FY2016 Project for Ministry of the Environment Japan

# FY2016
# Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration
## (Study of Renewable Energy Sector in Ulaanbaatar, Mongolia)

# Report

February 2017

Overseas Environmental Cooperation Center, Japan

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# Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration (Study of Renewable Energy Sector in Ulaanbaatar, Mongolia)

February 17, 2017

Overseas Environmental Cooperation Center, Japan（OECC）

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Attachment

1. Documents of local（Ulaanbaatar）workshop
   (1) Agenda
   (2) Invitation list
   (3) Presentation materials

2. Documents of domestic（Sapporo）workshop
   (1) Agenda
   (2) Invitation list
   (3) Presentation materials

3. Documents of JCM city to city collaboration seminar
   (1) Seminar in Kita-Kyushu City
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      - Presentation in Kita-Kyushu
   (2) Seminar in Tokyo

4. MRV methodology and Project Design Document（draft）

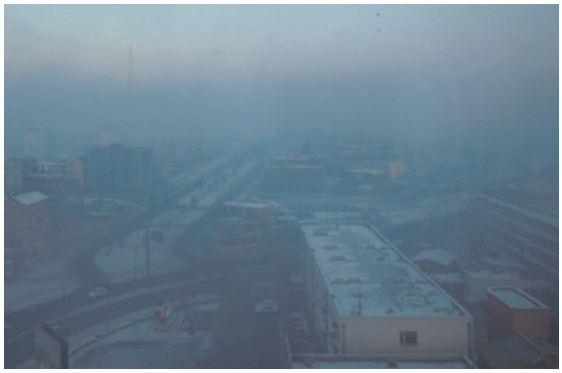
I. Overview of the Project

1. Purpose of the study

The population of Ulaanbaatar, the capital city of Mongolia, has been increasing rapidly since the 21st century. In 2000, the city's population stood at 0.7 million; in the space of 15 years, however, it has almost doubled, reaching 1.35 million in 2014.

This population growth has led to serious air pollution and social problems. One factor which is contributing to worsening air pollution includes rising emissions of air pollutants resulting from the increasing consumption of coal. Coal is the cheapest obtainable fuel in Mongolia, and accounts for over 90% of its total fuel consumption, used for such things as power generation, heating and cooking. In particular, in areas where many of Mongolia's low income class lives, known as "ger" area, smoke emitted from coal-fired stoves (ger stoves) used predominantly in these areas is said to be the main cause of air pollution. Mongolia's National Agency of Meteorology, Hydrology and Environment Monitoring reported in December 2015 that it measured PM2.5, PM10, sulfur dioxide and nitrogen dioxide levels that were far in excess of global standards. Today, Ulaanbaatar is known as one of the worst cities in the world for air pollution.

(August, 2014)



(February, 2015)

Air pollution stage of Ulaanbaatar City

In order to promote sustainable development in Mongolia, there is a need to deal with the complex issues that have arisen due to rapid population growth and urbanization, as well as recent individual environmental issues. Japanese municipal governments could play a part in efforts to present effective solutions by providing knowledge of how they overcame similar complex issues during Japan's period of rapid economic growth, and by introducing the kinds of policies and environmentally-friendly / energy-saving technologies that they used to combat these.

Hokkaido Government and Sapporo City are the biggest municipalities in Japan's cold

region. As of 2015, the estimated population of Sapporo was 1.95 million people. As with Ulaanbaatar, in the 1960s Sapporo's main form of fuel was coal, which it produced in vast quantities within the prefecture, and air pollution resulting from smoke emissions from coal became a major social issue. However, the issue of air pollution in Sapporo was resolved in the 197os through a combination of a switchover from coal to oil and the implementation of environmental policies. Since the 1980s, the city has been pushing forward with energy saving projects, and is currently one of Japan's leading cities in terms of environmental conservation.

Sapporo and Ulaanbaatar are members of the World Winter Cities Association for Mayors, an association with members from 10 countries and 21 cities worldwide. At the 15th conference, held in Ulaanbaatar in January 2012, the "Ulaanbaatar Declaration" was adopted. This declaration contains a number of goals, such as curbing emissions of greenhouse gases, cutting energy consumption volumes and the realization of urban activities of a kind that have a low impact on the environment.

In March 2015, Hokkaido signed a memorandum with Mongolia's Department of Energy concerning economic and technological exchanges in the field of energy, and is striving to further technological cooperation between Mongolia and private enterprises in Hokkaido.

"Ulaanbaatar Declaration (Jan. 2012)"
City of Sapporo & City of Ulaanbaatar

Memorandum Signing Ceremony between Hokkaido Government and Department of Energy Mongolia (Mar. 2015)

This project seeks to promote City to City collaboration between Ulaanbaatar and Hokkaido Government, a municipality in Japan's cold region, and Sapporo City, and to disseminate Japan's outstanding low carbon technologies through a Joint Crediting Mechanism (JCM). Specifically, at the same time as cutting Greenhouse Gases (GHG), it aims to implement projects to introduce facilities for cutting environmental pollutants and energy use based on a framework of collaboration between cities.

2. Contents of the study

(1) Feasibility study on introduced technologies, systems and services

Here, we undertook studies on the following two projects scheduled for the environs of Ulaanbaatar in cooperation with Hokkaido and the city of Sapporo.

① Mega-solar project for Ulaanbaatar and surrounding

② Introduction of large capacity secondary battery for wind power generation

The main points of consideration for feasibility were as follows.

① Mega-solar project for Ulaanbaatar and surrounding

(a) Implementation structure

We studied Mongolia, the country planning a domestic mega-solar project, and the Japanese companies involved were studied, in order to select companies capable of implementing the JCM projects. Also, we formed an international consortium together with the companies, to discuss measures for work involving JCM ancillary equipment. In addition, by collaborating with the municipalities, we were able to work at developing a cooperation structure between Mongolia and the Japanese stakeholders.

(b) Financial structures for clients and partners

We acquired information on financial structures, capacity to borrow funds and borrowing status of Mongolia and the Japanese representative business operator candidate, and confirmed their ability to fully discharge project obligations.

(c) Solar panel selection

The Mongolian representative company candidate produced a work plan, and is considering the solar panels and power supply equipment to be used. However, as the Japanese candidate company is a solar panel manufacturer, they will use their own solar panels if actual work commences.

(d) Introduction of storage battery cells

We discussed the feasibility of storage battery cells with a view to achieving power leveling and stable supply. Prioritizing and costing were discussed for the scenario where storage battery cells were to be introduced; however, consideration of revenue from sales of electricity and its cost effectiveness led to the decision that there was no merit in introducing such storage battery cells.

(e) Consideration of business feasibility and economic feasibility

We discussed the feasibility of a sustainable electricity purchasing system if the project was implemented. Further, we conducted a simulation on internal rate of return (IRR) using the range of the fee-in tariff.

② Introduction of large capacity secondary battery for wind power generation

(a) Implementation structure

We acquired data for determining storage battery cell capacity from the operator of the Salkhit wind power generation farm where the cells are scheduled for introduction. Based on these research results, we discussed feasibility with the operator, but have given up the idea of forming this project as the investment sum would be large.

(b) Financial structure for clients and partners

The company that will introduce the storage battery cells is in the process of confirming the feasibility of working with the Mongolian company earmarked for this project. However, there are issues related to the work of forming the project, and financial statements have yet to be acquired.

(c) Consideration of how storage battery cells will be put to practical use

As the investment sum for this case is large, introducing the storage battery cells with private enterprise funds has been deemed difficult. From here on, we will look for a way in which storage battery cells can be feasibly introduced by discussing the issues with official bodies, such as the Department of Energy.

(d) Confirming authorization formalities

We did not consider authorization issues as the idea of forming this project was given up this time round.

(e)Consideration of support structure for facilities

For the same reason as above, we did not consider a support structure.

(2) Workshops in Mongolia and in Japan

The following workshops have been held between concerned parties from both Japan and Mongolia in an effort to encourage the formation of proposals at an early stage and form new proposals.

① Workshop in Mongolia

A workshop was held in Ulaanbaatar on October 27, 2016. Experts from Hokkaido and Sapporo participated in this workshop, during which they introduced successful examples of energy saving.

② Workshop in Japan

A workshop was held on January 20, 2017, on parallel with the below seminar in Tokyo. Experts from Ulaanbaatar Department of the Natural Environment were

invited to this workshop.

(3) Conferences, Monthly reports and Progress report briefing sessions

① Attend at conferences

Representatives from Hokkaido and Sapporo attended the following two domestic conferences that were specified by the Ministry of the Environment.

- Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration Kitakyushu Seminar (October 20 – 21, 2016)

- Feasibility Study of Joint Crediting Mechanism Project by City to City Collaboration Tokyo Seminar (January 23, 2017)

A request was made by the office to invite to representatives from Ulaanbaatar, and experts from the city's departments related to the environment (Air Pollution Reducing Department and Natural Environment Department) participated in the workshop.

②Monthly reports

During the period in which surveys were carried out (April 2016 – January 2017), the progress of the surveys was ascertained using Gantt charts submitted at the time of application and a monthly mail was sent out reporting the status of progress for each month.

③ Meetings in Japan

The following meetings were held in Japan during the period in which the survey was being carried out. Representatives from Hokkaido and Sapporo were requested to attend the Progress Report Briefing Sessions.

- Kick-off Meeting (May 10, 2016)
- Progress Report Meeting (July 6, 2016)
- 1st Progress Report Briefing Session (August 8, 2016)
- Progress Report Meeting (September 15, 2016)
- Progress Report Meeting (November 25, 2016)
- 2nd Progress Report Briefing Session (January 12, 2017)
- Final Progress Report Briefing Session (February 9, 2017)

## II. Feasibility study on introduced technologies, systems and services

### 1. Mega-solar project for Ulaanbaatar and surrounding

According to the "national renewable energy project" announced in Mongolia in 2005 there is massive potential for the use of solar power because there is some 2,250 to 3,300 hours of sunshine per year as the weather is fine on some 270 to 300 days of the year in Mongolia. Indeed, some 160,000 square kilometers of land (ten percent of Mongolia's land) also is suitable for wind-powered energy production.

What is more, in January 2012, results of a joint study by Mongolia's National Renewable Energy Center and America's National Renewable Energy Laboratory show that the latent capacity of renewable energy via solar, wind and other sources in Mongolia reaches some 2.6 million megawatts, which is seven times the generative capability of all the nuclear power plants in action around the globe.

In Mongolia, the aim is to raise the proportion of renewable energy among all types of energy by 25-30 percent. Indeed, there is also a plan to cut energy loss by ten percent by 2020.

Based on this plan, the Mongolian government is enthusiastically granting permission to private renewable energy projects for the installation of power generation facilities; yet, no specific plans have been reached, as insufficient consideration has been given to issues such as the securing of land, capital planning and the outlook for power purchasing agreements (PPA).

Therefore, from among these projects, we focused attention on D company (a private power distribution company), which has a 20-megawatt solar generation setup, in the study this time round, in order to encourage some concrete action in terms of a JCM project via discussions between D company and the company acting as the partner on the Japanese side.

#### (1) Outline of the project

D company was established some 50 years ago as a national corporation for power distribution. In 2003, it became a joint corporation with Russian capital and local Mongolian capital. At present, the family of the CEO holds 80 percent of its shares.

The contents of the main operations are as follows.

* Supplying electricity to 41,400 households and 4,600 workplaces.
* Turnover for 2015 was 25 million USD, with 430 million kilowatt-hours supplied.
* Distribution covers 74,000 square kilometers in the north of Mongolia, which is an area greater in size than Ireland.
* It has seven branch offices with 420 staff in Mongolia.

* It has obtained nine operating permits from the Mongolian energy agency and energy regulating committee.

D company's project involves building a 20-megawatt solar power generation plant 15 kilometers southwest from Dalkhan and then supplying electricity to the Mongolian central power grid. With this 20-megawatt project, a prerequisite is that technical reliability is good enough to connect the project to the Dalkhan-Erdenet-Ulaanbaatar power transmission and distribution network.

D company has secured 60 hectares of planned construction site land. The following shows the land status.


Fig. 1-1 Position of planned construction site (Dalkhan)


Fig. 1-2 Shape of planned construction site

Fig. 1-3　Current status of planned construction site

(2) Feasibility study

① Implementation structure

As described later, we evaluated the business feasibility and economic feasibility of this project at D company, and are calling for other parties that can provide financial assistance. And, having received information about S company of Japan considering expansion of solar power generation business in Mongolia via the Overseas Environmental Cooperation Center (OECC), we offered D company and S company the opportunity to discuss matters. As a result of those discussions, S company said it would consider investing in D company, and a non-disclosure agreement (NDA) was concluded between both companies. And, according to the outcome of deliberations by S company, the project will move forward in the following way from here on.

- If neither company has financial problems, then they can move forward with specific discussions with the Japanese stakeholders.
- Work to comprehend the state of affairs in Mongolia from here on to confirm whether or not issues such as permits will be affected.

Note that S company would like to apply for the business involving facility assistance as of April this year.

This case will likely take the following implementation structure.

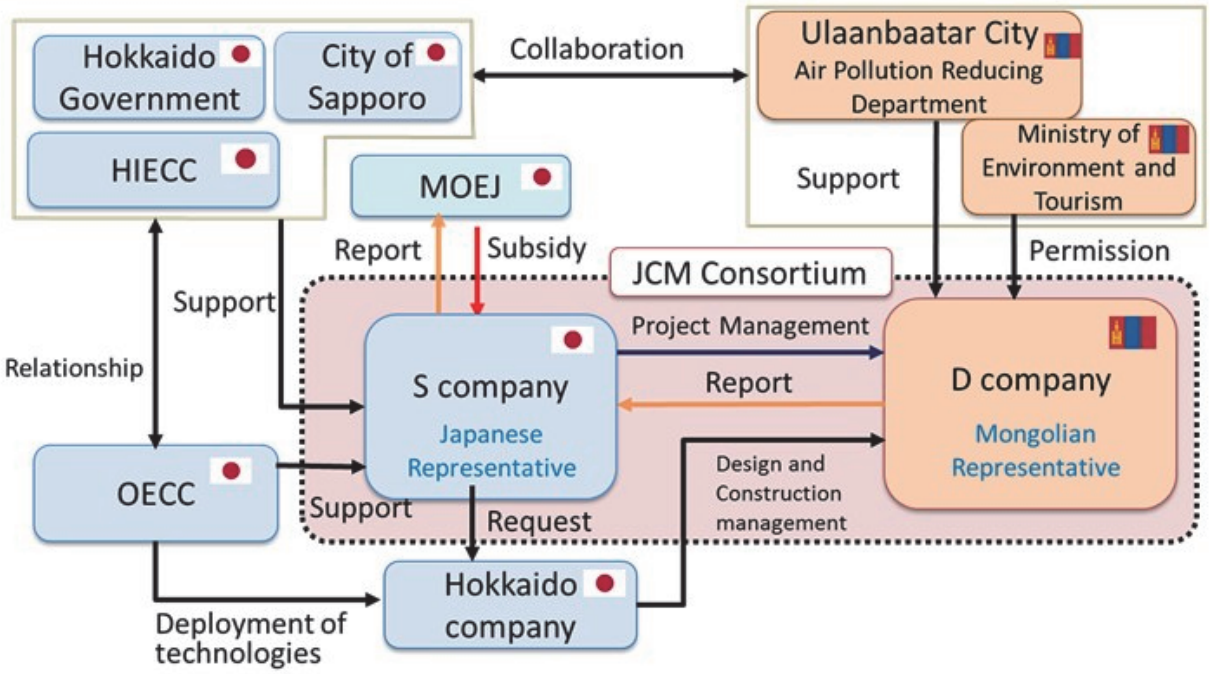



Fig. 1-4　Example of implementation structure

② Financial structure for clients and partners

The financial analysis conditions are as follows.

- Project cost: 40 million USD
- Project period: 25 years
- Rate of inflation: 3%
- Annual operating and maintenance cost: 390,000 USD
- Annual amount of generated power: 30.9 million kWh
- Power selling price: 0.17 USD/kWh

Reference: Basic data for solar analysis as a source of electrical power

- Number of fine-weather days: Annual average of 223 days (Summer: 7-19 days a month, Winter: 21-29 days a month)

Over the past 30 years, the Dalkhan area's quantity of direct solar radiation has been 2,411 mdj/m2, while global solar radiation is 4,360 mdj/m2.

The main technical variables and economic study are as follows.

