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CDM POTENTIAL FROM A GEOTHERMAL PERSPECTIVE – A CASE STUDY OF OLKARIA II 3RD UNIT, KENYA

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ABSTRACT

The Clean Development Mechanism (CDM) is a project-based mechanism designed to promote investment in projects that reduce or sequester emissions of greenhouse gases (GHG) in developing countries, under the Kyoto Protocol (UNFCCC). The Kyoto Protocol, which was created out of the United Nations Framework Convention on Climate Change (UNFCCC), and entered into force in February 2005, commits signatories from the industrialized nations to reduce their emissions of Greenhouse Gases (GHGs) such as carbon dioxide and methane by an average of 5.2% in the period 2008 -2012. The CDM is known as one of the flexible mechanisms under the Protocol. The CDM helps the industrialized countries meet their emissions targets by earning 'credits' for their contribution to the developing countries' emissions reductions. This investment, which is directly related to the extent that emissions are reduced, could make greenhouse gas reducing projects in developing countries (such as renewable energy or landfill gas to electricity projects) more viable. In other words, developed countries will pay developing countries money for projects that reduce emissions of GHGs by purchasing a commodity, which can be referred to as "Greenhouse Gas Emission Reductions". Thereby the project developer may obtain additional revenue streams as a result of selling this commodity to interested carbon buyers, e.g. European governments and companies.

1. INTRODUCTION

CDM Projects must:

- Be implemented in a non-Annex 1 country that is a party to the Kyoto Protocol
- Be additional to what would occur in the absence of the project activity
- Support sustainable development in the host country
- Obtain approval of the host country's Designated National Authority for the CDM
- Result in real, measurable, long-term climate change benefits

CDM Projects must not divert Official Development Assistance (ODA) or involve nuclear power.

Projects covered under the CDM include renewable energy, energy efficiency, fossil fuel switch, waste management, N_2O removal, SF_6 recovery, transportation and others. Geothermal energy therefore qualifies as a CDM project since it is a renewable energy resource.

2. HISTORY OF KENGEN CDM INITIATIVES

In 2005, Kenya ratified the Kyoto protocol, paving the way for the country to engage with developed countries in CDM projects. Most of KenGen's ongoing geothermal, hydropower and combined cycle projects could qualify under the CDM since they generate less or no carbon dioxide at all in comparison to alternative fossil fuelled plants.
KenGen's interest in CDM started in 2000 when the company wrote to the UNFCC, through the Ministry of Environment seeking support in obtaining benefits from CDM for some of the projects. However, not much progress was made. In 2005, KenGen submitted several project proposals to the Government of Belgium CDM Tender. The Tana Redevelopment project was pre-qualified among 14 short listed projects from developing countries. In early 2006 discussions were held with the Japan Carbon Fund who had shown interest in a few of the projects. The constraint that has hampered progress with the Belgium and the Japan Governments' funds is that they require KenGen to incur the costs for the whole documentation processes before they can consider the projects into their portfolio. As this would incur rigorous costs for KenGen, pursuing projects with the governments of Japan and Belgium was not a viable option at that time.

In pursuance of potential buyers of emission reductions, the KenGen Managing Director accompanied by several KenGen officers attended the Carbon Expo in Cologne, Germany in May 2006. Discussions were held with the World Bank (Bank) carbon team who promised to offer KenGen technical assistance on carbon trading.

The Bank sent a team of technical specialists in June 2006 that together with KenGen staff developed Project Idea Notes (PINs) for nine projects. The following project PINs were developed:

1. Eburru Geothermal Project
2. Olkaria II Geothermal Expansion Project
3. Redevelopment of Tana Power Station Project
4. Optimisation of Kiambere Power Project
5. Kipevu Combined Cycle Power Project
6. Sondu Miriu Power Project

3. THE CASE OF OLKARIA II EXPANSION

The Olkaria site is located in the Hell's Gate National Park, approximately 132km northwest of Nairobi by road, near Naivasha Town. The Olkaria geothermal field is located 6 km to the south of Lake Naivasha in Kenya's Rift Valley Province and occupies a circular area of roughly 80km².

