Summary of CDM/ JI Feasibility Study Report FY2009

Title of Feasibility Study

Programmatic CDM Feasibility Study for Electrical Power Saving at Locomotive Factories in China

Implementing Entity

Mitsubishi Research Institute, Inc.

Research Implementation Structure

Corporate names contributing to the program and their roles are as follows:

- Factory A, Factory B, Factory C, Factory D and Factory E
- Company A Compaby B
- Energy Service Company, ESCO. Joint company of China and Japan (Cooperative Counterpart, input of basic information)
- Beijing Lifangjie Huanjingjishu Youxiangongsi (Local Research Consultant, input of data for establishing PDD, input of technical data, input of data related to assessment of business potency, arranging and attending for local research)

1. Overview of the Project

Based on the CDM/ JI Feasibility Study FY2008 “CDM Feasibility Study for Waste Electricity Utilization at a Locomotive Plant in China” (Individual CDM for Factory B), this project conducts programmatic CDM for locomotive manufacturing and repairing plants in 5 places in China (Beijing, Liaoning, Sichuan, Henan, Hubei). At the moment, the electricity generated in the performance test before shipping diesel generating unit is lost by water rheostat. By this project, the electricity is recovered by the inverter installed with Japanese technological guidance and the recovered electricity is utilized in the factories. It replaces a part of the electricity purchased from the network. It is estimated that 14,215t-CO2 average per year and 142,147t-CO2/year in 10 years from 2011 to 2020 will be reduced in the 5 places in total. For some factories, waste heat and waste gas generated in testing diesel generating unit are also able to be utilized, so we will consider registering it as CDM as well. While each factory practices individual CDM program activities (CPAs) under programmatic CDM, Energy Service Company (ESCO) will be a Coordinating/Managing Entity of Program of Activities (PoA) and will conduct the project together with the factories. The facilities will be installed at the factories around June-December in 2010.

Application Methodology

Revised ACM0012

2. Contents of the Research

Below are the tasks at the time of proposal of this research.

(1) Tasks of the Research

Task 1 Approval of Proposal for Methodology Revision

It is necessary to revise or to newly propose the methodology because there is no applicable methodology for the project which recover and utilize waste electricity. Therefore, since the CDM/ JI Feasibility Study FY2008 “CDM Feasibility Study for Waste Electricity Utilization at a Locomotive Plant in China”, we have been working on revising the small-scale methodology AMS-III.Q “Waste Energy Recovery (gas/heat/pressure) Projects”. AMS-III.Q is a methodology for utilizing waste gas, waste heat and waste pressure, so utilizing waste electricity is not in the scope of it. However, it allows transforming recovered waste energy into electrical energy to utilize. From a rational point of view, it must be worthwhile and rather preferable to utilize waste energy recovered as waste electrical energy. In the research last year, the revision proposal submitted to the small-scale CDM working group was on the agenda at the 20th meeting held from 29.April to 2.May in 2009, but it was rejected because there was a misunderstanding of the contents about the project (It was wrongly understood that waste electricity was used for water treatment. Actually, it was not used anywhere.). Thus, we applied again adding the explanation of the misunderstood point. We anticipate the approval in September 2009, and we will carry on establishing POA-DD and CPA-DD. If it is not approved, we will need to propose again.

Task 2 Coordinating PoA

While there are high expectations for Programmatic CDM (PoA) as a new type of activity accumulating the small-scale emission reductions, there are problems such as taking lots of time for coordinating and registering because there are many stakeholders. We will carry on the project with the help of the senior companies (Company A groups and Company B groups) because it deals with the factories which have a stake belonging to two senior companies. We will visit Company A and Company B with ESCO to discuss how to cooperate. Since the restructuring and amalgamation of locomotive factories accelerates in China, we will see the movement.

Task 3 Challenges for Operation

It is particularly necessary to check the details of ESCO operation (spec of energy saving facility, amount of investment, risk sharing ratio, benefit sharing ratio, selection of manufactures etc.) and obtain the factories’ agreements. We estimate a smooth process of the project by picking out the challenges from the pilot operation continuing since last year at Factory A, and stylizing the other factories. We will check the details of ESCO operation (spec of energy saving facility, amount of investment, risk sharing ratio, benefit sharing ratio, selection of manufactures etc.). We will study recovering waste electricity mainly and the availability of recovering and utilizing waste gas and waste heat as well. Based on the experience at Factory A, we will collect the data and the points to be checked, then will distribute the questionnaires to the factories. We will conduct the site visit based on the result of the questionnaires.

(3) Results of the Research

The research can be divided into two major steps.

