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Impact of the Clean Development Mechanism (CDM) on Geothermal Development

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ABSTRACT

The Clean Development Mechanism (CDM) established under the guiding principles of the Kyoto Protocol has encouraged organizations in developed nations to fund geothermal projects in developing nations. The CDM can in that way promote and/or accelerate the development of geothermal energy utilization in developing countries. As a result CDM is becoming a very powerful incentive for geothermal projects.

At last, the geothermal industry can participate in CDM on a full power. The environment that the CDM has created, the ability to sell carbon credits, is an important additional revenue stream contributing to the development of commercial scale geothermal projects and makes a number of geothermal projects attractive that have hitherto been uneconomic.

Geysir Green Energy is a shareholder in Shaanxi Green Energy Geothermal Development Co. (SGE) through its subsidiary Enex China. The first project of the company was the construction of a geothermal district heating system in the city of Xianyang in Shaanxi Province, China. The geothermal heating system is replacing coal burning facilities, thereby significantly reducing emission in the community. The approval of the CDM methodology AM0072, Fossil Fuel Displacement by Geothermal Resources for Space Heating, will give the district heating project in Xianyang a new economy, which will enable a further expansion of the project. SGE is currently in the application process for the validation and subsequently registration of the Xianyang project as a CDM project.

1. INTRODUCTION

The Clean Development Mechanism (CDM) established under the guiding principles of the Kyoto Protocol has encouraged organizations in developed nations to fund renewable projects in developing nations. The CDM allows emission-reduction/removal projects in developing countries to earn carbon credits, Certified Emission Reductions (CERs), with 1 tonne of CO_2 equivalent equaling one carbon credit each equivalent to 1 tonne of CO_2. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol (UNFCCC - Clean Development Mechanism, 2009).

The Kyoto Protocol lays down the mechanics of the CDM process. The basis for an approval of a CDM project is the requirement of a Designated National Authority (DNA) in the host countries (where a project takes place). The role of the DNA is to authorize and approve a participation in CDM project. This may be done on the basis that the project complies with various requirements, including contributing to Sustainable Development in the host country (UNFCCC - Clean Development Mechanism, 2009).

All CDM projects must use a baseline and monitoring methodology that has been approved by the CDM Executive Board (EB). If an approved methodology does not fit the project activity, a new methodology needs to be developed and approved by the EB (CDM Rulebook, 2009). The baseline methodology is used to construct the project's baseline, which estimates the level of GHG emission that would occur in the absence of the registered CDM project and, based on this, the amount of GHG emission that the project will reduce, store or avoid. These reductions are monetized as tradable carbon credits, CERs. (Pearson and Kill, 2004) This information must be defined in a project design document (PDD) which is a key document involved in the validation and registration of a CDM project activity.

After a project has been approved on the basis that it will indeed reduce emissions as compared with a baseline of anticipated emissions that would have occurred without the project, the actual emissions must be validated and the EB will register the CERs. (United Nations Development Programme, 2003)

Finally, the geothermal industry can participate in CDM at full power. This paper will recapitulate the impact that CDM will have on geothermal development as well as describe the CDM application process for the geothermal district heating project in Xianyang. Experience achieved by this project will definitely stimulate the further development of geothermal district heating systems in China, a clean, stable and inexpensive energy provider.

2. CDM AND GEOTHERMAL

The development of geothermal energy utilization, both electricity and direct use, appear to be increasing significantly in the first decade of the 21st Century. However, the environment that the CDM creates should promote the development furthermore (Gawell and Greenberg, 2007). The geothermal industry should see the CDM as a chance, but not as a panacea that will achieve an overall market breakthrough (Michaelowa, 2001).