Olkaria II is approximately 3km north of Olkaria I power station and was commissioned in September 2003 with two generating units. Olkaria II field covers an area of approximately 12km² and is situated in the northeast quadrant of Olkaria geothermal field. Much of the field lies within Hell's Gate National Park (Figure 1).

The objective of Olkaria II Geothermal Expansion Project is to increase the capacity at the existing Olkaria II Geothermal Power Plant, thereby generating more renewable energy for sale to the Kenya Power and Lighting Company Limited on the basis of a power purchase agreement (PPA). The project activity - electricity generation- will result in greenhouse gas (GHG) emission reductions by avoiding

CO_2 emissions from electricity generation by fossil fuel power plants, which form part of the generation mix in Kenya's energy power plants.

The project contributes to the sustainable development of Kenya by:

a) Assisting KenGen to lower the use of thermal power generation plants and use them only as stand-by power generation, thereby displacing expensive heavy fuel, diesel, and gas-fired generation, thus reducing CO_2 emissions to the atmosphere by generating energy without GHG emissions.
b) Employing local labour in construction and plant management.
c) Contributing to Kenya's fiscal revenues through the payment of taxes.
d) Helping the country improve the hydrocarbon trade balance through reduction of oil imports to be used for electricity generation.
e) Assisting poor rural communities through the implementation of community programs funded by a designated portion of the carbon revenues.
f) Increasing the number of clean energy projects in the country.

