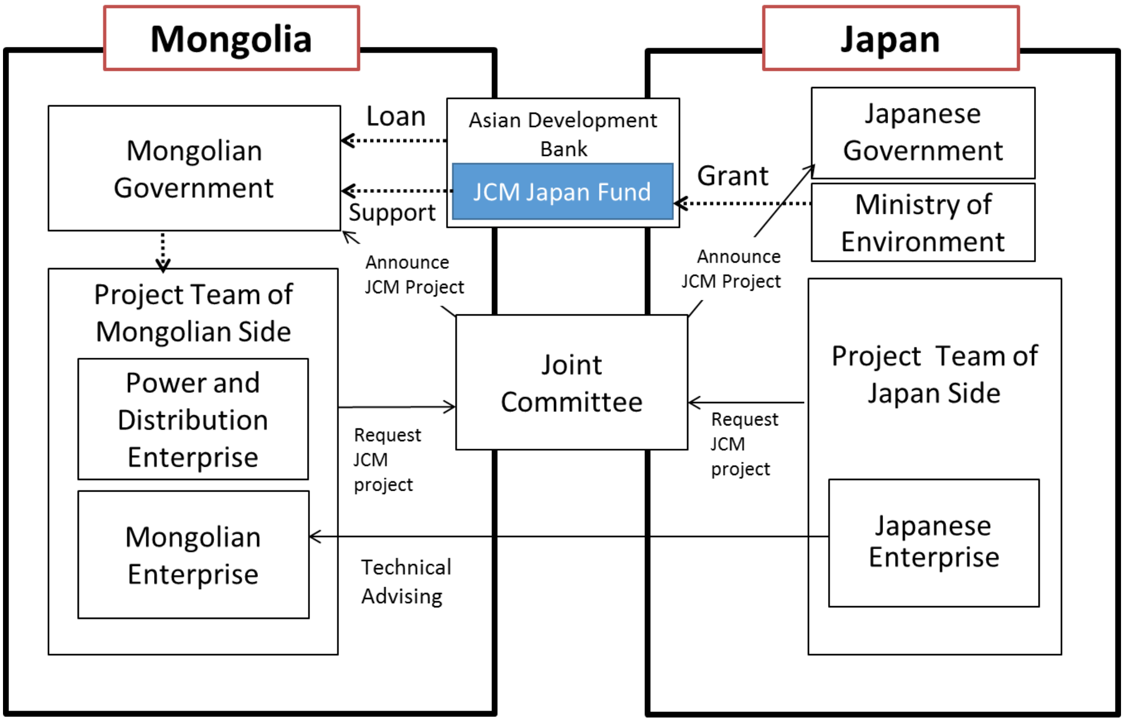


Figure 2 Project Scheme

(2) MRV Methodology and Monitoring System

MRV methodology and monitoring system were prepared separately for

①Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3

②Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar

① Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3

(i) JCM Methodology

This methodology is applied to the project that attempts to achieve GHG emissions reductions by introducing an OCS to reduce coal consumption used in generating steam from boilers at CHP-3.

An OCS generates an optimized operating condition where the absolute minimum necessary amount of coal is consumed at each point in time based on specific plant equipment data collected based on the constantly changing conditions of the plant. Based on these results, control orders are sent to other equipment comprising the plant through the plant control system (DCS), which makes it possible for the plant to constantly and continuously achieve optimized operations.

In this methodology, all relevant process data includes official data applied to all CHP in Mongolia in order to quantitatively ascertain the reduction amount of GHG emissions. This official data is compiled based on data measured at each power plant each month and sent to the Ministry of Energy (Dispatch Center). It has been determined that valid assessments of GHG emission reductions can be carried out with official data.

The amount of GHG emissions reduced by the introduction of an OCS can be calculated by multiplying CO2 emissions coefficient of coal by the amount of coal consumed that was reduced by the efficiency improvements.

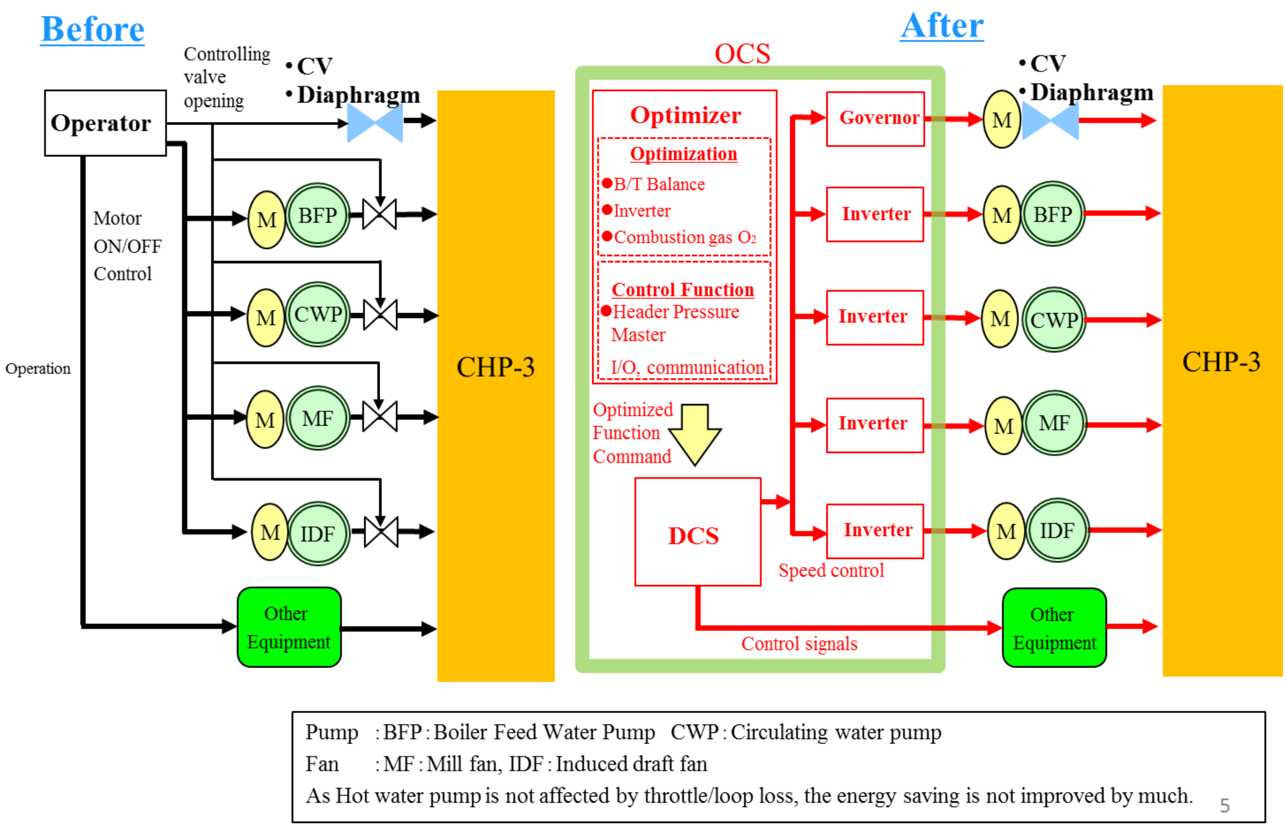


Figure 3 Improving Control Systems with OCS (Before vs. After)

(a) Definition of words

Basic words related to OCS used in this methodology are defined in Table 3.