The overall prospects for geothermal energy utilization, either for electricity generation or direct use are excellent. Today, the highest potential and the largest amount of undeveloped geothermal energy is mainly connected to two regions, the East African Rift Valley, which incorporates about 12 countries, and the western margin of South America. (U.S. Department of State's Bureau of International Information Programs, 2008) Many other regions in the world possess resources with high direct use potential. Nevertheless, not all countries with geothermal potential can afford to turn the resource into power or make them available for heating. For that reason it is an interesting fact that many of the attractive geothermal potential areas are situated in countries without emission targets under the Kyoto Protocol, thus potential CDM host

countries (Figure 1). Recognizing that each tonne of greenhouse gas (GHG) emission reduction can be securitized and sold in the emerging GHG market, developing countries with an attractive geothermal potential and geothermal expansion plans have much to gain from developing geothermal CDM opportunities (Michaelowa, 2001).

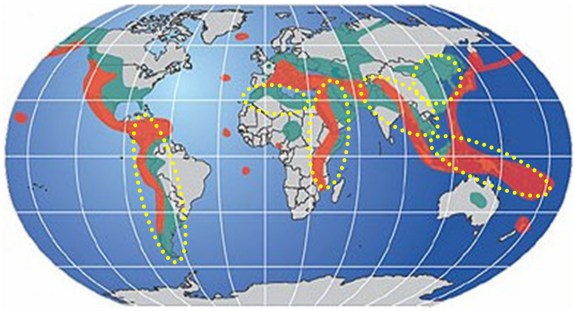

Figure 1: World geothermal potential (BRGM, 2009). The red area indicates high temperature areas, green area low temperature areas and gray areas are without geothermal potential. The yellow circles mark potential CMD host countries.

Recently, the geothermal industry has been facing bad profitability for many interesting geothermal projects due to high investment cost, high interest rates and low tariffs. There is no doubt that the revenue stream generated from the selling of CERs is going to assist the project activity to overcome those tariff barriers. This will contribute to a further acceleration in the development of geothermal utilization worldwide.

At high Certified Emission Reductions (CERs) unit prices, geothermal projects can cover a significant share of the investment costs through CERs sales and may thus make projects attractive that have hitherto been uneconomic. (Michaelowa, 2001) Thereby, the CDM have become a powerful financial incentive and increased geothermal competitiveness with traditionally cheaper fossil-fuel fired systems, both for electricity generation and space heating.

2.1 Approved Methodologies Usable for Geothermal Utilization

Two approved CDM methodologies for the geothermal industry are available:

- ACM0002, Consolidated baseline methodology for grid-connected electricity generation from renewable sources, for geothermal power generation and methodology
- AM0072, Fossil Fuel Displacement by Geothermal Resource for Space Heating, for geothermal space heating.

Several geothermal power generation projects have been registered as CDM projects as the methodology, for such production, has been available for a while. That is not the case for geothermal space heating projects. Today (Sept. 2009), no geothermal space heating projects have been registered as CDM projects, however it is likely that several projects are already in the pipeline. The industry will without a doubt see the number of registered space heating projects rise rapidly. The approval of the CDM methodology for geothermal space heating projects is a breakthrough for district heating projects in developing countries. The environment that the CDM has created, the ability to sell carbon credits, is an important additional revenue stream contributing to the development of commercial scale geothermal space heating projects and makes a number of geothermal projects attractive that have hitherto been uneconomic (Michaelowa, 2001).

3. XIANYANG PROJECT

Shaanxi Green Energy Geothermal Development Co. (SGE) is a joint venture between Enex China, an Icelandic company whose main focus is to develop geothermal projects, and Shaanxi Geothermal Construction Co. Ltd., a subsidiary of the Sinopec Group. SGE was formally established in December 2006. Geysir Green Energy is a shareholder in SGE through its subsidiary Enex China (Figure 2). The company's first project was the construction of a geothermal district heating system in the city of Xianyang in Shaanxi Province, China.

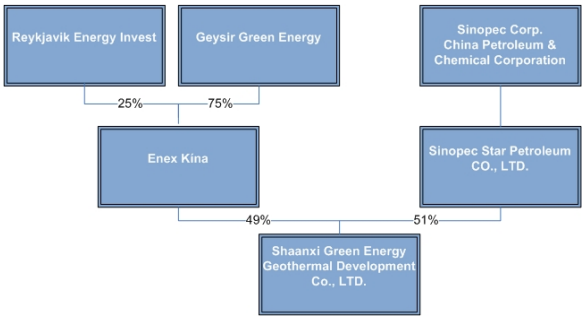

Figure 2: SGE shareholding structure.