Table 1-1 Details of capacities, etc.

| No | Parameter | Amount |
|---|---|---|
| 1 | Capacity | 20 MW |
| 2 | Annual production of electric power | 30.9 million kWh |
| 3 | Investment | 39 million USD |
| 4 | Plant area | 60 hectars |
| 5 | Capacity of solar panel unit | 320 Wh |
| 6 | Relevant substation | Darhan 220/110/35 |
| 7 | Length of power lines | 5 km |
| 8 | Capacity of transformers | 2xТДН-16000/110/10 |
| 9 | Internal electricity consumption | 10 kW |

The funding plan for the 40 million USD project cost is for self-funding of ten percent and the other 90 percent to be procured externally. A call for investors in Mongolia started from the beginning of 2016, but no investors that would be regarded as strong candidates have come forward yet because of the current economic state of affairs in Mongolia. Nevertheless, as a recovery in primary work in Mongolia is being seen in both 2015 and 2016, consideration of investing sources is underway (requests for financial figures for 2016 have been made).

Note that we have confirmed that Golomt Bank (the relevant correspondent bank) is prepared to accommodate talks as a loan target if progress is seen on the finance front from here on.

With this as the state of affairs, Japan's S company has placed business expansion in Mongolia into its scope of business, and is prepared to discuss matters with D company. And, as to the financial composition of S company, we judge that there is no foreseeable problem, as it is a company listed on the Tokyo Stock Exchange.

Table 1-2 D company's main financial composition for previous 2 yeas

| No | Type | 2014 | 2015 |
|---|---|---|---|
| 1 | Owners' Equity | | |
| | a) Asset | 29,642.63 | 29,077.34 |
| | b) Working capital | 2,873.77 | 2,884.05 |
| 2 | Sales income | 24,187.45 | 25,040.01 |
| 3 | Total profit | -1,767.85 | 774.94 |
| 4 | Profit (loss) | -1,768.99 | 732.06 |
| 5 | Loan | 744.22 | 17.30 |
| 6 | Account receivable | 1,794.59 | 1,255.75 |
| 7 | Account payable | 2,044.30 | 2,334.30 |

③ Selection of solar panels

In its business plan, D company is considering which solar panel to purchase. The following are the specifications involved.

| | |
|---|---|
| PV module type | Standard |
| Technology | Polycrystalline |

The panel manufacturer is JA Solar (China), and the module type (JAP6-72-320/330), with a highly efficient 320 watt peak capacity (Wp) is to be used.

| | |
|---|---|
| Nominal power | 20MW |
| Load profile | Grid- connected system (CES) |

The points that were given consideration in selecting the solar panels were the module's cost performance and warranty period. With regard to cost performance, D company judged that a polycrystalline type would be suitable. And, for this project, a large number of modules were considered, with the final choice being the JAP-72-320/330 type. The basis of this conclusion is as follows.

Table 1-3 Module considerations

| | |
|---|---|
| Type of PV module | Poly |
| PV module type, model | JAP6-72-320/3BB |
| Nominal capacity of Photovoltaic module, Wp | 320 |
| The maximum capacity current of Photovoltaic module, V | 37,56 |
| The maximum capacity current of Photovoltaic module, A | 8.52 |
| Open-Circuit Voltage of PV module, B | 45,82 |
| Short-circuit Current of PV module, A | 9,03 |
| Efficiency of PV module | 16,51 |
| Temperature coefficient of open circuit voltage, %/°C | -0.330%/°C |
| Temperature coeffiicient of short-circuit current, %/°C | +0.058%/°C |
| Size of Solar cell, mm | 156*156 |
| PV Module dimension | 1656*991*45 |
| PV module weight (kg) | 19.3/19.5 |
| Quality Standards for PV module | IEC- 61215 IEC 61730 |
| Photovoltaic performance depreciation (%) | ±2% |

he above performances was measured according to the International Standard M1.5 where solar radiation level 1000W/m2, ambient temperature were 25°C, air ass is 1.5

able 4.4 Temperature coefficient of photovoltic module electric indicator

| | |
|---|---|
| Usage standard (°C ) | 45 ±2 |
| Efficiency coefficient of photovoltaic module (%/°C) | - 0.07 ±0.01 |
| Temperature cofficient for photovoltaic module capacity (%/°C) | - 0.43 ±0.05 |
| Temperature coefficient of open circuit voltage (%/°C) | - 0.34 ±0.05 |
| Temperature coefficient of short-circuit (%/°C) | - 0.065 ±0.05 |

able 4.5. PV Module electrical performance

| PV Module electrical performance | 1000W/m2 | 800W/m² | 400W/m² |
|---|---|---|---|
| Nominal capacity of PV module, W | 320 | 200.6 | 100.00 |
| Nominal voltage capacity of photovoltaic, B | 37.41 | 36.8 | 35.8 |
| A short-circuit of PV module, A | 8.9 | 7.10 | 3.33 |
| Open circuit voltage of PV, B | 47.0 | 45.0 | 43.0 |
| Efficiency coefficient of PV, % | 16.41 | 15.32 | 15.27 |
| Temperature coefficient of PV module | -0.43%/°C | -0.43%/°C | -0.44% |

able 4.4, 4.5 and 4.6 shows the details about the PV module used in this system.

There were two kinds of inverter up for selection in this project, the central inverter and the multi-string inverter. Compared to the central one, the multi-string converter is technically superior but the cost is high. Moreover, when it comes to large-scale power generation, the central inverter is widely used. As a result, D company selected the central inverter.

Next, in this project, the module strings and inverters have to be simultaneously gauged. Consideration must be given to voltage and current input to ensure the biggest modules are used in conjunction with the limited-capacity inverter that has been selected. Thus, for 20-megawatt solar power generation, a string of ten two-megawatt inverters

must be configured. As to generation peak, the module's capacity is 320Wp, which means that the two-megawatt inverter system will be controlled by two central inverters, with inverter capacity to be 1,000 kilowatts.

Up to now, companies, such as SMA, ABB, Siements and Schneider Electric, have proposed central inverters, inverter stations and megawatt power stations for large-scale power generation plants.

For this project, the ABB Megawatt Central Inverter (ABB PV800-57-C type), which offers a maximum efficiency of 96.5 percent, was chosen.

Table 1-4 Inverter considerations

| | |
|---|---|
| Type code PVS800-57 and Nominal capacity | -1000kW-C, 1000kW |
| **Input (DC)** | |
| Maximum input power ($P_{PV,\ max}$) | 1200 kWp |
| DC voltage range, mpp (Udc, mpp) | 600 to 850 V |
| Maximum DC voltage ($U_{max\ (Dc)}$) | 1100 V |
| Maximum DC current ($I_{max\ (DC)}$) | 1710 A |
| Number of protected DC inputs | 8, 12, 16 (+7-) |
| **Output (AC)** | |
| Nominal power ($P_{N(AC)}$) | 1000 kW |
| Maximum output power | 1200 kW |
| Power at cosj = 0.95 | 950 kW |
| Nominal AC current ($I_{N(AC)}$)} | 1445 A |
| Nominal output voltage ($U_{N(AC)}$) | 400 V |
| Output frequency | 50760 Hz |
| Harmonic distortion, current | < 3% |
| Distribution network type | TN and IT |
| **AYK** | |
| Maximum | 98.8% |
| Euro-eta | 98.6% |
| **Power consumption** | |
| Own consumption in operation | 630 W |
| **Environmental conditions** | |
| Protection level | IP22 / IP42 |
| Environmental temperature range | From -20°C to +40°C |
| Maximum environmental temperature | +50°C |
| Relative humidity | 15-95% |
| The highest above sea level | 2000 м |
| The maximum noise level | 75 Дб |
| Cooling air flow | 3760 м3/ц |
| **Protection** | |
| Grounding | Yes |
| Network control | Yes |
| DC reverse current protection | Yes |
| AC short circuit protection | Yes |
| Over-voltage, current and temperature protection (AC and DC) | yes |
| **Communications** | |
| Customer relations | Control panel |
| Analoi input | 2*PT100, 2*A in |
| Power isolation relay | 2 |
| The maximum noise level | 75 Дб |
| Cooling air flow | 3760 $м^3$/ц |

Scrutiny of the above issues became the preconditions for purchase of solar panels by D company. Yet, at present, the partner being considered to turn this project into business is a solar panel manufacturer – so, if business goes ahead, that partner's solar panels will be used.

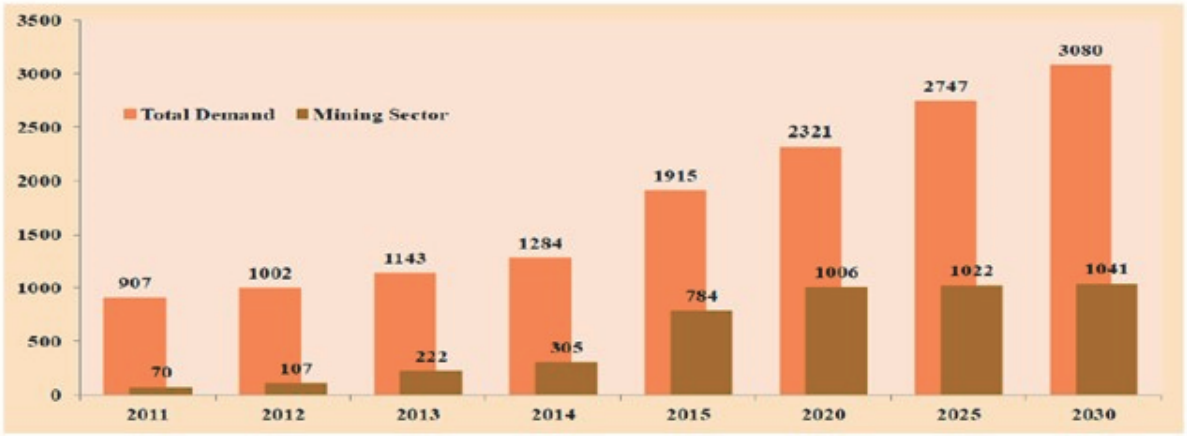
④ Introduction of storage battery cells

Solar power generation fluctuates with changes in the weather, which can lead to an unstable transmission system. Therefore, as output fluctuations can be controlled by introducing storage battery cells, the feasibility of such cells was considered. However, large capacity storage battery cells are very expensive, so revenue from sales of electricity and its cost effectiveness led to the decision that there was no merit in introducing such storage battery cells. Thus, for this project, the introduction of storage battery cells has been shelved.

⑤ Consideration of business feasibility and economic feasibility

(a) Business feasibility

We believe that the business feasibility of solar power generation in Mongolia is reliant on the purchasing system being a sustainable one. The following shows the outlook for power demand in Mongolia.




Source: "Mongolian National Energy Agenda and Policy Measures -Scope for Sub regional Cooperation" Energy Agency (2013) *Unit; Megawatt (MW)

Fig. 1-5 Outlook for power demand in Mongolia

According to energy demand forecasts, the electricity demand is expected to be 2,321 megawatts in 2020.

And the following shows the electric power generation proportions occupied by fossil

fuels, nuclear power and renewable energy as compared to surrounding countries.

Table 1-5 Electric power generation in Mongolia and surrounding countries

(Amount of power: TWh)

| Power Source | Japan | | Mongolia | | Russia | | | China | |
|---|---|---|---|---|---|---|---|---|---|
| Fossil Fuel | 711 | 65.7% | 5.32 | 96.7% | 708 | | 68.1% | 2,788 | 80.6% |
| Nuclear | 258 | 23.8% | | | 163 | | 15.7% | 68 | 2.0% |
| Hydro | 83 | 7.7% | 0.06 | 1.1% | 167 | | 16.1% | 585 | 16.9% |
| Solar | 2 | 0.2% | 0.01 | 0.1% | | | | | |
| Wind | 3 | 0.2% | 0.15 | 2.7% | | | | 13 | 0.4% |
| Biofuel | 22 | 2.0% | | | 13 | | 1.3% | 14 | 0.4% |
| Total Power | 1,082 | | 5.52 | | 1,040 | | | 3,457 | |

2008/2016 IEA/OECD

The proportion of renewable energy (including hydropower) in Mongolia is low compared to surrounding countries. Consequently, the Mongolian parliament approved the national renewable energy program 2005-2020 (2005), making the development of renewable energy a priority in the energy field. The renewable energy sources proposed are hydropower, solar power, wind power and geothermal power. And, as a concrete target, the idea is to gradually increase the share of renewable energy within total energy generation, so that it reaches 20-25 percent of the total by 2020.

Therefore, solar power generation in Mongolia will contribute to the increase in renewable energy. Indeed, as considerable time will be required to develop hydropower and geothermal energy sources, the proportion occupied by solar and wind power will have to be bigger. For this reason, the sustainability of the power purchasing system is an utterly important one.

The following shows the recent developments on the legislative front.

Legal environment related to renewable energy 1

| Governing law and political policy | Establishmed year | Amended year |
|---|---|---|
| **Laws** | | |
| **Energy law** | 2001 | 2015 |
| **Renewable energy law** | 2001 | 2015 |
| **Energy Saving law** | 2015 | |
| **Political Policy** | | |
| **National energy policy** | 2015 | |

Legal environment related to renewable energy 2

- **Energy law**

  New clauses related to independent power producers (IPP) and power purchasing agreements (PPA) introduced.

  Article 5-1.6.: The government will provide necessary support to IPP.

  Article 6-1.16.: Energy agency will empower relevant bodies with the right to conclude PPA.

- **Renewable energy law**

  Setting of fixed purchasing price — Feed-in Tariff

  ✓ Wind power — 80 to 95 USD/MWh

  ✓ Solar — 150 to 180 USD/MWh

- **Energy national policy**

  Proportion occupied by renewables:

  - To reach **20%** by 2020 and **30%** by 2030.

  Increase production of renewables and improve the tax system environment in order to increase investment.

(b) Project's economic feasibility

The following shows a simulation on internal rate of return (IRR) using the price range in the concluded power purchasing agreement (PPA).

Table 1-6 Consideration of IRR

| Feed-in Tariff (USD/kWh) | 0.15($/kWh) | 0.16($/kWh) | 0.17($/kWh) | 0.18($/kWh) |
|---|---|---|---|---|
| NPV (USD) | 7,486,079 | 8,851,390 | 10,210,785 | 12,012,010 |
| IRR (%) | 8.2 | 9.1 | 9.9 | 10.8 |
| Payback period (year) | 13 | 12 | 11 | 9 |
| LCOE*, USD/kW hour | 0.165 | 0.165 | 0.165 | 0.165 |

LCOE -Levelized Cost of Electricity

The following shows the repayment schedule on the assumption that the loan interest rate is seven percent annually (to USD). We have refrained from making a judgment as to whether taking a loan at such an interest level is actually possible.

| Loan term | Outstanding balance | Interest repayment | Principal loan repayment | Total | No of days |
|---|---|---|---|---|---|
| 1 | 39,150,330.0 | 2,740,523.1 | 3,915,033 | 6,655,556.1 | 365 |
| 2 | 35,235,297.0 | 2,466,470.8 | 3,915,033 | 6,381,503.8 | 365 |
| 3 | 31,320,264.0 | 2,192,418.5 | 3,915,033 | 6,107,451.5 | 365 |
| 4 | 27,405,231.0 | 1,918,366.2 | 3,915,033 | 5,833,399.2 | 365 |
| 5 | 23,490,198.0 | 1,644,313.9 | 3,915,033 | 5,559,346.9 | 365 |
| 6 | 19,575,165.0 | 1,370,261.6 | 3,915,033 | 5,285,294.6 | 365 |
| 7 | 15,660,132.0 | 1,096,209.2 | 3,915,033 | 5,011,242.2 | 365 |
| 8 | 11,745,099.0 | 822,156.9 | 3,915,033 | 4,737,189.9 | 365 |
| 9 | 7,830,066.0 | 548,104.6 | 3,915,033 | 4,463,137.6 | 365 |
| 10 | 3,915,033.0 | 274,052.3 | 3,915,033 | 4,189,085.3 | 365 |
| Grand total | | 15,972,877.1 | 39,150,330.0 | 54,223,207.1 | |

| | | |
|---|---|---|
| Loan amount | 39,150,330.0 | USD |
| Annual interest rate | 7.00% | |
| Discount period | 0 | Years |
| Loan term | 10 | Years |

Fig. 1-6 10-year repayment schedule

| Factors used in financial analysis | Amount | Measuring unit |
|---|---|---|
| 1. Capacity of the plant | 20 | MW |
| 2. Project duration | 25 | Annually |
| 3. Investment share of the implementing organization | 30 | % |
| 4. Total investment | 39,150,330 | USD |
| 5. Maintenance cost | 300,000 | USD/ annually |
| 6. Annual depreciation | 300,000 | USD/ annually |
| 7. Annual production | 30,900,000 | kWh/kW |
| 9. Sale price to grid | 0.15 | USD/ kWh |
| 10. Inflation (of USD) | 1.5 | % |
| 11. Discount rate calculation | 4 | % |
| 12.Income tax | 10 | % |
| 13. Annual loan interest rate | 7 | % |
| 14. Loan duration | 10 | annually |
| 15. VAT | 10 | % |
| 16. Customs tax | 5 | % |
| 17. Decline of solar panel efficiency | 0.7 | %/annually |
| 18. MNT rate | 1 USD =2008.46 MNT | |

Fig. 1-7 Relevant indexes for considering business feasibility

(3) Study of CO2 reduction

Yearly GHG reduction (REy) of the project is calculated as follows.