Table 3 Definition of Terms used in Methodology

NO.	Term	Definition
1	Combined heat and power plant (CHP)	A power plant, where steam produced from multiple boiler units is supplied to multiple turbine/generator units through the same steam header, which can supply electricity as well as supply steam to surrounding factories and hot water for local heating needs by extracting steam from the middle of the turbines.
2	CHP-3 (high pressure)	The CHP plant targeted in this methodology is the Ulaanbaatar Thermal Power Plant No. 3 (CHP-3) high pressure plant (primary steam

		pressure of 9.8MPa) that comprises seven boilers and five turbines/generators.
3	Optimized control system (OCS)	A system that controls plant equipment to ensure that the minimum necessary amount of coal is consumed based on calculated data from the upstream optimized computing system that receives data from the Dispatch Center (equivalent to the central power supply command center) and as a result minimizes (optimizes) total plant CO_2 emissions.
4	Optimized computing system	A system that computes deviations of the plant's actual operating condition from optimized operating conditions calculated from specific data on plant equipment at each time point, and conveys these results to the optimized control system.
5	Optimized control system	A system that issues revised commands for the operational condition of each plant's equipment based on information from the optimized computing system in order to achieve optimized operating conditions.
6	Distributed control system (DCS)	As a distributed digital control system, a DCS connects each control loop into a network and ensures individual control loops are coordinated with one another, while controlling applicable equipment so that the CHP's control targets from the optimized control system can be met.
7	Inverter	An inverter converts from DC to AC in order to reduce energy consumption by controlling the speed of the motors used in supplementary plant equipment (fans/pumps) that make up part of the OCS
8	Heat pump	A piece of equipment that achieves energy efficiency by collecting and using heat energy from waste heat, which is more than the input

		energy (electricity in large part, but there are other power sources and heat).
9	Induced draft fan (IDF)	An induced draft fan, or IDF, is a high capacity fan that is used to discharge exhaust gas from boiler furnaces through the smoke stack into the air. Conventionally, the flow rate of IDFs were controlled by adjusting the openness of the damper, however, using a matrix converter, a high efficiency inverter that has a high degree of controllability, a larger amount of power consumption can be reduced by controlling the speed of the motor.
10	SFC	An acronym for Specific Fuel Consumption. For this methodology, coal consumption per unit of electricity generated (kWh) is expressed as SFC(E), while coal consumption per unit of heat energy (Gcal) is expressed as SFC(H).
11	COP	An acronym for Coefficient of Performance, a coefficient used to check the energy consumption efficiency of heat pumps. It is also often called the performance coefficient (movement coefficient). This value shows the cooling capacity and heating capacity per 1kW of consumed electricity rated based on JIS C9220.

(b) Qualification Requirements

This study anticipates that the following qualification requirements will be set. Each of these requirements is described in Table 4.

Table 4 Methodology of Qualification Requirements

	Requirement
Criterion 1	The project introduces OCS to the existing grid-connected coal-fired CHP-3 (High Pressure) plant which provides heat and electricity. OCS consists of the following facilities in order to save coal consumption within CHP-3 (High Pressure) plant: - OPTIMIZER

	- DCS - Inverter control - Heat pump
Criterion 2	Electricity for grid and internal use is generated by generators driven directly by steam turbine, and heat generation to produce hot water for district heating and steam supply to factories is performed by steam extraction in turbines.
Criterion 3	Introducing OCS achieves efficiency improvement in electricity generation and heat generation to result in reducing the quantity of coal consumption in the following manner; 1. Dynamic models of equipment equivalent to actual ones which are pre-installed in the "Plant Optimizer" identifies the ideal status of equipment and process values according to the plant condition varying from time to time, then the control demand to cancel the deviation between the condition in the "Plant Optimizer" and actual plant condition through the "Optimum Controller" to DCS. 2. DCS control is executed under the boiler master demand which is basically given from "Plant Optimizer" through "Optimum Controller" under dispatch center direction. 3. Scope of inverters newly applied to motors for speed control as part of OCS are as follows, but not limited to; - Feed water pump Motor speed control for optimized feed water flow and feed water header pressure - Mill Fan Motor speed control for optimized fuel control and stable combustion by reducing feeding air flow for coal supply - IDF Motor speed control for optimized O_2 control by precise furnace pressure control eventually resulting in reduction of combustion gas flow - CWP Motor speed control for maximizing HP performance by keeping temperature of water returning from condenser to cooling tower

	higher.
Criterion 4	Inverter introduced for pump control in this methodology is capable of three level control-applied power-supply provision in order to provide a more stable power source.
Criterion 5	Inverter introduced for control of fans in this methodology is capable of AC-AC conversion instead of AC-DC-AC conversion with 97% efficiency together with regeneration function for responsive control performance.
Criterion 6	As part of OCS, heat pump (HP) system, of which expected average COP is more than 5.0, is installed for the purpose of waste heat recovery from circulating water before entering the cooling tower to heat up returning district heating hot water. Circulating water flow into HP is controlled by the OCS with inverter controlled CWP (Circulating Water Pump) and district heating hot water temperature is concurrently controlled by OCS by reducing necessary quantity of extraction steam which is used for heat exchange with hot water returned from the city at the dedicated heat exchanger.
Criterion 7	All monitoring parameters are included in the data set reported to the government authority by CHP-3 (High Pressure) management according to the decree regulated by the relevant authority.
Criterion 8	Any rehabilitation work on the CHP-3 (High Pressure) is not permitted other than regular maintenance work such as regular inspection, small scale preventive maintenance work, etc. to eliminate any impact on improvement by the project. Emission reductions From the 2nd year onward, emission reductions are capped with the value of the 1st year.

The reasons why the technologies targeted in this methodology are believed to qualify for a JCM project are as follows.

a) Prevalence

All of Mongolia's thermal power plants are Russian-made CHP. There have been cases where inverters and DCS have been installed in these CHP, but there are no cases of any OCS control systems linked to DCS being installed.

Additionally, there are, of course, no cases of any Matrix converters , being used to control the motors of fans or the CHP, as they are only purchasable from a Japanese manufacturer.

Furthermore, this will mark the first time that a system is used in Mongolia where, as part of overall optimized control, Japanese-made high performance heat pumps are used to supply exhaust heat collected in the cooling toward as surplus heat for the return lines of hot water used for local heating.

