

## Green Pipelines – Is Sustainable Geothermal Development In Natural Forest Areas Just A Pipe Dream?

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### ABSTRACT

By their nature, many geothermal resources are located in natural forest areas. Geothermal developers are often faced with a conundrum – how can they develop a resource in a way that strikes a sustainable balance between the competing social, economic and environmental pressures which are always at play in such situations? Careful planning, design and contractual incentives can help to construct geothermal pipelines in ways that minimise impacts on the environment during construction and operation. SKM has designed geothermal pipelines throughout the world including locations where these issues of sustainability have been successfully confronted. This paper discusses SKM's recent experience in such methodologies and reviews similar experiences by others across different geographies.



**Figure 1: A green pipeline at the Darajat geothermal project. Note the buttress tree root extending under the pipeline**

### 1. INTRODUCTION

Geothermal fields along volcanic arcs are commonly found at high altitude with steep topography. This generally correlates with areas that are too difficult to farm and are thus covered in forest. Such forests have important water catchment and water retention qualities and are areas of high biological diversity. As such they are generally protected by governments to retain these important qualities for the sake of downstream water users and to maintain a nation's environmental heritage.

A moderate and broadly held view of sustainability is that we should aspire to sustain human existence (and improve human quality of life), without compromising acceptable standards of living for anyone, and this depends on the products and services of healthy ecosystems and a vibrant economy.

What does this mean in the context of sustainable geothermal development within natural forest areas?

The developers of geothermal projects which occur in forest settings have to prepare wellpads and roads, drill wells, install pipelines, connect them to a power plant and export the electricity to end users. It is not possible to do this without cutting down some trees and cutting into sloping ground to provide benched land features which allow a development to proceed.

In order for these activities to be sustainable (from a holistic perspective) they must be carried out in such a way that positive economic and social benefits, both locally and further afield, demonstrably exceed any potentially negative environmental impacts of the development.

There is increasing scrutiny of geothermal projects in sensitive forest areas and this leads to public challenges of whether such projects are sustainable – following are two such recent examples:

*“The government has set a target for the Kamojang plant in West Java [a 60 MW development] to start operating by 2009, but the project is caught up in a wrangle over a permit to operate in a protected forest.” (Hutabarat, 2008).*

*“The approval by the provincial government [in July 2008] of a memorandum allowing the entry of Energy Development Corporation, formerly PNOC-EDC, into the 169-hectare buffer zone of Mt. Kanlaon National Park, [for the 20 MW Northern Negros power plant] poses a danger to the people of Negros. If such activities are not stopped, Negros might experience the same kind of devastation as that of Iloilo and Aklan during typhoon Frank.” (Ombion, 2008).*

### 3. SOCIETAL PRESSURES ON THE FORESTS

In many forest areas in developing countries there is already a long history of pressure on natural forests through the illegal collection of wood for fuel, charcoal or sawn timber. The reasons for this pressure are almost always socio-economic. Little by little such places are being deforested by people who are essentially faced with no other choice if they want to stay alive.

Generally speaking, many of these people would choose to do something else if they had the opportunity. They may not have the opportunity because of their socio-economic condition. In a 1990 study (Hadikusumah et al.) of wood energy in the district of Majalaya, close to the Kamojang project mentioned previously, the following conclusions emerged:

*"1. Wood energy is still used in significant amounts in the town of Majalaya, both by households and by commercial users. Most households using wood energy on a regular basis have low incomes. In the commercial sector, small and home industries are still using wood energy.*

*2 Most of the wood energy used in Majalaya comes from the forest. The proportion of wood energy that originates on private farmland is very small. Much more comes from the protection forest or the production forest. Wood energy is also obtained from construction residue, packing residue, and from rivers.*

*3. Wood energy is still being obtained from illegal cutting in the forests. The limited job opportunities and low wages of available jobs compel some workers to work as fuelwood collectors, taking wood from the forest for commercial purposes.*

*4. Wood energy trading is profitable, so entrepreneurs will invest capital to employ low-income people as fuelwood collectors to maintain business profits.*

*5. The demand for wood energy for specific purposes will persist because it is based upon taste and perceived quality. The continuance of these activities will depend upon the availability of wood fuel, but as of now there is no regular management of resources to maintain a supply of wood energy to fulfill those needs.*

*6. The illegal nature of their activities encourages wood collectors to devise new methods of getting wood from the forests that are quicker and more difficult to detect, but are also wasteful.*

*7. The development and improved distribution of alternative energy sources (kerosene, electricity, and LPG), which are at present used only by the more privileged sectors of society, will reduce the number of wood energy producers and the volume of trade in wood energy products. While this may lessen the pressure on the forests, it may also adversely affect the livelihood of wood energy producers, textile factory workers, and construction workers."*

Since this study was carried out, the Asian Financial Crisis occurred (1998) and oil prices peaked (2008). The effects of these events on communities in Asia and around the world are likely to have increased the illegal gathering of fuelwood from forests.