REy = Electric power generation (EGy) x Grid emission factor (EFy)

= Power generation capacity (kW) of system to be introduced × Annual operation rate (%) × 24 hours × 365 days × EFy

Annual operation rate: 15.8%, EFy: 1.1298 tCO2/MWh

= 20,000×(0.158×24×365/1000)×1.1298

= 31,275 tCO2/year

Annual operation rate (%) is calculated as the following equations.

Annual Operation rate = yearly power generation / full day power generation

= (solar radiation amount (kW/m2/day)×total design factor×system power capacity (kW)×365 (day)) / (system power capacity (kW)×24 (hour)×365 (day))

= (4.74×0.8×20,000×365) / (20,000×24×365)

= 27,681,600 kWh / 4,204,800,000 = 15.8 %

(4) MRV methodologies & PDD

An English draft will be attached as material for the MRV methodologies (draft). Also, the following show the calculation methods for things like application range, eligibility criteria and reference emission output.

① Application range

These methodologies should be applied to this project because the introduction of a solar power generation system in Mongolia will reduce existing system power consumption, which in turn will reduce emissions of greenhouse gas.

② Eligibility criteria

(a) Project will facilitate installation of solar power generation system.

(b) Solar power generation system will be tied into existing system, to substitute the electricity of the existing system.

(c) Solar battery module is certified in terms of performance guarantee and safety warranty.

(d) Solar battery module's conversion efficiency is 15 percent or higher, with a mass of 6.5 kg/m2 or less.

(e) Equipment to monitor power generation and solar radiation for the solar power generation system will be installed at the project site.

③ Reference emission

The reference emission output of these methodologies will be assumed to be the amount of electricity generated by the solar power generation system as the amount of greenhouse gas that would probably be generated if that electricity was to be supplied by the existing system.

④ Project emission

The project emission output in these methodologies will be assumed to be the greenhouse gas emission output of the solar power generation system (0tCO2/y).

⑤ Method for calculating greenhouse gas emission

The following are the calculation formulas for greenhouse gas emission reduction effectiveness.

(a) Reference emission output

$$Rey = \Sigma i\ EGi,y \times EFRE$$

(b) Project emission output

$$PE = 0$$

(c) Emission reduction

$$ERy = REy - PEy = REy$$

Default value to be used in calculation of reference emission output

| Parameter | Content | Value | Source |
|---|---|---|---|
| EF RE | Emission Factor of electricity from existing system | 0.797 | |

(5) Future problems

① Investment risk

In view of the current economic situation in Mongolia, the number of domestic investors with economic clout is extremely small. The present local interest rate on loans is 20 percent (tögrög basis). So to judge from that, the financial capital would likely have to face up to a domestic loan that is beyond the internal rate of return (IRR) of solar power generation. Conversely, overseas investors who can finance in USD and would opt to sell electricity as a 20-year investment can be found. However, even if the investment or the loan is in USD, returns will be in local currency – in particular, the electricity charges will be paid in local currency, so investors will be exposed to great risk in the exchange rate. Here, consideration must be given to ways in avoiding such an exchange risk. Of course, if there were other things to invest in

locally with the local currency, then, it goes without saying, the risk can be avoided.

② Limitation of investors

Mongolia's country risk is lower than a single B, so it is highly likely that institutional investors will not approve of investing in solar power generation. Therefore, investor candidates will probably be limited to private business people, in particular those who own businesses.

Furthermore, under the present circumstances, in cases where overseas organizations demand improvement in the capital adequacy ratio of a local bank, a private bank in that situation would doubtless reduce the loan in order to improve the capital adequacy ratio. Thus, there is a limit to the capital that can be obtained in Mongolia.

③ Feasibility of changing electricity selling price

The purchasing period according to the electricity purchasing agreement is fixed at 20 years, but it has been pointed out that there is a risk that the electricity selling price will change. Moreover, there is also a risk of whether or not the price will be maintained at the current one if a new electricity selling price is set in the future.

In answer to the above, the following could conceivably be ways to avoid such risks.

- Consider adapting an overseas investing and lending insurance (Japanese trading insurance) to the situation, with a proviso for the insurance adaptation being that a warranty is obtained from the Ministry of Finance of Mongolia, while also an electricity selling agreement would have to be made with the energy agency.
- As a way of avoiding the exchange rate risk, when the monthly payment for electricity from the power company is received, it should be changed to USD.

2. Introduction of large capacity battery to wind power generation system

(1) Outline of project

① Background to proposal for this project

The Salkhit Wind Farm (50MW) started operating from June 2013, but an expansion project (50MW) is being planned. At present, the daytime average wind power output from Salkhit is approximately 15MW (30%), but nighttime output is being curtailed in accordance with instructions from the National Dispatching Center (NDC). This is because, in general, the generation of renewable energy, like wind power, fluctuates greatly, and excessive introduction may cause instability in the electricity transmission system. Notably, as electricity demand is light at nighttime, the small capacity of the existing system for the Mongolian grid is impacted in a big way by electricity from renewables (wind and solar, etc.), so curtailing output is said to be a necessary step to maintain stability in the system.

Meanwhile, as the daytime electricity demand is big, there are supply shortages at existing power stations, so the grid is relying on power purchases from Russia.

Amidst this kind of imbalance in supply and demand of electricity and the fact that the wind farm supply capability is not being fully exploited, the construction of new wind farm facilities is being planned, and the new 50MWt installation at Salkhit Wind Farm is part of that plan. With the plan to build new wind farms to solve the problems (nighttime curtailment of equipment capacity and daytime power purchases from Russia) afflicting the currently running Salkhit Wind Farm and all of Mongolia's power supply system, the Overseas Environmental Cooperation Center (OECC) proposed that Japanese storage batteries (in particular, large-capacity sodium sulfur cells [NAS batteries]) be used to solve those problems.

The NAS batteries developed by Japan's G company are used successfully in more than 200 locations around the world. The technology of these batteries is such that they are used for leveling power loads and absorbing power fluctuations that are a common trait of renewables (this fluctuation problem is becoming increasingly common as renewables are used more extensively). And, as the N group that owns the Salkhit Wind Farm will be able to increase the profit ratio by increasing nighttime power generation, they are showing a lot of interest in NAS batteries, so bringing this project to fruition is highly likely. Indeed, as Salkhit Wind Farm has received loans from America's General Electric and the European Bank for Reconstruction and Development, we were able to make this proposal in the

knowledge that worries about credit issues are minimal.

②Outline of NAS battery

The following is an explanation outlining the NAS batteries themselves as well as being about the concept of the Energy Storage System (ESS) that uses the NAS batteries. To start with, we would like to simply introduce the features of the NAS battery, which, put simply, are large capacity, long life and fast response features.

(a) Large-capacity: This is a power storage system on a megawatt scale. It can store energy equivalent to rated output multiplied by seven hours. And its capacity can be easily increased by setting up multiple NAS battery modules in serial parallel.

(b) Fast response: The system also copes with momentary voltage drops by detecting such drops and instantly supplying power to production lines and offices as needed to avoid equipment stoppages.

(c) Maintenance friendly: Maintenance is easy and a remote monitoring services also is available.

(d) Compact: NAS battery's energy density is approximately three times that of a lead storage battery, which enables effective use of space.

(e) Reliability: Ceramic material is used as the electrolyte, giving the NAS battery excellent long-term durability, without any self-discharge, while the heat-resisting property and insulation property have been enhanced, quality control maximized and safety raised even further.

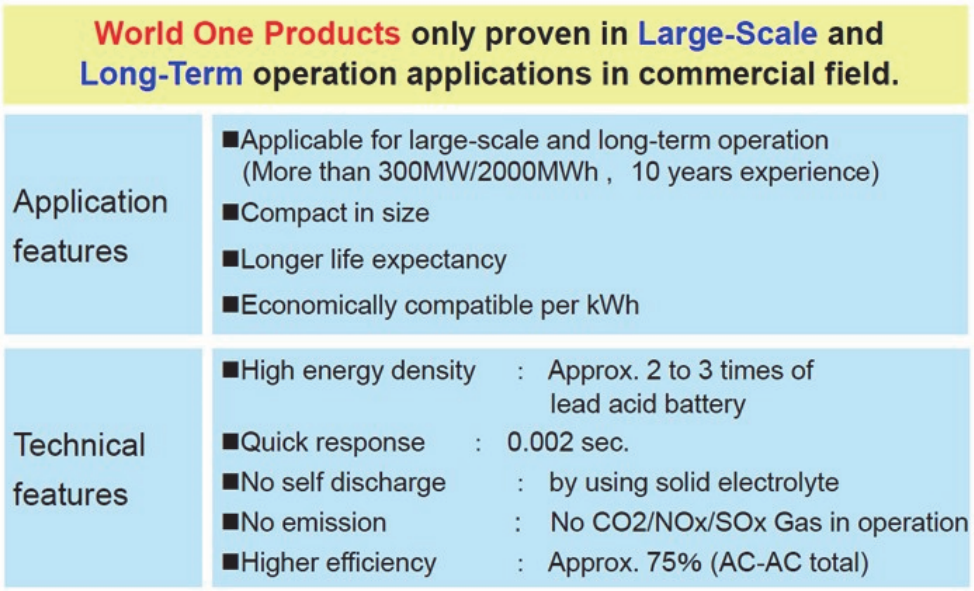



Fig. 2-1 NAS battery features

Next, the following shows the configuration of and the principle behind the NAS battery.

A fine ceramic material is used as the electrolyte to separate the sodium (Na) at the negative electrode side and the sulfur (S) at the positive electrode side in the NAS battery, which is a storage battery (accumulator), based on a principle where sulfur chemically reacts with sodium ions to provide repeated charging and discharging.

To explain the above principle in greater detail, we need to say that a NAS battery cell is a completely sealed cylindrical construction, equipped with sodium and sulfur as the active materials and fine ceramics as the electrolyte. The sodium is the active material for the positive electrode and sulfur for the negative electrode. These active materials are in liquid form maintained at temperature of 300℃, while the electrolyte is beta alumina ceramic in a solid state, which is a sodium ion conducting electrolyte.

As to the operating principle, when discharging, the negative electrode's sodium discharges electrons that become Na ions and pass through the solid electrolyte to move to the positive electrode. The positive electrode's sulfur uses electrons from an external circuit to chemically react with the Na ions, changing into sodium polysulfide (Na2Sx), which in turn consumes and depletes the sodium at the negative electrode.

When charging, a reverse reaction to that of discharging will occur as power is supplied from an external source. As the external voltage is applied, the Na2Sx at the positive electrode will separate into Na ions, sulfur and electrons, with the Na ions passing through the solid electrolyte, to split into electrons received by the negative electrode and sodium. Here, the operating principle involves the generation of electricity from the flow of electrons via their discharge from the negative electrode to the external circuit and onto the positive electrode

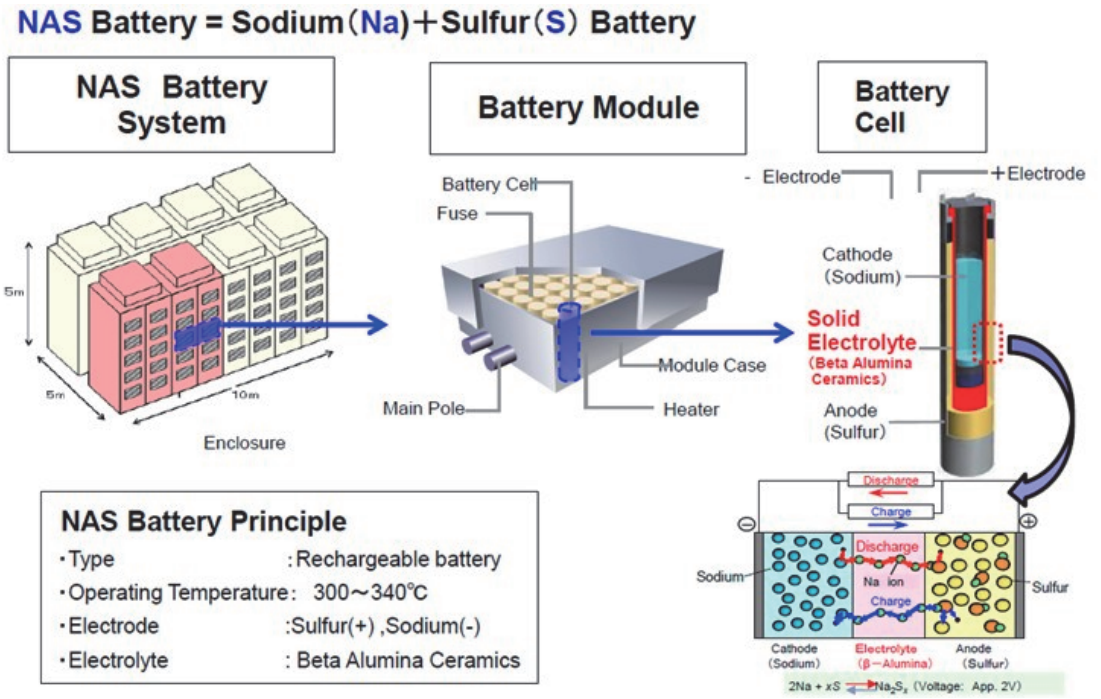



Fig. 2-2 NAS battery configuration

③Comparison of NAS battery with other batteries

The following shows comparisons between the NAS battery other batteries (Source: G company study)

◎ Good ○ Normal △ Weak

| | NAS | Redox flow | Li-ion | Pb (long-life type) | NiMH |
|---|---|---|---|---|---|
| **Energy density** | ◎ | △ | ◎ | △ | △ |
| **Charging/discharging efficiency** | ○ AC 75% | ○ | ◎ | ○ | ◎ |
| **Lifespan expectancy** | ◎ 15 years (4,500 cycles) | ◎ | ○ | ○ | ○ |
| **Self-discharging** | ◎ None | △ | ○ | △ | ○ |
| **System price Per amount of power (kWh)** | ◎ Inexpensive | ○ | △ | ○ | △ |
| **Installation space** | ◎ Compact | △ | ○ | △ | △ |
| **Application scale (output)** | Large scale (600kW-several tens of thousands of kW) | Large scale | Medium scale | Medium scale | Small scale |
| **Duration** | ◎ 6 hours | ◎ | △ | ○ | △ |
| **Installation results (capacity)** | ◎ 3 million kWh | △ | △ | △ | △ |