Based on the above, a project that attempts to improve the overall efficiency of a single CHP in Mongolia using an OCS has never taken place in the country, and from the perspective of prevalence rate, this project is believed to maintain sufficient qualifications as a JCM project.

b) Investment Amount and Payback Period

An investment of several billions of yen will likely be required to install the OCS for this project. Nevertheless, this can be deemed as a realistic investment project because of long-term low interest rate loans using the JCM leap-frog fund and grants for advanced technologies provided by Japan's Ministry of the Environment.

Ultimately close to several billion yen in investment costs are anticipated. In such a scenario, around 10% can be funded by grants, while the remaining amount can be covered by low-interest loans, meaning there will be no initial upfront costs for the Mongolian side, making it an extremely viable and achievable project.

The project's primary revenue will be the reduction in coal consumption and the payback period anticipated for CHP-3 should be around 15 years.

c) Priority of Investment

Air pollution in Ulaanbaatar is quite serious. For example, the city's PM10 is 279μg/m3, which is about 14 times that of Japan and roughly double of China. A study by the Government of Mongolia found that the main factors behind this air pollution are pollutants emitted from CHP, coal-fired heat and power plant boilers, and wood stoves. On top of this, the city's industry is growing steadily, which has made air pollution measures an extremely important task. Therefore, the investment priority of a project to reduce CO_2 emissions by improving the efficiency of CHP is very high and government officials as well as other stakeholders have very high expectations for this project.

This project will also involve introducing Japan's leading control technologies and energy efficiency technologies, which are believed to be qualified technologies for employing JCM.

d) Targeted GHG and Sources of Emissions

The target GHG in this methodology is CO_2. The source of this CO_2 is coal-fired boilers.

This is because technologies targeted in this methodology only target reducing coal consumption by improving power plant efficiency. Improving power plant efficiency involves improving the efficiency of individual equipment and recovering exhaust heat, but the power source of the heat pump used to collect exhaust heat is the same as the power plant, so the power grid is not considered in this situation. Therefore, the target GHG is CO_2 derived entirely from coal fuel.

e) Information and Data for Computations

The data required to compute CO_2 emissions considered in this methodology is the amount of coal consumption reduced by improvements in efficiency related to coal consumption at CHP. This amount can be calculated from the specific unit of coal consumption reduced by efficiency improvements.

As a result, the following data is necessary.

Parameter	Explanation of data	Measurement method	Basis for setting
$SFC(E)_{RE,y}$	Reference coal consumption (ton/kWh) necessary for the unit of	Calculated from the multiple linear regression analysis results of specific unit of coal consumption $SFC(E)_{BP,z,i}$ versus monthly	Because SFC(E) fluctuates greatly month to month, when calculating reference values the correlation coefficient is calculated from

	electricity generated	electricity generated for the one year period prior to project implementation. $SFC(E)_{BP,z,I}$ uses official data released monthly by the power plant.	the multiple linear regression analysis as a function of parameters believed to effect SFC(E). The reference SFC(E) is then determined for the project implementation year based on this coefficient.
$SFC(H)_{RE,y}$	Reference coal consumption (ton/Gcal) necessary for the unit of heat supplied	The simple average of specific unit of coal consumption $SFC(H)_{BP,z,i}$ versus the monthly heat supply for a period of one year prior to project implementation. $SFC(H)_{BP,z,I}$ uses official data released monthly by the power plant.	Since SFC(H) fluctuates very little month to month, the one-year simple average is calculated based on the monthly SFC(H) value for the one year period directly before project implementation. Reference SFC(H) is determined based on this.
$EGN_{PJ,y}$	CHP electricity generated in year y of project implementation	CHP electricity generated for each month of the project implementation year. Uses official data released monthly by the power plant.	
$QH_{PJ,y}$	CHP supplied heat in year y of project implementation (total of steam supplied to plants and hot water supplied)	CHP supplied heat for each month of the project implementation year (total of steam supplied to factories and hot water supplied). Uses official data released monthly by the power plant.	
$EF_{CO2,y}$	Emissions coefficient of coal consumed	2006 IPCC Guideline	

f) Default Value Settings

This methodology reviewed default settings for the following items.

- CO_2 emissions coefficient of coal (brown coal)

  The coal used at CHP-3 target of this methodology is Baganuur coal and the following was calculated based on the 2006 IPCC Guideline:

  = 25.8[tC/TJ] * 44/12 * 4.184[TJ/Tcal]*7[Gcal/ton-coal]/103 = 2.771[tCO2/ton-coal]

  CHP-3 uses the same coal type as fuel and this is expected to remain the same every year, but given the possibility that publicly released data may fluctuate markedly, considerations will be afforded to using the latest publicly released information as a monitoring item.

g) Method Used to Determine Preliminary Settings

Currently this method is under review and it will be set based on the results of the next field study.

h) Calculation Basis of Reference Emissions

For this methodology, the business as usual (BaU) scenario focuses on continuing the operations of the plant without changes, and without implementing the efficiency improvement project. BaU emissions represent the GHG emissions in the event that the same electricity was generated and heat supplied assuming that the project was not implemented.

For JCM, reference emissions should be set more conservatively than BaU emissions and given the largest discrepancy in reference emissions calculated for this project, consideration will be made to set reference emissions conservatively.

i) Calculation Method Used for Reference Emissions

・Reference emissions from electricity generated

A multiple linear regression analysis using the following explanatory functions was carried out for specific unit of coal consumption $SFC(E)_{BP,z,I}$ versus the monthly electricity generated for the one-year period prior to project implementation.

2013 CHP-3 $SFC(E)_{BP,z,i}$

Month	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
SFC (E)	219	225	230	242	447	533	526	529	427	302	318	311

Multiple linear regression analysis carried out with the above values using the following explanatory functions:

Electricity generated ($EGN_{BP,z,i}$)

Heat supplied for community hot water heating ($QHS_{BP,z,i}$)

House electricity (for electricity generation) ($HEE_{BP,z,i}$)

House electricity (for heating supply) ($HEH_{BP,z,i}$)

$SFC(E)_{BP,z,i} = a * EGN_{BP,z,i} + b * QHS_{BP,z,i} + c * HEE_{BP,z,i} + d * HEH_{BP,z,i} + e$

The following results were obtained from the analysis:

Result of Regression Analysis (1)

Regression statics	
Correlation	0.9993
Determination	0.9987
Correction	0.9979

Result of Regression Analysis (2)

Coefficient		p-value
a	-0.00515	0.008819
b	0.00191	0.001924
c	0.11077	4.26E-06
d	-0.05571	0.000446
e (Intercept)	270.9	6.04E-06

Result of Regression Analysis (3)

