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International Cooperation for Geothermal Resources Developments in the Plan Puebla-Panama Region

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ABSTRACT

The Plan Puebla Panama (PPP) is addressed to integrate the economies and infrastructure SE of Mexico (States of Puebla, Veracruz, Tabasco, Campeche, Yucatan, Quintana Roo, Chiapas, Oaxaca and Guerrero) and the seven Central American countries. The SIEPAC project is within the energy initiative, one of the eight initiatives of the PPP, and is intended to integrate the transmission of electricity and electric markets of the PPP region. The present paper describes the fundamental philosophy of a Pilot Study, on grant basis, by the Japan Bank for International Cooperation (JBIC) to support the success of the objectives of the energy initiative. The necessity for this Study arose at the identification of possible negative effects induced by the economies of scale to be introduced by the SIEPAC and the necessity to devise and execute a strategic plan to avoid these undesirable effects. The paper explains why the energy mix in the region must be based on primary energy sources that endow at least five fundamental strategic values: high availability factor, energy independence, trade balance benefits, friendliness to the environment and multiple-utilization. With the exception of Mexico, in the other PPP countries, of the two primary energy alternatives, fossil fuels and renewables, the later seems to be the most adequate to base their energy mix. Upon an examination of the characteristics of renewable resources, geothermal is the only primary source of energy simultaneously offering the five fundamental strategic values. An examination to the barriers affecting the generalized utilization of geothermal resources in the region made possible the creation of an initial plan for their removal or mitigation. The JBIC is supporting this Pilot Study.

Background

In response to the increasing demand by the Japanese general public for more participation in the activities of Overseas Development Assistance, the Japan Bank for International Cooperation (JBIC) has established, from the fiscal year 2001, a new scheme of Pilot Studies. Under this new scheme, the JBIC calls, in public notice, for proposals of studies where all members of the Japanese society can participate. These proposals will allow JBIC and the recipient countries to accumulate new knowledge, findings, and lessons to formulate or implement future/ongoing projects/programs to be financed by JBIC ODA loans if the recipient countries so request after the Study. The eligible sectors for the Pilot Study Scheme are the following:

- Strengthening Support for Poverty Reduction
- Developing Infrastructure for Economic Growth
- Supporting Environmental Improvement and Anti-Pollution Measures
- Addressing Global Issues
- Supporting Human Resource Development
- Supporting the Dissemination of Information Technology in Developing Countries
- Supporting Provincial Development

For fiscal year 2002, JBIC selected 9 projects from 116 proposals. One of the best selected Pilot Studies was that proposed by West Japan Engineering Consultants, Inc..
This in combination with low income creates the spiral leading to poverty and all its undesirable consequences. Poverty affects not only the social structure but also the environment. The PPP region comprises a rich tropical forest area, which is important to the world’s climate balance. However, low income and high cost of basic services such as electricity induces deforestation for fuel or subsistence agriculture, thus creating an environmental problem of worldwide consequences. The PPP is intended to integrate the region and to create the required economies to boost competitiveness in good, services and human resources and thus to reduce the cost of basic services and improve income. The PPP is in fact an instrument to fight poverty.

To achieve this goal the PPP is founded upon three interrelated pillars; a) economic growth and fair distribution of wealth, b) human and social development and c) management and sustainable utilization of natural resources (IDB, 2002). Eight initiatives have emerged from these three pillars, namely; Sustainable Development, Human development, Prevention and Mitigation of Natural disasters, Promotion of Tourism, Facilitation of commercial intercourse, Road integration, Energy integration and Integration of communication services.

The Electric Sector in the PPP

There are two factors influencing the electric sectors of the PPP countries; the SIEPAC project (System for Electric Interconnection of Central America under the energy initiative of the PPP) and deregulation. The SIEPAC will create economies of scale and the second a competition environment. The SIEPAC is a project addressed to interconnect the electric grids of all Central American countries (there will be an additional interconnection between Mexico and Guatemala, refer to Figure 1). Though, currently there is a interconnection of electric grids, its capacity is limited (100 MW), the SIEPAC will allow additional energy transfers (up to 300 MW) through its planned 250 KVA double circuit transmission line. This will permit the operation of larger power plants upon its completion in 2006, and will create a Central America Wholesale Electricity Market (MER; Mercado Eléctrico Regional, Lippmann, 2003) that will be regulated by the Regional Electricity Interconnection Commission (CRIE; Comisión de Interconexión Eléctrica Regional) and will be operated by the Regional Operation Entity (EOR; Ente Operador Regional). Nonetheless, the main objective of the interconnection of electric grids is to create a competitive environment to bring down the generation costs and thus lower the electricity tariffs in benefit of consumers. The present situation is that electricity tariffs are raising. The reasons rest in the adjustment of electricity sectors to the real situation and in the price increase of fossil fuels. The advent of the SIEPAC will bring new situations of importance that it is necessary to take into account before the good intentions of integrations turn all the way around.