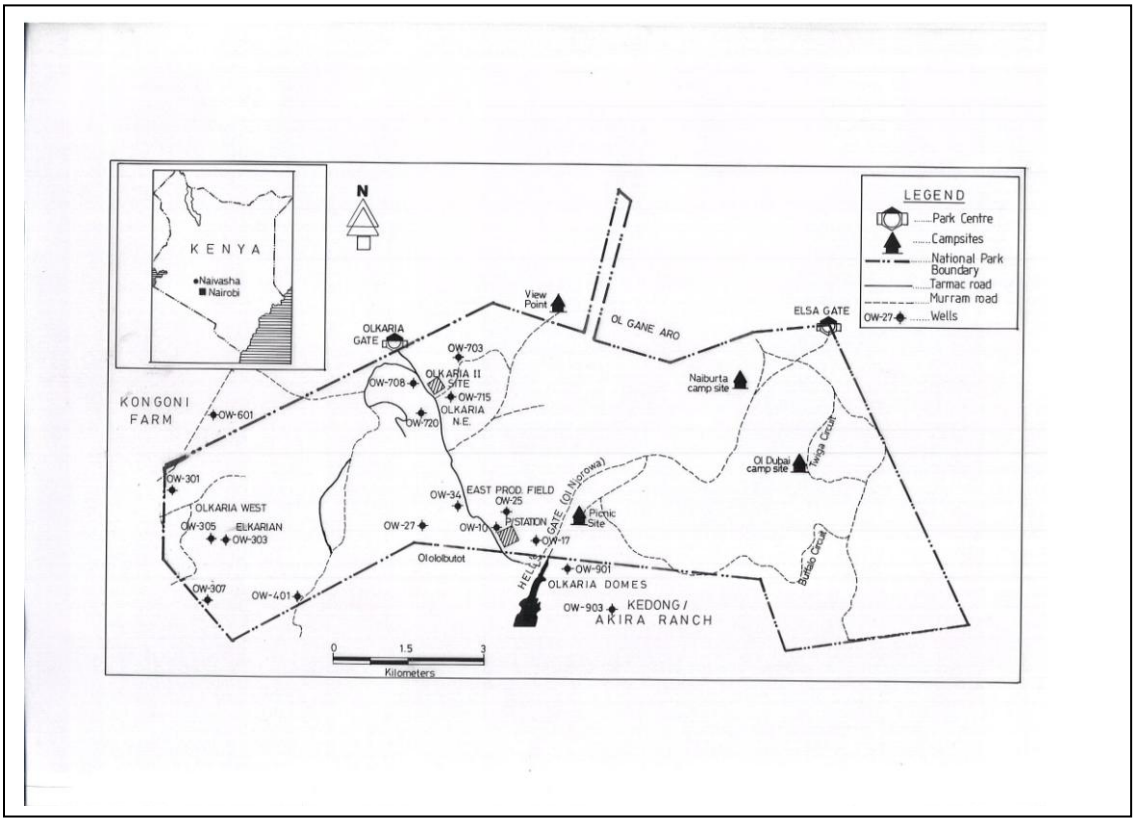

FIGURE 1: Location of Olkaria fields

3.1 Estimated amount of emission reductions over the chosen crediting period

Table 1 show the project estimated annual ERs, over the first 7-year crediting period. The resulting Combined Emission Factor for the grid is estimated at 0.6396 ton CO2e/MWh. With annual estimated generation of 276,000 MWh per year, once implemented, the project is estimated to reduce 171,026 tCO_2e annually, generating an expected total of 1,197,186 tCO_2e for the duration of the initial 7-year CDM crediting period.

TABLE 1: Estimated emission reduction

Year	Estimation of Project Activity Emissions	Estimation of Baseline emissions	Estimation of Leakage	Estimation of overall emissions reductions
	(tons of CO_2e)	(tons of CO_2e)	(tons of CO_2e)	(tons of CO_2e)
2009	5,503	176,530	0	171,026
2010	5,503	176,530	0	171,026
2011	5,503	176,530	0	171,026
2012	5,503	176,530	0	171,026
2013	5,503	176,530	0	171,026
2014	5,503	176,530	0	171,026
Total	**38,521**	**1,235,710**	**0**	**1,197,186**

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3.2 Assessment and demonstration of additionality

The following steps from the '*Tools for the demonstration and assessment of additionality*' (UNFCCC) demonstrate that the Olkaria II geothermal expansion project is additional.

While various opportunities continue to arise for Kenya to increase its clean energy projects after ratification of the Kyoto Protocol, KenGen is pursing its capacity expansion programs with a focus on projects that generate less greenhouse gas emissions. This expansion can help Kenya to meet the growing power demands as well as securing energy independence. However, some projects, which reduce greenhouse gas emissions, such as the abovementioned Olkaria II Expansion, face barriers that prevent them from being carried out if they are not registered as CDM activities. Being a registered CDM project activity, and negotiating a CER purchase agreement, has both financial and institutional benefits that enhance the viability of the project. In particular, the project faced four main barriers:

- . Investment barriers
- Tariff barriers
- Financing barriers
- Transaction/Financing cost barriers

3.2.1 Investment barriers

Over the past years, there has been very little investment of geothermal power projects in the country due to associated huge capital costs. There is no private sector investment in geothermal power plants of the magnitude of Olkaria II geothermal expansion despite the fact that there are many potential sites for geothermal development. CDM funds are therefore needed to make the project a more attractive investment due to the difficulty of the investment environment for geothermal power plants in Kenya. KenGen started the CDM process in order to secure funding to develop and operate the project.

A comparison as shown in Table 2 below is made between costs of constructing geothermal power plant against other power stations.

TABLE 2: Cost comparison of power plant construction

Type (MW)	Size (MW)	Total cost (million US$)	Cost (million US$) /MW
Medium Speed Diesel	80	67.2	0.84
Coal	150	240.1	1.60
Geothermal	35	76.3	2.18

These costs are based on estimates from 2006 - 2026 Least Cost Power Development Plan. While the geothermal costs are the latest estimates, they do not include the cost of drilling wells.

It is clear that the geothermal cost is much higher than a possible alternative of Medium Speed Diesel power plants that is identified in Step. 1. Even in comparison with other electricity generation sources such as coal thermal power plants, the geothermal cost is higher.

At a price of US $ 10.50 (Capoor and Ambrosi, 2006) per ton of CO_2e, the sales from CERs will generate about US $ 13 million in the first 7 years. Since funds from CERs are in hard (foreign) currency, this will enable the company to mitigate foreign exchange risks associated with the purchase of equipment from abroad.

If the project is registered and approved by the Executive Board, the CER purchase contract will greatly improve the cash flow and debt service cover ratio of the project (which is high for capital intensive projects). The hard-currency income will lower the considerable foreign exchange risks for the purchase of the turbines and spare parts and help overcome the high development costs of geothermal plants.

CDM registration will alleviate the financial hurdles of the project since it would provide risk-free revenue, attached to the project's annual generation. The CER revenues were used to offset the project's investment costs by about 10.8%, decreasing the project's levelized cost by about 7.9%. The sponsor considers the impact of CDM revenues critical for the project's financial viability.