Geothermal developments in forest areas require access roads. These provide avenues allowing people access into the forest and for transporting forest products that are removed illegally. But surely you say, cannot security be provided to prevent this happening along the roads that the development provides? Security can be provided, but should this be the responsibility of the developer or of the

local authorities? Unfortunately, in many instances security is weak, both from the forest management and the local authorities. This is a complex social issue. Sometimes the illegal gathering of forest wood is arranged by middlemen who come to an arrangement with either the forest management or the local authorities or both. Should geothermal development not proceed because this could possibly happen, thereby disadvantaging many people because of the actions of a few?

### 4. A SPECIFIC INDONESIA EXPERIENCE

At the Darajat geothermal project in Garut, West Java approval was given to Chevron Geothermal Indonesia (CGI) to build a steam pipeline in a nature reserve. It was agreed with the forest conservator that the design of the pipeline be done in such a way that the minimum number of trees would be cut down. This was achieved by:

1. Minimizing the pipeline corridor width by not installing any vehicular access alongside the pipeline.
2. Not installing any equipment that required routine inspection and maintenance in the heavily forested sections of the route.
3. Providing comprehensive water collection and drainage systems to prevent erosion from occurring in steep sections of the route.
4. Providing extensive soil nailing in a particularly steep section of the route to improve slope stability.
5. Surveying and inventorying all trees along the route (refer Figure 2).
6. Providing a significant financial incentive to the construction contractor to minimize the number of trees cut down. This incentive placed a value on trees (regardless of girth) and a value on wood volume. It was additional to the base contract value.
7. Actual trees cut were assessed at the end of the work, the forest authorities were paid for the trees removed and the contractor's incentive was assessed and paid.



**Figure 2: Surveying the pipeline route and the trees within the route. The tree with buttress root is the same one as in Figure 1.**

At the request of, and in order to allow the contractor to maximize their incentive opportunity, CGI revised the pipeline design to avoid several trees of significant size and value.

The design also required multiple supports which had piled foundations. The piled assemblies ranged from two up to six piles, with each pile 1m diameter and up to 6m deep. In the steep sections of the route the contractor opted to dig the pile holes by hand as access for machinery was very difficult and would result in a need to cut down many more



trees. Rather than compromise the safety of the workers by allowing them to work down hole, groups of workers sat at the surface and dug the holes with sharpened bamboo stakes driven into the earth, and removed with a small amount of soil trapped in the bottom of the stake and removed at the surface. Although it took several days to dig each hole, the net result was cheaper and less destructive to the environment.

The final result, as shown in Figures 1 and 3, is a pipeline that has been installed with a low impact on the forest environment.



**Figure 3: A similar view as in Figure 1.**

There was minimal removal of trees along the piping route, and because no permanent road access was required along the route, the vegetation has been allowed to re-establish in areas that had been cleared to enable construction. Only the pipeline itself and a walking path for inspection and maintenance are kept clear of vegetation.

## 5. PHILIPPINES EXPERIENCE

Energy Development Corporation (EDC, previously PNOG-EDC) has been the developer of the majority of the geothermal wellfields and steamfields in the Philippines.

EDC (de Jesus, 2005) has identified the major social issues raised against geothermal development as being:

- i. *lack of consultation*
- ii. *physical and economic dislocation of settlements*
- iii. *lack of benefits*
- iv. *encroachment of ancestral domain, and*
- v. *privatization of the people's forest patrimony.*"

It has developed the following measures to address these issues:

- "(a) *awareness and acceptance campaigns*
- (b) *opening up communication*
- (c) *translating commitments into action*
- (d) *third party multi-stakeholder monitoring*
- (e) *installation of environmental guarantee fund*
- (f) *resettlement*
- (g) *provision of benefits*
- (h) *protection of prior and ancestral rights*
- (i) *protection of patrimony, and*
- (j) *advocacy for appropriate public policies.*"

EDC notes that depletion of resources in the lowlands has increased the encroachment of peoples into forest watersheds where upland communities have traditionally existed in harmony with their environment. "Protecting and rehabilitating the watersheds in these sites has proved to be the most challenging task" (de Jesus, *ibid.*). One of the

approaches used by EDC was to support the formation of associations for slash and burn farmers to encourage them to collectively manage the forest areas. The farmers have consequently avoided entry into the forests, in effect creating a "social fence that has relieved the pressure on the forests resulting in its recovery".

The recent experience of EDC at Mt. Kanlaon, the site of its 49 MW Northern Negros geothermal power project on Negros Island in the Visayas, highlights the difficulty of development in a National Park. In order to maintain a dwindling steam supply to the power plant (without which it would have to remain shut down), and despite attempts to draw upon the resource from outside the Mt. Kanlaon National Park (MKNP), EDC needed access to a part of its geothermal resource concession which exists within the park. To achieve this it would be necessary to cut some trees in the park to provide access.