Month in 2013	Actual SFC(E)	Predicted SFC(E)	Error (%)
1	219.6	216.3	-1.5
2	225.5.	223.7	-0.8
3	230.5	238.9	3.6
4	242.9	247.4	1.8
5	447.7	440.3	-1.7

6	533.3	520.0	-2.5
7	525.5	533.0	1.4
8	529.4	536.2	1.3
9	426.9	433.7	1.6
10	301.9	297.2	-1.5
11	317.6	308.6	-2.8
12	311.1	316.9	1.7

Calculation of specific unit of coal consumption versus reference electricity generated

Because sufficient correlation was obtained from the regression analysis, the specific unit of coal consumption ($SFC(E)_{RE,y,i}$) versus reference electricity generated was calculated as follows using a, b, c, d, and e from above.

$$SFC(E)_{RE,y,i} = a * EGN_{PJ,y,i} + b * QHS_{PJ,y,i} + c * HEE_{PJ,y,i} + d * HEH_{PJ,y,i} + e$$

Calculation of reference emissions for electricity generated in the project implementation year

$$RE(E)y = \sum_{i}^{12} SFC_{RE,y,i} * EGN_{RE,y,i} * EF_{CO2} * 0.95$$

$$= 472{,}303 \text{ tCO2/y}$$

・Reference emissions from heat supply

The reference specific unit of coal consumption $SFC(H)_{RE,y,I}$ was calculated from the average value of monthly heat supply for the one-year period prior to project implementation.

$$SFC(H)_{RE,y} = \sum_{i}^{12} SFC_{BP,z,i} /12$$ (Average value: 181.0)

$$RE(H)y = \sum_{i}^{12} SFC(H)_{RE,y,i} * QH_{PJ,y,i} * EF_{CO2} * 0.95$$

$$= 671{,}229 \text{ tCO2/y}$$

・Reference emissions REy

The following calculation was made for reference emissions because reference emissions (REy) equal the sum of reference electricity generated (RE[E]y) and reference heat supply (RE[H]y).

REy＝ RE(E)y + RE(H)y

= 472,303 + 671,229 = 1,143,532 tCO2/y

The actual calculation results for the above reference emissions were reduced by 5% in order to make the value conservative.

j) Calculation Basis of Project Emissions

Project emissions for this methodology represents GHG emissions produced from electricity generated and heat supplied from coal consumed in the boilers operated by the plant after project implementation.

Coal consumption is expected to be reduced by efficiency improvements achieved by the project, so project emissions should be lower than reference emissions. The difference between the two is considered the emissions reduction amount.

k) Calculation Method of Project Emissions

・Project emissions accompanied with electricity generation

Project emissions from electricity generated PE(E) were calculated as follows. The specific unit of coal consumption for power generation after project implementation is $SFC(E)_{PJ,y,I}$ and is calculated with actual data for electricity generated and coal consumption, while the Ex-ante value can be calculated from the expected value achieved through efficiency improvements.

Considering efficiency improvements (Δη: table below), project emissions for year y and month i will be as follows:

$$PE(E)_{PJ,y,i} = EGN * SFC(E)_{PJ,y,i} * EF_{CO2}$$
$$= EGNPJ,y,i * SFC(E)RE,y,i * (1 - \Delta\eta) * EF_{CO2}$$

Annually:

$$PE(E)_{PJ,y} = \sum_{i=1}^{12} EGN_{PJ,y,i} * SFC(E)_{PJ,y,i} * (1 - \Delta\eta) * EF_{CO2}$$
$$= 432{,}019\ tCO2/y$$

・Project emissions from heat supplied

The specific unit of coal consumption from heat supplied after project implementation is $SFC(H)_{PJ,y,i}$ and is calculated with actual data for electricity generated and coal consumption, while the Ex-ante value can be calculated from the expected value achieved through efficiency improvements.

Considering efficiency improvements as Δη, project emissions for year y and month i will be as follows:

$PE(H)_{PJ,y,i} = QH_{PJ,y,i} * SFC(H)_{PJ,y,i} * EF_{CO2}$

$= QH_{PJ,y,i} * SFC(H)_{RE,y,i} * (1 - \Delta\eta) * EF_{CO2}$

Annually:

$$PE(H)_{PJ,y} = \sum_{i=1}^{12} QH_{PJ,y,i} * SFC(H)_{PJ,y,i} * (1 - \Delta\eta) * EF_{CO2}$$

= 596,647 tCO2/y

・Total annual project emissions

$$PE_{PJ,y} = PE(E)_{PJ,y} + PE(H)_{PJ,y}$$

= 432,032 + 596,647 = 1,028,666 tCO2/y

Expected value from efficiency improvements attributed to the OCS (Δη)

Month	Δη	Electricity generated (Incremental value)
Jan.	19.50%	100.0%
Feb.	14.47%	74.2%
Mar.	14.30%	73.3%
April	14.44%	74.0%
May	9.12%	46.7%
June	7.72%	39.6%
July	8.90%	45.7%
Aug.	8.81%	45.2%
Sept.	8.87%	45.5%
Oct.	14.47%	74.2%
Nov.	16.26%	83.4%
Dec.	18.81%	96.5%

l) Monitoring Methods

The required monitoring parameters for this methodology for calculating project emissions and reference emissions after project implementation are as follows.

(1) Electricity generated ($EGN_{PJ,y,i}$)

(2) Total heat supplied ($QH_{PJ,y,i}$)

(3) House electricity (for electricity generation) ($HEE_{PJ,y,i}$)

(4) House electricity (for heating supply) ($HEH_{PJ,y,i}$)

These parameters represent authoritative data released from the government monthly as official data for CHP-3. The use of this official data is considered to be the most valid form of monitoring data for this methodology.

m) GHG Emissions and Reduction

For this methodology, the emissions reduction was calculated from the reference emissions calculated in j) and the project emissions calculated in k) using the following formula.

$ER_y = RE_y - PE_y$

$= 1,143,532 - 1,028,666 = 114,866$ tCO2/y

(ii) Survey Results related to JCM PDD Preparation

(a) Project Implementation System and Project Participants

The implementation system for this project involves OECC as project participant from the Japan side and CHP-3 as project participant from the Mongolian side, both of which will manage the overall project. OECC will gather and analyze information on applied technologies necessary for preparing the PDD and data of companies involved in the project, and will prepare the PDD. CHP-3 will provide OECC with its own data and information on laws and regulations in Mongolia, both of which are required for PDD preparation, and support in the preparation of the PDD.

(b) Project Commencement and Implementation Period

Operations under this project are expected to commence in 2017, and the implementation period is expected to be 16 years.

(c) Qualification Requirements

The qualification requirements of this methodology are described in Table 5.