Fig. 2-3 Comparison of NAS battery with other batteries

④ Examples of how NAS batteries are used

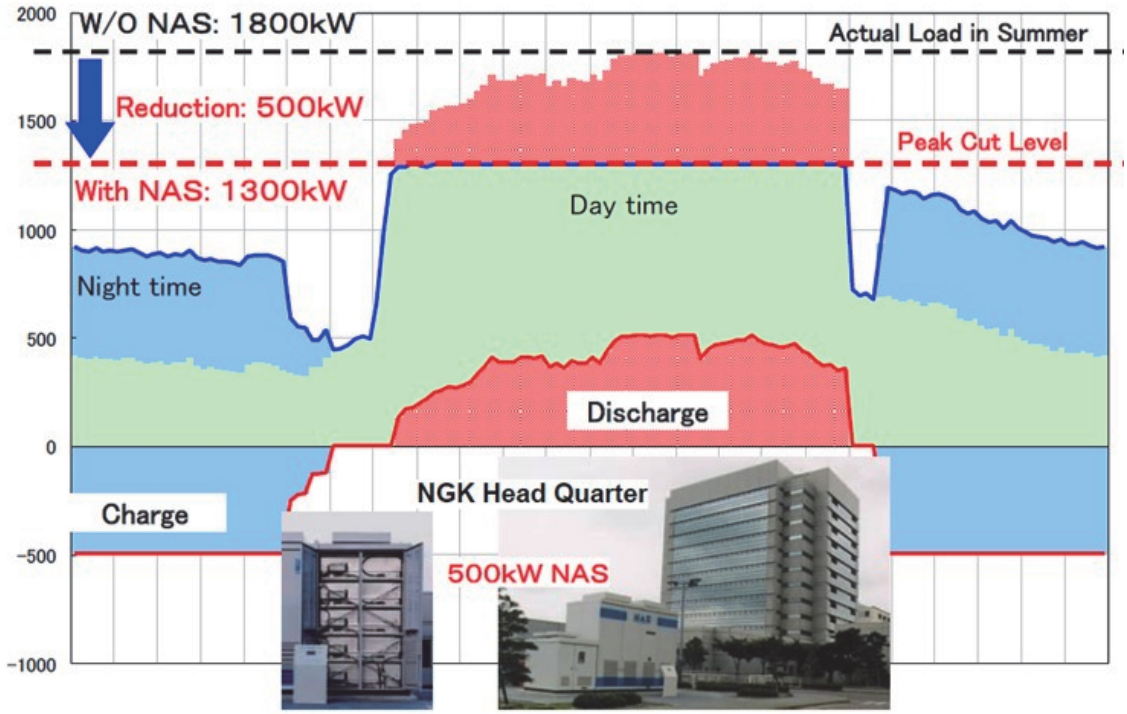
This is a compilation of examples of how the NAS battery is used.

| Site | Application | Merits by using NAS |
|---|---|---|
| Factory, Office | 1. Peak cut, Load leveling | ・Customer : Electricity fee saving (Reduce maximum demand and peak time use)<br>・Power utilities: Investment deferral |
| | 2. Emergency power/ Stand-by power for moment interruption | ・Power security against line interruption(Quick back-up)<br>・Avoid Products damage of plant |
| Power Producer | 3. Absorption of fluctuated renewable energy | ・Clear grid connection code<br>・Increase grid connection capacity<br>・Time shift (Solar: Daytime to Evening, Wind: Night to daytime) |
| Power Utilities | 4. Stabilization of Power Grid | ・Avoid cirtailment of Renewable Energy from grid<br>・Avoid additional investment of Transmission line<br>・Ancillary Service (Adjust power supply and demand) |
| | 5. High efficiency operation of turbine | ・Reduce fuel consumption<br>・Reduce CO2 gas emission |
| | 6. Network stabilization for Smart grid, local grid | For Smart grid ,Local grid (Islands, Isolated grid etc.)<br>・Utilization of renewable energy.<br>・Harmonization of current power source and renewable energy, distributed power sources etc. |

Fig. 2-4 Examples of how NAS batteries are used.

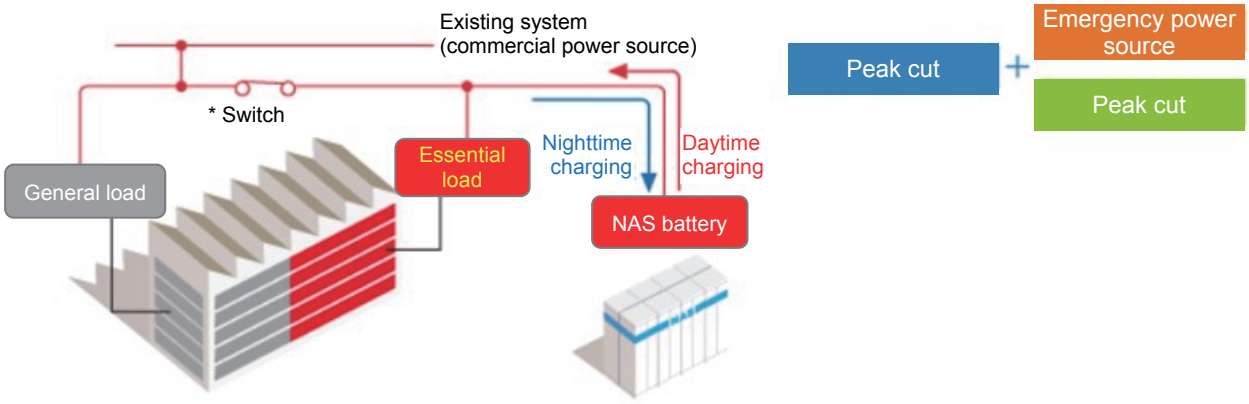
(a) Peak cut: The original meaning of peak cut is alleviation of peak demand for power, and it is one way of load leveling. As its name states, peak cut is a way of cutting the peak load.

As an example of NAS batteries in action, here we have spare nighttime power being used to charge a battery system, which then discharges during peak daytime hours when there is a shortage of power.




Fig, 2-5　Example of peak cut using NAS battery system

(b) Peak cut plus emergency power source/momentary power failure countermeasur




* A high-speed break will be used in order to provide a system that combines an instantaneous drop countermeasure.

Fig. 2-6 Example of peak cut plus emergency power source/momentary power failure countermeasure

a) Combining as an emergency power source system

- Essential services can be backed up during blackouts.
- Exhaust free and no need for bothersome replenishing of fuel.
- Maintenance is easy as there are only a few moving parts.

b) Combining as a system to deal with momentary voltage drop

- Production lines and offices can be protected collectively at times of momentary voltage drop due to lightning damage.
- Functions effectively to handle short, repeated voltage drops and power failures.

(c) Stabilizes renewables

With regard to renewables (wind and solar power) that free us from fossil fuel dependency and CO2 emissions, the drawback to using renewables is that they are susceptible to weather conditions, but power output fluctuations can be absorbed by NAS battery system discharges, to enable a stable grid supply.

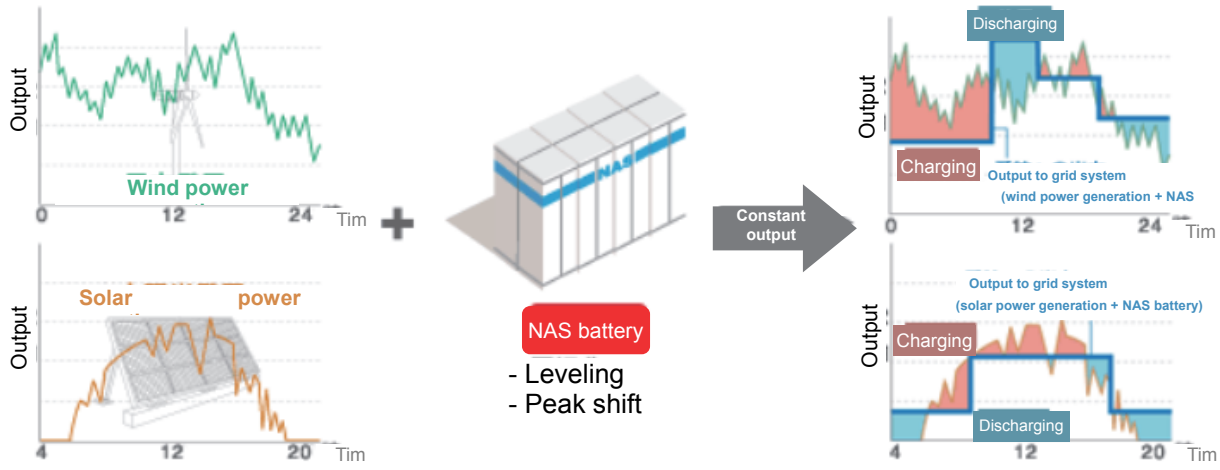



Fig. 2-7 Stabilizing renewables using NAS battery systems

(d) Ancillary service

In electricity jargon the term ancillary service refers to a service used daily by power system operators who need to maintain power quality (frequency and voltage), it is a system operating service for frequency curtailment, which makes it an extremely important service in the power business.

If the ancillary service is neglected, a diverse range of bad things can happen, including frequency and voltage fluctuations causing household lighting to flicker and causing quality unevenness in products produced at plants using electrical motors.

In the past, the electricity supply function and the ancillary service function were inseparable, with vertically merged power companies typically providing the ancillary service as their specialty service. Yet, later on, in overseas countries

where separation of electrical power production and power distribution and transmission was promoted, the services within ancillary service were subdivided in detail for a setup that has developed into selling and buying of such services on a trading market.

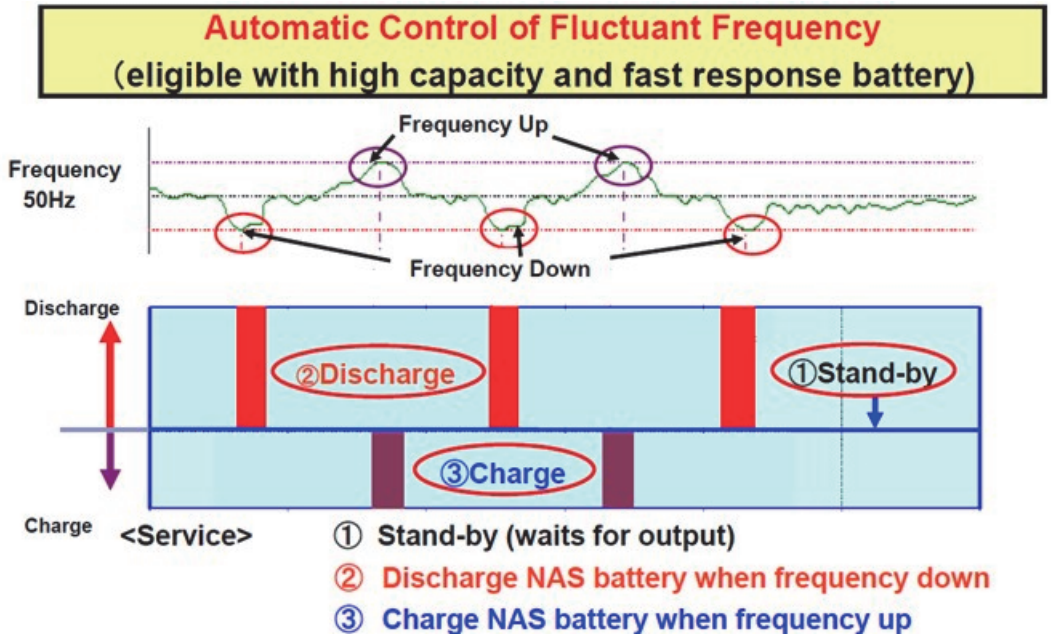



Fig. 2-8 Ancillary service using NAS battery system

⑤ NAS battery container layout

The following shows an example of NAS battery layout.

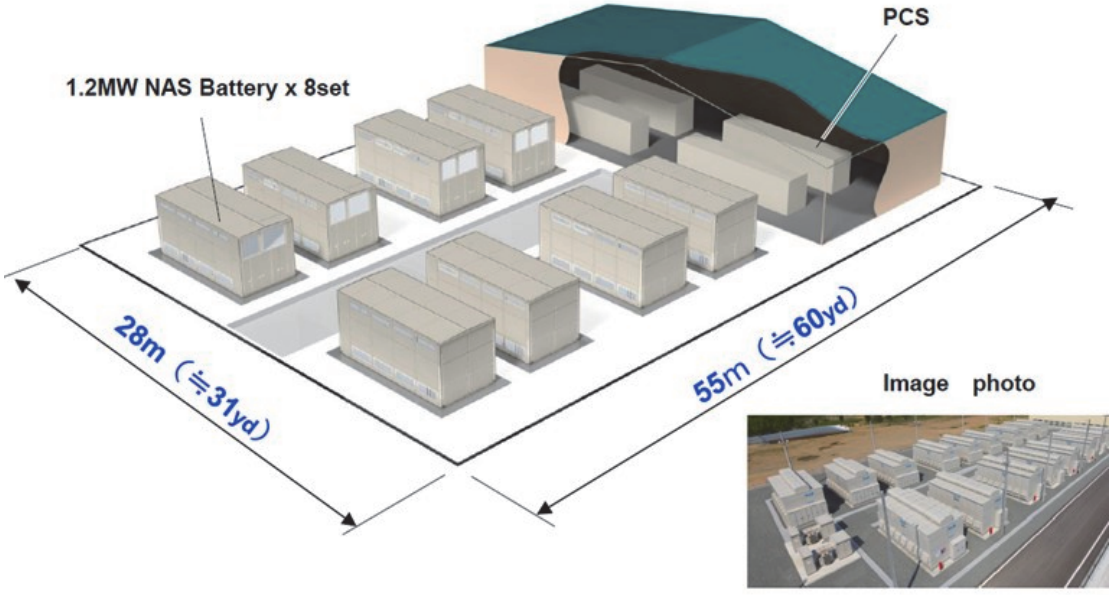



Fig. 2-9 Example of 10MW (9.6MW) NAS battery layout

⑥First site visit (June 2016)

In mid-June 2016, we invited a technician from the NAS battery manufacturer to join us on a visit to CE company, a subsidiary in the N group, which operates the Salkhit Wind Farm.

In the power purchasing agreement (PPA) for Salkhit Wind Farm (50MW), run by CE company, output is curtailed to three percent of the rated output. Hence, we visited CE company to consider how that curtailment portion could be charged to large-capacity batteries to then discharge it to the power system, in order to improve utilization rate of the facilities, expand profitability and contribute to the reduction of CO2.

We had already worked on proposing the NAS battery system as the storage battery cell; however, this time we had a technician from the Japanese NAS battery manufacturer with us, so specific discussions could be entered into on the subject of realizing a JCM, which we worked hard to do.

The following shows the main discussion points.

(a) Ahead of the meeting, we got CE company and G company to exchange opinions based on real data, which we then developed and considered. In specific terms, we looked at the state of curtailment, to develop discussions on what kind of size the NAS battery system would have to be to raise investment impact and efficiency to their maximum. As a result, we received the daily operating data again from G company, in particular several days' worth of data taken every ten minutes related to the operating results for curtailment. Based on these data, G company worked out an estimate for the optimum NAS capacity.

(b) During the meeting, the details of curtailment became reasonably clear. Curtailment is set at a three-percent rating, but, specifically, this is based on the power supply allotment in response to demand from the National Dispatching Center (NDC) from day to day – thus, as and when necessary, instructions will come from NDC for power generation, and any value that exceeds that is counted as curtailment. Hence, the three percent laid down in the PPA seems to be regarded as approximately three percent across the year. And, the payment (9.5¢/kWh) for curtailment exceeding three percent is paid

to CE company.

(c) In summer, CHP-3 and CHP-4 (power plants) electricity supply and heat supply have spare energy, so curtailment is not used.
At nighttime in winter, CHP-3 and CHP-4 are supplying electricity and heat up to about midnight, curtailment is not necessary, but even though electricity demand drops considerably after midnight, heat supply is still needed, so continued supply of electricity is also necessary to counterbalance the amount of heat supply. And, as that amount as it stands is regarded as surplus power, so NDC tells Salkhit Wind Farm to curtail power. In terms of time, curtailment is basically from midnight until six or eight in the morning. Therefore, with regard to installation of the NAS battery system, there needs to be clear understanding of the role of heat supply taken by CHP as well as future plans to use CHP for power source development and existing system operation.

(d) The circumstances governing implementation of curtailment are greatly related to stable upkeep of power supply and heat supply in the existing system run by NDC, so such curtailment is not necessarily limited to just winter nights it can take place any time. This point is clearly shown in past curtailment temporal data. The problem with this is that battery efficiency will drop if the NAS battery system does not repeatedly charge/discharge one hundred percent in an ongoing manner. Yet, rather than prolonged periods where the non use of curtailment is unfavorable it is the way in which the working characteristics required of the NAS battery system will have to be predicted to decide the optimum size of the NAS system that looks as if it will be extremely difficult to estimate.

(e) CE company is not just looking at the NAS battery system it also is simultaneously considering a Li-ion battery system and vanadium redox flow cells, taking time to compare cost performance. Taking into consideration that the JCM would be applicable as a precondition if the NAS battery system was used, the evaluation of NAS was extremely good compared to the other storage cells. However, as there are no definite preconditions governing the circumstances of charging and discharging, those evaluation results (especially payback years) are

(f) On the day after the meeting, CE company kindly invited us to visit Salkhit Wind Farm. CE company explained in detail how they used supervisory control data acquisition (SCADA), which enabled us to understand how curtailment is implemented.