Step 1: The electricity consumption situation at each factory, the detail survey of CDM eligibility

Step 2: Establishing the framework for making programmatic CDM of the whole 5 factories

However, the approval of the methodology beforehand is the major premise. The development and approval of the proposal for methodology revision occupied the large part of the research as written below.

Below are the main contents of research for each challenge:

Result 1 Development of Proposal for Methodology Revision

We had waited for the approval of the proposal for the revision of AMS-III.Q., but we couldn't get it in September 2009. Taking the comment, we considered the two things below.

- Revision of ACM0012 (Consolidated baseline methodology for GHG emission reductions for waste gas or heat or waste pressure based energy system)
- Revision of AMS-III.Q. (resubmission)

Result 2 Coordinating PoA

Our local consultant visited ESCO, Company A and Company B and discussed how to corporate with. Since the restructuring and amalgamation of locomotive factories accelerates in China, we have to continue to see the movement.

Result 3 Challenges for Operation

We checked the details of ESCO operation (spec of energy saving facility, amount of investment, risk sharing ratio, benefit sharing ratio, selection of manufactures etc.). We studied recovering waste electricity mainly and the availability of recovering and utilizing waste gas and waste heat as well. Based on the experience at Factory A, we collected the data and the points to be checked, then distributed the questionnaires to the factories. We conducted the site visit based on the result of the questionnaires.

3. Operating the Project

The possibility of applying Clean Development Mechanism to the project will be examined in this section, according to the amended project proposal of "Waste Energy Recovery (gas/ heat/ electricity/ pressure) Projects", which would add the aspect of waste electricity into AMS-III.Q. waste energy project.

(1) Boundary and Baseline

Proposal for Methodology Revision

There was an examination of the proposal of methodology revision from 21st to 24th September 2009. The result was "not to recommend revising AMS-III.Q for the proposal". It was because there is a condition of application in AMS.III.Q. that "gases that have intrinsic value in a spot

market as energy carrier or chemical (e.g., natural gas, hydrogen, liquefied petroleum gas, or their substitutes) are not eligible under this category". It is said that "electricity is certainly an energy carrier that has intrinsic value and thus establishing that in the baseline the electricity is truly wasted or abandoned would require significant documentation beyond the simplified approach defined in AMS-III.Q". And it is also said that the cap (the upper limit) needs to be set so that the amount of wasted electricity cannot be increased intentionally. Following the recommendation, we decided to consider the two options.

Option 1: Revision of ACM0012

ACM0012（Consolidated baseline methodology for GHG emission reductions for waste gas or waste heat or waste pressure based energy system） can be the applicable methodology to make effective use of energy which is to be lost without the project. However, it is the methodology for utilizing waste gas, waste heat and waste pressure. The utilization of "waste electricity" is not in the scope of the methodology. It is basically the large-scale version of AMS-III.Q and it takes stricter approach. In this project, we applied for the proposal of the revision of ACM0012 to the CDM Executive Board. We established the proposal to ask for expansion of the range of application to utilizing waste electricity and submitted it to the UN. The discussion is planned at the 44th methodology panel (from 19th to 23rd April 2010). It has theoretically no problem to apply for the revision to include waste electricity because it has the same idea of making effective use of waste energy.

Overview of the Proposal for ACM0012 Revision (proposed revisions are underlined)

Definition

Waste energy: By-products of gas/heat/electricity/pressure generated from the machines or the industrial process which have the possibility of generating re-usable energy, and which can be proved that it was wasted. For example, gas flared and emitted into the atmosphere, gas, electricity or pressure not retrieved (thus wasted).

Waste electricity: electrical energy which cannot be used without transforming (transforming from direct current to alternate current through inverter). WECM for waste electricity means electricity before transforming.

Option 2: Revision of AMS-III.Q (resubmission)

The main challenge was that electricity which has value in its original form was not in the scope of the methodology. However, at the examination of diesel generating unit, generated electricity cannot be used in the network in its original form because the load is changed according to the rule and also because it is direct current. We explained this when we resubmit. In addition, we can refer the idea of ACM0012 for setting the project cap (upper limit).

We take the revision application of ACM0012 into consideration as below.

Project Boundary

Each locomotive factory and the grid from which each locomotive factory purchases electricity will be the project boundary.

Baseline Scenario

It is highly probable that the baseline scenario without this project will be the current system (waste electricity is lost by water rheostat). Use of electricity other than from the grid is impossible at baseline. In China, there is no similar project recovering and using waste electricity in locomotive factories. This PoA including the project at Favtory A, last year is the first challenge. Company A and Company B, the senior companies of the factories are Chinese state enterprises. So, they are given the energy saving target (The energy consumption rate should be reduced by 20% by 2010 below 2005 levels) from State-owned Assets Supervision and Administration Commission of the State Council, but there is no benchmark for specific machines. Therefore, it is voluntary to conduct the project. The factories have poor knowledge and experiences of energy saving. They are inactive to introduce because the IRR of the system for recovering waste electricity is low.