Xianyang is a city of around 600,000 people, located close to the provincial capital of Xian (**Error! Reference source not found.**). The standard space heating technology in Xianyang, that the geothermal energy is displacing, is coal-fired boilers. The implementation of geothermal district heating system will improve the local air quality enormously by reduced burning of coal which contributes to a significant reduction of both local and global air pollution (Mitsubishi UFJ Securities, 2009).

Figure 3: Map of China and Shaanxi.

At SGE's first operational year in 2006, the space heating area was about 350,000 m^2 residential area. The space heating system has grown steadily till today, and is now (2009) producing hot water for about 900,000 m^2 of residential area. According to the project plan the heating area in 10 years is assumed to be 8,000,000 m^2.

The geothermal in Xianyang is sensitive to utilization. To further expand, SGE will have to perform re-injection of the geothermal liquid. This is imperative to ensure sustainability of the geothermal resource. However, the technical and financial barriers to the development and operation of re-injection wells makes further expansion of the geothermal district heating system uneconomical without an additional revenue stream, such as available through the generation and sale of CERs.

The Xianyang project is convenient to the approved CDM methodology AM0072, Fossil Fuel Displacement by Geothermal Resource for Space Heating; except that the project is expanding existing geothermal activity. Because the methodology does not fit the project activity entirely, the project developer decided to apply for a revision of the AM0072 methodology, intending to receive CDM validation for the project. In September 2009 the revised methodology was approved by the Meth Panel and will be on the agenda on EB 50 meeting (Oct 2009) for final approval.

Hereunder, the application process will be explained and the impact of registration described.

3.1 The Application Process

The CDM application is a time consuming process and requires a lot of paper work. When a suitable baseline and monitoring methodology has to be found, the preparation of Project Design Document (PDD) can be started which is a key document involved in the validation and registration for a CDM project activity. The PDD must:

- Describe the project and establish a project boundary;
- Describe a baseline methodology and assess additionality;
- Establish the duration and crediting period of the project;
- Describe the environmental impacts of the project;
- Provide information on the sources of public funding for the project;
- Summaries stakeholder comments;
- Describe the monitoring plan;
- Set out all relevant calculations. (CMD Rulebook, 2009).

The PDD is submitted to a Designated Operational Entity (DOE) for validation and once validated, to the CDM EB for registration. In the meantime the host country's government (DNA) needs to authorize and approve participation in the CDM project. The DNA must as well confirm that the project activity contributes to sustainable development in the country (CMD Rulebook, 2009).

Once the project has been registered, it can be implemented and monitored. In this period the project developer needs to start monitoring the project performance, according to the procedure laid out in the monitoring plan in the PDD. The monitoring results have to be submitted to the DOE for verification and certification. The verification process confirms the total number of CERs resulting from CDM projects during a specific period of time. The DOE provide the CDM EB with verification and certification reports. If the above process has been successful, the EB will issue CERs to the project developer in context with the result of the monitoring period. (United Nations Development Programme, 2003; Sterk and Wittneben, 2006)

3.1.1 Xianyang Application

In the case of the Xianyang project, the approved baseline and monitoring methodology AM0072, "Fossil Fuel Displacement by Geothermal Resources for Space Heating" did not fit the project activity entirely. For that reason the project developer applied for a revision of previous mentioned methodology. The revised methodology will enable existing geothermal district heating project to apply for a CDM validation for their future extensions.

The revised baseline and monitoring methodology AM0072 is applied to the project activity, referring to the most up-to-date versions of the "Combined tool to identify the baseline scenario and demonstrate additionality", the "Tool to calculate project emissions from electricity consumption", and the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Mitsubishi UFJ Securities, 2009).

As mentioned before the application process is a time consuming process. Figure 4 outlines the Xianyang application process in context with time. As the figure illustrates, the process covers approx. 3 years until the CERs will finally be issued.