There are a total of 31 wind turbines, made by China's GE company, which produce 1.6 megawatts per turbine (1.6MW × 31 = 50MW), with 12.5m/s wind speed needed for the rating of 1.6 megawatts. The average wind speed is 8.5m/s, so output is nearly 0.9 megawatts at the 8.5m/s wind speed.

The cut in speed of the turbines is 3.5m/s and the cutout speed is 25m/s. When wind speed is over 25m/s, blade feathering is used to reduce torque to zero in order to avoid damage (power generation = torque × propeller rpm, and maximum rpm is 19rpm).

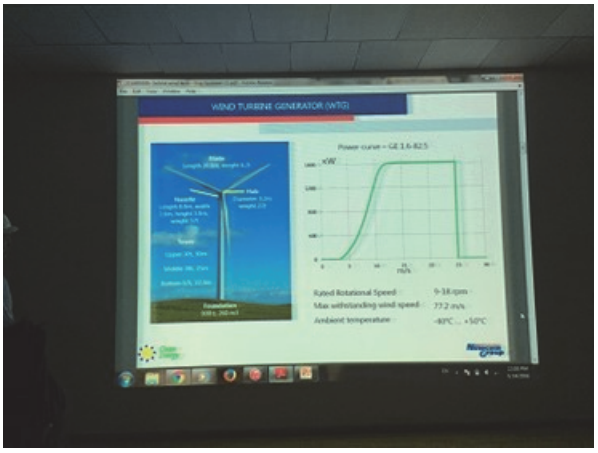
(g) The point we focused on in the SCADA functions was the trend graph showing power output forecast for up to one week in advance, with real-time displays of the actual power output and the predicted value. Having taken a look at actual results, we realized that the accuracy of the forecasts is extremely high. This predicted value is calculated from data, such as wind speed, air pressure and temperature, which are all recorded in real-time by sensors at the same height as the wind turbine. The measured values are transmitted via SCADA to an operation service company in Spain, where a simulation model predicts power generation, and sends that prediction back to SCADA.

(h) Salkhit Wind Farm is running a 50-megawatt system, and is planning to expand that by another 50 megawatts. The realization of that looks like it will be five years from now. First, we urged CE company to review the installation for the existing 50-megawatt system, and at the end we managed to elicit some "conditional maybes" from them. Naturally, to realize the project, investors will have to be persuaded. For that reason, it is important that the key person on the client side and G company work with us to come up with some feasible evaluations for implementation.

The following show some images of Salkhit Wind Farm during our visit.

i) Distant view SWF (50MW)

ii) Turbines and generators




iii) Presentation 1 at SWF


iv) Presentation 2 at SWF


v) Presentation 3 at SWF

vi) Control room at SWF

Fig. 2-10　Images from visit to Salkhit Wind Farm

⑦Salkhit Wind Farm data analysis

From the first visit to the local site (June 2016), we brought home power generation

and curtailment data taken every ten minutes that was handed over to us by CE company. Once home, the data were analyzed at G company.

The following show step by step the results of analysis.

- Daily averages of Generated Energy is 200 - 600MWh.
- Curtailed Energy is about 3 - 18% of Generated Energy.
- Generated Energy and Curtailed Energy were increased on 2016 from 2015, comparing the data from January to April of each year.

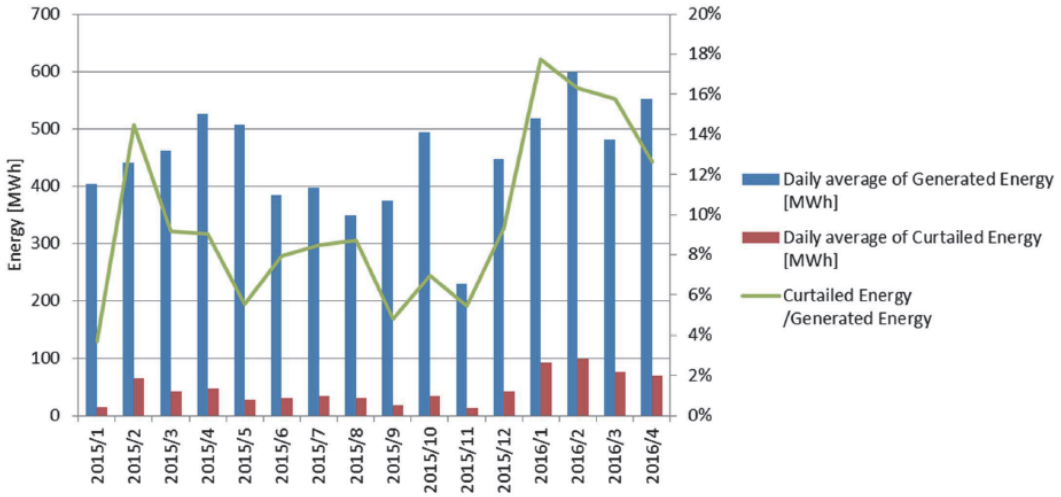



Fig. 2-11 Power generation by month and curtailment changes

- Daily averages of Curtailed Energy is 15 - 90MWh. (It is equivalent to the energy capacity of the NAS Battery of which system size is 2 – 15 MW.)
- Daily average of Duration of Curtailment is about 5 hours at maximum. The charging time of NAS Battery is about 8 hours. On most days, the Energy Capacity of NAS Battery is not fully utilized because the available charging time (Duration of Curtailment) is too short.

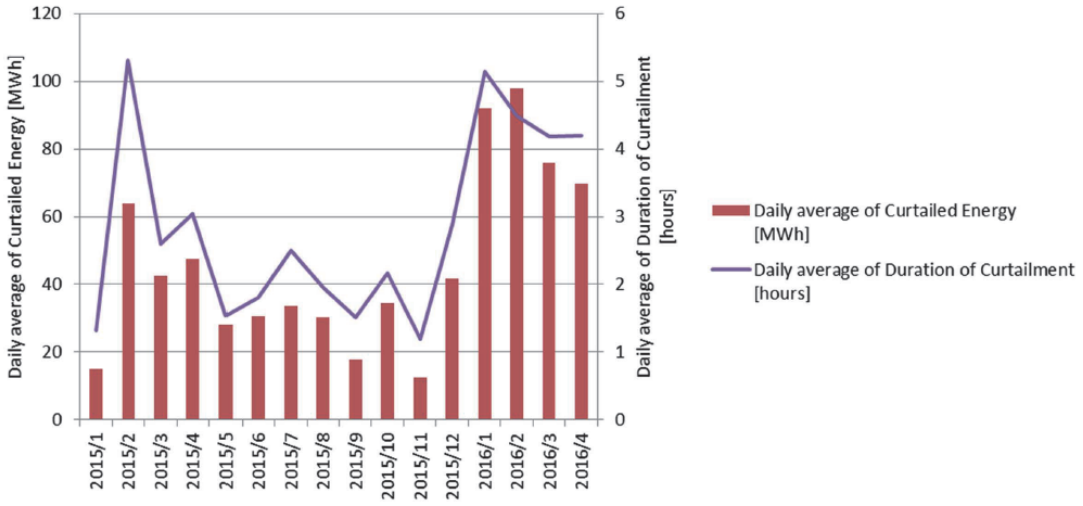



Fig. 2-12 Curtailment by month and curtailment time changes

- Simulated operation:
  - The battery is charged when curtailed power is available.
  - The battery is discharged so as the sum of the generated power and discharged power does not exceed 50 MW.

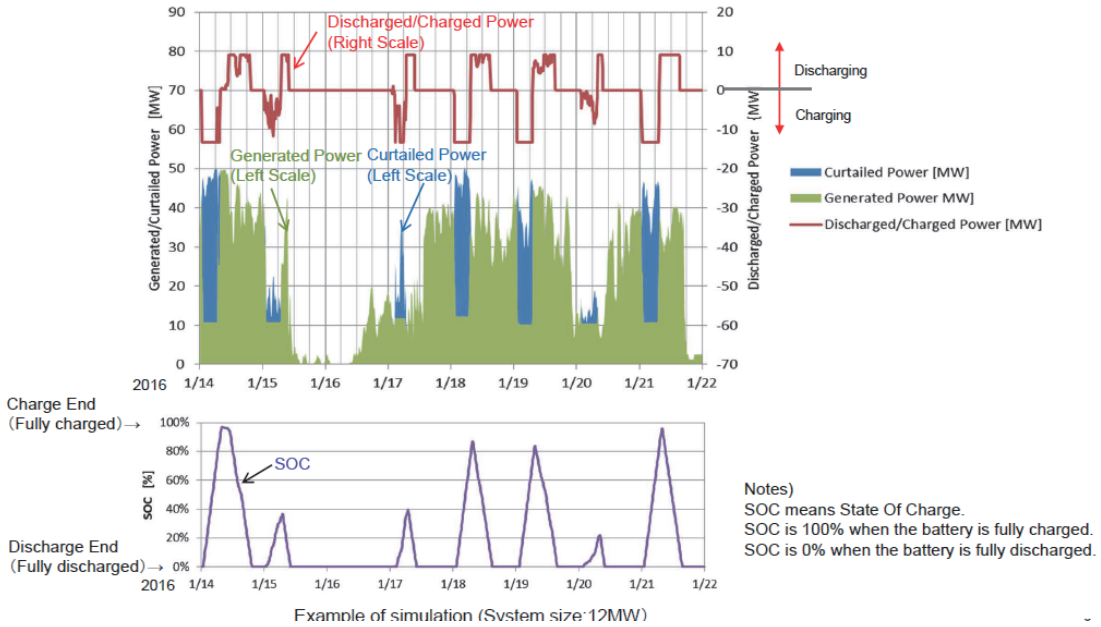



Fig. 2-13 NAS battery simulation results for the data we received

- The larger the System Size is, the larger amount of energy can be charged.
- It is estimated that 56% or Curtailed Energy can be recovered (be charged to the battery) in case the System Size is 12 MW.

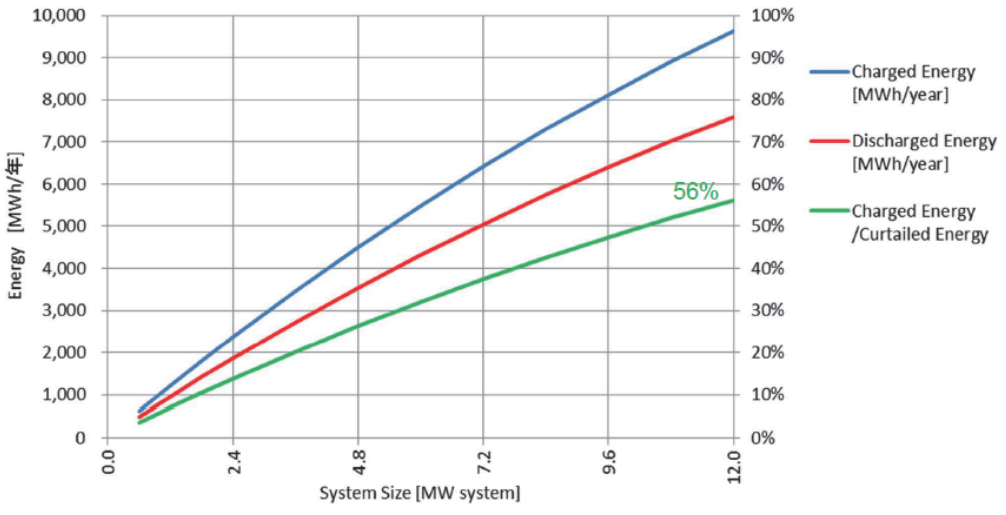
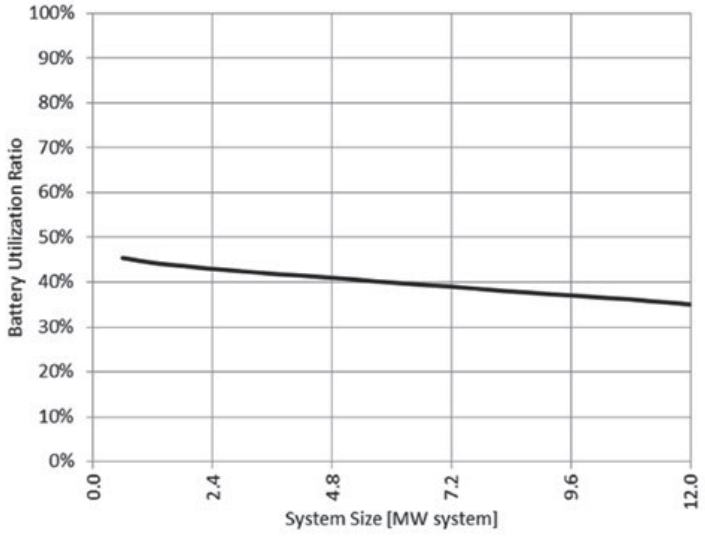



Fig. 2-14 NAS battery capacity based on simulation results

- The smaller the System Size is, the higher Battery Utilization Ratio will be achieved.
- The calculated Battery Utilization Rate is less than 50 % even the smallest System Size (0.6MW).




Notes)
(1) Battery Utilization Ratio=Discharged Energy per year / Rated Discharging Energy per year
=Discharged Energy per year / ( System Size x 6 hours x 300 cycles)
(2) This graph is calculated from the data from May 2015 to April 2016.

Fig. 2-15 System size and NAS battery utilization ratio

⑧Discussions related to analysis results

Based on the analysis results produced from data received from CE company, we met with the CEO of the N group, which CE company is a subsidiary of, to discuss the results.

The following are the main points from the discussion.

(a) Introduction of operating results

A technician from G company introduced NAS battery system operating method and results achieved in Japan. The details are as follows.

- By discharging the charged power from the NAS battery system to help with peak-time demand, some of that demand can be borne, to contribute to the reduction in power imports from Russia.
- And while implementing the above, the NAS battery system will level out frequency fluctuations, to contribute to the quality of electricity generated.

(b) Question

The technician from G company sounded out N group's feelings about the possibility of operating the existing system so charging time could be extended to enable full charge of the NAS battery system after curtailment was finished with.

N group's answer is as follows.

- CE company is a private company, so it is not in a position to change operations.
- Changing operations is not practical in terms of feed-in tariff (FIT) (the thinking here is that there is no sense in storing electricity to batteries when that electricity is going to be paid for anyway)

(c) Introduction of NAS battery system

The biggest problem with power supply in Mongolia is the demand gap (350MW in winter and even 250MW in summer), which is being dealt with by importing electricity from Russia. To break away from this dependency on importing, the maximum capacity of the NAS battery system would have to be 100 megawatts, which is an incredibly big capacity. So, with that in mind, we proposed the following as a realistic countermeasure.

- Import power for peak-time use and have the NAS battery system bear some of that peak-time demand.
- At first, take on a NAS battery system with a capacity of about ten megawatts, and then sequentially expand capacity.

Alas, CE company is just one private company, so even this proposal would be a massive investment sum for it, so adopting such a proposal is deemed difficult.

(d) National policy driven introduction

As the director of the energy agency shows interest in storage battery cells, we have decided to look for a good opportunity to talk to him in order to find out what he thinks of the current situation. And, as and when needed by the Overseas Environmental Cooperation Center (OECC), we will push ahead with discussions, making use of support from G company. However, it should be noted that the National Dispatching Center (NDC) has undertaken a study on power leveling, and there was opposition to the introduction of a NAS battery system.

As a result of meeting the N group CEO, we feel there are many points that need to be resolved in order for a NAS battery system to be introduced at Salkhit Wind Farm.