Baseline emissions

The electricity supplied from the existing grid is replaced. The baseline emission ($BE_{elec,y}$) is calculated as follows.

$$BE_{elec,y} = f_{cap} * f_{wcm} * \sum_{j} \sum_{i} (EG_{i,j,y} * EF_{Elec,i,j,y})$$

$BE_{elec,y}$	=	Baseline emission (tCO_2) due to electricity replaced in the year y
$EG_{i,j,y}$	=	Electricity (MWh) purchased from the grid without the PoA in the year y
$EF_{Elec,i,j,y}$	=	CO_2 emission factor of electricity supplied from the grid i（tCO_2/MWh）
f_{wcm}	=	1（$EG_{i,j,y}$ is assumed to be all generated by waste electrisity）
f_{cap}	=	1（It is assumed that the amount of waste electricity does not change between before and after the project.）

		Recovered electricity (MWh) = electricity replaced by the grid	Grid emission factor （tCO_2/MWh）	Annual CO_2 reduction (tCO_2/year)
Factory A	（Beijing）	1,427	0.89355	1,275
Factory B	(Liaoning)	4,240	0.92675	3,929
Factory C	(Sichuan)	4,439	0.85285	3,786
Factory D	(Henan)	3,394	0.85285	2,895

Factory E (Hubei)	2,731	0.85285	2,329
Total			14,215

Assumptions:

- Each factory introduces one system for recovering waste electricity (transforming efficiency 80%)
- One system can cover 60% of the tests at a factory.
- The testing time for one locomotive is 14.5 hours.

(2) Project emissions

No emission from the project. Leakage is not considered in this methodology.

(3) Monitoring Plan

According to ACM0012, direct measure of the amount of waste energy is necessary. It is planned to introduce a sensor for measuring.

(4) GHG emissions reductions

	2011	2012	・・・	2020
Recovery and utilization of waste electricity	14,215 t	14,215 t	14,215 t	14,215 t

(5) Duration of Project Activity/ Crediting Period

The project starting date is the date when each factory signs a contract of the system. For the first installation in autumn 2010, it is probable that the contracts may be signed around June 2010. Following the guidance about advance verification and evaluation of CDM, the factories need to submit the notification of advance consideration to National Development and Reform Commission and UNFCCC as soon as possible. The standard project period is 20 years, the system working lifetime. The credit acquisition period is 10 years.

(6) Environmental Impact/ Other Indirect Effect

This project sets up the energy saving system in the factories and it is similar with the third category of Chinese environmental impact assessment law. When it fits in the third category, the governmental approval is not necessary, but we need to report according to the environmental effect registration table. It is thought that the negative environmental impact by this project does not exist or is avoidable.

(7) Stakeholders' Comments

Before the operation, the briefing session for the stakeholders such as neighborhood residents, the government officials, stockholders and factory workers will be held and we will listen to their opinions. It is planned in summer 2010.

(8) Implementation structure

- ESCO (located in Beijing)

ESCO plays a role as a coordinating/managing entity. As for the primary investment for the project, ESCO will make the whole investment by its own capital. The installed facility will be owned by ESCO. ESCO can sell the recovered electricity to the factories. In addition to the income from selling the electricity, the CER sales will be the ESCO's income.

- Locomotive Factories

Locomotive factories will stop purchasing electricity from the network, and they will purchase electricity from ESCO at about 70% of the network electricity unit cost. ESCO will decide formulaic business plan, but they will decide the specific plans together with the factories. The factories will have merits that they can purchase electricity at lower cost than the network and that the cost of coal is lower than that of heat.

- Senior Companies of Locomotive Factories

Cooperation of Copmay A and Company B is vital for conducting the project smoothly as programmatic CDM because it is targeted for the factories under those two major locomotive manufactures in China.

- Beijing Lifangjie Huanjingjishu Youxiangongsi

Collecting data related to establishing PDD. It is not included in the project participants on PDD.

- Mitsubishi Research Institute

It is not a project participant, but it is agreed that MRI is in charge of the necessary administration for establishing PDD and crediting. It is not included in the project participant on PDD.

(9) Financial Plan

The rough estimation of the primary investment (system development and installation cost) is 480 million yen (about 80million yen * 5 factories). ESCO will make the whole investment by its own capital. The installed facility is owned by ESCO. Vehicle factories will stop purchasing electricity from the network, and they will purchase electricity from ESCO at about 70% of the network electricity unit cost.