Table 5 Qualification Requirements in this Methodology

	Details of Requirement
Criterion 1	The project introduces OCS to the existing grid-connected coal-fired CHP-3 (High Pressure) plant which provides heat and electricity. OCS consists of following facilities in order to save coal

	consumption within CHP-3 (High Pressure) plant: - Optimizer - DCS - Inverter control - Heat pump
Criterion 2	Electricity for grid and internal use is generated by generators each of which is directly driven by steam turbine, and heat generation to produce hot water for district heating and steam supply to factories is performed by steam extraction in turbines.
Criterion 3	Introducing OCS achieves the efficiency improvement in electricity generation and heat generation to result in reducing quantity of coal consumption in the following manner; 1. Dynamic models of equipment equivalent to actual ones which are pre-installed in the "Plant Optimizer" identifies the ideal status of equipment and process values according to the plant condition varying from time to time, then the control demand to cancel the deviation between the condition in the "Plant Optimizer" and actual plant condition through the "Optimum Controller" to DCS. 2. DCS control is executed under the boiler master demand which is basically given from "Plant Optimizer" through "Optimum Controller" under dispatch center direction. 3. Scope of inverters newly applied to motors for speed control as part of OCS are as follows, but not limited to; - Feed water pump Motor speed control for optimized feed water flow and feed water header pressure - Mill Fan Motor speed control for optimized fuel control and stable combustion by reducing feeding air flow for coal supply - IDF Motor speed control for optimized O_2 control by precise furnace pressure control eventually resulting in reduction of combustion gas flow - CWP Motor speed control for maximizing HP performance by keeping temperature of water returning from condenser to cooling tower higher.
Criterion 4	Inverter introduced for control of pumps in this methodology has capabilities of three level control-applied power-supply provision in order to provide a more stable power source.
Criterion 5	The inverter introduced for controlling fans in this methodology has

	AC-AC conversion capabilities rather than AC-DC-AC conversion capabilities, with 97% efficiency together with regeneration function for responsive control performance.
Criterion 6	As part of OCS, heat pump (HP) system, of which expected average COP is more than 5.0, is installed for the purpose of waste heat recovery from circulating water before entering to the cooling tower to heat up returning district heating hot water. Circulating water flow into HP is controlled by the OCS with inverter controlled CWP (Circulating Water Pump) and district heating hot water temperature is concurrently controlled by OCS by reducing necessary quantity of extraction steam which is used for heat exchange with hot water returned from the city at the dedicated heat exchanger.
Criterion 7	All monitoring parameters are to be included in the data set reported to the government authority by CHP-3 (High Pressure) management according to the decree regulated by the relevant authority.
Criterion 8	Any rehabilitation work on the CHP-3 (High Pressure) is not permitted, other than regular maintenance work such as regular inspection, small scale preventive maintenance work, etc. to eliminate any impact on improvement by the project. Emission reductions From the 2nd year onward, emission reductions is capped with the value of the 1st year.

(d) Source of Project Emissions and Monitoring Points

For this project, the source of emissions is coal-fired boilers for both reference emissions and project emissions. This is because technologies targeted in this methodology are only targeting reducing coal consumption by improving power plant efficiency. Improving power plant efficiency involves improving the efficiency of individual equipment and recovering exhaust heat, but the power source of the heat pump used to collect exhaust heat is the same as the power plant, so the power grid is not considered in this situation. Therefore, the target GHG is CO2 derived entirely from coal fuel.

The required monitoring points for this methodology for calculating project emissions and reference emissions after project implementation are as follows.

Electricity generated ($EGN_{PJ,y,i}$)

Total heat supplied ($QH_{PJ,y,i}$)

House electricity (for electricity generation) ($HEE_{PJ,y,i}$)

House electricity (for heating supply) ($HEH_{PJ,y,i}$)

These parameters represent authoritative data released from the government monthly as official data for CHP-3. The use of this official data is considered to be the most valid form of monitoring data for this methodology.

(e) Monitoring plan

The monitoring parameters expected to be used for this methodology are the same as those presented in the item l) of (i)(b) . The field study investigated monitoring methods, data storage methods, and monitoring system for this data.

All monitoring parameters are contained in data reported to official institutions (Dispatch Center) by CHP-3. This data is collected, stored and managed following a system that has already been established within CHP-3.

It is probable that the above system will be maintained and monitoring will be continued with this system after this project is actually installed

The required monitoring parameters for this methodology for calculating project emissions and reference emissions after project implementation are as follows.

Electricity generated ($EGN_{PJ,y,i}$)

Total heat supplied ($QH_{PJ,y,i}$)

House electricity (for electricity generation) ($HEE_{PJ,y,i}$)

House electricity (for heating supply) ($HEH_{PJ,y,i}$)

These parameters represent authoritative data released from the government monthly as official data for CHP-3. The use of this official data is considered to be the most valid form of monitoring data for this methodology.

The extent of equipment calibration that is taking place has yet to be investigated, but considering the fact that the responsibility to carry out such calibration work and the duty to report official data lies with CHP-3, it is believed that OECC is not in a position to actively get involved in this aspect.

(f) Environmental Impact Assessment

This project involves improving efficiency of the power plant and it has already been determined that a new environmental impact assessment does not need to be carried out for the facility. However, a study into the details of relevant Mongolian laws and regulations is necessary.

(g) Comments from Stakeholders

This project will be completed onsite at CHP-3 and therefore it is safe to assume that third party stakeholders are not a component of the project.

② Fundamentally Updating and Increasing the Capacity of Power Transmission and Distribution Facilities in Ulaanbaatar

(i) JCM Methodology

Figure 1 illustrates a quick overview of the distribution lines from power plant to household. This methodology assumes that the distribution transformer used in the distribution network will be updated or replaced with a high efficiency amorphous transformer. This will greatly reduce no-load loss by updating or replacing existing transformers that have loss (no-load loss) with high efficiency amorphous transformers. In turn, this can also lower GHG emissions.