As of today, taking a credible CER price of $10.50 per tCO_2e - CER revenues could improve the project's financial gap by $6.51/MWh or by 30%.

3.2.2 Tariff Barriers

Financial analysis of the project, based on the Tariff of 2.36 KSh/kWh[1], indicates a Post-Tax Project Rate of Return of 6.7 %, which is very low considering the high interest charged by commercial banks. Note that the determination of the tariff rate is primarily at the sole discretion of the Energy Regulatory Commission of the Government of Kenya. It is highly unlikely that they would raise the tariff due to the relatively weak financial performance of the Kenya Power and Lighting Company Limited (KPLC), the monopolized transmission and distribution utility. Thus the CDM will assist the project activity to overcome these tariff barriers and further accelerate the development of geothermal power plants in Kenya.

3.2.3 Financing barriers

The most significant barrier to develop the project is difficulty in securing financing.

Kenya does not yet have strong financial institutions in place for long-term borrowing. This has resulted in most project proponents looking for international financial markets, which offer more attractive rates and longer terms. However, international market financiers are more difficult to access given the perceived country risk of Kenya.

Further, KenGen is currently facing a big challenge obtaining financing for many other power generation projects. As mentioned above, KenGen has earmarked an aggressive capacity expansion program that includes more greenhouse gas emission reducing projects, enhanced by evolving opportunities derived from Kenya's ratification of the Kyoto Protocol. The expanding capacity in the

[1] This is the long-term tariff used for projection and project analysis. However, this tariff could change in the near future after completion of a tariff study being undertaken by the Electricity Regulatory Commission.

program is aggregated at mostly approximately 1970MW, comprising mostly renewable energy (hydro, geothermal, and wind), and a minor proportion of thermal power. Given KenGen's limited access to capital, it is a serious challenge to secure finance closure for all of these projects.

3.2.4 Transaction Costs/Financing

Being a small facility with a maximum output of 35 MW, Olkaria II 3rd Unit faces the barrier of high project development costs and high transaction costs for financing, reflecting the level of a high country risk.
Four barriers have been identified that would prevent the implementation of this type of project (geothermal power plants) under the current conditions in Kenya, but did not affect (at the same level) the other alternatives identified; consequently the project is additional.

3.2.5 Analysis of other activities similar to the proposed project

In order to test whether a credible claim can be made that there are real, prohibitive barriers to development of projects such as Olkaria II 3rd Unit Project, it is important to note that only three geothermal power stations that supply electric power to the national grid have been constructed since the first power plant was commissioned in 1981-85. Currently, there is no geothermal power station under construction.

Regarding the recent development of geothermal power plants there are only two relevant for this analysis: Orpower 4 and Olkaria II itself.

The Orpower 4 power plant is an independent power producer that was granted a contract to supply electricity to KPLC. The Power Purchase Agreement (PPA) comprises not only a higher tariff for the electricity delivered to grid, but also a royalty, a capacity charge, and a bonus if the generation exceeds annual target output. The three latter financial clauses are not common for KenGen contracts with KPLC.

However Olkaria II is also a KenGen project and there are several distinctive differences between the first one and its expansion. First of all is the change of ownership of KenGen. During 2005 the Government of Kenya divested some of its interest in the company, selling 30% of the shares to the public. This new ownership structure requires KenGen to evaluate its projects as a private investor on behalf of all of its shareholders (Government and the public), instead of as a purely public investment. Second, the prices of relevant commodities for the equipment (steel, copper etc) have increased significantly in the recent years making the expansion a more expensive project. Third, there has been a consolidation in the equipment supply side, decreasing the level of competition and increasing the price of the equipment. For example, the initial estimation for the cost of the expansion, based on the experience of the first two units, was US$50 million, and the final projection is currently more US$70 million, 40% higher.

4. CONCLUSIONS AND RECOMMENDATIONS

Development of geothermal projects in Kenya faces a number of barriers and these can be partly offset by CDM revenues.

Immense benefits can be realised for Olkaria II geothermal expansion if the project is registered as a CDM project since the funds obtained through the sale of CERs are in foreign currency. Since the project has a community benefit component, part of the CDM revenue will be used to improve the livelihood of the community surrounding the project.

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