(10) Economic Analysis

The targets of this research are the 5 factories. The profitability of Factory D is calculated as a sample here. The investment means the system installation cost, the income is the sales of recovered electricity (from each factory to ESCO) and there will be other maintenance fee every year. The IRR in Factory D (for 10 years) is calculated as below.

- Without credit 8.0%
- With credit 11.2%

Form now on, we will investigate the details of the profitability of the 5 factories including the main factory, and will prove that additionality of the CDM can be guaranteed at all the factories.

(11) Demonstration of Additionality

The additionality of the project is proved by “Tool for the demonstration and assessment of additionality”. The tool takes the steps below. Basically, it is proved by the investment analysis. Technical obstacles by obstacle analysis and general obstacle can also be proved, but it is difficult to collect the necessary data for them.

Step 1: Identification of alternatives to the project activity

Step 2: Investment analysis

Step 3: Barrier analysis

Step 4: Common practice analysis

- Investment Analysis

As shown in the economic potential analysis, the possibility that the factory will have the system to recover waste electricity by itself is low because of the low IRR even after taking the sales of electricity selling into consideration. If ESCO will have the system, the IRR is low when there is no income by the CDM credit. And it has no attraction to make investments.

- Technological barriers

Locomotive factories in China have poor knowledge and experiences of energy saving, so they are satisfied with the existing system. Therefore, the possibility that energy saving facility based on Japanese technology is installed is very low.

- Barriers due to prevailing practice

As written above, in China, there is no similar project recovering and using waste electricity in locomotive factories. This program including the project at Beijing Feb.7th Railway Transportation Equipment Co., Ltd., last year is the first challenge.

(12) Feasibility

A Japanese company and a Chinese company have jointly established a new company. It is a company established for promoting energy saving operation, so they share mutual interest with factories. The targeted factories which carry on the individual CDM program activities (CPAs) based on the programmatic CDM have agreed on conducting CDM practices.

4. Co-benefits Effects in the Host Country

(1) Evaluation of Pollution Prevention in the Host Country

Regarding SO_2 and NO_x, together with CO_2, baseline and project emission was estimated and the annual emission reduction by conducting the project will be calculated. Baseline emission was calculated based on the measured data of waste electricity at the factories and the fuel-specific grid emission factors. The project emission was set to be zero because waste electricity is utilized. Thus, it gives the reduction of 487 t- SO_2 and 175 t- NO_X in 10 years.

(2) Proposal of Co-benefit index

As for “co-benefit index”, we proposed integrating the environmental effect of CO_2, SO_2 and NO_x by using currency conversion.

5. Contribution to Sustainable Development

The project contributes to the improvement of energy security in China because it enables to make effective use of energy. In addition, the amount of coal consumption is reduced as coal fired power generation of the network is replaced. So, it will result in reducing CO_2 emission, one of GHG, and SO_2 and NO_x emissions in proportion to the reduction of coal consumption. Coal ash to be wasted can also be inhibited.

By the way, we drew upon the literature review as for the original emission factors of air pollution substances in this project. It is important for quantification of the co-benefit to establish the original emission factors in China with a cooperation of Japan. It will be useful information both for China and Japan.

For that purpose or for the necessity of the future MRV of CO_2, how about suggesting the establishment of MRV system of air pollution substances including CO2 to China and other developing countries? In concrete terms, setting up the concept of the whole GHG and air pollution substances inventory system (by sectors and by regions), and setting up the details. It means to create the amount of activity and emission factor data and to create a software which can effectively conduct them, in addition to setting the roles of the government organizations, companies as GHG emitter and other organization, their cooperative framework (including the one between the government organizations), and the monitoring system of GHG and air pollution substances (data input, check, revision of emission factor etc.). By creating the framework above, it will be able to understand the national and local data of emissions in China or other developing countries. Then it will lead to establishing the original emission factors of each air pollution substance.

The steps toward implementation of the above are as follows:
Step 1: development of international co-benefit guidelines originated in Japan;
Step 2: accumulation of data and establishment of clearinghouse together with partner countries
Step 3: Integration into the MRV system

Firstly, Japan needs to develop internationally acceptable co-benefit guidelines and next, accumulate data of several countries and establish clearinghouse together with partner countries sharing Japanese knowledge. And then, it will be integrated into the MRV system. In order to contribute to global environment protection, Japan can help development of software as well as promote installation of Japanese energy-saving devices. It is necessary to provide service in accordance with the particular needs of each individual country at the initiative of Japan as described in the three steps above.