(2) Feasibility study

① Implementation structure

In this case, there are some high hurdles that have to be surmounted in order to form the project – nevertheless, we have created again the implementation structure diagram used at time of proposal。

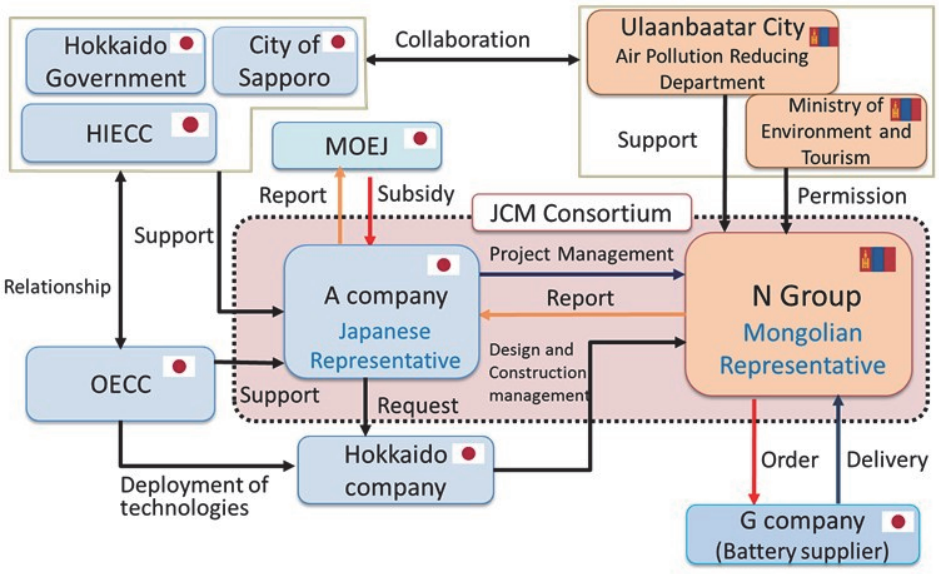



Fig. 2-16 Project implementation scheme

② Financial structure for client and partners

N company is a Mongolian infrastructure investment company. It owns group companies that are responsible for work such as telecommunications, air transport, conventional energy supply and natural energy supply.

N company is a leader in the development of natural energy in Mongolia. It built and runs the first commercial wind farm (output scale of 50MW) in Mongolia – namely, Salkhit Wind Farm.

From this it is clear to see that N company is a prime business in Mongolia; however, there are issues in forming this project and we have yet to receive financial statements concerning the company.

③ Consideration of how to utilize secondary battery

With a private business like N company, everything is about profitability, so it showed reluctance about introducing a NAS battery system.

Hence, we drew in public bodies like the energy agency, in order to look for ways to possibly introduce storage battery cells, as part of energy policy on a national level.

At the second onsite study in December, we met a former senior member of the energy agency. Also, the problem concerning the gap (300MW) between day and night demands for power in Mongolia was raised when we went to visit the energy regulating committee. Thus, there certainly are people who think that the introduction of a giant storage battery system is necessary to alleviate this gap problem.

Taking into consideration the current state of the Mongolian economy, the project cannot be expected to move ahead in the near future, so we would like to deepen relationships with securely related agencies and ministries, in order to push ahead, even marginally.

④ Confirming permission and authorization formalities

As described in item ③, we would like to keep an eye on how Mongolia works on its energy policy as a nation while we push ahead with introduction of storage battery cells.

⑤ Consideration of support structure for facilities

For this case, we did not get as far as configuring a support structure. Therefore, we will keep an eye on other cases as we consider issues like a local branch office and finding a route for introducing storage battery cells.

⑥ Consideration of business feasibility and economic feasibility

As mentioned earlier, we considered the capacity of the storage battery cells to be introduced in this case based on annual operating data. As a result, we judged that at maximum the capacity would need to be 100 megawatts. And, as the cost for introducing storage battery cells is 3,000 USD per kilowatt, the business feasibility has been judged to be low. Although we have not examined issues closely, even if a battery system with ten percent (10MW) of the necessary capacity was introduced, the investment sum would be 30 million USD, which would be tough in both business and economic feasibility terms. And, if we take into consideration the lifespan of the batteries (approximately 15 years), the expense placed on support would be a burden. Hence, under present circumstances, we have arrived at the conclusion that there is no concrete way of approaching this project other than a political policy driven introduction.

(3) Study of CO2 reductions

The following show the approach to CO2 reductions within this case.

- Store wind power generated over eight hours at nighttime (22:00 to 06:00 the following morning) in storage battery cells, and discharge the stored power over six hours in the daytime.
- The power to be stored overnight will be ten megawatts. This is because the power output from Salkhit Wind Farm at nighttime is limited to about 20 percent of the capacity (50MW).
- Stored power will be used to replace power generation by the thermal power plant CHP-4, which will reduce CO2 emissions that would be generated from coal used at CHP-4.
- With regard to coal consumption by CHP-4, we are using the figures for power output from the most efficient power generator, which is No. 7 (in action from 2014, 120MW).

Based on the above approach, we used the following figures to calculate CO2 reductions.

- Emission factor of coal /EFcoal,c: 0.0258 [tC/GJ] (IPCC default value)
- Heat calorific value of coal /HCVcoal: 3,500 [kcal/kg]
- Specific calorific value of coal /SCVcoal: 3,500 kcal/kg × 4.2 GJ/kcal = 14.7 GJ/ton
- Emission factor of coal /EFcoal, CO2 = 14.7 × 0.0258 × 44/12 = 1.39kgCO2/kg
- Yearly CO2 emissions by coal consumption /RECO2,coal = 88,800 × 1.39 = 123,430tCO2
- Yearly CO2 emissions by project /PECO2,coal = 73,920 × 1.39 = 102,749 tCO2

Data of Grid Emission Factor: 0.797 tCO2/kG (Mongolian default value)
Yearly Electricity Discharge to Grid: 10 MW×6 hours/day×300[days/y] = 18,000 MWh/y

Reference Emissions（REy)

RE = 18,000 MWh/y × 0.797 tCO2/MWh = 14,346 tCO2/y

REy = $RE_{CO2}$,coal + RE = 123,430 + 14,346 = 137,776 tCO2

Project Emissions（PEy）

PEy = $PE_{CO2}$,coal = 102,749 tCO2

Emission Reductions（ERy）

ERy = 137,776 - 102,749 = 35,027 tCO2

(4) MRV methodologies and PDD

①Monitoring points

Coal consumption for power generation: CHP-4

Transmitted power: Storage battery cells (watt-hour meter)

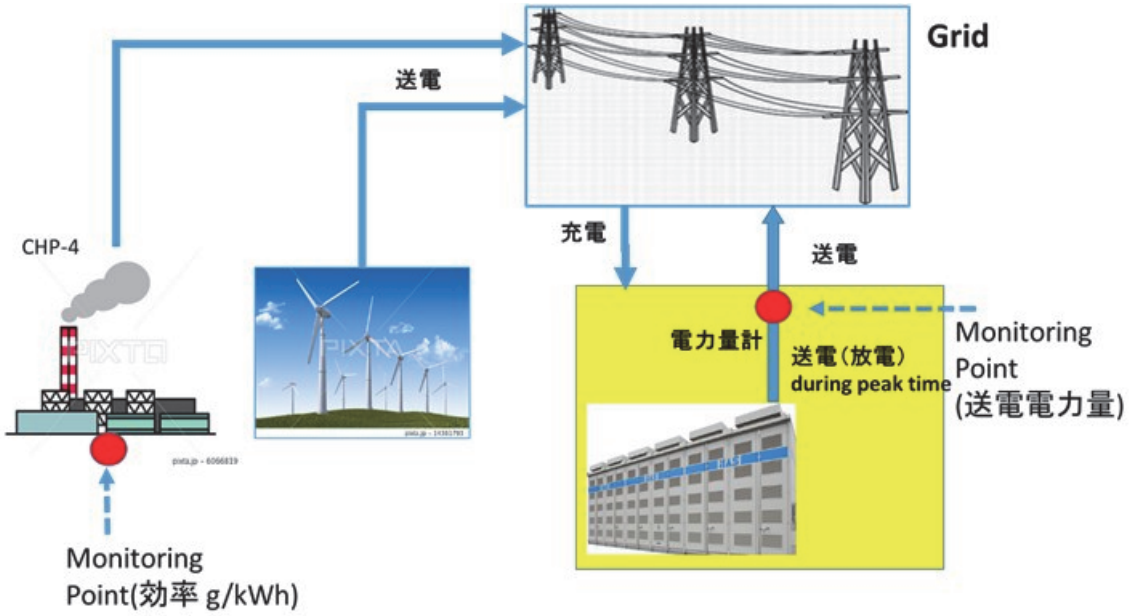



Fig. 2-17 Monitoring points

②Charging and discharging pattern for storage battery cells

Store (charge) 10MW of nighttime wind power in battery cells over eight hour and then discharge it over six hours in daytime.

Repeat this process 300 days of the year.

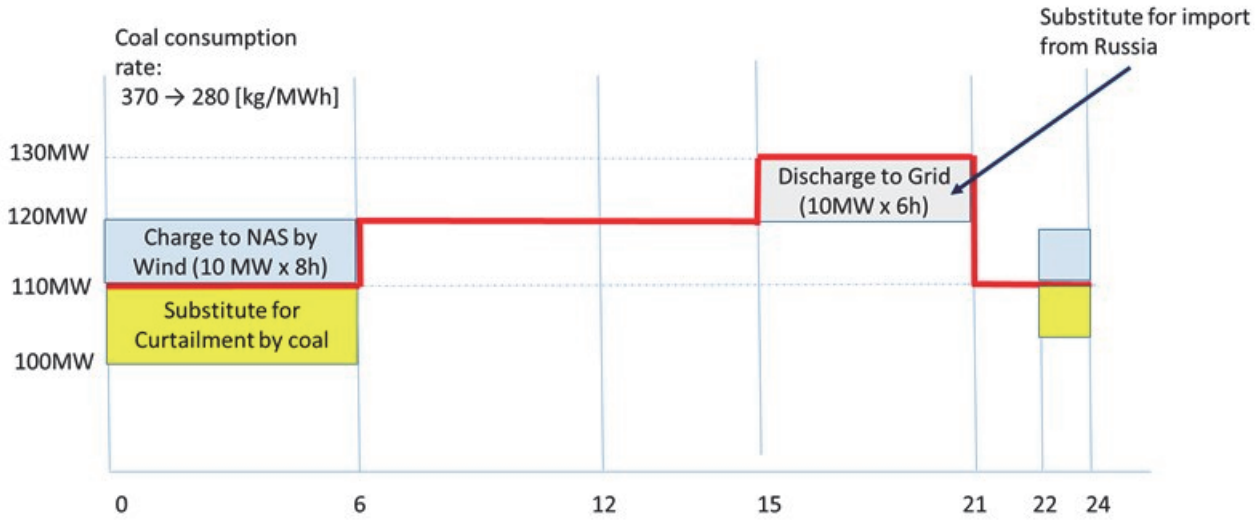



Fig. 2-18 Charging and discharging pattern

③CHP-4 coal consumption

We use the coal consumption figures for power output from the newest and most efficient power generator, which is No. 7 (in action from 2014, 120MW).

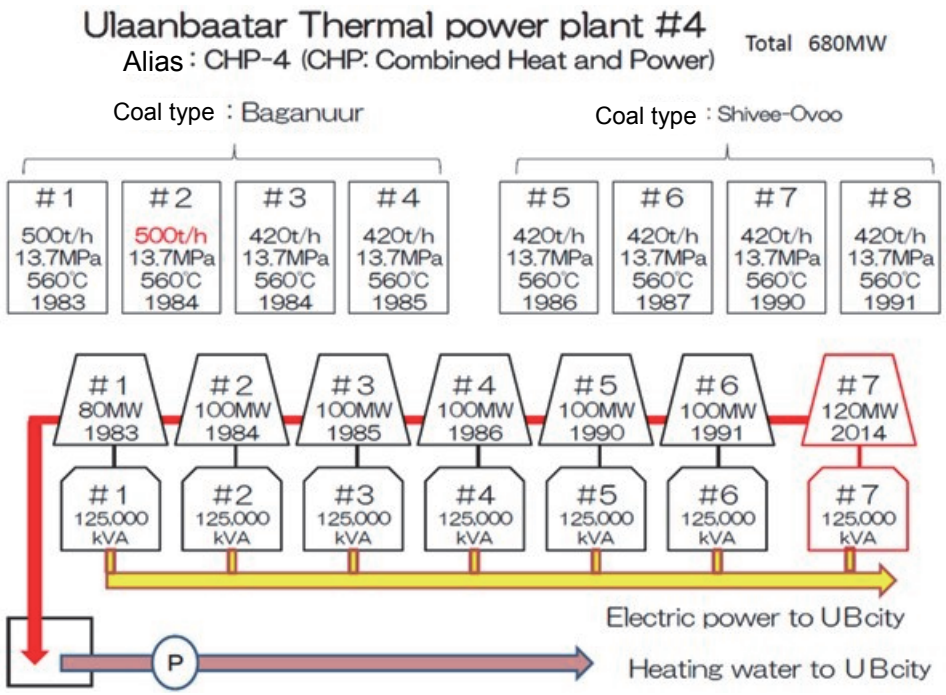



Fig. 2-19 Configuration of CHP-4 facilities

We use the above as a reference scenario to formulate the monitoring, recording and verification (MRV) methodologies and create the project design document (PDD).

(5) Future problems

We are forced to draw the conclusion that introducing a NAS battery system to a private company is going to be difficult given the economic state of affairs in Mongolia. For such an introduction to take place there will need to be dialogue on a dimension that encompasses the national level of the energy policy. From here on, we will discuss matters with bodies such as the energy agency, to see if we can enhance the feasibility of introduction via government assistance.

III. Workshops in Mongolia and in Japan

1. Mongolia（Ulaanbaatar）Workshop

(1) Purpose of the workshop

A workshop was held to introduce representatives from Ulaanbaatar to the Joint Crediting Mechanism (JCM) and related projects, along with the City to City Collaboration Project between Ulaanbaatar and Hokkaido Government / Sapporo City. The aim behind inviting these representatives to come and hear about the JCM system and overview in person was to obtain their cooperation in existing projects and form new proposals for future projects.

(2) Presentation

① Schedule

Date: October 27, 2016 (Thursday) 09:00～12:00

Venue: "Khaan" Hall, The Ministry of Environment and Tourism Mongolia (MET)

Organizers:
- Ministry of Environment and Tourism of Mongolia
- Ministry of the Environment, Japan
- Overseas Environmental Cooperation Center (OECC))
- Ulaanbaatar City / Air Pollution Reduction Department (APRD)
- Hokkaido Government and Sapporo City

Please see the attachment list of the details of participant.

② Program

| Time | Topic | Lecturer |
|---|---|---|
| 09:00-09:10 | Introduction | MET |
| 09:10–09:35 | Summary of JCM Project and Study through City to City Cooperation | OECC |
| 09:35-10:00 | Current Development of JCM in Mongolia by Nature Conservation Fund, Mongolia | MET／Nature Conservation Fund |
| 10:00-10:25 | Problem and Plan of Greenhouse Effect Gas Reduction in Ulaanbaatar City | APRD |
| 10:25-10:40 | Coffee Break | |
| 10:40-11:05 | Energy Saving Measures in Sapporo City | Sapporo City |
| 11:05-11:30 | Study of Energy Saving Project in Cooperation with the Company in Hokkaido | Mongolian National University |
| 11:30-11:40 | Closing | Hokkaido Government (HIECC) |

③ Brief of presentation

1) Introduction (Ministry of Environment and Tourism Mongolia)
   - In September, registration of Mongolia's first ever JCM Project was approved and credit was issued. Following on for this, the methodology for two solar power generation plants was approved and work is in progress on constructing these facilities.
   - My hope is that this workshop will help improve understanding of JCM and lead to the formation of new projects to follow on from these.
2) Summary of JCM Project and Study through City to City Cooperation (OECC)
   - Sequence of events leading to the staging of this workshop
   - Overview of JCM and projects to fund facilities
   - Overview of City to City Collaboration Surveys
3) Current Development of JCM in Mongolia by Nature Conservation Fund, Mongolia (MET／Nature Conservation Fund)
   - Overview of JCM and an introduction to the survey proposals for Mongolia
   - Overview of MRV and third party organizations (in Mongolia, NREC is registered as a local organization)
4) Issues with curbing Greenhouse Gases in Ulaanbaatar and Countermeasures (APRD)
   - Examples of measures that have been introduced to curb greenhouse gases in Ulaanbaatar
   - Case studies of renewable energy (solar power, wind power, hydropower, earth thermal power, solar heat power) and issues
5) Energy Saving Projects in Sapporo City (Sapporo City)
   - Introduction to Sapporo City (population: approx. 1.9 million people, with a total area of 1/4 of Ulaanbaatar)
   - Transitions in annual emissions of greenhouse gases in Sapporo City (tendency to decline from 2006, but rising once more in the wake of the Great East Japan Earthquake (2011))
   - Initiatives to put in place energy saving measures
   - Assistance for the introduction of renewable energy and next generation automobiles
6) Demonstrating the Effects of Energy Saving through Cooperation with Businesses in Hokkaido (National University of Mongolia)
   - Introduction to thermal storage heater sold by Kita Denryoku Setsubi Koji
   - Explanation of the progress of experiments with solar water heaters

7) Closing remarks (Hokkaido Government (HIECC)))

- Introduction to HIECC (explained by Mongolian word)
- Comparison between the situation in Hokkaido 50 years ago and Ulaanbaatar
- Environmental measures take time, but their effectiveness increases as steady steps are taken to address the issues. We look forward to your ongoing cooperation in the future.