Mexico and Costa Rica are the only countries in the PPP region where governments retain ownership in the electric sector. In the other countries the sector is already deregulated and there is a legal framework allowing private sector participation (Table 1). In these countries, generation costs will follow market constrictions rather than national policies. The expected demand growth in Mexico (Table 2) is too large for the Mexican government alone to match. In Mexico the participation of the private sector has been accepted using schemes within the present Federal Constitution (Build Operate Transfer, Build Lease Transfer, Obra Publica Financiada <Financed Public Works>). In Costa Rica the tendency is to maintain governmental control while allowing some private sector participation.

The Independent Power Producers (IPP) have preferred natural gas and other fossil fuels as their primary energy source because of the efficient new cycles, price or corporate policies. The IPPs compete for Power Purchase Agreements (PPA) in regulated and deregulated markets or compete for contracts to supply energy and/or capacity to other companies or to merchandise energy in the spot market in the deregulated markets. The new conditions offered by the SIEPAC and the PPP will be conducive to more competition and thus to an incremental use of fossil fuels as primary energy source to generate electricity. However, it is known that in the
Geothermal Energy the Best Alternative

To forestall the situation described above, an energy mix adequate to each of the countries and to the region as a whole is necessary. The primary energy source selected to supply at least the base load must hold the following five values:

a) High availability factors, meaning all year and all day around availability
b) Strategic energy independence, meaning an indigenous energy resource not pegged to external political decision or conflicts.
c) Beneficial impact to trade balance, meaning the reduction of the import bill or increasing the fossil fuels available to export.
d) Friendliness to the environment, meaning less green house gases (GHG) emitted to the atmosphere and avoiding the construction of facilities affecting the ecological balance of the development area.
e) Possibility of multiple-utilization, meaning a primary energy source with possibilities of different applications.

Between the two alternatives of primary energy source for generating electricity: fossil fuels and renewable resources, fossil fuels offer only two values (high availability factors and multiple utilization) to the Central American countries. For Mexico, this primary energy sources confers the values of energy independence and trade balance as well, if the current imports of natural gas are not taken into account.

Renewable sources of primary energy such as solar, wind, hydropower and geothermal all offer the value of strategic energy independence and trade balance. Solar and wind additionally confer the value of friendliness to the environment but both lack high availability factors and multiple utilization. Hydropower offers the value of multi-utilization but heavily depends on the hydrological cycle (currently affected by climate changes) therefore, to provide high availability factors, large dams are required, implying an extensive ecological impact. Smaller hydropower developments can mitigate ecological impact at the expense of sacrificing availability factor.

Geothermal energy, which is abundant in Mexico and Central America, is the only renewable primary source of energy offering all the five values together. The estimated most probable geothermal potential given in MW (in brackets the actual exploited energy) are; 3000 (953) for Mexico (Luis Quijano, personal communication 2003) and according to Lippmann (2002), 4,430 (405.5) for Central America of which 1,000 (33) for Guatemala, 130 (0) for Honduras, 500 (160) for El Salvador, 1,750 (70) for Nicaragua, 1,000 (142.5) for Costa Rica and 50 (0) for Panama. Considering the forecasted demand of energy up to the year 2010 for only the Central American region, the geothermal potential represents 54% of the required installed capacity (refer to Table 2), which is above the base load requirement for the region and that could be for many years the base of the energy mix for the region.

In addition to the capacity of supplying the electrical base load, depending on chemical characteristics, geothermal fluids can be
used for other industrial processes after electricity generation and if low to medium enthalpy geothermal resources are also considered, these multi-utilization characteristics endow the PPP region with even more enhanced values of strategic energy independence, trade balance and environmental friendliness.

The Hurdles to Develop Geothermal Energy

Even though geothermal energy holds many benefits, its utilization is stalled by the perception of risk in its development and exploitation. This discourages investors (private or public) and financial institutions turning into a barrier for the development of geothermal energy:

a) Market risk: Exists when the market size does not assure constant generation to amortize investments and pay for expenses. In the case of the PPP region, the SIEPAC will largely overcome this risk.

b) Technological risk: The degree of effort (time and money) necessary to prove a resource is feasible for exploitation is irrespective of the size of exploitation. Even after feasibility of exploitation is proven, an inherent mining risk remains during the period to repay pre-investments, investments and expenses for operation and maintenance of the steam field and power facilities.

c) Political risk: Basically meaning here, the still inadequate understanding of authorities and financial institutions of the global benefits of utilizing geothermal resources. This prevents efficient support for the exploitation of this natural resource, especially in cases where the economic sustainability (or profitability to attract private investments) is difficult to attain.