Despite EDC's willingness to make as small an impact as possible in their activities to access the geothermal resource, there are those who maintain that opening up such access will inevitably lead to an unrecoverable loss of biodiversity. Passions have run high and this is understandable, given the possibility that without careful and sensitive management such activities can indeed impact negatively on the environment and downstream communities.

EDC has maintained a policy of open engagement with all stakeholders in its effort to reach an agreement that strengthens the social benefits of development while minimising the environmental impacts of development – seeking to find a balance that represents sustainable development. This policy is formalized through a communications plan, the positive attributes of which has been recognized through two recent awards (IABC, PRSP, 2009).

In July 2008 this approach led to the signing of a Memorandum of Agreement (MoA) between EDC and the Negros Occidental local government. This allowed EDC to expand inside the MKNP, granting EDC a tree cutting permit within a 169 ha buffer zone on the edge of the MKNP and abutting the current approved geothermal resource concession area (Ombion, *op. cit.*). To date EDC has reduced its original 1,850 ha concession area in the MKNP to this 169 ha buffer zone and has further self-limited its activities in this zone to 13 ha (de Jesus, 2009).

Ombion observed: "*The MoA of EDC and the provincial government purportedly intends to address the Negros Occidental's power needs but at the same time commits to preserve and protect the environment and the resources in MKNP. It also requires the EDC to sell power at a price lower than or equal to that of the alternative power projects and to give priority in the sale of its electricity to the electric cooperatives in Negros island.*"

*The MoA also reiterated the conditions set in the governor's Executive Order creating an Oversight, Monitoring and Compliance Committee, to which the EDC will have to submit a detailed work program and a stand and stock table covering its activities in the 169-hectare MKNP buffer zone.*

*The MoA also includes a stipulation that the EDC must confine its geothermal development activities within the perimeters duly delineated and established by the Department of Environment and Natural Resources*

(DENR) in coordination with the Park Board and the Oversight committee; that the EDC must ensure that the cutting of trees with a diameter of 100 centimeters and beyond shall be limited to only 34 trees, and that it should exert all efforts to minimize the cutting of trees to a number lower than 34.

The MoA further required the EDC to institute and implement a Comprehensive Environmental and Reforestation Program to mitigate the effects of the exploration inside the buffer zone, and states that its reforestation activity at the MKNP shall involve 160,000 trees planted and grown over a span of five years to cover an area of 400 hectares; and provided that the cutting of trees by the EDC shall be done in the presence of the Oversight, Monitoring and Compliance Committee, and the company should give preference to the people residing in the locality for its unskilled labor requirement in its exploration activities.

EDC President and CEO Paul Aquino told local media that he was grateful to Zayco and the Sangguniang Panlalawigan (Provincial Council), saying that they have stood up for what is right and legal.

Energy Secretary Angelo Reyes, on the other hand, welcomed the decision by the provincial government, saying, "With the signing of the memorandum of agreement, EDC can now tap additional geothermal power to generate the province's much needed power," and added that "those who oppose the project should respect the decision of the local government and the desire of majority of Negrenses to support the project in answer to the power shortfall of the province."

The decision, however, was scored (sic) by progressive organizations and various environmental groups in the region, who said that it will open the floodgate for further deforestation of MKNP and thus complete the process of destroying the remaining frontiers of the region.

Bayan Muna (People First) Provincial Chairperson Alejandro Deoma slammed the signing of the MoA allowing EDC to conduct exploration in MKNP, saying that it poses great risks to the people of Negros, considering the already critical state of the island's forests."

The last two paragraphs above have been included to demonstrate a real tension among the social, environmental and economic factors affecting geothermal developments in natural forest areas. EDC would argue that the number of people supporting its Northern Negros development is several orders of magnitude greater than those who oppose it. Allowing for all voices to be heard and respected is a fundamental human right. Applying sustainability principles appropriate to such projects provides an opportunity to achieve a balance that reflects sustainable development.

## 6. SUSTAINABLE GEOTHERMAL DEVELOPMENT

Geothermal projects in developing countries provide electricity which improves the quality of human life for the inhabitants of those countries. They also displace more greenhouse gas intensive electricity which reduces the world's dependence on carbon generating nonrenewable energy sources. Some opportunities for local employment are also created. So in this manner they promote the concept of a vibrant economy, one of the indicators of sustainable development.

However, any activity in a natural forest has the potential to reduce biodiversity and damage the environment. Minimizing this impact in a sensitive manner while improving the quality of life of many provides a balance between the positive and the negative impacts of development. The approaches outlined in this paper that have been taken in Indonesia and in the Philippines to minimize negative environmental impacts and to actively promote positive social benefits of geothermal development demonstrate that it is possible to achieve such a sustainable balance.

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