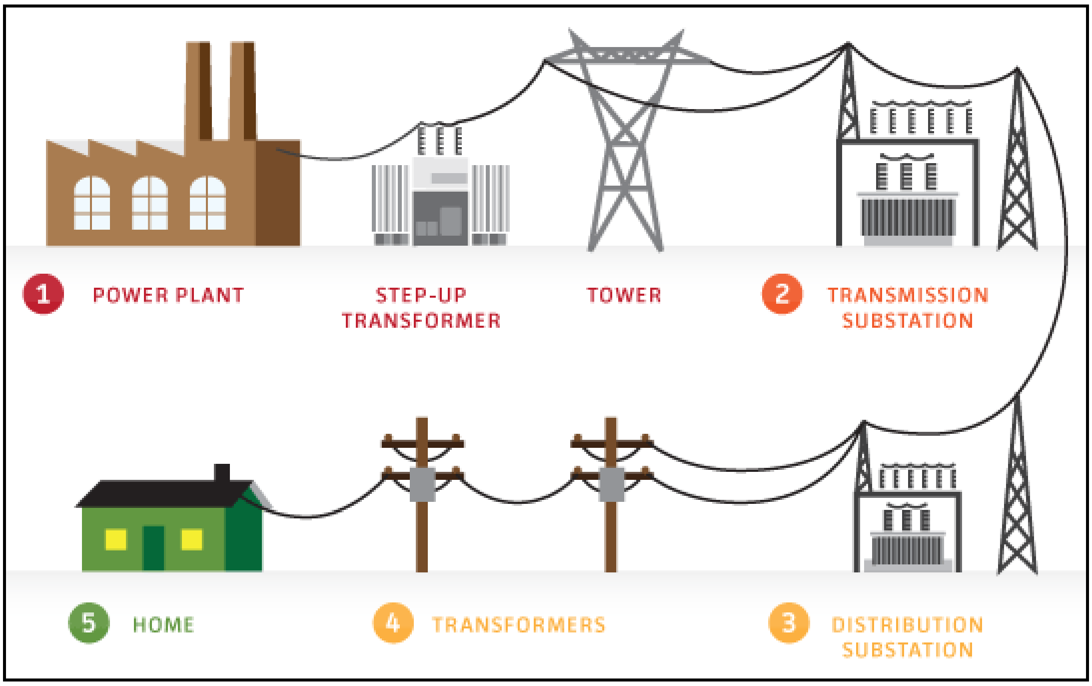


Figure 4 Distribution Lines from Power Plant to Household

Note: Pole transformers in ④ are the target of update or replacement.

(a) Definition of Terms

Table 6 provides definitions of fundamental terms for this methodology concerning distribution transformers used in the distribution network.

Table 6 Definition of Terms for this Methodology

Term	Definition
Distribution network	The distribution network is part of the power system installed in order to provide electrical energy to end users. This network supplies power at middle range voltage levels (generally higher than 50kV).
Load loss	Load loss and coil loss is loss attributed to electricity resistance in the transformer's winding wire. These types of loss include eddy current loss of primary and secondary conductors in transformers.
No-load loss	No-load loss and core loss is loss due to magnetization of the transformer's core or from power distribution. A certain amount of loss will occur during distribution from the transformer

	regardless of the amount of electricity distributed.
Reference transformer	A distribution transformer connected to the current distribution network that has been used for at least three years and that has an average no-load loss that is in the top 20% of average value among data on no-load loss and load loss.
Project transformer	A new high efficiency distribution transformer that has been installed to replace a reference transformer or to increase the capacity of the distribution network.
Performance standard	A performance standard provided by a government-appointed institution in accordance with a relevant international standard or an independent and qualified entity that defines the maximum level of installed transformer loss and no-load loss in a geographic area.
Transformer type	The type of transformer is defined based on its capacity (kilovolt-amperes) and transformer ratio.

(b) Qualification Requirements

The qualification requirements of this methodology are described in Table 7.

Table 7 Qualification Requirements for this Methodology

	Details of Requirement
Criterion 1	Replacement of Reference Transformers with Project Transformer in the Grid, or Installation of new Project transformers in the new areas covered by expansion of the Grid where in the absence of the project, Reference Transformers would have been installed.
Criterion 2	No-load loss of Project Transformers is lower than that of Reference Transformers, and Load loss of Project Transformers is not higher than that of Reference Transformers,
Criterion 3	Project Transformers installed comply in accordance with IEC 60076 as a national / international QA/QC standards. The certification report includes information on the measured performance levels for load losses and no-load losses as per Standard and in addition, the associated uncertainty
Criterion 4	A complete list of co-ordinates uniquely identifying each Project Transformer.

a) Prevalence

The scope of the current study found that the Ulaanbaatar Electricity Distribution Network Company has yet to introduce a high efficiency amorphous distribution transformer. Below, the primary reasons why efficiency amorphous distribution transformers have not been installed will be examined.

b) Investment Amount and Payback Period

A capital investment of several billions of yen will likely to be required for this project. Plans for conventional distribution equipment have been created for each area, or as part of specific projects (residential or industrial, etc.). Since plans and bids are determined on a project-by-project basis, even a large-scale project will cost only several millions of yen. Whereas, the investment amount for this project is large, which means the financing preparations and payback period will likely take a long period of time. As a result, without access to low interest rate JCM leap frog financing, this will be an infrastructure project with a low feasibility.

c) Priority of Investment

Mongolia has experienced rapid growth in recent years and its dependence on power has become more important, but priority is generally given to investments in production facilities, while distribution transformers are used until they breakdown or the technology is highly dependent on outdated Russian or former Communist Bloc countries, meaning no one wants to employ new technology, so it is believed that investments in distribution facilities have had a low priority.

This investment situation is considered to be the norm given the fact that distribution facilities have yet to be switched over to high efficiency models.

Based on the above, if there was no mechanism to financially support low-carbon technologies like JCM, it is assumed that investments would likely not be made in fields such as distribution facilities. These technologies, which are implemented through JCM, will involve introducing Japan's leading energy efficiency technologies, which are believed to be qualified technologies for JCM employment.

(c) Targeted GHG and Sources of Emissions

The target GHG in this methodology is CO2. The source of this CO2 is grid electricity. This is because this methodology is applied to a project where the distribution transformers used in the power distribution network will be updated or replaced with high efficiency amorphous transformers. This will greatly reduce no-load loss by updating or replacing existing transformers that have loss (no-load loss) with high efficiency amorphous transformers. In turn, this can also lower GHG emissions.

(d) Information and Data for Computations

The data required to compute CO2 emissions considered in this methodology is the net electricity alternative amount generated at combined heat and power plants for replacing grid electricity. This will greatly reduce no-load loss by updating or replacing existing transformers that have loss (no-load loss) with high efficiency amorphous transformers, which in turn can also lower GHG emissions.

As a result, the following data is necessary.

Parameter	Explanation of data	Calculation method	Basis for setting
$NLL_{RL,k}$	Loss of transformers currently connected to the distribution grid	The average loss of the "Top 20%" for each type that has been installed for at least three years based on data for no-load loss and installed numbers, in order to specify the no-load loss of low efficiency distribution transformers currently used.	Employs the designated calculation method of CDM methodology from the UNFCCC.
$NLL_{PR,k,y}$	Loss of amorphous transformers newly connected to the distribution grid	Loss of amorphous transformers newly connected to the distribution grid. Proper reporting and verification of emissions reduction amounts is necessary that considers data management and QA/QC	Employs measurements from testing and inspection reports under international standards IEC/ISO
$EF_{CO2,grid,y}$	Grid emissions	Default value: uses official data	CO2 emissions

	coefficient (tCO_2/MWh).	released by the Government of Mongolia.	coefficient for grid electricity released by the Mongolian Government for use in CDM projects.
Br	Blackout rate (%) during monitoring period	Default value: uses official data released by the Government of Mongolia.	Employs the designated calculation method of CDM methodology from the UNFCCC.
$n_{k,y}$	Total number of an applicable transformer type installed at year 'y-1'.	Proper reporting and verification of emissions reduction amounts is necessary that considers annual data management and QA/QC	Employs the designated calculation method of CDM methodology from the UNFCCC.