The JBIC’s PPP Geothermal Project

The problems stalling the development of geothermal resources and the benefits of its utilization are not only limited to the PPP region. However two situations helped the creation of the project presented in this paper. Synergies created by the PPP and the SIEPAC and the inclusion of the PPP region as target for international cooperation. The project is one of the efforts similarly done by other entities to promote the utilization of geothermal resources in other regions of the world and is limited to the PPP countries with geothermal potential. From the above-mentioned risks (barriers), those related to technological and the political risks await removal or mitigation. The JBIC-PPP Geothermal project is structured to set the basis for their effective removal or mitigation. The project started on April 2003 with duration of 19 months and is addressed to fulfill two separate but fundamental phases:

a) Phase-1: To remove or mitigate technological risk to promote standardization of existing local technologies.

b) Phase-2: To remove or mitigate political barriers, to construct a promotional strategy and to carry out promotion for an extensive utilization of geothermal resources.

Phase-1

In the PPP region, Mexico, Costa Rica and El Salvador have independently acquired and developed a good level of geothermal technologies. However, it is necessary to standardize procedures derived from their different experiences and make it available to the whole region. This will increase the confidence in the local capacity to reduce resource uncertainties, to overcome problems, to run the projects according to schedule and to adequately operate and maintain resource and power facilities. Considering time and funds available to this study, the best method to achieve standardization is through the execution of Feasibility Studies (F/S). An F/S is a complete process that involves considerations from the underground up to the economy of exploitation. Los Humeros in Mexico and Las Pailas in Costa Rica were the fields selected to carry out F/S because they comply with several conditions (strong commitment of the beneficiary country to proceed to build power facilities, steam available at surface and good level of geothermal technology). Both fields are scheduled for future 50MW power generation, size that will be verified within the present study. The F/S for each of the fields is going to be executed in three steps:

a) conceptual modeling; which will be the result of the study and validation of all available geological, geochemical, geophysical and well information,

b) resource evaluation; which will include numerical simulation to evaluate the resource potential and the forecasting of reservoir response to several production schemes and

c) power facilities & economics; which will include environmental aspects, conceptual design of power facilities cost analysis and economic and financial study to select the best scheme of exploitation.

Each of the three components will involve capacity building and standardization of procedures. The results of compiling the best of Mexican, Costa Rican and Japanese technologies, procedures and experiences will be shared with all the rest of PPP countries. At completion of the F/S, both Mexico and Costa Rica will end with a complete bankable report allowing these countries to proceed to the request of financial support or to decide the best scheme to build and operate the geothermal power plants.

Phase-2

This Phase will be carried out in three steps:

Step-1: Study of the present situation: This will involve the study of three main components of a strategic plan to promote the utilization of geothermal resources in the PPP region;

Component-1: To estimate quantity and quality of geothermal reserves of the region and study and evaluation of possible direct applications and co-generation schemes. Quality of the resource is important in order to assess the different possible applications for the mined underground heat. The importance of introducing multiple-utilization in geothermal exploitations is for economy and competitive reasons. One is the sharing of
commercial risk among different applications and the sharing of costs and expenses by different markets, thus reducing the electricity generation cost. The other reason is energy efficiencies include the utilization of medium and low enthalpy geothermal resources that would add values to the value of energy independence and trade balance.

Component-2: Study of the operational structure of the electricity markets in the region of the PPP, which is important to assess the viability of supplying at least the base load using geothermal resources.

Component-3: Study of the country and regional legal/environmental framework for the utilization of renewable energies, which is important in upgrading regulations so as to effectively bring the utilization of geothermal energy to market competitive levels.

Step-2: Construction of a strategic plan for promotional activities, which will consist in a) Comprehensive integration of the components of the present situation, b) Identification of barriers other than the technical and political barriers already discussed, c) identification of benefits of multiple-utilization (direct use and co-generation) in tropical climates and in the social, physical and development conditions of the region of the PPP, d) construction of a strategic plan to remove or to mitigate newly identified barriers and to enhance the identified benefits of using geothermal energy.

Step-3: Promotion of the strategic plan: The plan will be taken to all energy related institutions of each of the countries of the PPP and to regional financial institutions such as the World Bank (WB), Inter American Development Bank (IADB), Central American Bank for Economy Integration (BCIE) and the Global Environmental Facilities (GEF) and to Japanese technical and financial cooperation institutions.

Concluding Remarks

With the assistance of financial institutions, well-established energy policies to support the utilization of geothermal resources and a technological base sound enough to support the confidence of investors, the beneficial characteristics of geothermal energy will be put at work for the good of the PPP region. The success of this project and its replication in other regions will be greatly appreciated by future generations.

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