④ Questions and answers

1) Is a change of fuel source from coal to gas really effective? (Mongolia Water Partnership)
   Efforts to address the problem of global air pollution are being made in a step by step manner. These efforts also change according to the economic circumstances of cities and other factors. In Mongolia, gas fuel is currently twice as expensive as electricity and four times as expensive as coal, but in order to improve the situation concerning air pollution, it will be necessary to make the change to gas over the long term. (Ministry of Environment and Tourism)
2) Will the city consider putting in place large solar power generation plants in the future, too? And how would you go about connecting small solar power generation plants to the system? (Department of Energy Regulations)
   We will continue to expand the number of large plants into the future as long as budget allow. Solar power is subject to large fluctuations, so we would deal with the second issue through standardization. (Department for the Reduction of Air Pollution)
3) What is the cost of thermal storage heaters?
   A 2kW costs in the region of 120,000 yen, so they are not cheap. But I think the cost will come down in the future with mass production. (National University of Mongolia)
4) Will it be possible to manufacture heat storage heaters in Mongolia?
   They are not high tech products, so it would be possible in the long term. In Japan, there is not much difference between electricity during the day and night, so there is very little need for heaters. It would be possible if each of the production lines could be moved to Mongolia. (National University of Mongolia
5) Is it possible to adjust or stop the heaters?
   It depends on the level of stored heat, but in principle there are in continuous operation. The heat capacity can be switched between high, medium and low. (National University of Mongolia)

(Reference) Workshop in progress

(3) Results and problems

① Results

- This workshop created new business chances through direct contact with people from the Ministry of Environment and Tourism and organizations from Ulaanbaatar, with whom we had had no previous connections.
- In connection with the workshop, we were able to generate publicity of the JCM Project among newly appointed members of the government and businesses.

② Problems

- There are many organizations and business, also those who did not participate in the workshop, who wish to see projects take shape, and further work needs to be done in terms of promotion and disseminating information.
- In order for projects to take shape, the participation of organizations and business from Japan, especially Hokkaido, is desirable. At the Sapporo workshop, businesses from Hokkaido will give an introduction to their initiatives.

(4) Discussions and consultations related to the workshop

① Discussions with the Deputy Mayor in charge of the environment (October 27)

Following the workshop, Ulaanbaatar City Department for the Reduction of Air Pollution arranged for us to meet with the Deputy Mayor, who is in charge of the environment, with whom we held an exchange of opinions. Also present during these discussions was the Director of Ulaanbaatar City Department for the Reduction of Air Pollution and the Director of the Department for the Natural Environment, as well as other experts connected with the environment.

1) Explanation from the Deputy Mayor

- The population of Ulaanbaatar City is 1.3 million people, 1.7 million people when including those who commute from the suburbs.
- Half of the households in Ulaanbaatar (190,000 households) live in ger districts. Improvements to the living environments of people in ger districts is a pressing issue.
- 2016 was an election year, and there were many changeovers among government and city assembly members. Over the next 4 years, different policies will be pursued than before.
- Mongolia is currently suffering from economic stagnation, but I believe environmental policies are vital, and therefore ask for your cooperation in making sure projects take shape.

2) Explanation from OEC

- Since 2013, OECC has been engaging in fully fledged initiatives aimed at improving the environment in Mongolia, especially turning proposals for measures to curb greenhouse gases into reality.
- Various initiatives are taking shape through JCM's project to fund facilities, with 3 projects having gotten off the ground in Mongolia from last year to this year with the involvement of OECC.
- This year has seen the establishment of projects through City to City Collaboration between Hokkaido and Sapporo, one of which is a heat storage warm air heater that utilizes nighttime electricity. This is the result of a collaboration between businesses in Hokkaido and the National University of Mongolia, and we would like to see plans put in place to introduce this system in the next fiscal year.
- Concerning a separate survey, we would be grateful if you would consider gas fired heaters from manufacturers who are working to make improvements to HOB as a substitute for HOB.

3) Answers from the Deputy Mayor

- We are set to negotiate budgets for environmental measures at the city assembly. As part of these negotiations, we have included the proposals from OECC.

- The plan contains several options, so I would like to see dialog continue with the Department for the Reduction of Air Pollution concerning the adoption of the proposals from OECC.

Meeting with Deputy Mayer

② Meeting with Ulaanbaatar City Department for the Natural Environment

We received a request for a meeting regarding the JCM Project from the Director of the Department for the Natural Environment, who was in attendance at the meeting with the Deputy Mayor. On the day after the workshop, we met with the Head of the Natural Environment Resources Division in place of the Director to exchange opinions.

1) Explanation from the Head of the Division

Following a personal introduction from the Head of the Division and an explanation of the Natural Environment Resources Division, we were provided with an account of the problems and challenges facing the city in the field of the environment.

a) Problem of lack of infrastructure development (wells, sewage systems etc.) in holiday home areas in the suburbs (areas in which companies created vacation facilities for workers during the country's period of socialism) and ger districts.

b) Under the system of grid connection power purchasing inscribed in the country's Renewable Energy Law, renewable energy is limited to the 3 fields of solar power, wind power and hydropower. Therefore, the use of renewable energy through geothermal power and heat supply is not included within the scope of this law. Also, grid connection requires a high voltage of 35kV and had not been extended to 350V for the distribution system, meaning that there is no incentive for grid connection from solar panels installed on the roofs of houses in urban areas.

c) Power distribution systems are becoming increasingly outdated. As such, the problem of grid instability will occur if heat storage heaters are running simultaneously.

d) There are predicted to be water shortages by 2050. Underground water is being pumped up from wells close to the eastern section of the city. Water volumes are being further secured by moving pumps to inland regions. One of the reasons why work has yet to begin on CHP-5 is this issue of securing water and problems with wells.

e) Water resources – food – excretion – decomposition – soil… Natural cycles such as these have been severed, and this has led to problems with soil contamination in ger areas. The Department for the Natural Environment is receiving support from the U.S. Million Development Fund for projects to combat soil contamination.

2) Opinion exchange

- Explanation of JCM City to City Collaboration (OECC)
- Explanation of Sapporo's sewage treatment system (Sapporo City)

  The city's sewage system is 99.8% complete. There are 10 sewage treatment plants, covering 930,000 households. This means an average of 1 sewage treatment plant per 100,000 households. Sapporo's total area is 1,120m2, and has a rate of conversion of toilets to flush toilets of 99.9%.
- Regarding issues with sewage treatment (Department for the Natural Environment)

  There are two distinct problems with sewage treatment in Ulaanbaatar: first, the improvement of facilities and measures to make them more energy efficient, and second, the construction of sewage treatment systems in ger areas etc. in the suburbs.
- Example proposal for a waste water treatment system (OECC)

  At OECC, we investigated a case in Erdenet for curbing greenhouse gases by cutting the amount of power needed to draw water from wells through the installation of a waste water treatment system.

3) Possibilities for JCM projects

a) Waste water treatment system

- Condominium developments are gaining pace in the airport area and I believe they are not connected to the existing sewage treatment system, so would it be possible to consider standalone sewage treatment systems like these for JCM?
- Plans for the city's sewage treatment systems are investigated by the Department for the Natural Environment.

b) Measurement to automobile exhaust gas

- Exhaust gas from automobiles is another factor behind the city's air pollution.

While automobile inspections are carried out on an annual basis, testing and measurements for exhaust gas are not in place. I feel that there is a need to construct testing centers for automobile inspections and to establish proper methods for measuring exhaust gas.

- In the past, OECC investigated the possibility of a JCM project to introduce electric automobiles.

c) REDD+

- The Department for the Natural Environment has plans to plant 4,000 ha of greenery along rivers within the city.
- While greening plans are handled by a different department, I would like you to consider the application of REDD+.

(Concerning this matter, we have received a reply stating that they would like us to consult with the person in charge at the Ministry of Environment and Tourism.)

d) Treatment of waste disposal

- All refuse in Ulaanbaatar goes to landfill. There are two landfill sites, one located in the northeast of the city and the other the southeast. 80% of the daily refuse amount from 4 districts in the city goes the one on the northeastern side.
- It seems that plans are in place to turn refuse sent to the northeastern landfill site into biomass.
- While there has been a JCM project for power generation in refuse incinerators in Myanmar, in Mongolia's case, consideration needs to be given as to whether it would be profitable in terms of scale.

③ Meeting with the Mayor of Ulaanbaatar

The president of an influential company in Mongolia arranged for us to meet with the Mayor of Ulaanbaatar. The following is a summary of this meeting.

1) Explanation from the company president

- I have heard that there are plans in place to construct a subway system in central Ulaanbaatar.
- The costs for constructing a subway system are high and the construction period is long. Compared with this, trams cost a lot less and take less time to construct.
- Last month, I met with representatives from Hokkaido (HIECC) in Sapporo and found out that they would be visiting Ulaanbaatar with representatives from Sapporo City, which is why I arranged a meeting and requested an explanation be given to the Mayor.

- If the Mayor is interested in the construction of a tram system, I would like him to write a letter to Sapporo City requesting cooperation.

2) Explanation of the status of Sapporo's tram system

- Hokkaido (HIECC) and Sapporo City gave an explanation on the total length of the existing tram system, along with details on such things as who it is run and maintained.

3) Reply from the Mayor

- I am quite interested in constructing a tram system. I think it is a very good idea.
- We will hold discussions with ADB on 10/31 concerning a construction project for a dedicated roadway for buses (BRT). If possible, I would like to have trams run along this BRT, but I would need to consult with ADB on this matter.
- Would it be possible to receive support in terms of an international yen loan etc. for laying down tram lines?
- I can send a request for support to Sapporo City, but where should I send it?

4) Reply from Sapporo City

- First of all, please send your request for cooperation to the office of the President of the World Winter Cities Association for Mayors.
- The members of our party on this visit are not in a position to provide an answer concerning this matter, and have yet to discuss it with the relevant parties in Sapporo City (International Department, Transport Department etc.).
- The sudden arrival of such a letter would probably create confusion among the relevant parties there. Therefore, those of us present today will explain this matter immediately upon our return, so please wait a little while before sending the letter.
- We at Sapporo City would like to do whatever we can to cooperate with you, and hope to discuss the details with Ulaanbaatar on a separate occasion.

5) Future action

- Ulaanbaatar and Sapporo City will discuss the possibility on introducing a tram system.
- We will ask Sapporo City to enquire with JICA etc. about the possibility of funding in the form of an international yen loan etc.
- Concerning the applicability of this matter under the JCM Project, it will be difficult to use it as an alternative proposal for fuel, given that diesel fuel for buses and the emission factor for Mongolia's electricity are reversing.
- Concerning Ulaanbaatar's urban plan, ALMEC VIP has been commissioned by the Ministry of Economy to carry out surveys, so we will exchange opinions on the possibility of introducing a tram system.


Meeting with the Mayor of Ulaanbaatar

2. Japan (Sapporo) Workshop

(1) Purpose of the workshop

In the course carrying out surveys in the current fiscal year, the following issues became apparent.

- An insufficient grasp of the environmental technologies for cold regions possessed by organizations in Hokkaido (businesses, research institutes etc.)
- Lack of promotional activities for the JCM Project aimed at organizations in Hokkaido
- Lack of PR concerning the environmental technologies desired by the Mongolian side

Taking into account the above, a workshop was held in Sapporo with the cooperation of municipalities to facilitate relationship building and direct dialog between organizations.

(2) Presentation

① Schedule

Date : January 20, 2017 (Fri.), 13:30 – 15:30

Venue : TKP Sapporo Business Center Conference Room, Sapporo City, Hokkaido

Attendees : Hokkaido Government, Sapporo City, HIECC, representatives from Ulaanbaatar City, businesses and organizations from Hokkaido

Please refer to the attachment for more details on the attendees.

② Program

| Time | Session | Speaker |
|---|---|---|
| 13 : 30 | Opening session | HIECC |
| 13 : 33 | Overview of the JCM System and City to City Collaboration Surveys | OECC |
| 14 : 30 | Regarding the Possibility of Introducing Heat Storage Heaters in Mongolia through the JCM Project | Kita Denryoku Setsubi Kouji Co. Ltd. |
| 14 : 50 | Possibilities for the JCM Project through Technologies in Cold Regions | Hokude Sogo Sessei Corporation |
| 15 : 10 | Question and answer session | Presenter : HIECC |
| 15 : 40 | Closing of session | |

③ Overview of the session

a) Opening of session (Mr. Yoshimura, HIECC)
   - Mr. Delgerekh, Director of Ulaanbaatar City Department for the Reduction of Air Pollution, was originally scheduled to give a talk today, but unfortunately could not make it. He is not able to participate due to an urgent situation concerning air pollution in Ulaanbaatar.
   - Mr. Delgerekh has sent the materials he was due to use in his talk, so Mr. Nishimura of OECC will give an explanation in his place.
   - Mr. Bolortuya, Director of Ulaanbaatar Department for the Natural Environment, is taking part in today's workshop, and will kindly say a few words following the talk from OECC.

b) Overview of the JCM System and City to City Collaboration Surveys (Mr. Nishimura, OECC)

   Mr. Nishimura gave the following explanation.
   - Purpose of holding this workshop
   - Overview of JCM and projects to fund facilities
   - Overview of proposals underway through City to City Collaboration Studies
   - Explanatory materials from Ulaanbaatar City Department for the Reduction of Air Pollution (current situation concerning air pollution and countermeasures)

c) Remarks (Mr. Bolortuya, Ulaanbaatar Department for the Natural Environment)

d) Regarding the Possibility of Introducing Heat Storage Heaters in Mongolia through the JCM Project (Mr. Fushiki, Kita Denryoku Setsubi Kouji Co. Ltd.)

Mr. Fushiki gave the following explanation.。

- Company profile of Kita Denryoku Setsubi Kouji Co. Ltd.
- Regarding the company's connections with Mongolia
- What is a heat storage heater?
- Regarding the possibility of introducing heat storage heaters in Mongolia

e) Possibilities for the JCM Project through Technologies in Cold Regions (Mr. Shinohara, Hokuden Sogo Sekkei Corporation)

Mr. Shinohara gave the following explanation.

- Things which unite technologies in cold regions and the JCM Project
- Introduction to specific technologies in cold region

f) Question and answer session (Answerer: Mr. Yoshimura, HIECC)

- The content of this question and answer session is detailed in the following section.

g) Closing of session (Mr. Yoshimura, HIECC)

④ Total question and answer

a) Are there any technologies under the JCM Project for areas outside cold regions? (Mr. Maeda, ELCOM))

The purpose behind this workshop was to introduce those technologies that are effective for cold regions. One example of a technology which is effective for other regions is the introduction of heat pumps to heating and cooling lines in drinks factories. (OECC)

b) What about the method of gasification power generation utilizing poultry manure? (Mr. Kagami, Setec)

To begin with, we aimed at a method of generating electricity which utilizes gas generated through methane fermentation, but with gave up on this for various reasons. At present, we are proposing binary power generation which utilizes the heat generated from the carbonization of poultry manure. (OECC)

c) Has Kita Denryoku Setsubi Kouji Co. Ltd. been able to gain inroads into Mongolia with its construction systems? (Mr. Ide, Sekisui Chemical Hokkaido Co., Ltd.)

Not yet. But if Mongolia's economy picks up in the future, there is the potential for us to participate there with construction companies. (Kita Denryoku Setsubi Kouji Co. Ltd.)

d) What advice would you give those who wish to turn candidate JCM proposals into reality?

To take solar power generation as an example, Japanese operators have already achieved success in terms of projects to fund facilities in Mongolia. When carrying out work, there are several items that operators need to get the green light for, such

as authorization from the Mongolian government and electricity purchasing contracts, but overall things should proceed smoothly. Also, if a collaborative system between Mongolia and Japan can be established, there is the possibility of project applications at the beginning of the next fiscal year. (OECC)

(3) Results and problems

(Results)

- In this workshop, we were able to provide organizations and businesses in Hokkaido and explanation of the JCM Project and request them to consider the possibility of initiating projects.
- The participants actively fielded questions and seemed to be eager to engage with the project.