(e) Default Value Settings

This methodology reviewed default settings for the following two items.

1) Blackout rate during the monitoring period (%)

2) CO2 emissions coefficient for grid electricity

1) Blackout rate during the monitoring period (%)

Generally, the Ulaanbaatar Electricity Distribution Network Company publishes an annual report every year on its distribution facilities. The blackout rate is one of the published figures for the distribution grid and this figure was applied to this methodology.

SAIDI: from 1270 min.

Blackout rate during the monitoring period (%) = 0.24%

2) CO2 Emissions Coefficient of Grid Electricity

The distribution grid project covered by this methodology will be carried out Mongolia, and the Government of Mongolia releases values for its CO2 emissions coefficient for grid electricity. The emissions coefficient includes operating margin (OM), build margin (BM), and combined margin (CM). For the purposes of this study CM will be used as the assumption. Furthermore, the Government of Mongolia releases emissions coefficient data for both Ex-ante (value used when finalizing the emissions coefficient in advance) and Ex-post (value used when the coefficient fluctuates each year after project implementation). The methodology spreadsheet used for this methodology assumes that the coefficient value is finalized and approved in advance, so it uses the Ex-ante value. Specifically, the following values are used.

$EF_{CO2,grid,y}$ ＝Emission Factor of the grid (tCO_2e/ MWh)

Emissions Factor of Mongolia's power grid: 1.154 (CES Central Energy Grid, 2010)

(f) Method Used to Determine Preliminary Settings

As stated above, this methodology employed the following settings for the following two items per the results of the review.

1) Blackout rate during the monitoring period (%)

The Ulaanbaatar Electricity Distribution Network Company publishes an annual report every year. The blackout rate is one of the published figures for the distribution grid and this figure was applied to this methodology.

SAIDI:　from 1270 min.

The value will be set in advance for projects in each fiscal year based on the value from the particular fiscal year.

2) CO2 emissions coefficient for grid electricity

The emissions coefficient for CDM released by the Government of Mongolia was used as the default value. This methodology focuses on principal grid electricity in Mongolia and project participants using this methodology will select grid electricity for the project to connect and used as an alternative as the parameter of "grid" when preparing the PDD. Selecting grid electricity on the monitoring plan spreadsheet will automatically set the corresponding emissions coefficient.

(g) Calculation Basis of Reference Emissions

For this methodology, the business as usual (BaU) scenario focuses on continuing the operations of the plant, while BaU emissions represent the GHG emissions in the event that the same amount of electricity as generated by the project was obtained from grid electricity. For JCM, reference emissions should be set more conservatively than BaU emissions and while there is a method to lower the emissions coefficient of generated electricity or grid electricity in this type of project, it is difficult to support the basis or rationality of setting a discount value for the emissions coefficient of grid electricity. Therefore, this methodology employs a method to conservatively calculate generated electricity, or net electricity generated from the project (self-consumed electricity).

Therefore, the reference emissions for this methodology is calculated by multiplying the emissions coefficient of grid electricity by the average value of the group in the "Top 20%" of the conservative calculation and the electricity emissions of the net reduction from the project per the actual plant testing results.

(h) Calculation Method Used for Reference Emissions

In order to specify no-load loss values for low efficiency distribution transformers used until now, the average loss value of the "Top 20%" for each type obtained from data on the number and load loss of transformers that have been installed for at least three years can be used as an alternative to grid electricity. As a result, this methodology calculates net alternative electricity amounts using the following method.

(i) Calculation Basis of Project Emissions

For this methodology, project emissions are calculated by multiplying the emissions coefficient of grid electricity by the electricity emissions of the net reduction from the project per the actual plant testing results.

(j) Calculation Method Used for Project Emissions

For the above reason, the following formula is used to calculate project emissions.

(k) Monitoring Methods

Under this methodology, emissions are calculated by multiplying the emissions coefficient of grid electricity by the average value of the group in the "Top 20%" of the conservative calculation and the electricity emissions of the net reduction from the project per the actual plant testing results.

Therefore, the parameters used for monitoring will be electricity emissions of the net reduction from the project per the actual plant testing results and the number of upgraded or added transformers for each type and each fiscal year. No special methods or technologies are believed to be required for continuously measuring the total cumulative amount of electricity generated.

It is anticipated that a certificate of screening will be obtained for this project from an IEC standards compliant manufacturer. Additionally, the frequency of calibration will be examined based on the use of a manufacturer's specifications and warranty.

(l) GHG Emissions and Reduction

The emissions reduction amount for this project will be calculated by subtracting project emissions [PEy] from reference emissions [REy]. Specifically, the following formula will be used for the calculation.

$$ER_y = RE_y - PE_y$$

Year	Estimated Reference emissions (tCO_{2e})	Estimated Project Emissions (tCO_{2e})	Estimated Emission Reductions (tCO_{2e})
2017	20,710	6,282	14,429
2018	20,710	6,282	14,429
2019	20,710	6,282	14,429
2020	20,710	6,282	14,429
Total (tCO_{2e})	82,840	25,128	57,716

(ii) Survey Results related to JCM PDD Preparation

(a) Project Implementation System and Project Participants

The implementation system for this project involves Power Systems Company as project participant from the Japan side and Ulaanbaatar Energy Distribution Network Company as project participant from the Mongolian side, both of which will manage the overall project. OECC will gather and analyze information on applied technologies necessary for preparing the PDD and data of companies involved in the project, and will prepare the PDD. Ulaanbaatar Energy Distribution Network Company will provide to OECC its own data and information on laws and regulations in Mongolia, both of which are required for PDD preparation, and support in the preparation of the PDD.

(b) Project Commencement and Implementation Period

Operations for this project are expected to commence in 2017 and the implementation period is expected to be at least 7 years.

(c) Ensuring Consistency with Qualification Requirements

The qualification requirements of this methodology are described in Table 8.

Table 8 Qualification Requirements for this Methodology

	Details of Requirement
Criterion 1	Replacement of Reference Transformers with Project Transformer in the Grid, or Installation of new Project transformers in the new areas covered by expansion of the Grid where in the absence of the project, Reference Transformers would have been installed.
Criterion 2	No-load loss of Project Transformers is lower than that of Reference Transformers, and Load loss of Project Transformers is not higher than that of Reference Transformers.
Criterion 3	Project Transformers installed comply with in accordance with IEC 60076 as a national/ international QA/QC standards. The certification report includes information on the measured performance levels for load losses and no-load losses as per Standard and in addition, the associated uncertainty.
Criterion 4	A complete list of co-ordinates uniquely identifying each Project Transformers.