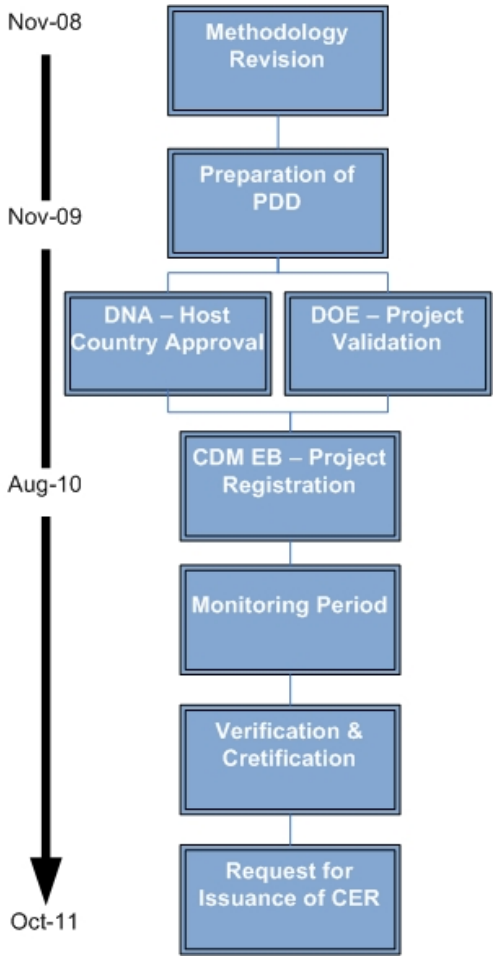

Figure 4: Application process and estimated time schedule for the Xianyang project (Sept 2009).

3.2 Emission Reduction

The use of the area's readily available geothermal energy will displace the current use of coal in boilers used for

space heating. This will lead to local air quality improvements, and also reduce the area's dependence on the non-renewable fuel, coal.

Emission reductions will be earned by the use of geothermal energy instead of the burning of fossil fuel for space heating. The first phase of CDM project activity is space heating capacity for approximately 1,500,000 m^2 that will be added to existing, pre-CDM, geothermal space heating capacity. Estimated annual emission reduction for the first phase is 53,000 tCO_2eq. As mentioned above the heating area in 10 years time is expected to achieve 8,000,000 m^2. If that works out, the total annual carbon emission reduction under the CDM project could reach 282,000 tCO_2eq.

3.3 Project Economy with CERs

Since the implementation of the initial phases of the Xianyang project, financial and regulatory barriers to further expansion became apparent. Consequently, the project required the additional revenue. Approval of the project as a CDM project will give it a new revenue stream which enables further expansion.

4. CONCLUSION

Many developing countries possess recourses with interesting geothermal potential, but cannot afford to turn the resources into power or make them available for heating. For that reason it is interesting fact that many of the attractive geothermal potential areas are situated in countries without emission targets under the Kyoto Protocol, thus potential CDM host countries.

At last, the geothermal industry can participate in CDM on a full power. The CDM will certainly provide a powerful incentive for geothermal projects as geothermal energy production only releases 1-10% of GHG emitted by comparable fossil fuel systems. The industry should see the CDM as chance that will increase geothermal competitiveness with traditionally cheaper fossil-fuel systems. The environment that the CDM has created, the ability to sell carbon credits, is an important additional revenue stream contributing to the development of commercial scale geothermal projects and makes a number of geothermal projects attractive that have hitherto been uneconomic. Recognizing that each ton of greenhouse gas (GHG) emission reduction can be securitized and sold in the emerging GHG market, developing countries with an attractive geothermal potential and geothermal expansion plans have much to gain from developing geothermal CDM opportunities.

DEFINITIONS

CDM: Clean Development Mechanism

CERs: Certified Emission Reductions

CO_2: Carbon dioxide

DNA: Designated National Authority

DOE: Designated Operational Entity

EB: Executive Board

PDD: Project Design Document

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