(Problems)

- Engaging in this project on an ongoing basis will result in success, something which municipalities also requested. We will put our utmost efforts into upcoming surveys.
- While Japan's tradition of technology is an important part of getting projects off the ground, some requested a more active stance in terms of interaction between people from both sides. In future surveys, we will consider the possibility of having people from Mongolia come to Japan for training and other purposes.

(Reference) Workshop in progress

(4) Discussions and consultations related to the workshop

In line with the workshop, a visit was made to the Central Energy Center of Hoku Netsu Corpration, which received an explanation of the project at an event held in Sapporo in October. Here, we received an explanation on the status of hot water supplies using biomass.

Attendees: Department of Environment and Lifestyle, Hokkaido Government, Hoku Netsu Corpration (3 people)
Ulaanbaatar City Department for the Natural Environment, HIECC, OECC

① Overview of the Central Energy Center

- Commences running as 1971 a facility for local heating in central Sapporo City.
- To begin with, its main source of heating was coal fired boilers. From 1986, it installed additional boilers fired by kerosene and natural gas, with today's heat supply coming mainly from these boilers.
- At one point, the coal fired boilers had biomass mixed in, but from 2009 the company started firing these boilers using biomass alone.

② Biomass boiler

- The boiler is a stoker type (moving bed combustion).
- The boiler is fired by wooden biomass, such as waste construction materials, timber from forest thinning and branches from when processing wooden materials.
- The amount of generated heat is 113GJ/h and the rate of consumption of biomass is 5t/h.
- Biomass creates a lot of moisture, so a natural gas boil has been put in place as a way of regulating heat volumes.
- The Central Energy Center supplies heat at 190 °C, which then cools down to 100 °C. This is determined by the diameter of the hot water piping and the amount of heat supplied.

(Questions)

- From where do you procure your biomass?

  We procure our biomass from a variety of sources, including construction companies, paper manufacturers and cement companies in the Sapporo City area. We supply combustion ash to cement companies at a cost.

・Is the biomass procurement enough?

  We procure around 40,000 tons of biomass on an annual basis. Every year, around 100,000 tons of construction waste is generated in the Sapporo City area. In addition, waste is also generated through timber from forest thinning, so at present we have plenty of biomass for our needs.

・Are you considering power generation using biomass?

Our site is not very big and it would be difficult to expand our facilities to include power generation. Other reasons we are not considering moving in this direction include the presence of nearby houses and environmental measures.

（Reference） Workshop in progress

Biomass (consisting mainly of waste construction materials)

Boiler combustion section
(manufactured by Hitachi Zosen Corporation)

IV. Attend and presentation at Conferences

1. JCM City to City Collaboration Seminar (Kita-Kyushu)

(1) Overview of the seminar

① Events in Sapporo

Around the time of the Kitakyushu seminar, a series of events and visits between cities were planned involving representatives from Ulaanbaatar. In addition to the events held by Hokkaido Government Office (Hokkaido International Exchange and Cooperation Center (HIECC)), the following presents an overview of the kinds of questions that were fielded on this occasion.

| | |
|---|---|
| Date : | October 18, 2016 (Tue.), 13:00 – 15:00 |
| Venue : | Hokkaido Government Office/ Hokkaido International Exchange and Cooperation Center (HIECC) 12th Floor Meeting Room |
| Attendees : | Ulaanbaatar Department for the Reduction of Air Pollution<br>National University of Mongolia<br>Department of Environment and Lifestyle, International Affairs Division Office of the Governor, Hokkaido Government (2 people)<br>Sapporo City (2 people), HIECC (2 people), OECC |

Program

| Time | Topic and Presenter |
|---|---|
| 13:15-13:25 | Opening remarks (OECC), Introduction of attendees (HIECC) |
| 13:25-14:00 | Energy Saving Initiatives in Hokkaido Prefecture centering on Earth Thermal Heat Pumps<br>Hokkaido Research Organization |
| 14:00-14:20 | Regarding District Heat Supplies in Central Sapporo City<br>Hoku Netsu Corporation (2 people) |
| 14:20-14:40 | Q & A and discussion |
| 14:40-14:45 | Closing remarks (HIECC) |

Speakers
(members of an industrial research institute and a heating supply company)

Q&A session in progress

1. Energy Saving Initiatives in Hokkaido Prefecture centering on Earth Thermal Heat Pumps

(1) Regarding heating systems utilizing horizontal reheating type underground thermal heat pumps

- Advantages and challenges of earth thermal heat pumps (short construction period but a temperature difference of around 10 °C)
- Overview of research (resin heat exchangers and laying them underground in shallow sections (1.5 – 2 m)
- Outline of resin palisaded earth thermal heat exchangers
- Heat collection experiments at trial homes

(2) Regarding hot water supply preheating systems in hot spring areas

- Background of research on utilizing the heat from hot springs (utilizing unused

springs and waste hot water following use)

- Issues with conventional heat exchangers (metal and resin circular type)
- Outline of resin palisaded earth thermal heat exchangers
- Outline of hot water supply preheating systems at hot spring facilities and heat recovery experiments

(Questions)

- How much time is required to lay heat exchangers underground? → Work can be completed within a matter of hours when using heavy machinery.
- Are resin palisaded earth thermal heat exchangers only available through the company introduced during the talk?
  → I heard that they possess patents etc. for this equipment.

2. Regarding District Heat Supplies in Central Sapporo City

(1) District heat supplies in central Sapporo City
(A central energy sensor supplies heat at 190 °C and cools it down to 100 °C.)

(2) Initiatives utilizing cogeneration

(3) Utilization of unused energy etc. (Snow melt water (45 °C) is supplied in addition to hot and cold water.)

(4) Effects through the development of energy throughout the whole area

(5) Future initiatives in central Sapporo City (Increase the number of energy supply points.)

(Questions)

- Have you decided on the locations where you will increase the number of energy supply points?

→ So far, we have decided on 1 location. We will sound out other potential locations in cases where plans for major construction work are in place. This is because the heat supply plants cannot be easily installed unless the site has a space of 100,000 m2 or more.

- Will installation not be carried out under the supervision of the municipalities concerned? □ The way in which we go about this is for public corporations to request private corporations to explore the potential for installation at sites.

(Results)

- The Japanese company Sekisui Chemical Co. Ltd. has already successfully installed earth thermal heat pumps in Ulaanbaatar.
- With this project, there is the possibility that Hokkaido Research Organization and other public bodies will act as the representative operators on the Japanese side for subsidized work to put facilities in place.

- District heat supplies have been installed in central Ulaanbaatar and there is the potential to introduce further systems when expanding the number of heat supply districts in the future.

② Seminar in Kita-Kyushu

Following the events held in Sapporo, we travelled to Kitakyushu City and participated in a seminar held there. The schedule for the program was as follows.

Date : October 20, 2016 (Thu.), 09:30 – 17:40

Venue : Riga Royal Hotel Kokura "ORCHID" (Kokurakita Ward. Kita-Kyushu City)

Attendees : International Cooperation Office, Ministry of the Environment
Representatives from Mongolia, Indonesia, Vietnam, Thailand, Myanmar, Cambodia and Malaysia
City to City Collaboration representatives from Japan (Kanagawa Prefecture, Yokohama City, Kawasaki City, Fukushima City etc.)
Institute for Global Environmental Strategies (IGES)
Kita-Kyushu Urban Center
Air Pollution Reducing Department of Ulaanbaatar City,
Hokkaido Government, OECC

Program

| Time | Presentation Topic |
|---|---|
| 09:30-09:35 | Opening remarks　Mr. Mizutani, Ministry of the Environment |
| 09:35-10:10 | JCM City to City Collaboration Project and JCM Finance Support Scheme |
| 10:10-10:50 | Examples of proposals for JCM projects (Kitakyushu City, Yokohama City) |
| 10:50-11:05 | Coffee Break |
| 11:05-11:45 | Technology Selection and Budgeting in General Waste Disposal<br>Kita-Kyushu International Techno-cooperative Association |
| 11:45-12:30 | Examples of Initiatives carried out by Overseas Municipalities participating in the Fiscal Year 2016 City to City Collaboration Project (Part 1)<br>(Cambodia (2 titles), Indonesia, Malaysia) |
| 12:30-13:30 | Lunch |
| 13:30-14:30 | Examples of Initiatives carried out by Overseas Municipalities participating in the Fiscal Year 2016 City to City Collaboration Project (Part 2)<br>(Mongolia, Myanmar (2 titles), Thailand, Vietnam) |
| 14:30-15:40 | Discussion 1 – "Current Status of Surveys and Issues in getting Projects off the Ground"<br>(Hokkaido, Fukushima City, Kanagawa Prefecture and related parties) |
| 15:40-16:00 | Coffee Break |

| | |
|---|---|
| 16:00-17:30 | Discussion 2 – "Current Status of Surveys, Issues in getting Projects off the Ground and Proposals for Solutions"<br>(Kawasaki City, Yokohama City, Kitakyushu City and related parties) |
| 17:30 | Closing remarks |

(2) Presentation

Representatives from Ulaanbaatar Department for the Reduction of Air Pollution and the National University of Mongolia were invited as key players involved with the environment in Ulaanbaatar. The content of their talks in the "Examples of Initiatives carried out by Overseas Municipalities" segments is as follows.

"Current Status of Air Pollution in Ulaanbaatar" (Ulaanbaatar Department for the Reduction of Air Pollution)

- Causes of air pollution in Ulaanbaatar
- Monitoring of soot and dust
- Transitions in air pollution

Representatives from Hokkaido Government were invited as a Japanese municipality to give a talk along with OECCC on the "Current Status of Surveys and Issues in getting Projects off the Ground," the content of which is as follows.

"Regarding District Heat Supplies in Central Sapporo City"

- Background behind the surveys
- System under which the surveys were implements and targets of the surveys (3 sectors)
- Past case studies from Hokkaido and Sapporo City

There were no questions concerning Mongolia, given that this was the first instance of participation and that there are yet to be any examples of projects that have been put into practice.

(3) Results of the seminar and impression

(Results)

- This workshop facilitated the sharing of a wide range of information, including the status of municipal collaboration in other countries and examples of specific case studies, thus serving as a useful point of reference for dealing with future proposals.
- The municipalities participating in the workshop were able to exchange views on each municipality's systems for dealing with projects.

(Impression)

- The talks given by each country and municipality were extremely long and the content was wordy, which meant that the speakers spoke too quickly and it was

difficult to pick up and understand everything.

- In the talks given by representatives from other countries, much of the content consisted of specific requests rather than expectations for the City to City Collaboration Project. We felt that it would be difficult for municipalities to meet these requests.
- Even in cases where projects had materialized, some were of the opinion that the overseas subsidiaries of Japanese companies would need to assume main control over projects.

2. JCM City to City Collaboration Seminar (Tokyo)

(1) Overview of the seminar

We participated along with representatives from Ulaanbaatar, Mongolia in a seminar on surveys for City to City Collaboration held by the Ministry of the Environment in Shinbashi, Tokyo. For this session, there was a closed seminar in the morning and a public seminar in the afternoon. During the morning seminar, the participants were split into two groups and reported on the state of progress of the proposals for the current fiscal year. In the afternoon, a panel discussion was held among municipalities.

Date : January 23, 2017 (Mon.), 09:00 – 11:00, 14:00 – 17:00

Venue : TKP Shinbashi Conference Center (morning)
Iino Hall and Conference Center (afternoon)

Attendees : International Cooperation Office, Ministry of the Environment
Representatives from Mongolia, Indonesia, Vietnam, Thailand, Myanmar, Cambodia and Malaysia
City to City Collaboration representatives from Japan (Kanagawa Prefecture, Yokohama City, Kawasaki City, Fukushima City etc.)
Institute for Global Environmental Strategies (IGES)
Kita-Kyushu Urban Center
Air Pollution Reducing Department of Ulaanbaatar City,
Hokkaido Government, OECC

Program

Morning (closed seminar)

| Time | Topics | |
|---|---|---|
| 09:00-09:05 | Opening remarks from the organizers Mr. Mizutani, Director of the International Cooperation Office, Ministry of the Environment | |
| 09:05-09:10 | Move to venue (Group B moves to a separate room) | |
| 09:10-10:10 | Section 1: Reports on proposals | |
| | Group A | Group B |

| | | |
|---|---|---|
| | - Siem Reap City, Cambodia<br>- Bali Province, Indonesia<br>- Ayeyarwady Region, Myanmar<br>- Rayong Province, Thailand<br>- Phnom Penh Municipality, Cambodia<br>- Haiphong City, Vietnam<br>- Iskandar Development Area, Malaysia | - BatamCity, Indonesia<br>- Yangon City, Malaysia<br>- Bangkok City, Thailand<br>- Ulaanbaatar City, Mongolia |
| 10:10-11:30 | Coffee Break | |
| 10:30-11:00 | Part 2: Overview of the Funding Support Scheme<br>(1) Projects to fund facilities<br>Mr. Bannai, Global Environment Centre Foundation<br>(2) JCM Japan Fund (JFJCM)<br>Mr. Teshima, Asian Development Bank<br>(3) Green Climate Fund (GCF)<br>Mr. Maruyama, Mitsubishi UFJ Morgan Stanley | |

Afternoon (open seminar)

| | |
|---|---|
| 14:00-14:10 | Opening remarks from the organizers Mr. Kajiwara, Vice-Minister for Global Environmental Affairs, Ministry of the Environment |
| 14:10-14:25 | Promoting Low Carbon Initiatives in Asia's Cities that utilize City to City Collaboration (Ministry of the Environment Japan) |
| 14:25-15:00 | Introduction to the Funding Support Scheme to promote Low Carbon Initiatives in Asia's Cities and Case Studies<br>(1) Projects to fund facilities<br>(2) JCM Japan Fund (JFJCM)<br>(3) Green Climate Fund (GCF) |
| 14:25-15:50 | Part 1 – "Introduction to Initiatives undertaken by Participating Cities in the City to City Collaboration Project<br>(1) Bali Province, Indonesia (Tokyo Metropolis)<br>(2) Rayong Province, Thailand (Yokohama City)<br>(3) Ayeyarwady Region, Myanmar (Fukushima City)<br>(4) Haiphong City, Vietnam |
| 15:50-16:00 | Coffee Break |
| 16:00-17:20 | Part 2 – "Panel Discussion"<br>Japanese municipalities: Hokkaido Government/Sapporo City, Kawasaki City, Kanagawa Prefecture, Kitakyushu City<br>Overseas municipalities: Ulaanbaatar City, Rayong Province |
| 17:20 | Closing remarks |

(2) Presentation

Morning

The content of the explanations provided by OECC is as follows.

- Content of the most recent surveys (surveys and interviews)
- Proposals made under 3 sectors (renewable energy, energy saving and waste disposal)
- Status of the proposals and future initiatives

Afternoon

The participants in this afternoon session included Hokkaido Government and Sapporo City from among Japanese municipalities and Ulaanbaatar City's Bureau for the Natural Environment from among overseas municipalities. They discussed the following points during their talks.

- Status of Joint Crediting Mechanism (JCM) Formation Feasibility Investigation Work in municipal policies
- Matters that had become apparent upon reflection on the activities conducted as part of Joint Crediting Mechanism (JCM) Formation Feasibility Investigation Work for the current fiscal year
- The significance of City to City Collaboration, its merits for municipalities, and its issues and solutions

(3) Results of the seminar and impression

(Results)

During this workshop, we were able to hear about the following directly from the municipalities of the countries concerned, thus proving a useful point of reference for future proposals.

- Ways of thinking concerning support through City to City Collaboration
- Words of caution for when creating plans (not to set goals that are too high)
- Support organizations and activities for local private businesses

We were able to understand the status of initiatives for the JCM Project among the various municipalities.

(Impression)

This seminar consisted mainly of introductions to specific cases and the majority of presentations were conducted from the Japanese side. The content was relatively easy to understand, but the scripts for the talks were too long and had to be cut due to time constraints.

The presentation scripts contained too much content and it was difficult to get a total understanding to the content through a casual reading. In order to understand what was being said fully, it was necessary to reread the scripts later on.

We were able to sympathize with the opinions of Mr. Mizutani, Ministry of the Environment, in the following ways.

- The municipalities and other concerned parties are involved in this project from the standpoint of avoiding a repeat of the kind of environmental situation experienced by Japan 40 – 50 years ago.

- Improvements to the environment are not something which can be achieved easily in the short term. They require ongoing support


View of the morning session



View of the afternoon session


View of the panel discussion