(d) Source of Project Emissions and Monitoring Points

The target GHG in this methodology is CO2. The source of this CO2 is grid electricity, because this methodology is applied to a project where the distribution transformers used in the power distribution network will be updated or replaced with high efficiency amorphous transformers. This will greatly reduce no-load loss by updating or replacing existing transformers that have loss (no-load loss) with high efficiency amorphous transformers. In turn, this can also lower GHG emissions.

The necessary data for calculating CO2 emissions considered in this methodology is the net electricity alternative amount generated at combined heat and power plants for replacing grid electricity. This will greatly reduce no-load loss by updating or replacing existing transformers that have loss (no-load loss) with high efficiency amorphous transformers. In turn, this can lower GHG emissions.

As a result, the following data is required.

Parameter	Explanation of data	Measurement method	Basis for setting
$NLL_{RL,k}$	Loss of transformers currently connected to the distribution grid	The average loss of the "Top 20%" for each type that has been installed for at least three years based on data for no-load loss and installed numbers, in order to specify the no-load loss of low efficiency distribution transformers currently used.	Employs the designated calculation method of CDM methodology from the UNFCCC.
$NLL_{PR,k,y}$	Loss of amorphous transformers newly connected to the distribution grid	Loss of amorphous transformers newly connected to the distribution grid. Proper reporting and verification of emissions reduction amounts is necessary that considers data management and QA/QC.	Employs measurements from testing and inspection reports under international standards IEC/ISO
$EF_{CO2,grid,y}$	Grid emissions coefficient (tCO_2/MWh).	Default value: uses official data released by the Government of Mongolia.	CO2 emissions coefficient for grid electricity released by the Mongolian Government for use in CDM projects.
Br	Blackout rate (%) during monitoring period	Default value: uses official data released by the Government of Mongolia.	Employs the designated calculation method of CDM methodology from the UNFCCC.
$n_{k,y}$	Total number of an applicable transformer type installed at year 'y-1'.	Proper reporting and verification of emissions reduction amounts is necessary that considers annual data management and QA/QC	Employs the designated calculation method of CDM methodology from the UNFCCC.

(e) Monitoring Plan

The following two items will be monitored in this methodology in order to clarify the applicable conditions.

・Values for the type, capacity, transformer voltage ratio, no-load loss and load loss for high efficiency transformers to be introduced by this project

・Installation records of transformers that have been in service for at least 3 years by type

The following four items will also be monitored in this methodology in order to calculate project emissions.

・No-load loss and load loss of high efficiency transformers introduced by this project

・Details of high efficiency transformers introduced by this project (date installed, location and technical data)

・Annual blackout rate

・Number of high efficiency transformer units installed by this project

The monitoring parameters required for each of these methodologies are summarized in the Table 9.

Table 9 Monitoring Data and Parameters

Parameter	Unit	Measurement	Data source	Frequency
k	-	Reports	Type of project transformers "'k' installed in year 'y-1' (records)	-
$NLL_{PR,k,y}$	W		No-load loss value of type of project transformers "'k' installed in year 'y-1' (testing results of manufacturer)	-
MP	Hours		Official documents from the power utility	Annually
Br	%		Official documents from the power utility (blackout rate)	Annually
$EF_{CO_2,grid,y}$	tCO_2/MWh	Calculations	Emissions coefficient of grid electricity in year 'y'	Annually
$LL_{PR,k,y}$	W		Load loss value of type of project transformers "'k' installed in year 'y-1' (testing results of manufacturer)	-

n_k	Units	Reports	Cumulative number of type of transformer ‘k’ installed during project activities up until year ‘y-1’	Annually

(f) Environmental Impact Assessment

This is an efficiency improvement project that involves installing high efficiency transformers within Ulaanbaatar Electricity Distribution Network Company’s distribution network. The realization of this project will mean that electricity loss associated with distribution network transformers will be continuously reduced, while GHG emissions will be lowered and the urban environment and safety will be improved. This same sentiment is shared by many stakeholders in Mongolia. It has been determined that a new environmental impact assessment onsite will not be required.

(g) Comments from Stakeholders

The realization of this project will mean that electricity loss associated with distribution network transformers will be continuously reduced, while GHG emissions will be lowered, power system will be stabilized and the urban environment as well as safety will be improved. This same sentiment is shared by many stakeholders in Mongolia. As a result, there is believed to be no problematic matters regarding this project from a stakeholder perspective.

(3) Implementation Plan and Detailed Schedule

① Improving efficiency of Ulaanbaatar Thermal Power Plant No. 3

Going forward, specifications of the system to be introduced will be finalized in cooperation with CHP-3 and the Government of Mongolia and the necessary procedures for using the JCM Japan Fund will also be carried out.

Of the specific technologies being introduced by this project, similar needs have been confirmed for the introduction of OCS at power plants or reuse of heat energy using a heat pump system, for example, at power plants and factories in Mongolia, such as CHP-4, a combined heat and power plant in Ulaanbaatar, and at the power plant operated by the Erdenet Mining Company. Consequently, similar solutions will be rolled out next fiscal year at other domestic cities. These technologies can also be applied at power plants in other countries as well. A review will be made into the potential for expanding these solutions in other Asian countries.

③ Fundamentally updating and increasing the capacity of power transmission and distribution facilities in Ulaanbaatar

Ulaanbaatar Energy Distribution Network Company and the Ministry of Energy of the Government of Mongolia are moving forward with plans to upgrade more than 1,000 existing state-owned distribution facilities. Moving forward, this project will target more than just upgrades to existing distribution facilities by rolling out solutions at distribution facilities in newly zoned areas under Ulaanbaatar's urban plan. Specifically, Ulaanbaatar plans on newly developing 54 zones, and to achieve this goal.

Abbreviation List

Abbreviation	Proper Name
BaU	Business as Usual
BTG	Boiler, Steam Turbine and Generator
CDM	Clean Development Mechanism
CHP	Combined Heat and Power Plant
CHP-3	Ulaanbaatar No.3 Combined Heat and Power Plant
CHP-4	Ulaanbaatar No.4 Combined Heat and Power Plant
COP	Conference of the Parties
COP	Coefficient of Performance
tCO_2	ton-CO_2
CWP	Circulating Water Pump
DCS	Distributed Control System
GHG	Greenhouse effect gas
IDF	Induced Draft Fan
JCM	Joint Credit Mechanism
MEGDT	Mongolia Ministry of Environment, Green Development and Tourism
MOE	Mongolia Ministry of Energy
MRV	Measurement, Reporting and Verification または Measurable, Reportable and Verifiable
NAMA	Nationally Appropriate Mitigation Action
OCS	Optimized Control System
PDD	Project Design Document
SFC	Specific Fuel Consumption
STG	Steam Turbine and Generator
UBEDN	Ulaanbaatar Electricity Distribution Network Company
UNFCCC	United Nations Framework Convention on Climate Change